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AUTOMATIC REGULATING DEVICES FOR HYDRAULIC BARREL-TYPE PUMPS OR MOTORS

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Fig. 1

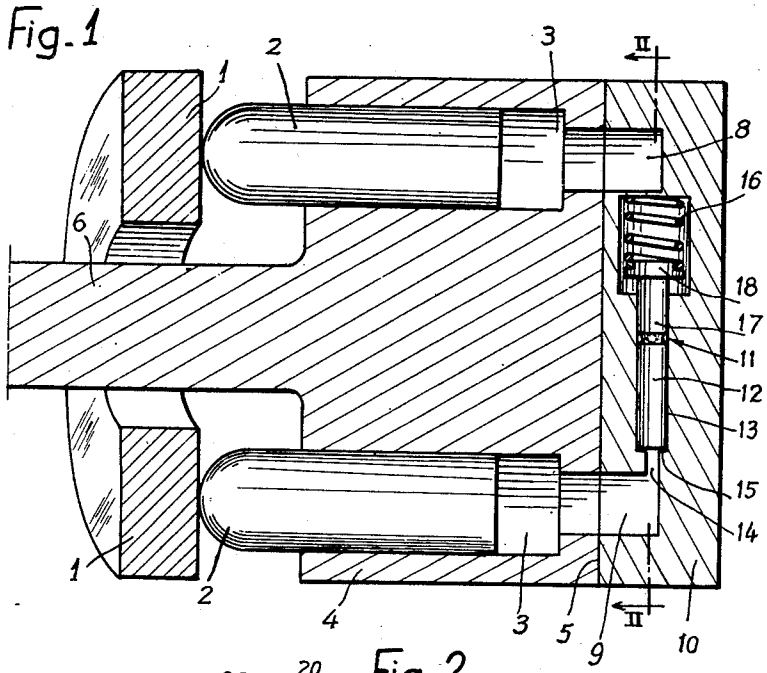
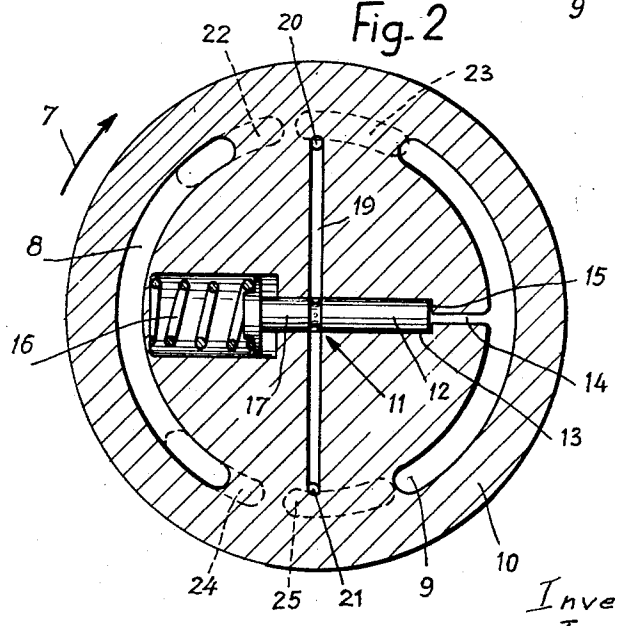


Fig. 2



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AUTOMATIC REGULATING DEVICES FOR HYDRAULIC BARREL-TYPE PUMPS OR MOTORS

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2 Claims. (Cl. 103—162)

This invention relates to hydraulic pumps or motors of the multiple parallel piston type.

In apparatus of this type—also called hydraulic barrel-type pumps or motors—the pistons bear through their rods on an inclined plane called a swash plate and are caused to move in their respective cylinders formed in a block or barrel solid with either a driving shaft in the case of a pump or a driven shaft in the case of a motor. During each half-revolution of the barrel, each piston performs a full stroke. The distributor slide face of a distributor plate has formed therein, opposite the corresponding barrel slide face, an inlet port and an exhaust port, this distributor slide face engaging said corresponding barrel slide face. The swash plate and the distributor plate, on the one hand, and the barrel, on the other hand, have a relative rotary motion applied thereto. During this rotation, the opening through which each cylinder opens into the barrel face moves successively past the ports of the distributor plate.

In a barrel-type hydraulic motor or pump operating under a relatively high pressure due account must be taken of the pressure variations during the change from suction to delivery, or from inlet to exhaust, and vice versa.

During the change or switching, that is, when each cylinder passes from the suction zone to the delivery zone and vice versa, the liquid containtained in the cylinder is subjected to rapid and sometimes important pressure variations producing mechanical reactions between the drive members and causing knocking noises to be eliminated for the sake both of discomfort and of the loss of efficiency resulting therefrom.

This elimination is closely related to the compressibility of the liquid and therefore it has been endeavoured, by properly disposing the ports of the distributor and slide valves, to create pre-compression and pre-expansion gaps for avoiding as far as possible any noise-generating sudden pressure variations. However, in this case it is obvious that these pre-compression and pre-expansion zones are exactly applicable for only one cubic capacity of the pump or motor, and also for the corresponding dead space and a predetermined pressure; if anyone of these elements changes, the pressure variation in the momentarily isolated liquid will not correspond anymore to the difference between inlet and exhaust, and the "switching" will cease to be satisfactory.

The defect arising from variations for more or less important speed ranges may be corrected by modifying the timing of the distributor plate with respect to the swash plate. This correction was also effected heretofore by a proper adjustment of the inclination of the pivot axis of the swash plate.

However, when frequent operations at pressures considerably lower than normal rated pressures are contemplated, it may become necessary to temporarily suppress the pre-compression and pre-expansion phases, the pre-expansion phase notably being the cause of troubles such as the loss of bearing contact between the pistons and the swash plate.

It is the essential object of this invention to improve the conventional timing system in hydraulic motors and pumps of the barrel type as broadly set forth hereinabove,

-and to permit the elimination of the precompression and pre-expansion features when the operating pressure drops below a predetermined value. This improvement consists essentially in forming on the distributor face of the distributor plate two orifices located each centrally of the gaps provided intermediate said ports, these orifices being interconnected through the two passages of a slide-valve. The movable valve member or slide valve proper is responsive to a control piston slidably fitted in a control cylinder communicating with the delivery or exhaust port. The slide valve is constantly urged in its opening direction by a calibrated coil compression spring and in its closing direction by the pressure likely to prevail in the delivery port and, therefore, in the aforesaid control cylinder.

The force of said spring and the cross-sectional area of said control cylinder are so calculated that the slide valve displacement in the closing direction occurs only when the delivery pressure exceeds a predetermind value.

The invention will now be described with reference to the accompanying drawing illustrating diagrammatically by way of example sectional views of a barrel pump. In the drawing:

FIGURE 1 is a diagrammatic longitudinal section showing a hydraulic pump equipped with a typical embodiment of the distributor device according to this invention, and

FIGURE 2 is a cross-sectional view showing the distributor plate, the section being taken upon the line II—II of FIGURE 1 and rotated 90° counterclockwise.

Referring first to FIGURE 1, the essential component elements of a barrel pump comprise, as shown, a swash plate **1** cooperating with a plurality of pistons **2** slidably fitted in corresponding cylinders **3** formed in a rotary barrel **4** driven from a shaft **6**; a distributor face **5** is also formed on a distributor plate **10** in which suction and delivery ports **8**, **9** respectively are formed in front of the barrel.

A slide-valve **11** is actuated by a control piston **12** slidably fitted in a control cylinder **13** communicating through a passage **14** with the delivery port **9**. A bottom **15** in cylinder **13** limits the stroke of piston **12** so that the slide-valve is open when the piston stroke is stopped by said bottom.

A calibrated coil compression spring **16** constantly urges the slide valve **17** of slide-valve **11** in the opening direction through the medium of a head **18**.

In this specific example, the slide-valve **11** and its control members are shown as being mounted inside the distributor plate **10** to simplify the illustration of the distribution system according to this invention, but it will be readily understood by anybody conversant with the art that these elements may also be disposed externally of the distributor plate according to any arrangement likely to facilitate their manufacture and assembly.

The slide-valve **11** is interposed in a passage or duct **19** interconnecting a pair of diametrally opposite orifices **20**, **21** opening each into the distributor face **5** substantially centrally of a gap left between the suction and delivery ports **8**, **9** respectively. Thus, the slide-valve **11** will permit, retard or stop the flow of fluid to or from the orifices, according to the pressures exerted by the spring **16** and by the fluid acting within the cylinder **13**.

FIGURE 2 illustrates the arrangement of orifices **20**, **21** relative to the ports **8** and **9**. On the other hand, the broken lines **22**, **23**, **24** and **25** denote the four apertures of barrel cylinders opening into the barrel face.

The arrow **7** indicate the direction of rotation of the barrel.

The number of cylinder, the angular extent of the corresponding apertures, the angular extent of the gap between ports **8** and **9**, and the position of orifices **20** and

21 relative to the timing arrangement are so selected that the barrel cylinder apertures in conjunction with the orifices 20 and 21 cannot cause the suction to communicate through these orfices with the exhaust. As will be seen in FIGURE 2, with this arrangement the orifice 20 or the corresponding orifice 21 may be either connected to the suction or delivery side of the pump, or closed to a moderate extent, or connected directly, without any external connection, to one of the barrel cylinder apertures.

The distributor device of this invention operates as follows:

As the delivery pressure is communicated to the control piston 12, spring 16 will counter-balance the resulting force. The cylinder bottom 15 keeps the slide-valve open when the operating pressure is zero or the spring force is preponderant. The calibration of spring 16 permits of adjusting at will the pressure value at which the slide-valve 11 is closed.

When the slide-valve 11 is open and permits the communication between two cylinders substantially opposite in relation to the axis of rotation of the barrel, no pre-compression or pre-expansion can take place as long as the overlapping of the gap separating the cylinder apertures from the orifices 20, 21 is negligible, and due to the fact that the suction and delivery circuits cannot be interconnected through the passage 19.

When the slide-valve 11 is closed, the orifices become inoperative and the distributor arrangement operates in the conventional manner.

I claim:

1. Automatic adjustment device for hydraulic pumps and motors comprising a rotary barrel having multiple parallel piston-and-cylinder assemblies, said barrel having

a face with apertures each communicating with a specific cylinder, a distributor plate having a face bearing against said barrel face having in front of said barrel face an inlet port and an exhaust port, said ports being so disposed that during the barrel rotation said apertures register successively with said ports, a swash plate for reciprocating said pistons in said cylinders, said distributor plate having in the face thereof an orifice spaced intermediate said ports, a passage interconnecting said two orifices, a slide-valve controlling said passage comprising a control cylinder communicating with said exhaust port, a control piston in said control cylinder controlling said slide-valve, a calibrated coil compression spring urging said slide-valve constantly in the opening direction and in the closing direction by the pressure prevailing in said exhaust port, the force of said spring and the cross-sectional area of said control cylinder being such that the displacement of said slide-valve in the closing direction takes place only when the delivery pressure exceeds a predetermined value.

2. A device as set forth in claim 1 wherein the number of cylinders, the angular extent of the relevant apertures, the angular extent of the gaps intermediate said ports, and the position of said orifice on the distribution plate are so selected that said cylinder apertures, in connection with said orifices, cannot interconnect said suction and delivery ports through said orifices and the passage interconnecting same.

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