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CALIBRATION VALVE

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3 Claims. (Cl. 137—625.4)

This application is a continuation of co-pending application Serial No. 862,733 now abandoned.

This invention relates generally to valves and more particularly to a calibration valve through which testing and/or calibration of the operating limits of a fluid pressure actuated device can be quickly accomplished.

Although not limited to such environmental use, the calibration valve of this invention has particular application in the guided missile and rocket field. A continuing desideratum in the launching of missiles is the reduction of time required to prepare the missile prior to blast off since this would obviously increase the number of missiles that could be fired in a given time period. One area in the preparation of a missile for launching requiring considerable expenditure of time is the missile component and engine checkouts. Among other things, the checkout procedures requires calibration and for checking of pressure actuated devices, such as pressure switches, to insure reliability of missile operation during its flight. A pressure switch calibration or check is accomplished by closing off the local source of fluid pressure supplied by the missile to the pressure switch and then checking the upper and lower limits of switch operation by fluid pressure supplied from a source external to the missile. This checkout is accomplished through a valve, sometimes referred to as a calibration valve, permanently connected into the pressure switch. Thus, in past pre-launching checkouts it was necessary to break into the plumbing connections in the missile to calibrate and/or check the pressure switches. This resulted in considerable labor and expenditure of valuable time, lengthening the total checkout time period before the missile could be fired and also adding a possible element of unreliability to the action of the missile during flight.

Thus, it became apparent that means must be developed to speed up missile and engine checkout time by eliminating the necessity of breaking into line fittings for calibration and pressure checks while, at the same time, adding to the reliability of the missile. To solve this problem, it would be necessary to develop a valve which would (1) when coupled to a source of external (to the missile) fluid pressure would allow normal pressurization of the pressure actuated component (2) concurrently, therewith isolate the component being checked or calibrated from the pressure supplied from the local source of fluid pressure (carried within the missile) and (3) provide a quick and positive connect and disconnect coupling means between the valve and the external source of pressure while insuring that upon disconnection, communication would automatically be re-established between the component being checked out and the local source of pressure.

It is, therefore, an object of this invention to provide a valve which will reduce the time required to check or calibrate a pressure sensitive component such as, for instance, a pressure switch.

It is a further object of this invention to provide a calibration valve which is quickly coupled to and disconnected from an external source of fluid pressure while closing the flow of pressure from a local source when the external source is connected into the valve and insure automatic unblocking of the local source of pressure

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when the external source is disconnected from the valve.

Another object of this invention is to provide a valve which is simple in construction, reliable in operation, rugged in use, economical in manufacture, positive in action, and automatic in change from a first mode to a second mode of operation with a minimum amount of fluid leakage.

The above and other objects may be attained by employing the valve of the present invention which incorporates among its features a housing having a longitudinal bore therethrough and a lateral passageway in communication with the bore at one end and opening through the housing at its other end, a hollow piston having an exit port slidably mounted within the bore, resilient means for urging the piston to move in one direction, means in the form of a retaining member carried by the housing adjacent one end thereof to limit or stop the movement of the piston in the one direction and thus define a first or normal position for the piston, means carried by the piston and extending longitudinally therefrom toward said one end of the valve housing, a female coupling part carried by the retaining member, the female coupling part being adapted for quick attachment to and disconnection from a corresponding and mating male coupling member through which a fluid pressure can be introduced into the valve housing bore, said means carried by the piston being engageable by the attachment of the male coupling member to the female coupling member to move the piston from its normal or first position in opposition to the urging of the resilient means to a second position where the piston blocks communication between the bore and the passageway and establishes communication between the exit port and the passageway and upon disconnection of the male coupling member the piston will be moved under the bias of the resilient means to its original or first position to re-establish communication between the valve housing bore and the passageway, and the piston being provided with means to establish communication between its interior and the interior of the female coupling part.

Other objects, features and advantages will become apparent from the following detailed description taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is a longitudinal cross section, with portions thereof broken away, of the calibration valve embodying the present invention shown in its first or normal position;

FIGURE 2 is a schematic view, partly in section and partly in elevation, showing the incorporation of the valve of FIGURE 1 in its second position; and

FIGURE 3 is a fragmentary sectional view of the modified form of the valve shown in FIGURE 1.

With continued reference to the drawings, there is shown in FIGURE 1 a pressure checkout or calibration valve, generally indicated at 10, constructed in accordance with this invention and which may be considered to be of the two position shuttle type. In one position valve 10 will allow a fluid flow between a local source of fluid pressure and a pressure sensitive instrument or component, such as a pressure switch, and in its second position permit flow of fluid under pressure between the instrument or component and an external source of fluid pressure while, at the same time, blocking the flow of fluid between the local source and the component. The first position will be considered the normal or first position of the valve 10.

To carry out the foregoing functions of the valve in its alternate positions of operation, the valve 10 comprises a generally tubular housing 12 having a longitudinal axial bore 14 opening through its respective opposite ends 16, 17. The bore 14 has an enlarged portion 20 opening through the housing end 16 and a restricted passage 22

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adjacent its other end 17 which opens into an enlarged internally threaded bore portion 24. The threaded bore portion is adapted for connection to a local source of fluid pressure (not shown), such as the pressure system within a guided missile 25, shown fragmentarily in FIGURE 2, through suitable piping and connections 26. A cylindrical boss 28 is formed integrally with the housing 12 and extends laterally therefrom. The housing 12 has a vent therein which insures that a pressure build up does not take place in annular well 44 when the piston is displaced within the longitudinal bore as will be later described. An internally threaded passageway 30 extends axially of the boss 28 and opens at one end through the outer face 31 of the boss and communicates with the bore 14 through a restricted axial channel 32 which is outwardly beveled at its juncture with bore 14 to define a mouth 34. An elongate, hollow piston 35 having a series of spaced external annular grooves 36, 37 and 38 cut therein adjacent its closed inner end 40 is disposed within the bore 14 for rectilinear sliding movement longitudinally of the bore and is urged in one direction toward the housing end 16 under the resilient influence of a spring 42. The spring 42 has one end seated in the bottom of an annular well 44 formed in the enlarged bore portion 20 and its other end bearing against the inner face 43 of an enlarged head 45 on the piston 35 which fits snugly but slidably within the enlarged bore portion 20. Into grooves 36 and 38 are placed O-rings 46 and 48 respectively to provide sealing means preventing passage of fluid between the outside of the piston and the inner wall of the bore. A means to provide communication between the interior of the piston 35 and the passageway 30 may take the form of a plurality of spaced exit ports or outlet openings 49 provided in the bottom of the groove 37. If desired, a single opening may be provided in the groove 37 as the exit port means. On the piston head 45 there is provided an O-ring 50 to prevent leakage of fluid past the piston head.

To maintain the piston 35 within the bore 14 and to provide means for limiting the movement of the piston in the one direction under the influence of the spring 42, a retaining member in the form of a retainer cap 52 is threadably engaged onto the outer surface of the valve housing at the end 16 to close the bore portion 20. The retainer cap is provided with an axial bore 54 centrally therethrough to have its axis coincident with the axis of the bore 14 and to open into the bore portion 20. At its outer end, the cap bore 54 is enlarged and is internally threaded to threadably receive therein the externally threaded connecting boss 56 of a female coupling member 58 of a quick-disconnect device 61 of a design well known in the art. An O-ring 59 is carried on a reduced diameter annular lip at the housing end 16 and seats in an annular groove provided in the cap 52 to prevent leakage from the valve 10 at this point.

With the valve 10 having its piston 35 urged into the solid line position of FIGURE 1 by the spring 42, it will be seen that there is communication established between the bore 14 and the passageway 30 whereby fluid pressure introduced into the bore through bore portion 24 will flow through the passageway and into a pressure sensitive device, such as the pressure switch 60 (FIGURE 2), to be operated by the fluid pressure while concurrently blocking communication between passageway 30 and opening 49 in the piston. The pressure switch is normally connected into the passageway 30 by suitable plumbing connections in a well known manner. Thus, when the fluid pressure flowing into the pressure switch reaches a predetermined value, the switch will operate to further control or cause other components (not shown) connected thereto to function.

During static testing of a guided missile, it is necessary to check the operating limits of the pressure sensitive devices, such as the switch 60, and to calibrate such devices if required. This means that the local source of

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fluid pressure must be shut off from the device and an external source of fluid pressure, which can be read or monitored, be introduced into the device. The normal procedure would be to drain or bleed a portion of the local pressure system, block this portion off and tap in an external source of fluid pressure. This procedure is time consuming and may result in unreliable operation of the pressure sensitive device if the tapped portion of the local fluid pressure system is not properly sealed and restored to its original condition. To avoid the possibility of faulty operation in the pressure sensitive device and to provide the valve 10 a quick, yet positive acting, capability whereby the pressure sensitive device can be rapidly and accurately checked and/or calibrated, the novel valve 10 also includes means on the piston 35 responsive to the attachment and disconnection of the quick-disconnect device 61 to move the piston from its first to its second position and to insure the automatic return of the piston to first position respectively. This piston actuating means, in the form of the invention shown in FIGURE 1, comprises a hollow piston rod or stem 62 secured at one end in the piston head 45 and extends longitudinally outward therefrom with its axis lying along the axis of the bore 14. The interior passage 63 through the rod 62 opens into the interior of the piston 35 so as to form therewith a continuous, uninterrupted passage from the exit port means 49 to an entrance port 64 in the rod 62 which may conveniently be located adjacent its end remote from the piston head 45.

As seen in FIGURE 1, the hollow piston rod 62 extends axially into the female coupling member 58 to terminate just short of the outer end of the member. Within the member 58 there is inserted a bearing ring of an abrasive-proof, smooth synthetic material, such as Teflon, to provide a support bearing surface for the rod 62 in the member 58. This bearing ring is not normally a part of the conventional type quick-disconnect device 61.

When it is desired to attach an external source of fluid pressure to the valve 10, the male coupling member 65 of the quick-disconnect device 61 is inserted into the female member. As the male member 65 is inserted, it engages the adjacent end 66 of the piston rod, causing the rod to move to the left as viewed in FIGURE 1 and also permitting the external fluid pressure to flow through the now open male coupling valve and into a continuous passage surrounding the rod 62 whereby the external fluid pressure will impinge upon the piston head 45, all as clearly shown in the construction illustrated in FIGURE 1. The movement of the rod plus the pressure impinging on the enlarged piston head 45 causes power piston 35 to move from its first or normal position (solid line position, FIGURE 1) to its second position (broken line position, FIGURE 1). In its second position, the exit port means 49 will be in substantial registry with the beveled mouth 34 of the passageway 30 while communication between the bore 14 and the passageway 30 will be effectively blocked by movement of the O-ring 46 beyond the mouth 34 of the passageway. This will prevent a fluid under pressure supplied to the valve 10 through the threaded bore end portion 24 from flowing into the passageway 30, and block communication between the passageway and the bore 14 while fluid under pressure flowing from the external source will flow through the coupling 58, 65 into the entrance port 64, out of the exit port means 49 and continue into the passageway 30 to the pressure sensitive switch.

Upon disconnecting or uncoupling of the device 61, it will be apparent that the spring 42 will immediately become effective to automatically cause the piston 35 to move to the right, as viewed in FIGURE 1, from the broken line to the solid line position where the first or normal position of the piston is again assumed and thus re-establish communication between the bore 14, through its end portion 24, and the passageway 30 while, at the

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same time blocking further communication between the interior of the piston and the passageway 30.

The valve 10 is schematically shown in FIGURE 2 with the piston 35 in its second position due to the male member 65 of the quick-disconnect device 61 being coupled into the female part 58. The male member 65 is secured at the free end of a flexible hose or line 66 which leads from a source of fluid pressure external to the missile 25 on which the valve 10 is carried. Since the piston 35 has been moved by the action of coupling together of the male and female members of the device 61, the flow of fluid under pressure will be in the direction of the arrow A and follow a course indicated by the broken line 68 and the valve 10 will now function to direct the flow of fluid pressure from the external source into the pressure sensitive device in the manner hereinbefore in detail. When the device 61 has its male and female parts disconnected, the valve 10 will automatically re-establish communication between the local source of fluid pressure and the pressure sensitive device as the piston once again assumes its first position under the influence of the spring 32.

In FIGURE 3, the modified calibration valve 10' differs from the valve 10 only in that the hollow stem or web 62 of the valve 10 has been replaced by a solid stem or rod 70, and permits the flow of fluid under pressure from an external source through the device 61 and into the hollow piston 35 through a piston head 45' which has a plurality of spaced passages 72 drilled transversely therethrough. The passages 72 will, thus, define a conduit means whereby the fluid under pressure flowing through the device 61, in its coupled or connected condition, will be channelled into the interior of the piston 35. The operation of valve 10' will be the same as that described for valve 10 in all other respects. For instance, the rod 70 will be contacted and moved longitudinally toward the end 17 of the valve housing 12 so that the piston 35 will move from its first to its second position to establish communication between the external source of fluid pressure and a pressure sensitive device attached to the valve 10' and concurrently block communication between the pressure sensitive device and the local source of fluid pressure. Upon uncoupling of the device 61, the piston 35 will be moved to its first position under the resilient bias of the spring 42.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various other applications and structural changes may be made within the scope of the appended claims without departing from the spirit and concept of the invention.

I claim:

1. A calibration valve for handling fluid pressures of the magnitude of at least 3000 pounds per square inch comprising:

- (a) a housing having a longitudinal bore opening through opposite ends thereof;
- (b) a passageway disposed in said housing in angular relation thereto and opening at one end into said bore and having its other end opening through said housing;
- (c) a hollow power piston closed at one end and having an enlarged head at the other end;
- (d) said power piston having at least one exit port therein and disposed within said bore for longitudinal movement with respect to said bore;
- (e) resilient means carried by said housing for urging said piston to move in one direction;
- (f) a piston limiting means carried by said housing to limit the movement of said piston in said one direction;
- (g) said piston limiting means having a longitudinal passage therein opening into said bore;
- (h) a female coupling part of a quick-disconnect device carried by said piston limiting means and adapted for attachment to and disconnection from a male coupling member,

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- (i) said female coupling part having a longitudinal passage which is in axial alignment with the passage through said piston limiting means;
- (j) a hollow piston rod having an entrance port therein carried by said piston to have its interior in communication with the interior of said piston and extending longitudinally from said piston through said passages;
- (k) said rod being disposed for engagement by the male coupling member which causes the rod to be displaced longitudinally and also permits an external fluid pressure to flow through the passages surrounding the rod to impinge upon the piston head;
- (l) whereby the movement of said rod and the pressure impinging upon said power piston head causes said piston to be displaced from a first position where communication between the interior of said piston and said passageway is blocked to a second position where communication is established between the interior of said piston and said passageway through said entrance and exit ports while communication between said bore and said passageway is blocked; and
- (m) upon the disconnecting of said male coupling member, said resilient means being operative to return said piston to said first position.

2. A valve comprising:

- (a) a housing having a longitudinal bore therethrough and a passageway opening into said bore at one end and through the housing at the other end;
- (b) a hollow power piston having port means and disposed in said bore for longitudinal movement between a first position in which said bore communicates with said passageway and a second position in which communication between said bore and said passageway is blocked and communication is established between said passageway and the interior of said piston through said port means;
- (c) said power piston being closed at one end and having an enlarged power piston head at the other end;
- (d) resilient means for urging said piston into its first position;
- (e) seal means located between said piston and said longitudinal bore for positively sealing said passageway from said port means when said piston is in said first position and for positively sealing said longitudinal bore from said port means when said piston is in said second position;
- (f) a female coupling member of a quick-disconnect device carried by said housing;
- (g) said female coupling part having a longitudinal passage which is in communication with the interior of said piston;
- (h) and said female member being adapted for coupling with and disconnection from a corresponding male coupling member and an external source of fluid pressure;
- (i) a hollow piston rod having an entrance port adjacent one end and having its other end in communication with interior of said piston;
- (j) said hollow piston rod extending through said longitudinal passage of said female coupling part and being adapted for engagement by the male coupling member which causes the rod to be displaced longitudinally and also permits the external fluid pressure to flow through the passage surrounding the rod to impinge upon the piston head;
- (k) whereby the movement of said rod and the force of the pressure impinging upon said power piston head causes said piston to be displaced from its first position to its second position; and
- (l) said resilient means being effective to return said piston to its first position when the male member is disconnected.

3. A calibration and checkout valve comprising:

- (a) a housing having a longitudinal bore therethrough and

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- (b) a passageway opening into said bore at one end and through said housing at its other end;
- (c) a hollow power piston having port means and disposed in said bore for longitudinal movement between a first position in which said bore communicates with said passageway and a second position in which communication between said bore and said passageway is blocked and communication is established between said passageway and the interior of said port means,
- (d) said power piston being closed at one end and having an enlarged power piston head at the other end;
- (e) resilient means for urging said piston into its first position;
- (f) seal means located between said piston and said longitudinal bore for positively sealing said passageway from said port means when said piston is in a first position and for positively sealing said longitudinal bore from said port means when said piston is in said second position;
- (g) a female coupling part of a quick-disconnect device carried by said housing,
- (h) said female coupling part having a longitudinal passage which is in communication with the interior of said piston,
- (i) and said female part being adapted for coupling

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- with and disconnection from a corresponding male coupling member and an external source of fluid pressure;
- (j) rigid means carried by said piston extending through said passage in said female coupling part and adapted to be contacted by said male coupling member which causes the rod to be displaced longitudinally and also permits the external fluid pressure to flow through the passage surrounding said rigid means to impinge upon the piston head.
- (k) whereby the movement of said rigid means and the pressure impinging upon said power piston head causes said piston to be displaced from its first position to its second position, and
- (l) said resilient means being effective to return said piston to its first position when the male member is disconnected.

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