PATENTED JUN 29 1971 3,589,396

Fig. 1

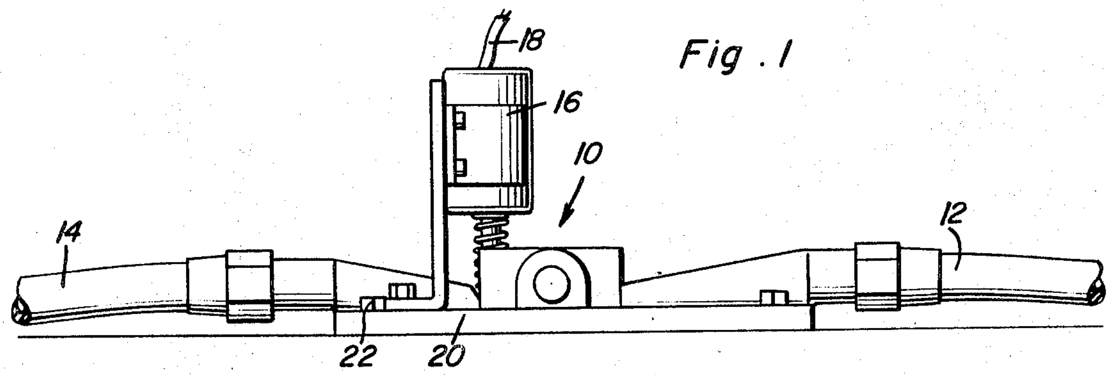


Fig. 2

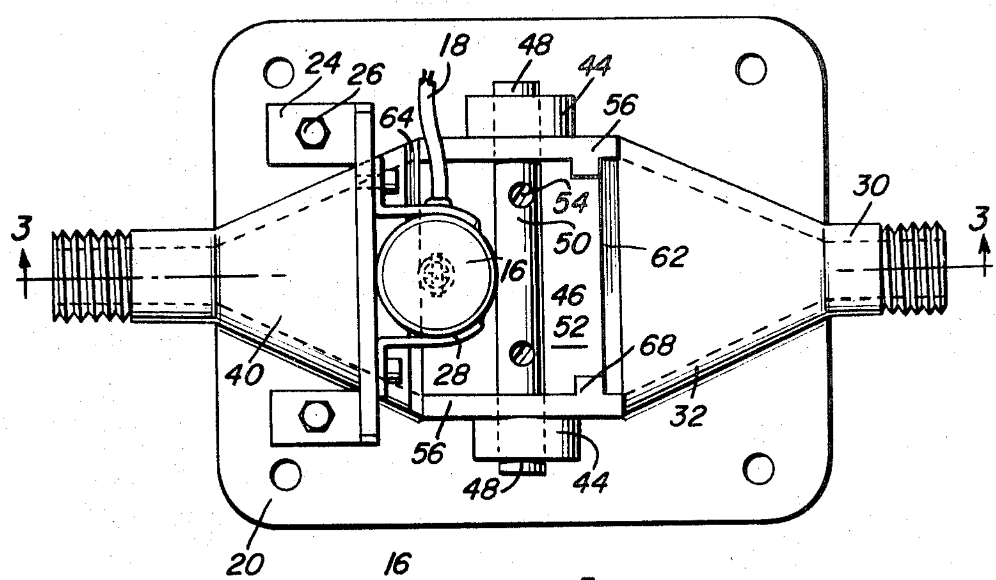


Fig. 3

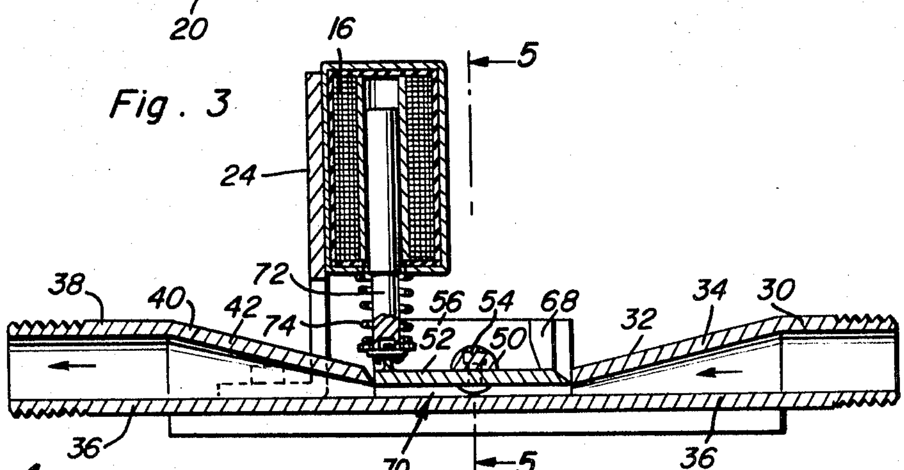
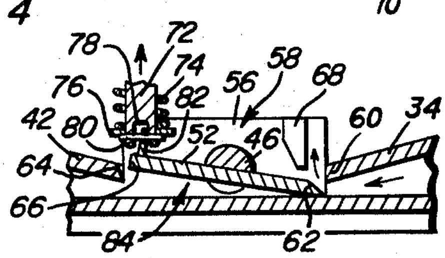


Fig. 4



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United States Patent

[11] 3,589,396

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[54] **VALVE CONSTRUCTION**
3 Claims, 8 Drawing Figs.

[52] U.S. Cl. 137/612
[51] Int. Cl. F16k 11/02
[50] Field of Search 137/625.44, 625.43, 612; 251/124

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ABSTRACT: A valve for controlling fluid flow between inlet and outlet ports incorporating a solenoid controlled vane member. During an open condition of the valve, the plane of the vane is maintained in parallel relation to the fluid flow stream between the inlet and outlet ports. Upon selective actuation, by the solenoid, the vane is angularly inclined with respect to the flow stream. The edge of the vane which confronts the inlet port is bevelled to form an enlarged impinging surface upon which the stream from the inlet port may operate in a manner aiding and hastening the rotation of the vane to its pivotally inclined position. In the latter mentioned position, the valve inhibits flow between the ports. A second actuation of the solenoid returns the vane to its original nonimpeding position.

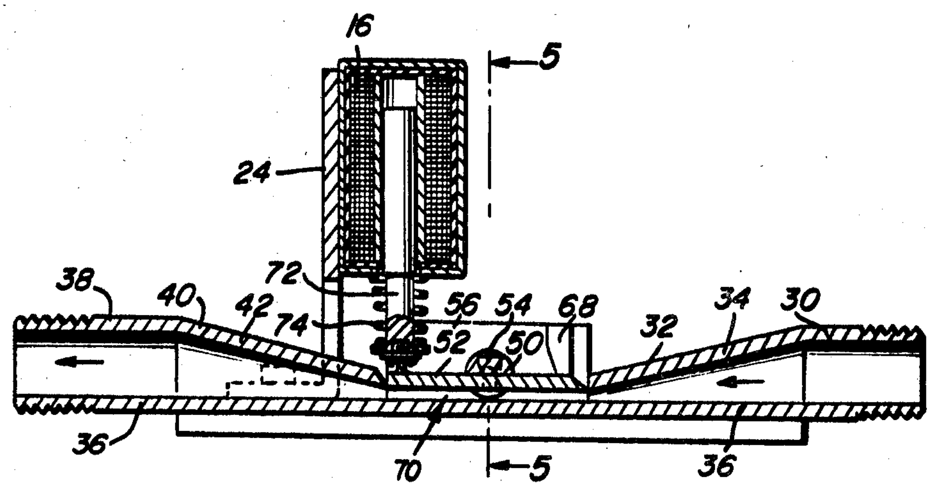


Fig. 5

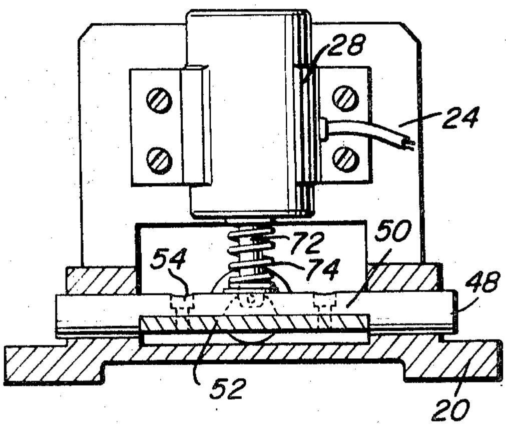


Fig. 6

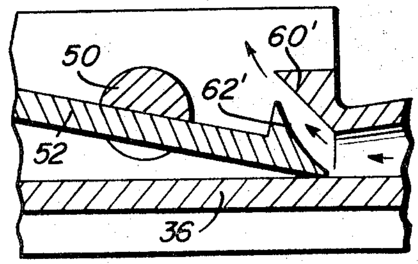


Fig. 7

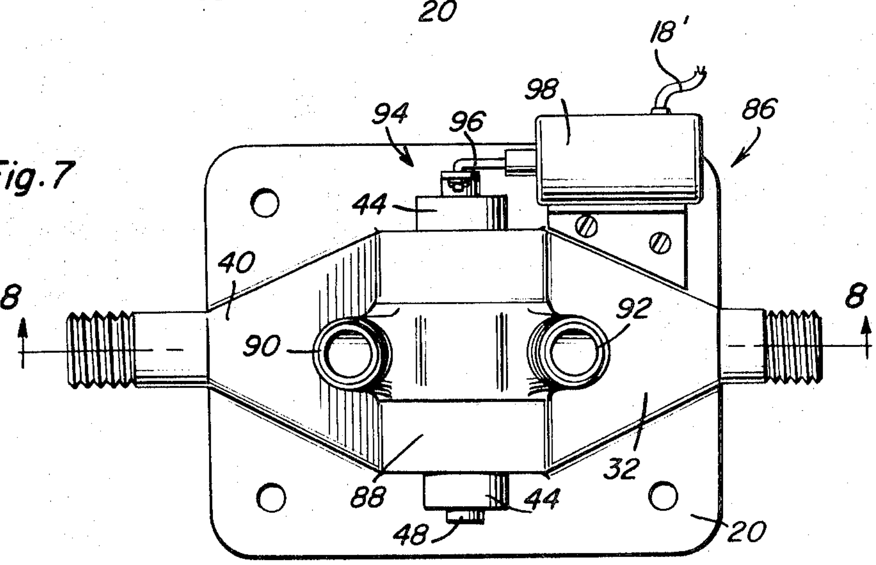
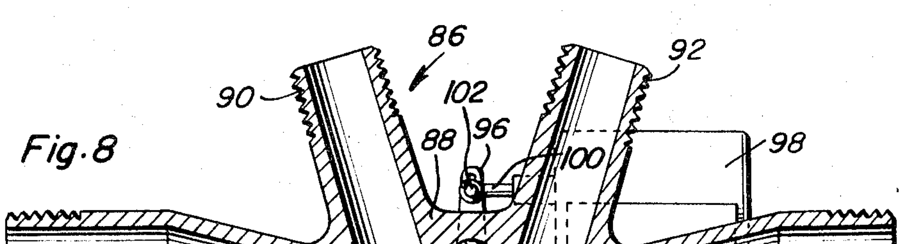


Fig. 8



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VALVE CONSTRUCTION

The present invention relates to fluid control valves and more particularly to such a valve incorporating a rotating vane member.

Systems for controlling fluid motors, fluid cylinders, and like devices generally include a valve for selectively ceasing device operation. In order to obtain precise and accurate control, it is necessary to stop the device at a particular position in a very small increment of time. In the past, valves have been constructed with valve members which develop relatively large static inertia when maintaining the valve in an open position. Thus, when instantaneous shutoff is required, relatively large forces are required to develop sufficient momentum of the valve member to close the valve. Such prior art valves suffer from their inability to cause shutoff within a vary short time increment. Further, because large forces must be utilized to rotate the valve member, prior art devices are subject to unnecessarily rapid wear and subsequent loss of proper function.

The present invention may be described as a balanced vane-type valve. The purpose of the invention is to provide rapid shutoff action for fluid motors, cylinders and other fluid-driven devices that are required to stop at a precise position in a small increment of time. A working model of the present invention has been constructed for a pneumatic system and test results demonstrate that the valve is capable of shutting off an air motor in less than one one-hundredth of a second. The present invention can operate at extremely high speeds because the moving valve member in the form of a vane is normally positioned so that the plane of the vane is parallel to a flow stream between inlet and outlet valve ports. More particularly, the valve is balanced by fluid pressure under the surface of the vane so that a solenoid that initiates vane rotation does not have to work against fluid pressure or against a bias spring which is usually incident to certain prior art devices. Further, the vane utilized in the present valve structure is so shaped that upon initial rotation by a control solenoid, fluid discharged from the inlet port impinges upon the vane thereby forcing it to a securely closed position very rapidly.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a side elevational view illustrating the present valve structure in a first embodiment particularly suited for pneumatic operation.

FIG. 2 is a top plan view illustrating the structure of the pneumatic embodiment.

FIG. 3 is a vertical sectional view taken through the valve structure to illustrate the interior components thereof. The view is taken along a plane passing through section line 3—3 shown in FIG. 2.

FIG. 4 is a partial sectional view illustrating the moving vane of the valve in a flow restricting position.

FIG. 5 is a transverse sectional view taken along a plane passing through section section line 5—5 of FIG. 3.

FIG. 6 is a partial sectional view illustrating a modified formation on the vane edge.

FIG. 7 is a top plan view of a second embodiment of the present invention which is employed in hydraulic systems.

FIG. 8 is a vertical sectional view taken along a plane passing through section line 8—8 of FIG. 7.

A first embodiment of the present invention is utilized to rapidly shut off airflow between inlet and outlet valve ports. This first embodiment is shown in FIG. 1 and is generally indicated by reference numeral 10. The valve is seen to be serially inserted between an inlet hose 12 and an outlet hose 14. A valve controlling actuator 16 provides means for changing the state of the valve and is initiated upon proper electrical energization through leads 18. The valve structure includes a generally rectangular mounting plate 20 which is fastened to a suitable surface by means of mounting fasteners 22.

In greater detail, reference is made to FIG. 2 wherein there will be shown an L-shaped mounting bracket 24 attached to the base 20 by suitable fasteners 26. A vertical portion of the bracket includes a slitted sleeve or clamp 28 which secures solenoid 16 in a vertical position over the mounting plate 20.

The valve structure is seen to include an inlet fitting 30 which extends to an integrally cast and outwardly funnelling conduit section 32. The upper surface of the conduit section 34 slopes downwardly toward the central portion of the mounting plate 20. The upper wall 32 cooperates with an integrally cast lower wall 36, the latter being secured to the mounting base 20. The outward end of the upper conduit section wall 32 and vertically aligned portion of lower wall 36 forms an inlet port for the valve.

An outlet fitting 38 maintained in oppositely disposed relation to the inlet fitting 30 appends to an outwardly funnelling conduit section 40 similar to the aforementioned inlet conduit section 32. The outlet conduit section 40 includes a downwardly tapering wall 42 terminating at the outer end thereof over a central portion of the bottom conduit wall 36 to form an outlet port. In this connection it will be noted that the inlet and outlet ports are disposed in horizontally aligned spaced relation

Referring to FIGS. 1 and 2, it will be noted that journal members 44 are disposed in transverse aligned spaced relation and permit the mounting of a shaft 46 therein, the shaft being retained in parallel aligned relation with respect to the inlet and outlet ports. The journaled ends of shaft 46 are cylindrical (48) and the intermediate section of the shaft has a semicylindrical cross section (50) to permit the mounting of a rectangular vane 52 to the planar surface of the semicylindrical section by means of suitable fasteners 54. Two integrally cast or likewise formed wall sections 56 connect the transversely aligned edges of the inlet and outlet ports thereby directing and restricting the flow of fluid therebetween.

Referring to FIGS. 3 and 4 it will be noted that the vane 52 is normally positioned in a horizontal orientation whereby the plane of the vane extends between the upper edges of the inlet and outlet ports. It will also be noted that the space above the vane is substantially opened to the atmosphere as indicated by reference numeral 58 in FIG. 4.

Attention is directed to FIG. 4 which illustrates the inlet port in detail as indicated by 60. An adjacent and confronting edge 62 of vane 52 is bevelled so that the lower edge of the bevel contacts the inlet port 60 when the vane is maintained in a horizontal position as shown in FIG. 3, and generally indicated by reference numeral 70. In this position, the vane clears the inlet port 60 and forms a seal therewith to prevent the escape of fluid from the path defined between the inlet and outlet ports. A similar function is achieved by bevelling the end of conduit section wall 42, the bevelled edge being indicated by 64. This bevelled edge cooperates with a straightened edge 66 on the vane, the vane edge 66 being oppositely disposed from the aforementioned bevelled valve edge 62. As shown in FIG. 3, a mechanical stop 68 is provided by forming an inwardly directed flange portion of wall 56. The mechanical stop serves to orient the vane 52 in the horizontal position denoted by reference numeral 70. In order to bias the vane in the horizontal position, the shaft 72 of solenoid 16 contacts the left edge of vane 52 viewed in FIG. 3. Biasing action is achieved by a coil spring 74 concentrically engaging the outward section of shaft 72 and is restrained at the outward end thereof by an annular shoulder 76. Transmission of the bias force to the vane is accomplished by positioning a pin 80 through the downward end portion of shaft 72. Thus, the outward bias force of spring 74 is exerted upon shoulder 76 which is in turn exerted upon pin 80. Inasmuch as the pin 80 is anchored to the shaft 72, the bias force is transmitted to the shaft 72. In order to effect force transmission to the vane 52 per se, a notch 78 is formed in the downward edge of shaft 72 thereby permitting the sliding mounting of a miniature yoke pin **82**. The latter is connected at the free end thereof to the left edge of vane **52**. Thus, as will be appreciated, downward biasing displacement of shaft **72** is transmitted to the yoke **82** which in turn is transmitted to the vane **52**. This biasing force tends to urge counterclockwise rotation of the vane **52** as viewed in FIG. **4** until the mechanical stop **68** is engaged whereupon vane **52** is maintained in the horizontal position **70** illustrated in FIG. 3.

FIG. **4** illustrates the disposition of the vane in a valve closing position demoted by reference numeral **84**. This position is effected by energizing solenoid **16** causing the solenoid shaft **72** to travel upwardly. This motion in turn causes upward displacement of the left valve edge resulting in clockwise rotation of the vane about shaft **46**. In this position, the left vane edge is separated from the outlet port. Thus, when the valve is used in conjunction with a pneumatic system, and more particularly for controlling an air driven motor, separation of the vane from the outlet port will result in the free escape of residual air from the driven motor. Attention is particularly directed to the right bevelled edge **62** of the vane which is displaced downwardly from the mechanical stop when the vane is rotated to a valve closing position. Considering the increment of time during which the vane is rotated clockwise, the impinging force of the flow stream from the inlet port against the bevelled edge **62** causes extremely rapid rotation of the vane to a shutoff position once solenoid shaft displacement begins to rotate the vane, so that the impinging edge surface catches the flow stream from the inlet port. Further, this impinging action from the inlet port retains the valve member in its closed position until the solenoid shaft is displaced downwardly to effect the initial open valve position. Still referring to FIG. **4**, inasmuch as the area above the vane is open to the atmosphere, once the vane retains a closing position, flow of fluid from the inlet port is diverted by the bevelled edge to the atmosphere, above the vane.

Attention is directed to FIG. **6** which illustrates an alternate or somewhat modified edge on the vane, confronting the inlet port. As will be noted from the figure, this edge is built up as indicated by **62'** and has a somewhat contoured outward edge which confronts the discharge port edge **60'**. The latter edge is bevelled so that a smooth flow path is formed by the confronting parallel spaced edges **60'** and **62'** when the vane **52** is inclined to its valve closing position. The enlarged vane edge **62'** defines a greater impinging surface than that previously described, which makes the vane more responsive to the vane rotating forces of the inlet fluid flow stream.

FIGS. **7** and **8** represent a modified version of the previously described valve generally indicated at **86**. This particular embodiment is substantially identical to the aforementioned embodiment with the principal difference being the enclosing of the space immediately above the vane so that the valve is particularly suited for hydraulic operation. By enclosing the flow path between the inlet and outlet ports, fluid which is discharged from the inlet port, for impingement on the vane, and residue fluid from the outlet port, may be recovered and recirculated to a hydraulic reservoir. As FIGS. **7** and **8** illustrate, a connecting flange **88**, with conduit fittings **90** and **92** extending therefrom and communicating with the space above the vane, ensures a sealed hydraulic valve unit.

A variation in the position of the control solenoid is illustrated in FIGS. **7** and **8**. The solenoid **98** having an actuating lead **18'** is mounted to the baseplate **20** and oriented so that the solenoid shaft extends in a horizontal rather than a vertical position. A crank mechanism shaft is driven by the solenoid shaft and is connected to the vane supporting shaft **48**. More particularly, a linkage member **96** is connected at a lower end thereof to an end of shaft **48**. The opposite end of the linkage **96** is connected by means of a cotter pin connection **102** to the outward end of the solenoid shaft **100**. Thus, as seen in FIG. **8**, with the solenoid shaft extended, the vane is maintained in an opened valve position. However, upon energization of the solenoid **98**, the solenoid shaft retracts inwardly thereby cranking or rotating the valve to a closed position as previously explained.

Although the second valve embodiment, suited for hydraulic operation, is explained with the modified solenoid mechanism, it will of course be appreciated that the vertically oriented solenoid discussed in the first embodiment may be employed just as well. Likewise, the first-mentioned embodiment which is particularly suited for pneumatic operation can be operated with the control solenoid **98**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

I claim:

1. A valve construction comprising inlet and outlet ports retained in aligned spaced relation for directing normal fluid flow between the ports, a vane mounted between said ports having an inlet end and an outlet end oppositely disposed therefrom and pivoted at a point intermediate said ends, said ports tapering down toward said vane to form inlet and outlet openings adjacent respectively to the ends of said vane, said vane having a first angular position substantially parallel to the direction of normal fluid flow and a second angular position for diverting the fluid flow, said vane having a beveled fluid impinging surface at the inlet end defined in part by a confronting edge which engages said inlet opening when said vane is in the first angular position, said impinging surface being exposed to the flow in said second angular position, and control means connected with said vane for rotating said vane toward the second angular position.

2. The valve construction defined in claim **1** wherein said outlet opening has a leading edge engaging the outlet end of said vane when said vane is in the first angular position, and being spaced therefrom when the vane is in said second angular position.

3. The valve construction defined in claim **2** together with a second surface defined in part by said leading edge of the outlet opening and extending outwardly in a direction substantially parallel to said impinging surface when said vane is in said first angular position.