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E. F. PULS

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ROTARY SLIDE VALVE DEVICE

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Fig. 1.

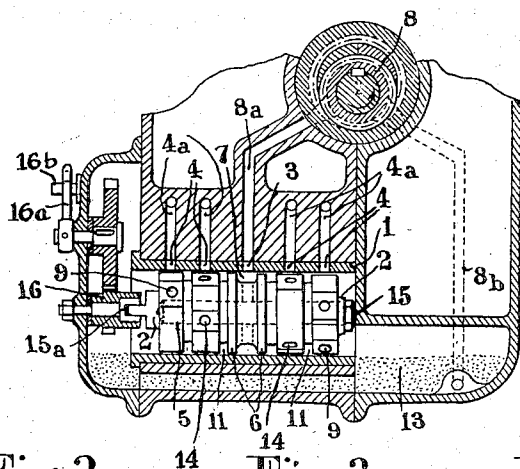


Fig. 1a.

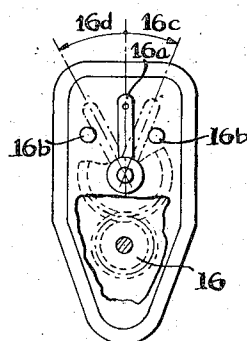


Fig. 2.

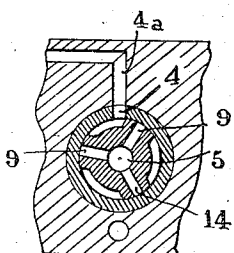


Fig. 3.

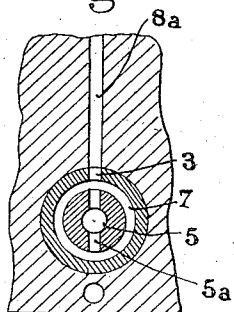


Fig. 4.

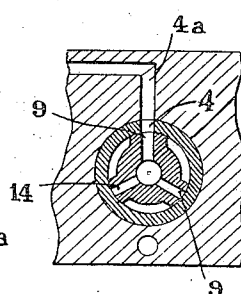
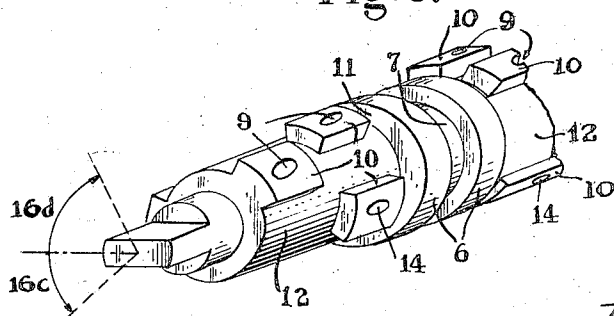


Fig. 5.



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ROTARY SLIDE VALVE DEVICE

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5 Claims. (Cl. 137—624)

The object of the present invention is a cylindrical distributor with a rotary slide valve for the distribution of liquids or gases under pressure. It is designed for controlling the supply and return of a fluid under pressure, for instance of an oil under pressure, delivered by a pump, by allowing, according to its position, on the one hand the arrival of the fluid under pressure into the pressure chambers and, on the other hand, the return to the vat of the fluid issuing from the pressure chambers, a return during which it expands so as to be capable of being again sucked in by the pump. The pressure chambers may, for instance, be hollow cylinders inside which slide working pistons for the clutching in or out of the gear trains of a gear shift mechanism.

Rotary distributors are known, comprising a rotary or sliding valve guided inside a cylindrical bore, for instance in a casing or a hollow cylinder and in which channels, drilled or cut in the periphery of the slide valve and in the hollow cylinder or in the wall of the casing control the flow of oil under pressure and the return of the expanded oil. Rotary distributors of this kind require, for their driving in rotation, a relatively important motive force, because of the resistance due to the frictions of the slide inside the core in the casing. These frictions are increased by the pressure exerted on the wall of the casing by the fluid under pressure in the numerous channels of the slide valve and by the reaction exerted radially on the slide. In order to decrease the frictions of the rotary slide valve, attempts were made to compensate the radial thrusts by opposite thrusts, by means of additional channels provided in the slide and in which the fluid under pressure exerts a thrust opposite to the above-mentioned thrusts. But most often, the space available does not make it possible to provide a relatively important number of channels for the reaction. Further, these additional channels also increase in an undesirable manner the losses due to leakages.

It is convenient, however, to completely balance, by a single torque, all the radial thrusts to which a rotary slide is subjected. The calculation of these thrusts has been made impossible, so far, by the fact that the rotary slide is subjected to additional thrusts which cannot be determined by calculation. These additional thrusts result from the fact that the fluid under pressure issuing from the channels under pressure penetrates forcibly between the sealing surface of the outer periphery of the rotary slide and the inner wall of the bore in the casing to escape laterally, causing leakage losses. Now it is not possible to calculate exactly the pressure drop of the liquid in its irregular path on the cylindrical sealing surface nor the surfaces involved in this case.

The present invention concerns a cylindrical rotary slide in which the sealing surfaces of the outer periphery are exactly defined and shaped so that the thrusts exerted on this periphery may be calculated with a mathematical accuracy. It thus becomes possible to balance completely all the radial thrusts acting on the rotary slide, by two thrusts located in two planes perpendicular on the axis

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and chosen arbitrarily. These thrusts have a well defined orientation for all the radial thrusts to be compensated so that this rotary slide is held in a space equilibrium (three dimensional) when the fluid is under pressure. Under such conditions the axis of the rotary slide is held at the theoretical center, so that this slide floats by all its sealing surfaces on an oil film of uniform thickness. No metal contact thus takes place between the rotary slide and the hollow cylinder (or the bore in the casing) and the slide can easily be displaced, whatever may be the pressure of the fluid.

The appended drawing represents a preferred type of embodiment of the invention.

Figure 1 shows the arrangement of a rotary slide valve inside a casing.

Figures 2, 3 and 4 are sections through several planes perpendicular on the axis of the rotary slide valve.

Figure 5 is a view, in perspective, of a portion of a rotary slide valve and shows, in particular, one mode of embodiment of the sealing surfaces.

The bore in the casing or hollow cylinder 1 (Figure 1) in which the rotary slide valve 2 is mounted, offers an orifice 3 for the arrival of the fluid under pressure and, for each one of the pressure chambers to be supplied (four according to the drawing), an orifice 4 for the arrival and return of the fluid under pressure. The drawing shows only the incoming ducts 4a of the pressure chambers and not these chambers which may be constituted in any manner. The rotary slide offers an axial channel 5, closed at both ends, which is in communication with a peripheral throat 7, defined by two cylindrical ribs 6 and provided in the cylindrical periphery of the rotary slide. In this throat, the fluid under pressure enters, supplied, for instance by a pump 8. Channels 9 drilled radially (or nearly so) in the periphery of the rotary slide, in communication with the axial channel 5 closed at both ends, cause the passing of the fluid under pressure in a desired order, determined by the relative arrangement of the channels, through the pressure chambers or through the ducts 4a reaching said chambers, as soon as the orifice of one of these channels comes in register with the corresponding orifice opening into the inner wall of the hollow cylinder. In all other positions, the orifices of the channels are masked by the wall of the hollow cylinder.

According to the invention, the orifices 9 (Figures 1 and 5) of the channels opening on the outer periphery of the rotary slide are surrounded by sealing surfaces 10 (Figure 5) preferably rectangular, which are part of the cylindrical surface of the slide. These rectangular surfaces are formed, on the one hand, by peripheral grooves 11 cut on the lathe, on the other hand by longitudinal grooves 12, milled parallel with the axis of the slide valve. The peripheral grooves 11 may be helical, which gives sealing surfaces (not shown) in the shapes of parallelograms. This type of embodiment is used in cases in which the rotary slide should also move axially, which is advantageous when numerous speeds should be obtained by means of a few pressure chambers.

The milled longitudinal grooves 12 (Fig. 5) constitute the cut-out portions of the outer periphery of the rotary slide, to which the expanded fluid issuing from the pressure chambers returns as soon as a rectangular sealing surface 10 unmasks the corresponding orifice of the wall of the bore or of the hollow cylinder 1. Starting from these cut-out portions, the expanded fluid re-passes freely in the vat 13.

The sealing surfaces 10 defined according to the invention and surrounding the outlet orifices 9 for the fluid under pressure, cause, during the rotation, the opening and closing durations of the various pressure chambers, and also determine in cooperation with the orifices, the order of sequence of the motions or changes in the gear

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trains ensured by the distribution of the fluid under pressure.

The sealing surfaces 10, defined according to the invention, allow an accurate calculation of the thrusts to which they are subjected and which result from the pressure in the outlet orifice 9 of the fluid under pressure and from the pressure exerted on the corresponding sealing surface 10. The thrusts exerted in each radial plane are comprised of resultant thrusts which may be completely balanced, for instance, by means of a single opposite torque. This opposite torque is represented by orifices 14 (Figures 2, 4 and 5) surrounded on the periphery of the rotary slide by a rectangular sealing surface defined according to the invention. The reaction orifices 14 are in communication with the axial channel 5, but they are masked permanently by the inner wall of the hollow cylinder 1 or by the bore in the casing, so as to be able to cause a reaction thrust.

In Figures 2, 3 and 4, the same elements are designated by the same reference numerals as in Figures 1 and 5.

Figure 3 is a view in section in a plane perpendicular on the axis of the rotary slide at the point where the oil arriving through the forcing conduit 8a of the pump goes through the peripheral throat 7 and the radial channel 7a into the axial channel 5 closed at both ends.

Figure 4 is a view, in transverse section, of the rotary slide in the plane in which the oil under pressure passes from the axial channel 5 through a radial channel 9 into the conduit 4a opening into a pressure chamber.

Figure 2 is a view in transverse section of the rotary slide at a point where a sealing surface defined in accordance with the invention unmasks the orifice of the conduit 4a of one pressure chamber, so that the expanded oil may pass through the cut-out portions 11 and 12 of the cylindrical periphery of the slide for returning freely to the oil sump 13 (Figure 1) where it is again seized by the pump 8 along a suction duct 8b. The oil may also be replaced by any other fluid under pressure, gas or liquid.

The rotary slide, preferably, is mounted horizontally and guided with little play between two lateral stops 15 and 15a. The small vibrations which are present, most often, in a machine, also cause a reciprocating motion of the slide in the direction of its axis, and thus facilitate the floating of the rotary slide on the oil film kept in constant motion, which increases the sensitivity of the rotary slide to a constant control force, for instance from a centrifugal governor.

The rotary slide is preferably so driven that it is subjected to no thrust tending to throw it off center. The driving element, therefore, is preferably mounted on a shaft (or on a trunnion) the axis of which is in line with the axis of the slide. This driving element 16 (Figure 1) is preferably rigidly associated with the slide in the direction of rotation, but coupled with said slide so as to allow a relative displacement in the axial direction.

The rotary slide valve lends itself to automatic control and can then be driven in rotation by a constant driving force. It may respond, for instance, with a high precision, to the impulse from a centrifugal governor. The pressure of the fluid has no action on this precision, since all the radial thrusts exerted on the slide can be balanced. There results an additional advantage which consists in that the slide stops or slows down its rotation motion during the filling of a pressure chamber because the equilibrium between the radial pressures on the slide valve is opposed at that time until the pressure chamber is filled. This gives an additional advantage for automatic control, because it avoids hunting, i.e. a variation back and forth of the speeds of the gear shifting mechanisms.

The drawing, of course, represents only one mode of embodiment. The number of the pressure chambers is not limited and there may be provided, side by side, any number of groups of orifices on the periphery of

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the rotary slide, the peripheral throat 7', which the fluid under pressure enters may also be offset laterally with respect to the middle of the slide. The principle of the invention consists in that the outlet orifices for the fluid under pressure are surrounded by sealing surfaces, limited, intended to determine the durations of opening and closing, and in that the orifices for the balancing of the radial thrusts are surrounded with limited sealing surfaces and hold the rotary slide valve in equilibrium along the three dimensions and in a floating condition on its sealing surfaces.

What I claim is:

1. A pressure-fluid distributor comprising a hollow cylinder open on both ends for free access to an oil sump and provided with radial fluid-pressure inlet hole and radial fluid-pressure delivery and return holes in the wall of the hollow cylinder, and a rotary slide valve having a cylindrical surface in smooth frictional engagement with the inner surface of said hollow cylinder, said rotary slide valve having formed therein radial channels comprising an inlet channel disposed in the radial plane of said inlet hole, delivery channels disposed in and adapted to register with the radial planes of said delivery and return holes respectively when said rotary slide valve is rotated to certain angular positions in said hollow cylinder, and at least two balancing channels which do not register with any hole in the wall of the hollow cylinder during the rotation of the rotary slide valve in said hollow cylinder, said rotary slide valve having also formed therein a longitudinal channel connecting said inlet channel with said other radial channels, the cylindrical surface of said rotary slide valve having formed therein an annular groove adapted to connect said delivery hole with said inlet channel, and recesses of substantially uniform depth, disposed on either side of said annular groove, said recesses limiting the cylindrical surface by which said valve engages said hollow cylinder to the annular edges of said groove and to sealing zones, said sealing zones surrounding each one of said radial channels, except said inlet channel, and means to rotate said rotary slide valve in the bore of said hollow cylinder within two end stops whereby pressure fluid enters into said delivery and return holes when they become aligned with said delivery channels and whereby pressure fluid returns from said delivery and return holes when said sealing surfaces open said delivery and return holes, allowing the pressure fluid to escape over said recesses into said oil sump.

2. A distributor according to claim 1, comprising at least two balancing sealing zones, a balancing channel opening into each of said balancing sealing zones, the radial thrusts exerted by the pressure fluid against the balancing sealing zones counteracting exactly the reaction exerted on said rotary slide valve by the aggregate radial thrusts exerted by the pressure fluid against said delivery sealing zones.

3. A distributor according to claim 1, wherein each sealing zone is limited laterally on the cylindrical surface of said valve by two segments of generatrices.

4. A pressure-fluid distributor according to claim 1, wherein each of said sealing zones is limited on the cylindrical surface of said valve laterally by two segments of generatrices and longitudinally by two circular arcs.

5. A pressure-fluid distributor comprising a hollow cylinder open on both ends for free access to an oil sump and provided with a radial fluid pressure inlet hole together with radial fluid pressure delivery and return holes in the wall of the hollow cylinder, and a rotary slide valve having a cylindrical surface in smooth frictional engagement with the inner surface of said hollow cylinder, means adapted to restrict the longitudinal sliding movement of said valve in said cylinder to a moderate amplitude and means for rotatably actuating said valve in said cylinder, said valve having formed therein radial channels comprising an inlet channel disposed in the radial plane of said inlet hole, delivery channels disposed in the radial

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plane of, and adapted to register with, said delivery and return holes respectively when said valve is rotated to certain positions in said hollow cylinder, and at least two balancing channels which do not register with any hole during the rotation of said valve in said hollow cylinder, said valve having also formed therein a longitudinal channel connecting said inlet channel with said other radial channels, a circular groove being formed in said cylindrical valve surface, for connecting said delivery hole with said inlet channel, and recesses of substantially uniform depth, disposed on either side of said circular groove, said recesses limiting the cylindrical surface through which said valve engages said hollow cylinder to the circular edges of said groove and to sealing zones, said sealing zones surrounding each one of said radial channels, except said inlet channel, and means to rotate said valve in the bore of said hollow cylinder whereby pressure fluid enters into said delivery and return holes when they become aligned with said delivery channels and whereby pressure fluid returns from said delivery and return holes when said seal-

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ing surfaces open said delivery and return holes allowing the pressure fluid to escape over said recesses into said oil sump, and at least two of said sealing zones forming balancing zones, a balancing channel opening into each of said balancing zones, the radial thrusts exerted by said pressure fluid against said balancing zones counteracting exactly the reaction exerted against said rotary slide valve by the aggregate radial thrusts exerted by the pressure fluid against said delivery sealing zones.

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