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R. LUCIEN
SELF REGULATING PUMP

2,918,012

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2 Sheets-Sheet 1

Fig. 1.

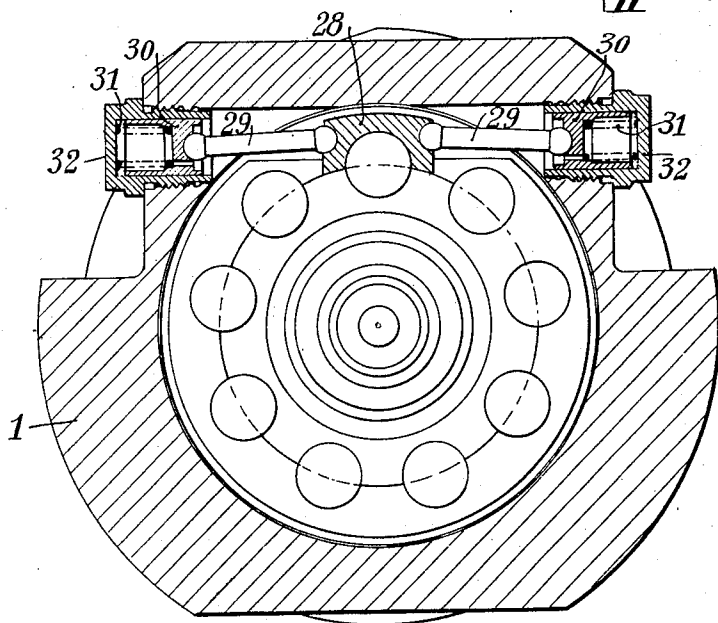
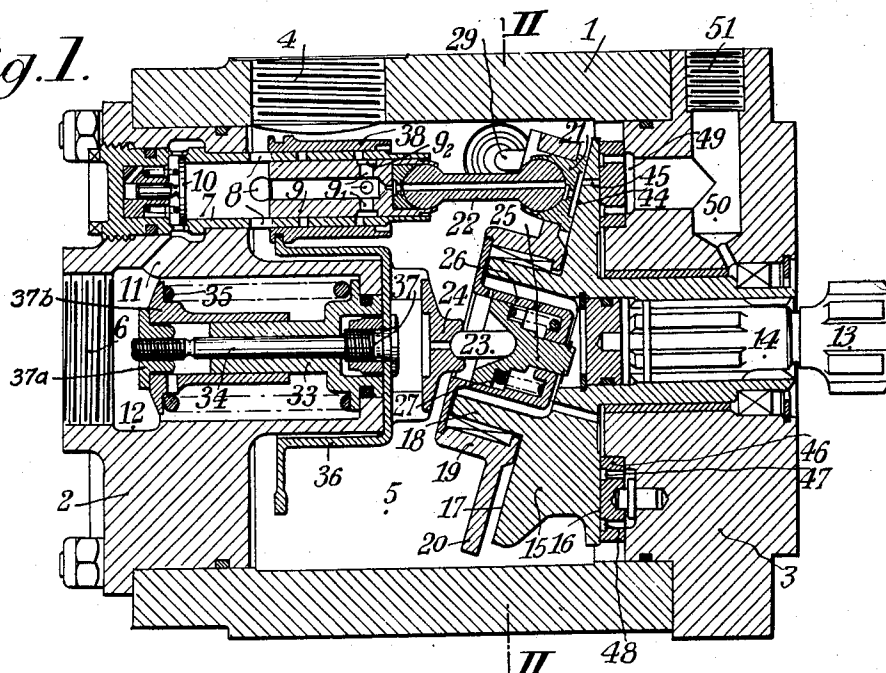


Fig. 2.

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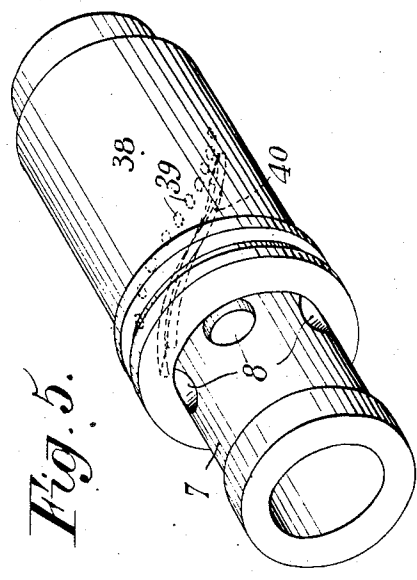
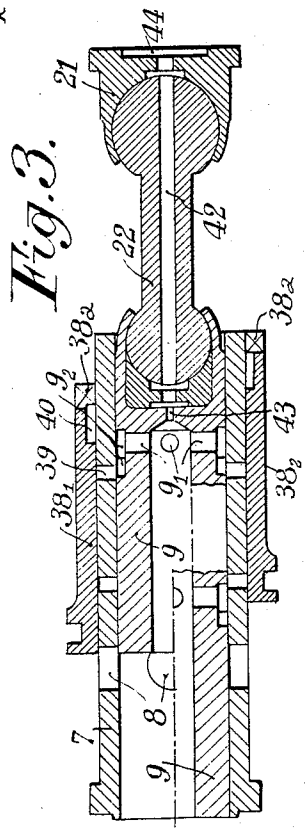
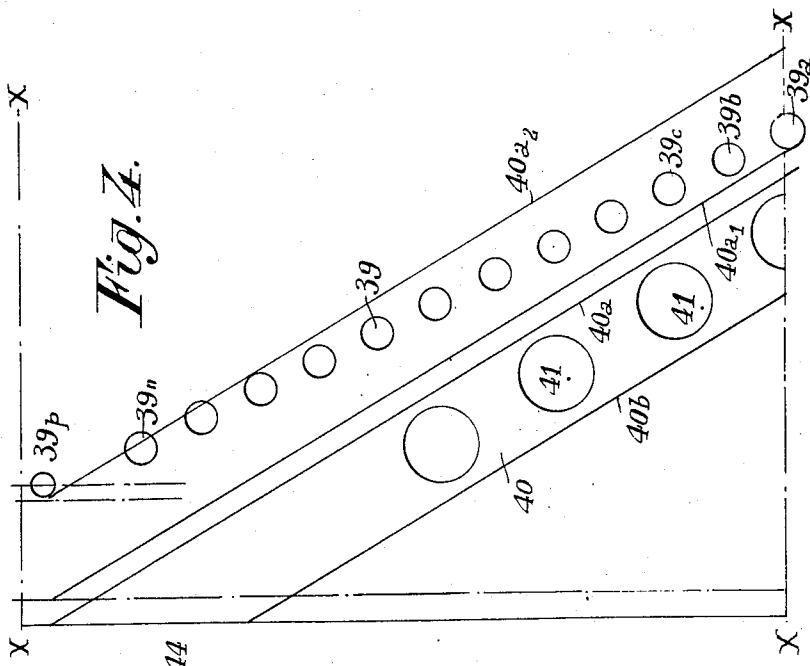
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2 Sheets-Sheet 2



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SELF REGULATING PUMP

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Claims priority, application France September 5, 1955

6 Claims. (Cl. 103—37)

The invention relates to self-regulating pumps, and more particularly to a type of pump the output of which is automatically regulated as a function of the pressure of the fluid in an associated utilization circuit.

An object of the invention is to provide an improved pump of the so-called barrel type, in which pump elements are equally spaced around a central axis and in which the pistons are actuated by a plate mounted on a swivel and capable of assuming variable inclinations in all directions with respect to the central axis.

A self-regulating pump, in accordance with the invention, is also of the type in which, when the pressure on the delivery side exceeds a predetermined limit, a piston which is subjected to the delivery pressure and acts against a calibrated spring, actuates sleeves fitted round the cylinders of the individual pumps, these sleeves normally closing ports formed in the cylinders but which, when the pressure forces back the spring, put the ports of the cylinders successively into communication with the suction side, thus progressively limiting the useful stroke of the pistons and, in consequence, their output.

A further object of the invention consists in a particular construction of this self-regulation device.

This and other special features of the invention will become apparent from the following description of one embodiment of the invention as illustrated in the attached drawings, in which:

Fig. 1 is an axial cross-section taken along the axis of one of the pump elements;

Fig. 2 is a cross-section taken along the line II—II of Fig. 1;

Fig. 3 shows a detail of Fig. 1 on a larger scale;

Fig. 4 is a diagram which shows the self-regulating operation; and

Fig. 5 is a perspective view of a detail of Fig. 1.

The pump comprises a pump body 1 with two end walls 2 and 3. The admission of fluid is effected through the orifice 4 into the admission chamber 5, and the fluid under pressure is discharged through the orifice 6. In the wall 2 are arranged pumps which are centered on the axis of the pump body 1. They are each formed by a cylinder 7 provided with admission orifices 8 which communicate with the admission chamber 5. In this cylinder is movably mounted a hollow piston 9, the base of which is pierced with transverse orifices 9₁ which communicate with a circular groove 9₂, the function of which will be hereinafter explained.

The fluid which is compressed during the stroke of the piston towards the left pushes back the non-return valve 10 and passes through the channel 11 into the chamber 12 which is in communication through orifice 6 with the outlet conduit for fluid under pressure.

The movement of the piston is obtained in a manner known as to its principle, in accordance with the following details: a motor drives the extremity 13 of a shaft 14 which is rigidly fixed to a member 15. This latter member has a flat surface 16 at right angles to the axis of the pump body, and an inclined surface 17. The

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member 15 carries a cylindrical portion 18 which rotates in a bearing 19 housed in a member 20. The latter is provided with shoes 21 which have a flat surface in contact with the surface 17. Each shoe corresponds to one of the pistons 9 and has a hemi-spherical cavity for the swivel mounting of a crank-arm 22 which is also swivel-mounted on the piston 9. The member 20 is urged against the plate 17 by the following arrangement: a member 23 has its extremities formed by two hemi-spherical bearing surfaces which are housed in corresponding cavities respectively in a member 24 which is rigidly fixed to the wall 2 and in a member 25 which is movable in a cylinder 26 fixed to the member 20; a spring 27 is interposed between the member 25 and the cylinder 26 and forces the member 25 against the member 23. It will be understood that rotation of the member 15 acts through the intermediary of the member 20 and the crank-arms 22 to cause all the pistons 9 to perform a reciprocating movement in the cylinders 7.

In order to prevent the member 20 from being driven in rotation, the device described below with reference mainly to Fig. 2 is employed. This device constitutes in itself a characteristic feature of the invention.

On each side of a boss 28 formed on the member 20, two crank-arms 29 are swivel-mounted and these crank-arms are also swivel-mounted on a piston 30. A spring 31 housed in a cylinder 32 rigidly fixed to the pump body, forces the crank-arms against the boss 28 which thus receives the thrust from each side. The oscillations of the member 20 during the rotation of the member 15 are permitted by the flexibility of the springs 31.

The self-regulating device which constitutes the essential feature of the invention will now be described with reference to Figs. 1, 3, 4 and 5.

In the chamber 12, in which the delivery pressure exists, there is axially arranged a cylindrical guide 33 inside which a piston rod 34 is adapted to move. The piston rod is connected at one end to a piston head 37A in the chamber 12. A spring 35 abutting against a flanged sleeve 37b slidable on guide 33 tends to prevent movement of the piston head 37A and rod 34 towards the right under the action of an increase in the pressure inside the chamber 12. A member 36 which is locked on the other end 37 of the piston rod 34, engages the sleeves 38 which are fitted on each of the cylinders 7 of the pumps and thus forces them to follow the movements of the piston 34.

Each cylinder of the pumps 7 is provided, in addition to the suction orifices 8, with two series of perforations or orifices 39 disposed along a path formed by two spirals of the same pitch and displaced by 180°, and the sleeve 38 is provided on its internal face with two helical grooves 40, also displaced by 180°, the bottom of each groove being pierced with orifices 41 which put them into communication with the admission chamber 5. The pitch of the grooves is slightly different from that of the spirals along which the orifices 39 are drilled.

As long as the delivery pressure has not reached the critical value of self-regulation, the groove 40 does not cover any of the orifices 39 and each pump operates as an ordinary pump, the exhaust ports 39 being closed by the sleeve 38. This relative position is that shown in Figs. 4 and 5. In Fig. 4, there is shown a development of the surfaces in contact of the cylinder and the sleeve, cut along the generator XX. The other groove 40 and the other series of orifices 39 are located exactly in the same relative position. In the position of rest of the sleeve, shown partly at 38, in Fig. 3, the two edges of the groove 40 are at 40a and 40b. An increase

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in the delivery pressure compresses the spring 35 and moves the sleeve towards the right. When the edge 40a of the groove comes into the position 40a₁, the critical pressure is reached; the line 40a₁ is then tangential to the nearest orifice 39a. From this position onwards, at the beginning of the compression stroke of the piston, a part of the fluid is delivered through the orifices 9₁ and the groove 9₂ of the piston and returns through the orifice 39a, the groove 40 and the orifices 41 to the admission chamber, which reduces the useful stroke of the piston. If the pressure still tends to increase, the orifice 39b is reached in its turn, which still further reduces the useful stroke of the piston, and so on. When the maximum admissible pressure is reached, all the orifices 39a to 39n have been covered by the groove 40, and the pump is in the completely self-regulating condition. In this state of operation, however, in order to avoid wire-drawing of the fluid between the orifices and the edge of the groove, which would result in a poor efficiency of the pump, there has been provided on one of the pump cylinders, a supplementary orifice 39p beyond the extreme orifice 39n and slightly offset from the line of the orifices 39, as shown in Fig. 4. On the corresponding piston 9, the groove 9₂ has been displaced in consequence, so that in the condition of full self-regulation, corresponding to a zero or very low output, the wire-drawing takes place only through this orifice and all the others remain entirely covered by the groove 40. By this means, the efficiency of the pump in these conditions of operation, is improved to a considerable extent.

In order that the self-regulation may be effected correctly, it is important that the sleeve 38 is not able to rotate about the cylinder 7. This result is obtained by milling two symmetrical flats on the cylinder 7 over a length at least equal to the possible travel of the sleeve 38—shown in its extreme positions at 38₁ and 38₂ in Fig. 3—these two flats forming slides for re-entrant portions 38a formed at the extremity of the sleeve 38.

It can be seen that the self-regulating device in accordance with the invention makes it possible to obtain, by virtue of the helical arrangement with slightly different pitches, of the orifices and of the groove, a self-regulation with a small stroke of the regulating piston head 37A, which simplifies the construction of the spring 35.

The pump in accordance with the invention is also provided with the following novel arrangement which concerns the lubrication by the fluid of the frictional surfaces of the member 15 in contact with the wall 3 of the pump body.

In accordance with an arrangement which is already known, the crank-arm 22 (see Fig. 3) is provided with a longitudinal channel 42 which receives through a narrow orifice 43 a small part of the fluid during the compression stroke of the piston 9. The shoe 21 is provided on its face which is in frictional contact with the flat surface 17, a hollowed-out portion 44, the surface area of which is determined so as to create a back-pressure which reduces the frictional forces of the shoe against the surface 17.

In accordance with the invention, the plate 15 is provided with perforations 45 (see Fig. 1) distributed along a circular path and which come in rotation opposite the hollow portions 44. The fluid passes through these perforations and lubricates a plate 46 in the form of a ring, fixed on the internal face of the wall 3 and slightly projecting from it, on which is frictionally engaged the smooth surface 16 of the member 15. The pressure of the fluid has the effect of tending to separate the member 15 from the ring 46. In this ring are also machined two concentric circular grooves 47, 48, which communicate by means of transverse passages with a circular groove 49, this groove being in communication with a chamber 50 connected through an orifice 51 with the return piping system to the reservoir tank. By this means, the surface of the ring 46 which is subjected to the fluid pressure is

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limited to that comprised between the two grooves 47, 48. The space between these latter is determined in such manner that the force required to separate the two surfaces in contact may be fairly small in order not to separate the two members by too great an extent, while at the same time it may be adequate to provide satisfactory lubrication. The small amounts of leakage are drained off through the groove 49 and return to the reservoir tank.

What I claim is:

1. A self-regulating barrel-type pump for delivering fluid under pressure and comprising a pump body defining a central axis and a plurality of individual pumps in said body and arranged circularly around said axis, each individual pump including a cylinder and a piston reciprocable therein, the body having a fluid admission chamber communicating with each cylinder, each cylinder having a discharge outlet, a sleeve surrounding each cylinder and slidable thereon, spring means acting on and opposing movement of the sleeves with the delivery pressure of the barrel-type pump below a critical value, said cylinders each being provided with transverse orifices disposed in a helical path, the sleeves each being provided with an internal helical groove having a pitch different from the helical path and communicating with the admission chamber, and means responsive to the delivery pressure and acting on said sleeves to displace the same against the opposition of said spring means, the grooves communicating with the respective orifices in succession with the sleeves displaced on the cylinders by a delivery pressure above the critical value.

2. A pump as in claim 1, wherein the piston in each cylinder has a cylindrical cavity opening into the associated cylinder and transverse orifices opening from said cavity into a peripheral circular groove provided in each piston, the grooves being adapted to register intermittently with the transverse orifices of the respective cylinders.

3. A self-regulating pump in accordance with claim 2, wherein each piston has a head and in which the circular groove of one of the pistons is closer to the head thereof than are those of the other pistons, and in which an additional orifice is provided in the cylinder associated with said one piston at the head side of the said piston, said circular groove in said one piston being adapted to register intermittently with said additional orifice.

4. A self-regulating pump in accordance with claim 1, in which the pump body is provided with a delivery chamber coupled to the discharge outlets of the cylinders, the means responsive to delivery pressure comprising a tubular body inside the said delivery chamber and open at its two extremities, the said tubular body having an axis parallel to the pump cylinders, a rod slidably mounted inside the said tubular body, a head fixed to an extremity of the said rod within the interior of the said delivery chamber, said spring means comprising a helical spring on said tubular body between the said head and said body, and a member external to the said chamber fixed to the other extremity of the said rod and engaging each of the sleeves which surround the pump cylinders.

5. A self-regulating pump in accordance with claim 1, comprising a driving shaft, a first plate rigidly fixed to the driving shaft and having a flat surface inclined to the axis of the pump and a journal for said plate, said journal being perpendicular to the said flat surface; a further plate rotatably mounted on the said journal and shoes on said further plate and having a flat surface in contact with the flat surface of the first plate; crank-arms each pivotally coupled to a piston and to one of the said shoes, and means for preventing the further plate from being driven in rotation by the engagement of the shoes on the first plate, the latter said means comprising two crank-arms pivotally connected to the shoe-carrying plate, and

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piston and cylinder arrangements fixed to the body of the pump, the latter said pistons being slidable in the latter said cylinders and having pivotal connection to said two crank-arms, and a spring in each of the said piston and cylinder arrangements for urging the piston of the latter against said two crank-arms.

6. A self-regulating pump in accordance with claim 5, in which the first plate is provided with a circular surface at right angles to the axis of the driving shaft and the pump body is provided with an annular surface parallel to the circular surface and in contact therewith, the said annular surface being provided with two circular grooves concentric with the said axis, the pump body being provided with a circular groove communicating with the grooves in said annular surface, the said body being provided with an outlet orifice connected to the circular groove in the pump body, the first plate being provided

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with perforations along a circumference having a radius intermediate to those of the said grooves in the annular surface, the said shoes, the crank-arms and the said pistons being provided with bores connecting the perforations and the pump cylinders.

References Cited in the file of this patent

UNITED STATES PATENTS

10	1,050,779	Miller	Jan. 14, 1913
	2,439,879	Allen	Apr. 20, 1948
	2,448,347	Beeh	Aug. 31, 1948
	2,517,008	Marshall et al.	Aug. 1, 1950
	2,732,805	Lucien	Jan. 31, 1956

FOREIGN PATENTS

15	1,104,109	France	June 8, 1955
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