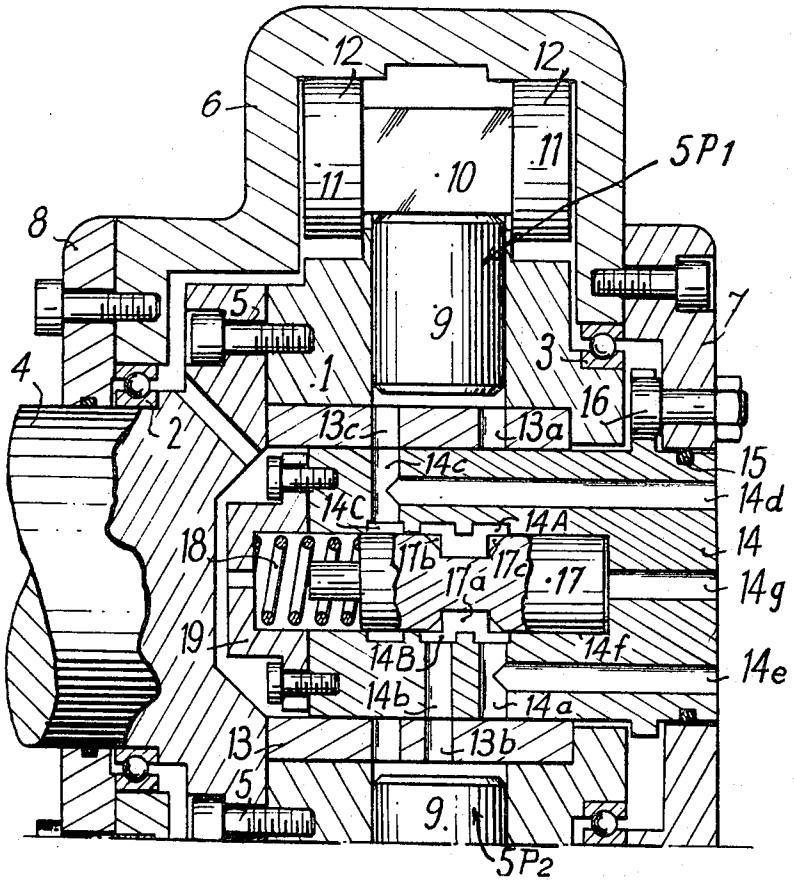
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HYDRAULIC MOTOR CHANGE-SPEED SYSTEM

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Fig. 1



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HYDRAULIC MOTOR CHANGE-SPEED SYSTEM

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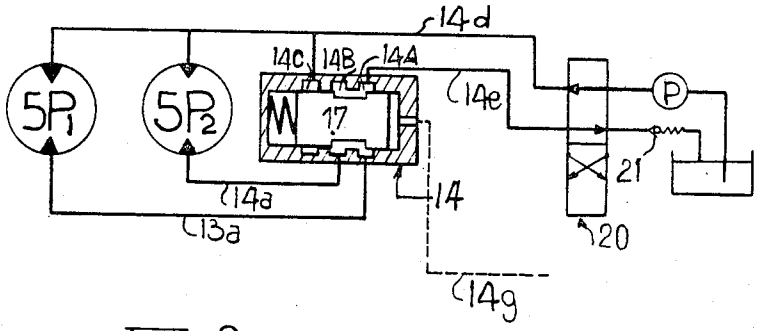


Fig. 2

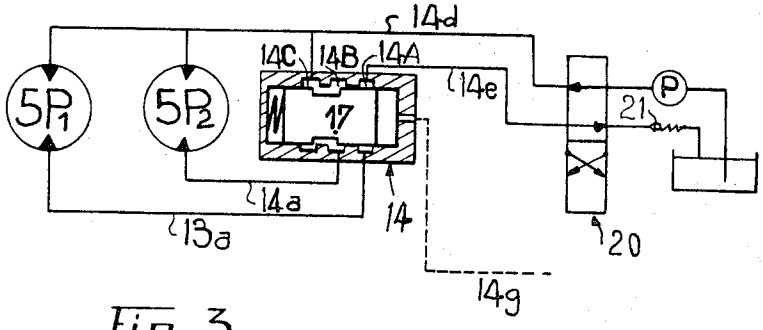


Fig. 3

United States Patent Office 3,403,599 Patented Oct. 1, 1968

3,403,599

HYDRAULIC MOTOR CHANGE-SPEED SYSTEM

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Filed Oct. 10, 1966, Ser. No. 585,394
Claims priority, application France, Oct. 8, 1965, 34,190
7 Claims. (Cl. 91—205)

ABSTRACT OF THE DISCLOSURE

An hydraulic motor including a rotating cylinder block having radial cylinders, pistons associated with the radial cylinders engageable with an undulating cam, the radial cylinders consisting of first and second cylinder groups, separate first and second adjacent chambers, discharge ports intercommunicating the first cylinder group with the first chamber, discharge ports intercommunicating the second cylinder group with the second chamber and supply ports intercommunicating the radial cylinders with a third chamber adjacent to and separate from the second chamber, the first chamber permanently communicating with a discharge line and the third chamber permanently communicating with a supply of fluid under pressure, and a distributing valve operatively connected to the three chambers to selectively communicate the first and second chambers, and the second and third chambers.

The physical means for speed changing in such a motor are often complicated and are outside the motor and therefore increase the bulk thereof. Also, they are so connected to the hydraulic circuit as usually to cause one of the following effects. One cylinder group is isolated by the circuit for that particular group being closed on itself. There is therefore no supply of pressure oil to compensate for losses, nor is there any flow of oil, which tends to heat up. In another known system, a cylinder group whose circuit is closed on itself still communicates with the pressure oil supply line. Losses of the oil circulating in closed circuit are therefore compensated for, but there is insufficient oil renewal to preclude heating.

It is an object of the invention to provide a simple and compact system which can readily be fitted to a hydraulic motor with substantially no increase in the bulk thereof. The system according to the invention also compensates for oil losses in cylinders which have been made inoperative—i.e., non-driving—and provides a relatively considerable renewal of the oil flowing in closed circuit, thus greatly reducing the risk of the oil heating up.

The invention is of use more particularly in hydraulic motors of the kind in which a cylinder block is secured directly to a driven shaft and rotates the same by being driven by radial pistons co-operating with a wavy cam. The cylinders and pistons are divided into two groups or sets. The total cylinder capacity of the motor corresponds to the two groups together, and a reduced cylinder capacity corresponds to one of the groups.

One of the main requirements for satisfactory operation of the motor is that the pistons which have been cut out of operation should still faithfully follow the cam contours; they must not vibrate freely nor strike the cam. Also, this continuous guiding of the pistons must not require power consumption. The invention meets this condition and also allows for reversal of the direction in which the motor runs.

In a system according to the invention, the discharge lines of a first cylinder group extend to a first chamber, the discharge lines of a second cylinder group extend to a second chamber near and separate from the first chamber, and the supply lines of all the cylinders extend to a third chamber which is near and separate from the second chamber, the first chamber being permanently connected to a discharge line and the third chamber being permanently connected to a pressure fluid supply line, and a distributing valve or distributor movable between the three chambers so acts as to provide selective communication in one position between the first and second chambers and, in a second position, between the second and third chambers.

The system as defined in the immediately previous paragraph could of course be inverted—in other words, the supply lines (and not the discharge lines) of the first cylinder group could extend to the first chamber, the supply lines (and not the discharge lines) of the second group could extend to the second chamber, and the discharge lines (and not the supply lines) of all the cylinders could extend to the third chamber. In such a case, the first chamber would be connected to a supply line (and not a discharge line) and the third chamber would be connected to a discharge line (and not a supply line).

The invention will be better understood, and secondary features and the advantages of the invention will emerge, from the following description of a scheme and embodiment given hereinafter by way of example, reference being made to the accompanying drawings wherein:

FIG. 1 is a partial and sectioned view of a hydraulic motor having a system according to the invention and

FIGS. 2 and 3 are theoretical diagrams showing how the system according to the invention can be used for selective connection of two cylinder groups of the engine shown in FIG. 1.

For the purposes of this description, the invention is applied to a hydraulic motor having 10 pistons distributed in two groups of 5 called $5P_1$ and $5P_2$ in FIGS. 2 and 3, where the system according to the invention has the general reference **14**. The system according to the invention is operated by pressure fluid supplied through a line **14***g*. The two piston groups $5P_1$, $5P_2$ are supplied in parallel from a common line **14***d*. The first group, $5P_1$, is permanently connected to a direct discharge line **13***a*, whereas the second group $5P_2$ discharges through a line **14***a*, the lines **13***a*, **14***a* extending to respective chambers **14A** and **14B** in the system **14**. Chamber **14A** is connected to discharge line **14***e* of the first group $5P_1$, and a third chamber **14C** is connected to the common supply line **14***d*.

In the position in which the system **14** is shown in FIGS. 1 and 2, both the groups are supplied in parallel, so that the motor runs on its maximum cylinder capacity.

In the position in which the distributor is shown in FIG. 3, discharge line **14***a* of the second group $5P_2$ communicates via chambers **14B**, **14C** with supply line **14***d*. Only the first group $5P_1$ operates and provides driving work. The motor runs on its smallest cylinder capacity.

Through the agency of the pressure line **14***g*, the system **14** can be placed selectively in either of its positions along the lines just described.

In practice, the system **14** is a physical and simply constructed device which is incorporated with the motor and which forms a compact assembly therewith; one embodiment is shown in FIG. 1. The hydraulic motor comprises a cylinder block **1** which is mounted on anti-

friction bearings 2, 3 and which is coupled by screws 5 with a shaft 4. The complete motor is placed in a casing 6 closed by a cover 7 and end plate 8. The cylinder block 1 is formed with 10 equidistant bores in which pistons 9 move. Each piston 9 bears on a beam 10 which is slidable in the cylinder block 1 and which bears two rollers 11 each running on a cam 12 rigidly secured to the casing 6. The cam contour is such that 5 equidistant pistons have an instantaneous rate of inlet flow equal to the rate of delivery flow. Consequently, if the inlet side and delivery side of these pistons are interconnected and raised to any pressure whatever the motor formed by such 5 pistons delivers zero torque as an instantaneous value as well as a mean value. Because of this feature of the motor, which can be provided on the basis of appropriate construction parameters, the set of 5 pistons can be coupled as required with the inlet or with the return of the other 5 pistons while the complete system continues to operate at a good over-all efficiency.

The bores are supplied through a ring 13, which is rigidly secured to the cylinder block 1, and through a distributor 14 which floats on the cover 7 with the interposition of a gasket 15 and which is locked in rotation by a finger 16. The ring 13 is formed with holes 13*b*, 13*c* for the delivery and supply respectively of one 5-piston group, and with holes 13*a*, 13*c*, for the delivery and supply respectively of another 5-piston group.

The distributor is formed with three systems of holes 14*a*, 14*b*, 14*d* which are each distributed in a radial plane, the number of holes in each radial plane being equal to the number of strokes per revolution, the holes 14*a* having an angular offset of half-a-stroke relatively to the holes 14*b* and 14*c*. The three systems of holes extend to grooves 14A, 14B, 14C. Groove 14A communicates directly and permanently with a main pressure fluid discharge line 14*e*, whereas groove 14C communicates directly and permanently with the joint main pressure fluid supply line 14*d*.

The grooves 14A, 14B, 14C are contrived in a central bore 14*f* in which a valve 17 can move; the valve 17 is formed with a communicating groove 17*a* having gradual slopes 17*b*, 17*c* on its sides. An abutment 19 screwed to the cylinder block 1 serves as a seat for a spring 18 which bears on one end of the piston 17. Via a line 14*g*, the base of bore 14*f* communicates with a pressure fluid source for placing the valve or piston 17 in one or other of its positions. The three grooves 14A, 14B, 14C therefore form three separate chambers—one, 14A, permanently connected to the discharge line, another, 14C, permanently connected to the supply source, and a central one, 14B, which communicates, via groove 17*a* in valve 17, either with chamber 14A, as shown in FIG. 3, or with chamber 14C. A very simple system is therefore provided which has a very small number of parts and which, as hereinbefore described, can selectively provide a driving fluid supply to all or some of a cylinder capacity. The valve 17 is a direct fit in the bore 14*f* and has no gasket which can be damaged or worn.

In the example described and shown it was assumed, for the sake of clarity in the description, that the main line 14*d* was for pressure fluid supply and the main line 14*e* was for discharge. Of course, the scope of the invention would not be exceeded if, as is familiar in the art, the direction of fluid flow in these two main lines were to be reversed to make the motor run to the opposite hand. In any case, this possible reversal feature is shown in FIGS. 2 and 3 by the provision of a conventional reverser 20.

Also, the discharge line has a non-return valve 21 to enable some pressure to build up in the return line 14*e*, the idea being to keep the pistons bearing on the cams, more particularly the pistons of the second group $5P_2$ when the same is inoperative.

The invention provides two main advantages which are not found together in any of the prior art. The first advantage is the forcible feeding of the group $5P_2$ when the same is inoperative, something which is essential to compensate for inevitable losses. The second advantage is that the oil of the inoperative group $5P_2$ does not remain in closed circuit but is continuously renewed by the general flow, and so there is very little risk of the oil of the inoperative group heating up.

The invention covers all variants possible without departure from the scope of the invention.

I claim:

1. An hydraulic motor comprising a rotating cylinder block having radial cylinders, piston associated with said radial cylinders and bearing on a undulating cam, first and second cylinder groups constituting said radial cylinders, separate first and second adjacent chambers, discharge ports leading from said first cylinder group to said first chamber, dischage ports leading from said second cylinder group to said second chamber and supply ports to all said radial cylinders leading to a third chamber adjacent to and separate from said second chamber, said first chamber being permanently connected to a discharge pipe line and said third chamber being permanently connected to a pressure fluid supply pipe line, and a distributing valve associated with said three chambers and movable into at least two positions, in one of which it provides communication between said first and second chambers and in the other of which it provides communication between said second and third chambers.

2. An hydraulic motor comprising a rotating cylinder block having radial cylinders, pistons associated with said radial cylinders and bearing on an undulating cam, first and second cylinders groups constituting said radial cylinders, separate first and second adjacent chambers, supply ports leading from said first cylinder group to said first chamber, supply ports leading from said second cylinder group to said second chamber and discharge ports to all said radial cylinders leading to a third chamber adjacent to and separate from said second chamber, said first chamber being permanently connected to a pressure ffuid supply pipe line and said third chamber being permanently connected to a discharge pipe line, and a distributing valve associated with said three chambers and movable into at least two positions, in one of which it provides communication between said first and second chambers and in the other of which it provides communication between said second and third chambers.

3. An hydraulic motor according to claim 1, wherein said distributing valve comprises a piston slidably mounted in a cylinder, parallel grooves provided in the inner wall of said cylinder and forming the said three chambers, and an annular groove being provided in the periphery of said piston, said annular groove being wider than the distance between two of said parallel grooves.

4. An hydraulic motor according to claim 2, wherein said distributing valve comprises a piston slidably mounted in a cylinder, parallel grooves provide in the inner wall of said cylinder and forming the said three chambers, and an annular groove being provided in the periphery of said piston, said annular groove being wider than the distance between two of said parallel grooves.

5. An hydraulic motor according to claim 1, wherein said distributing valve comprises a piston slidably mounted in a cylinder, parallel grooves provided in the inner wall of said cylinder and forming the said three chambers, and an annular groove being provided in the periphery of said piston, said annular groove being wider than the distance between two of said parallel grooves and provided with an inclinde recess in at least one of the side walls bounding said annular groove.

6. An hydraulic motor according to claim 3, wherein said cylinder is arranged at the centre of the motor and coaxially with respect to said cylinder block, said cylinder being provided with a spring and said piston being a close fit in said cylinder and being adapted to be moved by fluid pressure, against the action of said spring.

7. An hydraulic motor according to claim 4, wherein said cylinder is arranged at the centre of the motor and coaxially with respect to said cyinder block, said cylinder being provided with a spring and said piston being a close fit in said cylinder and being adapted to be moved by fluid pressure, against the action of said spring.

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