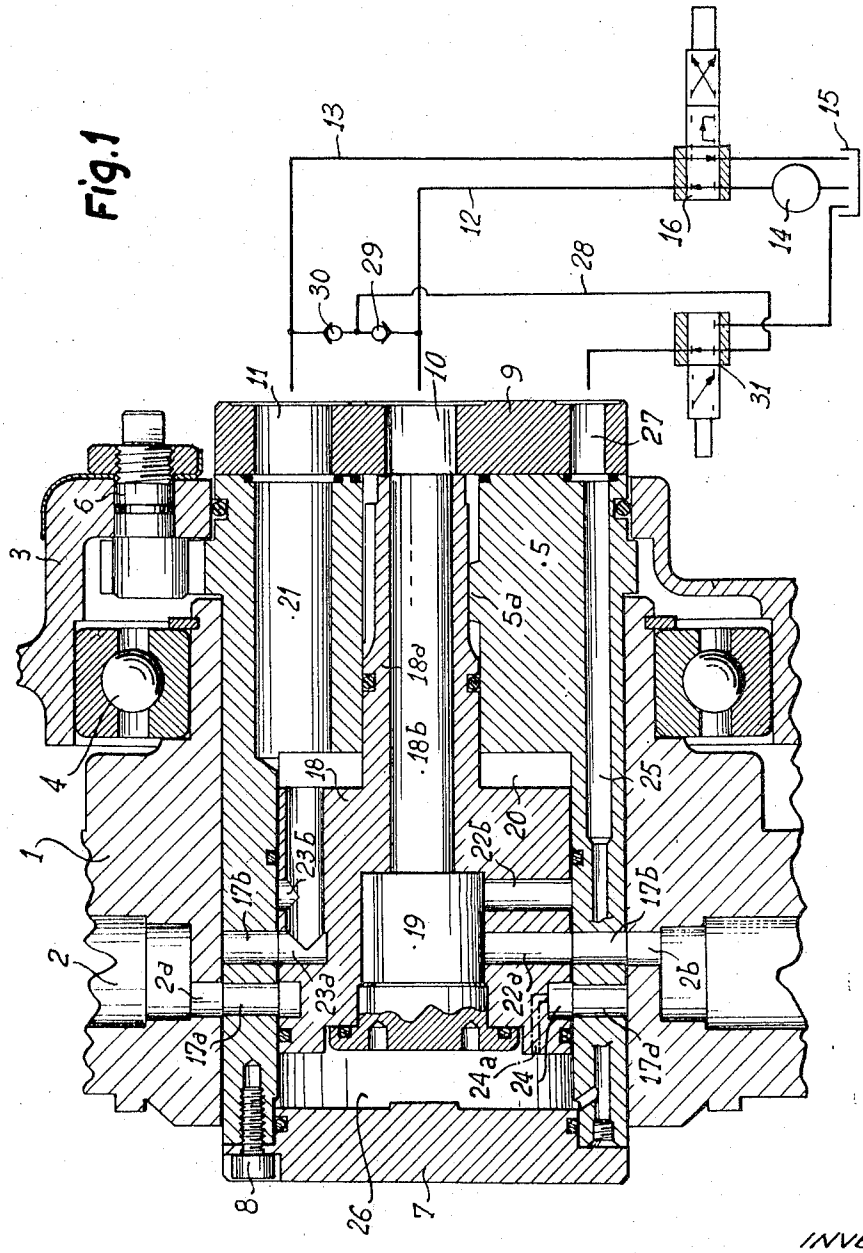
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SPEED CHANGE DEVICE FOR AN HYDRAULIC MOTOR

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Fig. 1



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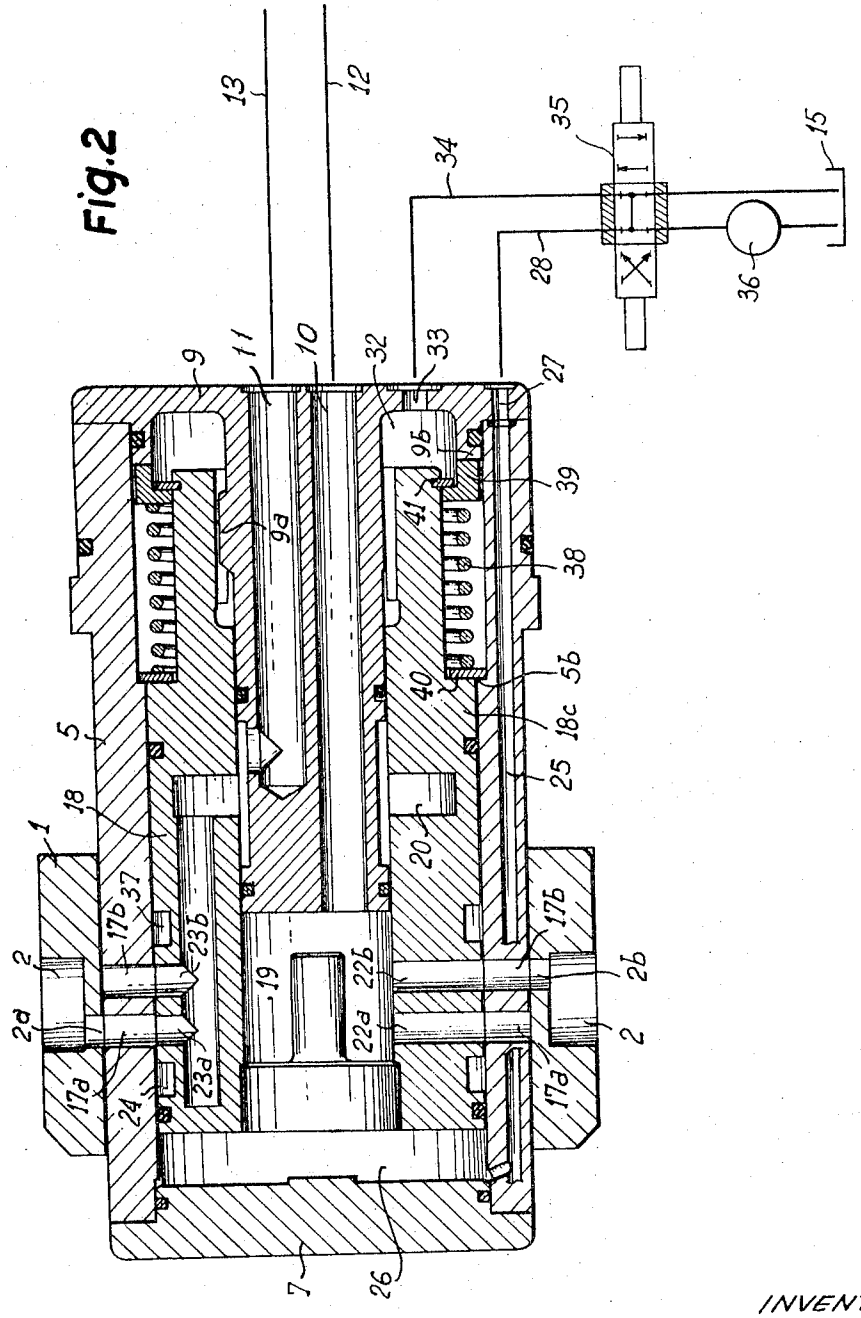
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SPEED CHANGE DEVICE FOR AN HYDRAULIC MOTOR

Filed May 28, 1965 2 Sheets-Sheet 2

Fig.2



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United States Patent Office 3,296,937
Patented Jan. 10, 1967

3,296,937

SPEED CHANGE DEVICE FOR AN HYDRAULIC MOTOR

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Filed May 28, 1965, Ser. No. 459,865
8 Claims. (Cl. 91—205)

Several types of hydraulic motors are already known which comprise at least one rotary cylinder block in which are provided a number of cylinders in which pistons reciprocate under the action of fluid under pressure, said pistons being supported on an undulating cam. It is known to vary the number of cylinders fed with pressure fluid in order to vary the speed of rotation of the motor whilst maintaining the fluid supply constant. For this purpose valve control means are provided in the supply pipe lines associated with each cylinder, said valve means being controlled individually or simultaneously. It is also known to provide such hydraulic motors with a plurality of cylinders arranged in a number of groups, each group of cylinders having separate supply pipe lines.

The object of the present invention is to provide a simple speed change device for hydraulic motors of the above type and which comprise at least two groups of cylinders supplied separately by means of openings provided in the external periphery of a distributor coaxial with the cylinder block, the said openings being grouped in transverse planes, preferably equidistant and corresponding respectively to transverse planes of the supply conduits of the cylinders of each group.

According to the invention, the distributor consists of a fixed sleeve in which openings are provided and on the inside of which is mounted on axially sliding valve. The slide valve comprises essentially an inlet chamber and an outlet chamber communicating respectively with a plurality of conduits, the ends of which are arranged in transverse planes, preferably equidistant, and are capable of being brought opposite the inner ends of the openings in the sleeve. Thus, it is sufficient to control the axial displacement of the slide valve, manually or automatically, in order to put into or out of service, the cylinders of one group.

The invention will be better understood and various other features and advantages will be apparent from the following description of two embodiments, given purely by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is an axial section of a first cylindrical distributor in accordance with the invention, and

FIGURE 2 is a view similar to that of FIGURE 1, of a second distributor in accordance with the invention.

Referring to FIGURE 1, the hydraulic motor comprises a single cylinder block 1 in which are provided, radial cylinders 2 arranged circumferentially at equidistant intervals. The cylinder block 1 is mounted for rotation relative to a casing 3 which supports undulating cam means (not shown), by means of at least one roller bearing 4. Pistons (not shown) reciprocate in the cylinders 2 and are supported by the said cam means.

A cylindrical sleeve 5 is disposed coaxially with respect to the cylinder block 1 and is fixed to the casing 3 by bolts 6. The sleeve 5 is provided at one of its ends with a closure plate 7 secured by screws 8 while at the other of its ends a coupling element is secured having two internally screw threaded openings 10 and 11 connecting pipe lines 12 and 13 for connecting to the motor a pump 14 and a reservoir 15 respectively, a reversing valve 16 being arranged in said pipe lines 12 and 13.

The sleeve 5 is provided with radial openings 17*a*, 17*b* spaced circumferentially at equidistant intervals around

said sleeve and disposed in two transverse planes. Each group of radial openings is situated in the same transverse plane as the supply conduits 2*a* and 2*b* of the cylinders 2 which are thus themselves disposed in two groups separately supplied with pressure fluid.

Inside the sleeve 5 is a slide valve 18 having an axial stem 18*a* and provided with external longitudinal grooves co-operating with longitudinal plates 5*a* provided on the inner wall of the sleeve 5. Thus, the valve 18 can slide axially with respect to the sleeve 5.

Two chambers are provided in the slide valve 18, one of which is an inlet chamber indicated at 19, communicates with the aperture 10 in the coupling element 9 through an axial bore 18*b* provided in the stem 18*a*. Preferably, the other or outlet chamber as shown in the drawing, consists of an annular space 20 formed between two opposing surfaces of the slide valve 18 and of the sleeve 5, and communicates with the aperture 11 in the coupling element 9 through the longitudinal bore 21 in said sleeve. The two chambers 19 and 20 are connected to the outer periphery of the slide valve 18 by conduits 22*a*, 22*b* and 23*a*, 23*b* respectively, the ends of which conduits open respectively into transverse planes spaced axially one from the other by a distance equal to that separating the two transverse planes of the openings 17*a* and 17*b*. Finally an annular passage 24 is provided in the external surface of the slide valve and is situated at a distance from the transverse plane of the conduits 22*a*, 23*a* equal to that of the two transverse planes of the openings 17*a* and 17*b*.

In order to ensure the displacement of the slide valve 18, any suitable manual control may be provided. However, it is preferred to use an hydraulic control as shown in the drawings. For this purpose, a conduit 25 provided in the sleeve 5, connects an aperture 27 in the coupling element 9 and the chamber 26 of the hydraulic ram of which the slide valve 18 constitutes the piston and the sleeve 5 of the cylinder. With aperture 27 is connected a pipe line 28 capable of being connected selectively to a source of fluid under pressure or a discharge reservoir by means of a two-way reversing valve 31. If, for example, the pipe line 28 is connected in parallel with two pipe lines 12 and 13 carrying motive fluid, the non-return valves 29 and 30 thus prevent any passage of fluid from the pipe line 28 towards one or the other of the pipe lines 12 and 13. The two-way reversing valve 31 or a three-way valve placed in the pipe line 28, is used for controlling the delivery of fluid under pressure in the chamber 26 or the evacuation of fluid to the discharge reservoir 15.

It must be understood however that the same result would be achieved if the cylinders 2 of the cylinder block were divided into three or more separately supplied groups. Conduits similar to conduits 22*a*, 23*a* and passages similar to the passage 24, would be disposed in transverse planes, preferably equidistant and allowing the largest possible number of combinations of supply to the cylinders by axial displacement of the slide valve. For this purpose, another advantageous embodiment hereinafter will be described.

The operation of the apparatus is as follows. When parts are in those positions shown in full lines in FIGURE 1, the pump 14 forces fluid through the pipe line 12, the chamber 19, the conduits 22*a* and the openings 17*b*, towards those of the cylinders 2 of which the supply conduits are indicated at 2*b*. Fluid is returned to reservoir 15 by the conduits 23*a*, the chambers 20 and 21 and the pipe line 13. As only one part of the cylinders is supplied, the motor rotates at high speed, presupposing the supply of fluid is constant. Meanwhile, it is to be noted that those of the cylinders 2 which are not supplied (corresponding to supply conduits 2*a*) are con-

nected to one another hydraulically by the passage **24** in accordance with that which is described in the specification of copending application Serial No. 459,864, filed May 28, 1965.

Furthermore, the passage **24** can be put in communication with a suitable source of fluid under pressure. For this purpose, a conduit **24***a* shown in dotted lines enables the passage **24** to be connected to the chamber **26**, itself in communication through pipe line **25** with the control circuit **28, 31** of the slide valve **18**.

If it is desired to vary the speed of the motor, the valve **31** is moved to the right, thus establishing communication between the chamber **26** and the reservoir **15**. In starting up the motor again in one sense or the other (valve **16** to the right or the left) the pressure of the fluid on the chamber **19** or on the face of the slide valve defining the chamber **20**, produces displacement of the said slide valve towards the left. The conduits **22***a*, **22***b* and **23***a*, **23***b* are then moved opposite openings **17***a* and **17***b* respectively in such a manner that all cylinders **2** are supplied with fluid. Thus, the motor rotates at slow speed.

In the example just described the motor has only two speeds depending upon whether one particular group or two groups of cylinders are supplied with pressure fluid. In the example shown in FIGURE 2, the device is slightly modified to enable fluid to be supplied to one or the other of the groups of cylinders or both at the same time, thus enabling three speeds of rotation to be obtained, if the cylinders of the two groups are not identical.

As most of the parts shown in FIGURE 2 have already been described with reference to FIGURE 1, they will not be described again in detail; but such parts are given like reference numerals.

Referring now to FIGURE 2 the slide valve **18** is not provided with a stem **18***a*, as in the first embodiment, but the coupling element **9** is provided with an axial extension on which are provided guide flutes **9***a* which engage in corresponding grooves in the slide valve. Furthermore, the slide valve and its sleeve constitute a double acting ram the cylinder **26** of which is always defined by the slide valve **18** and the closure plate **7**, the other end of the slide valve and the coupling element **9** defining a second annular chamber **32**. An opening **33** leading into the chamber **32** enables the fixing of a pipe line **34** similar to pipe line **28** in FIGURE 1. The two pipe lines **28** and **34** can be connected through a reversing valve **35**, either one to a pump **36** and the other to the reservoir **15** (extreme positions) or, both to the reservoir **15** (middle position). As will appear hereinafter it is not desirable in this case to use the motive fluid pump as a pilot fluid pump. On the other hand, in addition to the annular passage **24** disposed in a transverse plane located to the left of conduits **22***a*, **23***a*, another identical passage **37** is provided, located to the right of conduits **22***b*, **23***b*.

Finally a helical spring **38** is disposed co-axially with respect to the slide valve **18**, between this valve and the sleeve **5** in a space provided for that purpose. This spring is supported at its two ends by rings **39** and **40** freely slidable with respect to the sleeve and to the slide valve. Nevertheless, each ring is supported by the action of the spring on two abutments fixed respectively to the slide valve and to the sleeve. On the right, the ring **39** is supported by a keeper ring **41** fixed to the slide valve and by a shoulder **9***b* on the coupling element. On the left, the ring **40** is supported by shoulders **18***c* and **5***b*. It is to be noted that the abutments are disposed so as to be reached simultaneously by the rings **39** and **40** and to thus define a mean stable position of equilibrium of the slide valve. As becomes apparent, the latter moreover, corresponds to the simultaneous supply of fluid to the two groups of cylinders, although this arrangement is not indispensable.

The operation of the arrangement according to FIGURE 2 is similar to that described with reference to FIGURE 1. In the position of valve **35** shown in the drawing, the fluid in reservoir **15** is returned direct to said reservoir by the pump **36**, the two chambers **26** and **32** also being connected with the reservoir. The spring **38** thus acts on the slide valve to bring it into its central position.

If the reversing valve **35** is moved towards the left, the chamber **26** receives fluid under pressure which forces the slide valve towards the right against the action of the spring **38**. Thus only the cylinders corresponding to pipe lines **2***b* are supplied with fluid, the others being connected hydraulically by the free passage **24**. If, on the other hand, the reversing valve **35** is moved to the right, fluid is fed into the chamber **32** and forces the slide valve towards the left. The cylinders corresponding to the pipe lines **2***b* are thus taken out of circuit and connected hydraulically by the passage **37**, while the others are supplied with fluid. Then again, the passages **24** and **37** can be put into communication with sources of fluid under pressure, in the manner described in the specification of the aforesaid copending application.

It must be understood that the invention is not limited to the embodiments herein described, but may be modified in various ways without departing from the scope of the invention as defined in the appended claims. In particular it will be evident that the invention can be applied generally to hydraulic motors having any number of groups of cylinders with a view to obtaining a large number of speeds of rotation from a constant supply of motive fluid.

I claim:

1. A speed change device for an hydraulic motor of the kind comprising a cylinder block, at least two groups of cylinders in said cylinder block, means for supplying pressure fluid to each of said groups of cylinders separately, said means including a distributor mounted coaxially within said cylinder block and having openings leading to the periphery of said distributor and being grouped in transverse planes corresponding respectively to planes of the fluid supply conduits of the cylinders of each group, said distributor comprising a fixed sleeve provided with radial openings and having mounted therein an axially movable slide valve having an inlet chamber and an outlet chamber communicating respectively with a plurality of radial conduits arranged in transverse planes and capable of being brought opposite the inner ends of the radial openings in the fixed sleeve.

2. A speed change device for an hydraulic motor of the kind comprising a cylinder block, at least two groups of cylinders in said cylinder block, means for supplying pressure fluid to each of said groups of cylinders separately, said means including a distributor mounted coaxilly within said cylinder block and having openings leading to the periphery of said distributor and being grouped in equidistant transverse planes corresponding respectively to planes of the fluid supply conduits of the cylinders of each group, said distributor comprising a fixed sleeve provided with radial openings and having mounted therein an axially movable slide valve having an inlet chamber and an outlet chamber communicating respectively with a plurality of radial conduits arranged in equidistant transverse planes and capable of being brought opposite the inner ends of the radial openings in the fixed sleeve, and said distributor having in at least one of said transverse planes an annular passage capable of being brought opposite the inner ends of at least one group of said radial openings in said sleeve.

3. A speed change device for an hydraulic motor according to claim **1**, wherein the slide valve constitutes a piston and the fixed sleeve constitutes a cylinder of an hydraulic ram, a pipe line being provided for connection selectively to a source of pressure fluid and to a fluid reservoir leading to a chamber defined axially by a wall closing said sleeve at one of its ends and by an end face of the slide valve.

4. A speed change device for an hydraulic motor according to claim 1, wherein the slide valve constitutes a piston and the fixed sleeve constitutes a cylinder of a double acting hydraulic ram, a pipe line being provided for connection selectively to a source of pressure fluid and to a fluid reservoir leading to a chamber defined axially by a wall closing said sleeve at one of its ends and by an end face of the slide valve.

5. A speed change device for an hydraulic motor according to claim 1, wherein spring means is disposed in the sleeve and coaxial with the slide valve, said spring means being supported between sliding rings at least one of which rings is capable of being supported, under the action of the spring means, selectively by one of two shoulders on the slide valve and sleeve respectively.

6. A speed change device for an hydraulic motor according to claim 2, wherein the slide valve constitutes a piston and the fixed sleeve constitutes a cylinder of an hydraulic ram, a pipe line being provided for connection selectively to a source of pressure fluid and to a fluid reservoir leading to a chamber defined axially by a wall closing said sleeve at one of its ends and by an end face of the slide valve.

7. A speed change device for an hydraulic motor according to claim 2, wherein the slide valve constitutes a piston and the fixed sleeve constitutes a cylinder of a double acting hydraulic ram, a pipe line being provided for connection selectively to a source of pressure fluid and to a fluid reservoir leading to a chamber defined axially by a wall closing said sleeve at one of its ends and by an end face of the slide valve.

8. A speed change device for an hydraulic motor according to claim 2, wherein spring means is disposed in the sleeve and coaxial with the slide valve, said spring means being supported between sliding rings at least one of which rings is capable of being supported, under the action of the spring means, selectively by one of two shoulders on the slide valve and sleeve respectively.

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