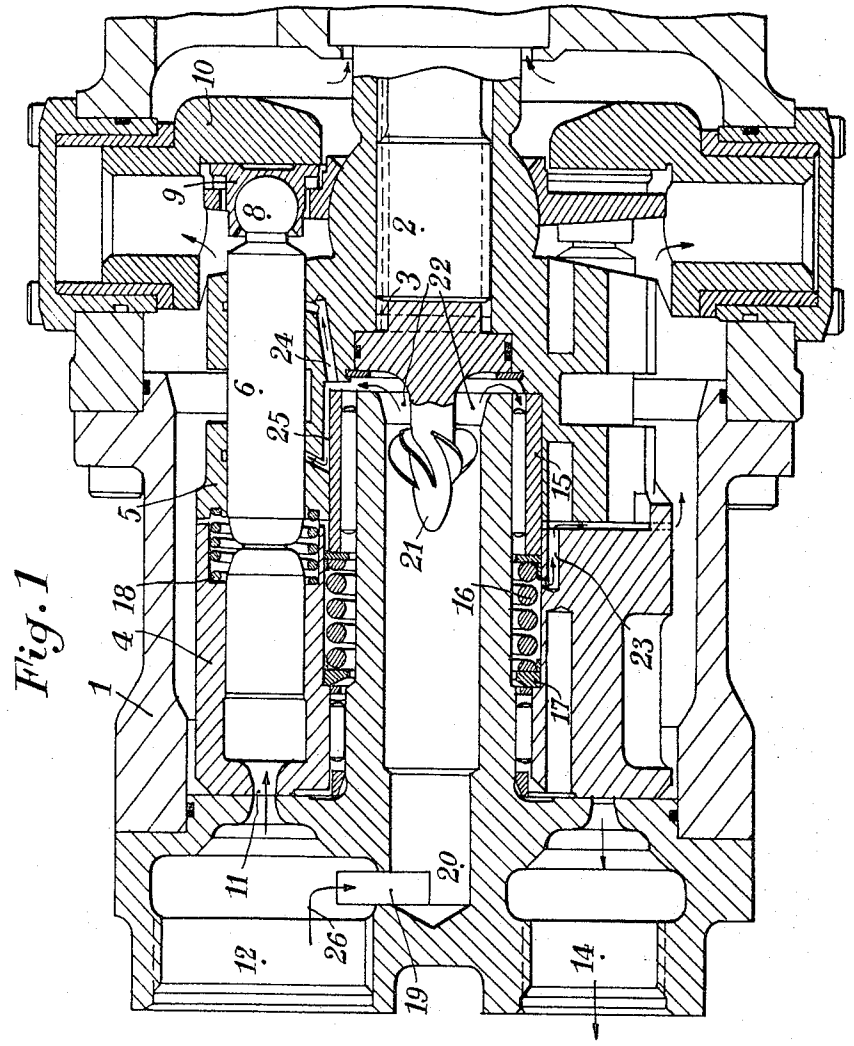
July 25, 1967 G. BOULET 3,332,356

HYDRAULIC PUMPS AND MOTORS WITH MULTIPLE CYLINDERS OF THE BARREL OR SWASH-PLATE TYPE

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Fig. 1

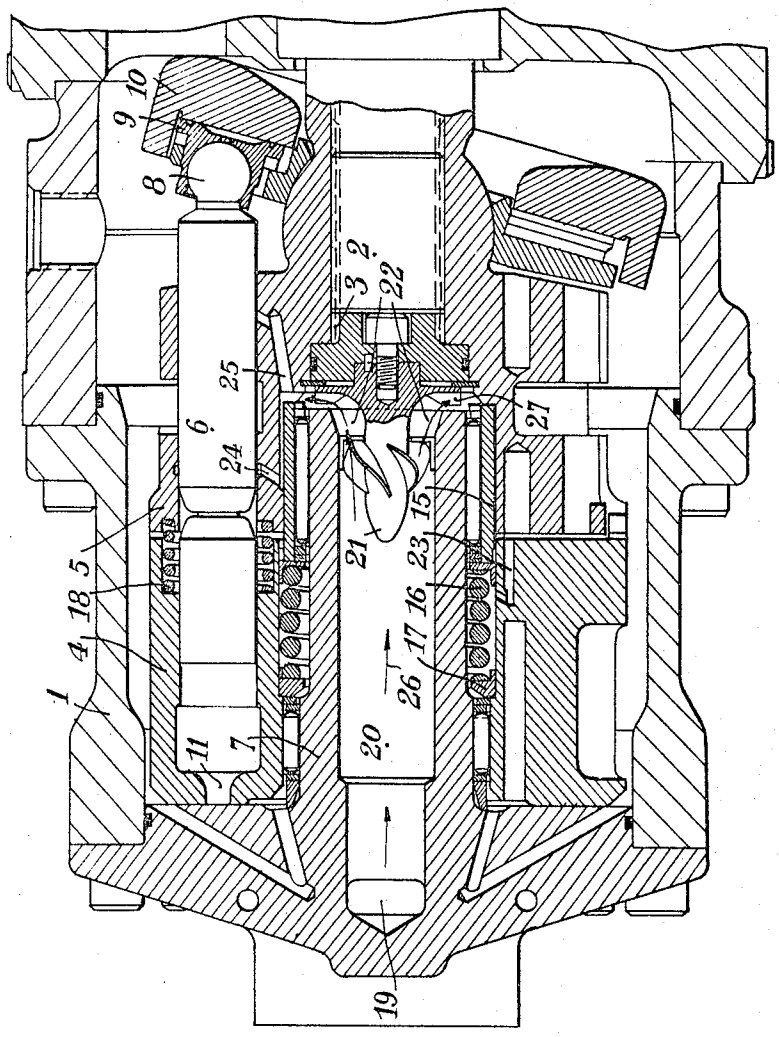


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Fig. 2



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HYDRAULIC PUMPS AND MOTORS WITH MULTIPLE CYLINDERS OF THE BARREL OR SWASH-PLATE TYPE

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3 Claims. (Cl. 103—162)

The present invention relates to hydraulic pumps and motors with multiple cylinders of the barrel or swash-plate type, in which an oblique plate controls the travel of the pistons and enables the pressure and/or the output to be regulated.

The lubrication of the rotating and sliding parts of these pumps and motors is generally effected, on the one hand by hydraulic leakages, and on the other hand by the evacuation of the regulation liquid when the pump or the motor is provided with regulation. These hydraulic leakages and these return-flows of regulation liquid depend on the typical conditions of operation of the pump—speed, output, pressure—and vary with the adjustments, the pressures and in the case of regulation, with the regulation frequency.

In addition, such leakages result in a substantial loss of power in the pump or the motor. In fact, the power W absorbed by a pump being given by the formula:

$$W=\frac{QP}{K}$$

in which Q represents the output, P the delivery pressure above the inlet pressure and K a coefficient, it is clear that the loss of power due to leakages is proportional to the flow-rate of these leakages and to the delivery pressure.

In spite of these disadvantages, this system of lubrication of the moving parts has the advantage of being particularly simple. It is however not completely satisfactory for hydraulic pumps or motors in which the arrangements are, for example, such as those described in U.S. Patent No. 3,130,593 of Apr. 28, 1961.

In such pumps or in such motors, the pumping barrel is driven so as not to generate any transverse reaction, and has in consequence a strictly-defined bearing surface on the face of the plate. As the pistons also are not subjected to any transverse forces, the hydraulic leakage is very small, even after a certain wear of the moving parts, and in consequence they cannot by themselves provide a suitable lubrication of the rotating and sliding parts.

The present invention has as an object the provision of an auxiliary lubrication device for hydraulic pumps and motors with multiple cylinders of the barrel type, which enables the moving parts to be lubricated under low pressure, irrespective of the conditions of operation, and which provides a supplementary supply of liquid which varies in accordance with the speed of rotation.

The device according to the invention comprises an auxiliary circuit for hydraulic circulation which couples together the suction orifices of the pump or the motor through the intermediary of conduits located inside the shaft of the front bearing carrier of the driving barrel, the barrel and the cylinders, and one or more pumps housed in the bearing-carrier shaft at the front of the barrel, and driven by the shaft of the barrel pump or motor, the said pumps generating a flow of liquid from the admission orifice to the liquid return, through all the orifices of the secondary hydraulic circuit, and thereby insuring a lubrication of the various parts which is variable according to the speed of rotation of the barrel.

The pressure of the auxiliary circuit should be at least equal to the pressure insuring the necessary flow-rate in the appropriate direction of the circuit, from the suction orifice to the leakage return, that is to say it should at least compensate for the depression at the suction and the hydraulic resistance of the whole return circuit under the conditions of operation, the flow-rate in this circuit being that imposed by the necessities of lubrication.

This minimum pressure of the auxiliary hydraulic circuit is in general comprised between 5 and 10% of the suction pressure, but the pressure employed may of course be greater than this value.

The lubricating device according to the invention has the advantage of absorbing a power which is very much smaller than the losses of power resulting from lubrication effected by means of hydraulic leakages.

It is thus found, in particular, that in the case of a pressurized pump giving a delivery pressure of 200 kg. for an intake pressure of 1 to 4 kg., the power absorbed by the lubrication device according to the invention is 500 times smaller than the losses of power caused by a lubrication by hydraulic leakage.

Two embodiments of the invention, applied to a barrel pump with small hydraulic leakage will next be described below by way of non-limitative examples, reference being made to the accompanying drawings, in which:

FIG. 1 is an axial section of a barrel pump provided with a form of construction of the device according to the invention, comprising a single helicoidal pump; and

FIG. 2 is an axial section of a barrel pump provided with a second form of construction of the device according to the invention, comprising a helicoidal pump and a centrifugal pump.

The pumps shown in the two figures comprise, in a manner known per se, a generally cylindrical casing **1**, a driving shaft **2** driving through the intermediary of teeth **3** a barrel **4** comprising cylinders **5**, in which pistons **6** are adapted to move. The barrel **4** rests on a bearing-carrier shaft **7**, and each piston **6** is provided with a ball-and-socket **8** engaged in a ring **9** carried by a moving plate **10**, the inclination of which controls the output of the pump. The cylinders **5** are connected by conduits **11** to an admission orifice or port **12** in the casing **1** and by the same conduits **11** to a delivery orifice or port **14**. A ring **15** located at the periphery of the shaft **7** is held in position by a spring **16** supported against abutments **17**; springs **18** are housed in the barrel **4** at the periphery of the cylinders **5**.

According to the invention, a conduit **19** connects the admission orifice **12** to a conduit or internal base **20** located in the interior of the bearing-carrier shaft **7**. A helicoidal pump **21** of the downstream type, comprising a certain number of blades (five in the case of the example shown) is housed in the conduit **20** and is driven by the working teeth **3** of the driving barrel **4**. The conduit **20** is connected by orifices **22** to conduits **23**, **24** and **25** located inside the barrel **4** and cylinders **5**, the said conduits being in turn in communication with the leakage return.

The liquid drawn-in by the helicoidal pump **21** enters the lubrication circuit via the conduits **19** and **20** in the direction shown by arrow **26** and is delivered by the pump **21** into the conduits **23**, **24** and **25** so as to come into contact with the various moving parts of the barrel pump, in particular with the shaft **2**, the pistons **6**, the ring **9** and the plate **10**.

The helicoidal pump **21** being directly driven by the working teeth **3** of the barrel **4**, the flow-rate of the secondary hydraulic stream is a function of the speed of rotation of the barrel pump. The minimum pressure of the auxiliary circuit is readily obtained by utilizing a helicoidal pump of an adequate power and type.

In the case where the speed of the barrel pump is sufficiently high to necessitate a higher pressure in the secondary hydraulic circuit, the helicoidal pump utilized in this circuit can be advantageously duplicated by a centrifugal pump of conventional type.

This particular arrangement is illustrated in FIG. 2, which is an axial section of a pump similar to that shown in FIG. 1, the section plane of FIG. 2 being perpendicular to the section plane of FIG. 1.

In these two figures, the same references represent the same parts, the only difference between the two arrangements being that the helicoidal pump **21** is completed by an element **27** of a centrifugal pump, located downstream of the helicoidal pump in the secondary hydraulic circuit.

The hydraulic circuit which has just been described is of course not in any way limitative; it may comprise any other conduit located in the fixed or moving parts, and the helicoidal pump and the centrifugal pump may be coupled fast to the driving shaft by any device other than by teeth. In addition, the pump employed in the lubrication circuit may be of the gear-pump type.

What I claim is:

1. A pump comprising a generally cylindrical casing having spaced ends one of which is provided with spaced inlet and outlet ports, a hollow shaft in and extending partly through said casing in axial alignment towards the other of said ends, said shaft having an internal bore coupled to said inlet port and extending through said shaft to open towards said other end of the casing, a barrel encircling said shaft, a ring between said barrel and shaft and defining a passage therebetween, said barrel including a portion extending beyond said shaft towards said other end of the casing, pump means on said portion spaced from the end of the shaft to define therewith a second passage communicating said bore with the first said passage, a drive shaft extending into said other end of said casing and into said portion of said barrel, said portion and drive shaft including interengaged teeth for the driving of said barrel, said pump means and barrel portion including interengaged teeth for the driving of said pump means, said barrel including axially aligned cylinder means adapted for being rotated into sequential alignment with said ports, pistons displaceable in said cylinder means, and a control ring mounted on said barrel portion to control the magnitude of displacement of said pistons, said barrel being provided with passages connecting said first and second passages with said cylinder means at spaced positions in the latter, said casing defining with said barrel an annular space and including a discharge port connected thereto, said barrel being provided with a further passage extending between said annular passage and said first passage.

2. A pump as claimed in claim **1** wherein said pump means includes a helical pump extending partly into the bore of said hollow shaft.

3. A pump as claimed in claim **2** wherein said pump means includes a centrifugal pump outside of said bore and cooperating with said helical pump.

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