United States Patent

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[33] **Japan**
[31] **71694**

[54] **FLAT SLIDE VALVE**
2 Claims, 3 Drawing Figs.

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[51] **Int. Cl.** **F16r 11/06**
[50] **Field of Search** 137/625.25, 625.68; 251/282

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ABSTRACT: The present invention relates to a flat slide valve characterized in that a pair of spacers and a slide board having connecting ports and pressure balancing holes are fitted intimately between two guide plates having valve holes and pressure balancing holes, with the thickness of said slide board being formed slightly thinner than that of the spacers, and that the pressure balancing holes for preventing augmentation of controlling power of the slide board by fluid pressure are formed in communication with the corresponding valve holes in said two guide plates and said spacers.

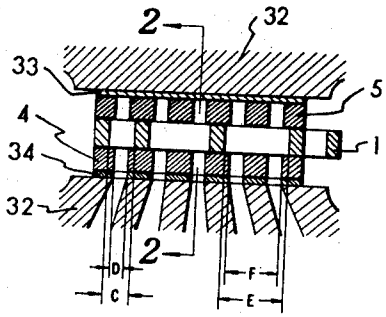


Fig 1

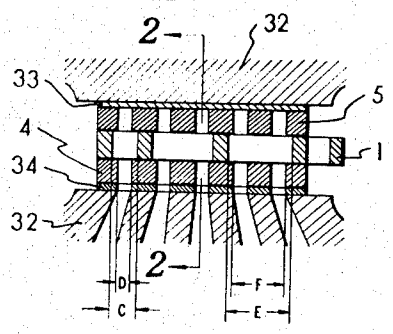
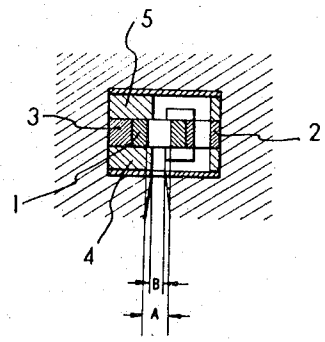


Fig 2



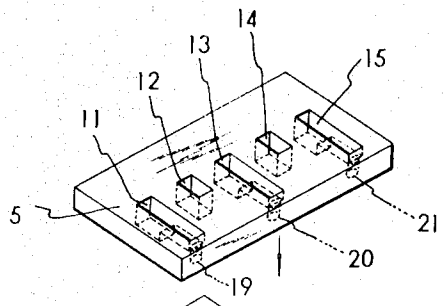
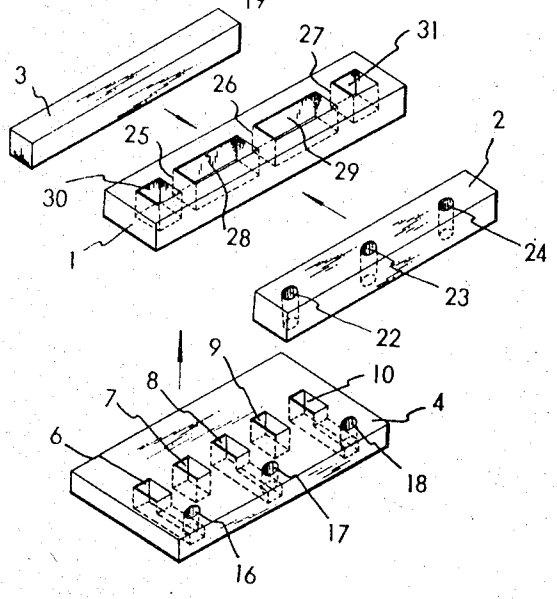


Fig 3



FLAT SLIDE VALVE

The present invention relates to improvements in a flat slide valve, and more particularly to such flat slide valve having same function as a spool valve in which the controlling action of the valve is not affected by variation in pressure of the fluid.

The conventional flat slide valve has been arranged in such manner that the edge of a cup-shaped slide board is pressed by a spring onto the valve port of the valve body and that changeover of the fluid is effected by sliding the slide board. Accordingly such conventional device, for supplying fluid pressure from the valve port of the valve body, it is required to change the spring in accordance with variation of pressure, so that the pressure feed port is structurally restricted to the bottom side of the slide board, and since the edge side of the slide board is a sealed face, fluid pressure does not work in the balancing direction for the slide board, but always works toward the bottom side of the board, thus forcing said slide board against the valve body and causing increase of sliding resistance on the sliding face in proportion to increase of fed pressure, so that changeover control of high pressure required so much enlarge control power.

The present invention is designed to overcome these defects and intended to provide an improved flat slide valve wherein such arrangement is made that the slide board is not directly oppressed to the sliding face and that pressure supplied from holes in two guide plates works uniformly on both upper and lower faces of the slide board and wherein it is possible to switch fluid pressure by a fixed valve controlling power irrespective of pressure strength and it is also possible to supply pressure from any of the valve holes or to supply different pressures simultaneously to two valve holes.

The other objects of the present invention will become more clear from reading the following detailed explanation made with reference to the accompanying drawings, in which:

FIG. 1 is a sectional view of the valve body;

FIG. 2 is a sectional view as taken on the line A–A of FIG. 1; and

FIG. 3 is an exploded slant view of the valve body.

Now, a preferred embodiment of the present invention will be explicated while referring to the drawings in general. It will be seen that a slide board 1 is flanked from both sides thereof by spacers 2 and 3 and from its upper and lower sides by guide plates 4 and 5 to thereby compose a valve. The thickness of the spacers 2, 3 is of same size, but the slide board 1 is formed slightly thinner than the spacers 2, 3 so that the slide board 1 can slide in the formed space so as to effect desired changeover of the fluid. The guide plate 4 has valve holes 6, 7, 8, 9, 10, and the other guide plate 5 has valve holes 11, 12, 13, 14, 15. Said both guide plates 4, 5 also have formed therein pressure balancing holes 16, 17, 18 and 19, 20, 21, and these holes constitute a pressure balancing mechanism in cooperation with corresponding pressure balancing holes 22, 23, 24 formed in the spacer 2. This pressure balancing mechanism is of such construction where the valve holes 6, 11 are connected with the pressure balancing holes 16, 22, 19, the valve holes 8, 13 are connected with the pressure balancing holes 17, 23, 20, and valve holes 10, 15 are connected with the pressure balancing holes 18, 24, 21. In the present embodiment is adopted a five-port two-position changeover valve in which the bulkheads 25, 26, 27 don't pass over the valve holes 7, 12 and the valve holes 9, 14, so that there is no need of providing any pressure balancing mechanism between the valve holes 7, 12 and the valve holes 9, 14.

The slide board 1 also has the connecting holes 28, 29 which serve to always provide opening and closing connections between the valve holes and the feed holes, while the pressure balancing holes 30, 31 are also formed in the slide board 1 serve to offer aid for balancing of pressure in the valve holes 6, 11 and the valve holes 10, 15 of the guide plates 4, 5.

The corresponding valve holes in the guide plates 4, 5 are formed in alignment with and equal in area to each other, and their pressure-receiving areas with respect to the slide board 1 are also formed equal to even more ensure the efficiency of this pressure balancing mechanism. However, to prevent any possible unbalance of pressure due to difference in area caused by manufacturing tolerance, such arrangement is made that the width A of the connecting holes 28, 29 and the pressure balancing holes 30, 31 in the slide board 1 is larger than the width B of the valve holes in the guide plates 4, 5, the length C of the pressure balancing holes 30, 31 in the slide board 1 is larger than the length D of the valve holes 6, 10, 11, 15 of the guide plates 4, 5, and the length E of the connecting holes 28, 29 in the slide board 1 is larger than the distance F between the adjoining valve holes in the guide plates 4, 5, whereby to provide a flat slide valve having a perfect pressure balancing mechanism.

Now, the invention will be further explicated by way of an actual example in which the present flat slide valve is adapted for control of the actuator. It will be noted that the principal parts of the valve incorporated in the valve body are sealed by gaskets 33, 34, except for the valve holes. The fluid fed from a feed port in the valve body 32 passes through the valve hole 8, connecting hole 28 and valve hole 7 to a first actuator hole in the valve body 32, while at the same time, the discharge fluid from a second actuator is fed in from a second actuator hole and flows through the valve hole 9, connecting hole 29 and valve hole 10 to a discharge port in the valve body 32 through which it is discharged.

On completion of changeover of the slide board 1, the valve holes 8, 9 and the valve holes 6, 7 are connected to each other through the connecting holes 29, 28, respectively thus permitting the feed fluid to flow to the second actuator and the discharge fluid of the first actuator to pass to the discharge port, thereby controlling the actuator.

At the occasion of changeover of the slide board 1, the valve holes 13, 14 are kept at same pressure as the valve holes 8, 9 by the pressure balancing mechanism, so that no balancing slide resistance is produced against the slide board 1.

It should also be noted that in this embodiment, five holes are provided, which permits simultaneous changeover control of two different pressures, wherein feed fluids of different pressures simultaneously flow into the valve holes 6 and 10. Although the fluid passes the pressure balancing hole 30 and the connecting hole 29, pressure works in all directions and is balanced in said holes 30 and 29, thus inhibiting generation of any undesirable force that tends to move the slide board 1, so that the device can be used under any multipressure condition.

The feed liquid that entered through the valve hole 6 is blocked at the pressure balancing hole 30, while the feed liquid that was introduced through the valve hole 10 passes through the connecting hole 29 and then the valve hole 14 to the second actuator hole. In the meantime, the discharge fluid from the first actuator hole enters through the valve hole 17 and passes through the connecting hole 28 and the valve hole 8 to the discharge port of the valve body 32. At the time of the changeover of the slide board 1, pressures are equalized by the pressure balancing mechanism of the valve holes, so that no sliding resistance is produced against the slide board 1.

Further it is noticeable in the above construction that the metal face to metal face sealing method is adopted where the contact faces of the two guide plates and the slide board are lapped and extremely small spaces are formed there between, thus permitting the slide board to be suspended in said spaces, so that the guide plates and the slide board remain perfectly free from wear and also no leakage of more than a certain fixed amount occurs. This sealing method will now be theoretically explicated. As depicted above, the slide board is "suspended" between the two guide plates, forming therebetween the spaces which are each h cm. in span. Assuming that the seal length of the slide board is 1 cm. and the seal width w cm., a pressure difference Δp g/cm^2 is produced at the opening of each space, and this causes leakage. Providing that the fluid viscosity at that time is η, the amount of leakage (cm3/sec) may be expressed by the following theoretical formula:

$$Q=\frac{980h^3W}{12\eta\phi l}X_2$$

Therefore, to minimize the leakage, while keeping the slide board afloat, the space h must be:

$$h=\frac{1\times 10^{-4}}{2}$$

Indeed, if the valve construction is arranged so as to form the spaces within the range of ± 25 percent of this value, the resulting article proves to be the one which satisfactorily performs the function of a preferred flat slide valve.

Thus, according to the present invention having the above described construction and function, pressure is suitably balanced by the pressure balancing mechanism to eliminate pressure resistance otherwise given to the slide board, with only fluid viscous resistance being inflicted, whereby need of high controlling power as required in the conventional devices is eliminated and also the means for giving such power, such as springs, electromagnets, or human power, can be reduced and lowered in capacity, thus making it possible to obtain a small sized high-performance valve which is convenient for manufacture. It is also possible to effect changeover control of super high-pressure liquid which could not be used in the conventional flat slide valves. Further, sealing with noncontacted metal faces makes the valve life semipermanent. Thus, the present device provides an excellent flat slide valve having extremely high reliability to the user.

We claim:

1. A flat slide valve, comprising a slide board having a plurality of connecting holes therethrough; a pair of spacers, one on each side of said slide board; and a pair of guide plates between which said slide board and said spacers are mounted, each of said guide plates having a plurality of valve holes and pressure balancing holes in communication with said valve holes, said valve holes and said pressure balancing holes in one guide plate being in alignment with the valve holes and pressure balancing holes in the other guide plate; one of said spacers having a plurality of pressure balancing holes in alignment with the pressure balancing holes of said guide plates; said slide board being of less thickness than said spacers, whereby said slide board is freely movable between said guide plates and is suspended therebetween by fluid passing through said valve holes and pressure balancing holes.

2. The valve of claim 1 wherein said pressure balancing holes of said guide plates are connected to said valve holes by transversely extending ports.