APPARATUS FOR CONTROLLING THE PARTIAL FILLING OF A WELL CONDUIT STRING AND CONTROLLING FLOW THROUGH THE CONDUIT STRING

Eugene E. Baker, Duncan, Okla., assignor to Halliburton Company, Duncan, Okla., a corporation of Delaware
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7 Claims

ABSTRACT OF THE DISCLOSURE

A float collar or float shoe apparatus including a sleeve-controlled, float valve superposed above a pair of unitized flapper valves. One flapper valve of this pair is carried by the other flapper valve. One flapper valve serves to control upward flow through the conduit string, while the other serves to control downward flow.

This invention relates to apparatus, such as float collars or float shoes, which are incorporated in well strings and used to control the partial filling of these strings, as well as flow both upwardly and downwardly through the strings.

GENERAL BACKGROUND OF INVENTION

During casing placing and cementing operations it is necessary to control the flow of fluid both downwardly through a well conduit string and upwardly into this string.

As a string is lowered into a well, it is desirable, at least initially, to allow it to fill partially with well fluid so as to avoid an excessive floating tendency and minimize the pressure differential across the wall of the conduit string in the well.

It is also desirable to provide a valve mechanism which will enable fluid to be circulated downwardly through the string.

During the terminal portion of the conduit string lowering, it often becomes appropriate to close off the lower end of the conduit string so as to enable a degree of "floating" to take place, i.e., to minimize the fluid weight of the conduit string.

Herefore, valves to enable the "floating-in" of conduit strings have been proposed. Many such valve structures have involved flapper valves initially maintained in an open position by a sleeve. This sleeve is movable axially within the string, out of engagement with the flapper valve, in response to selective wellhead control manipulations. Valve structures of this general type are well known and disclosed, for example, in the United States Cameron et al. Patent 2,447,842. A more recent and efficacious embodiment of this form of valve structure, in a float valve context, is featured in the United States Holland Patent 3,148,731.

Attempts have been made to incorporate sleeve-controlled float valves, as featured in the Holland Patent 3,148,731, in a compound valve assembly which will serve to permit circulation and control the extent of filling of a conduit string during lowering. Such prior art attempts are exemplified by the United States Park Patent 3,220,481. However, the Park structure is characterized by complete axial displacement of the various valving members. This displacement serves to disadvantageously isolate some valve components from any reasonable degree of access. Further, Park relies upon a differential, pressure operated sleeve valve which requires precision manufacture and installation and which is uniquely vulnerable to becoming inoperable should sediment or debris lodge in the passage within which the sleeve valve is mounted.

In short, the prior art compound valve structures as above noted have been characterized by excessive precision requirements, by a unique vulnerability to clogging because of sediment accumulation, and by structural complexity which increases manufacturing costs and creates servicing and assembly problems.

GENERAL OBJECTS AND SUMMARY OF INVENTION

It is a principal object of the invention to provide an improved, compound valve structure which obviates problems of the type herefore discussed and yet which promotes reliable control over circulating, floating, and casing string filling operations.

It is also an object of the invention to provide a unique and improved valve structure for controlling floating and circulation through a conduit string and which maintains multiple valve components in a compact area uniquely accessible for installation and servicing purposes.

It is likewise an object of the invention to localize multiple valve components in a single zone so as to reduce the bulk of the control structure.

A still further object of the invention is to provide an improved mechanism for locking a valve-controlling sleeve in place which requires no modification of sleeve structure, only minor alteration of a sleeve housing, and which is uniquely resistant to clogging problems.

It is another object of the invention to provide a unique arrangement of a valve-biasing spring in a well tool which serves to both bias and effectively support a flapper valve in the vicinity of the port controlled by the flapper valve.

Still another object of the invention is to incorporate multiple flapper valves in a tool so as to control multidirectional flow while providing a continuous and uninterrupted passage portion for the transmittal of solid articles.

In accomplishing these objects, an apparatus is provided which includes a conduit body portion mounted for axial movement, with a conduit string, through a well. Wall means define a passage extending longitudinally of the body portion. A first valve member is provided in combination with first pivot mounting means. The first pivot mounting means supports the first valve member within the body portion for pivotal movement in one direction about an axis extending transversely of the passage. First biasing means urge the first valve member in a direction generally opposite to the one pivot direction. First port means carried by the conduit body portion, in combination with the first valve member, serve to control fluid flow in one flow direction through the longitudinal passage.

A second valve member is mounted by second pivot mounting means on the first valve member for pivotal movement in a second pivot direction about an axis extending generally transversely of the longitudinal passage. Second biasing means urge the second valve member in a direction generally opposite to the second pivot direction. Second port means carried by the first valve member, in combination with the second valve members, serve to control flow through the longitudinal passage in a second flow direction generally opposite to the one flow direction.

Another independently significant facet of the invention resides in a recess and leaf spring arrangement for securing a valve-retaining sleeve, which arrangement is uniquely resistant to sediment clogging.

Of additional significance is a structural concept involving the basic combination, in a well tool, of a
Superposed above the composite flapper valve assembly 12 is a sleeve-controlled, float valve mechanism 14. Float valve mechanism 14 is adapted to be selectively actuated so as to close the passage 11 and thereby prevent a flow of well fluid upwardly into the passage 11 above the float valve 14. Operation of this float valve is effected when it is desired to “float” a conduit string as it is being lowered into fluid-filled well bore.

**STRUCTURAL DETAILS OF COMPOSITE FLAPPER VALVE**

The composite flapper valve assembly 12 includes a first flapper valve 15 disposed in valving cooperation with a first annular valve seat 16. Valve seat 16 is defined by the lower end of a sleeve member 17 contained within passage 11 and supported on the insert 7 by threaded fastening means 18.

Displace flapper valve 15 is supported by a pivot mounting means 19 for downward or counterclockwise pivotal movement away from the seat 16.

The flapper valve 15, when engaged with the seat 16, is designed to control the upward flow of fluid from the well bore through the passage mouth 13 and through the passage 11 above the valve assembly 12.

Pivot mounting means 19 comprises, as shown in FIGURE 3, a pair of lugs 20 and 21 which are fixedly mounted to the disclike valve member 15. Lugs 20 and 21, when the valve 15 is disposed in the vertical orientation shown in FIGURE 1, are located horizontally between flanges 22 and 23 provided by the insert 7. A pivot shaft 24 intersects the flanges 22 and 23, as well as the lugs 20 and 21, and thus serves to pivotally support the valve member 15 on the insert 7 within the passage 11.

A first elastically yieldable biasing means 25 serves to yieldably and elastically bias the valve member 15 clockwise into seated engagement with the annular sleeve end defined seat 16.

Biasing means 25 comprises a unitary spring including a pair of spaced anchor rod portions 26 and 27 embossed within and extending generally longitudinally of sockets formed in the insert 7. The anchor rods and their associated sockets thus extend longitudinally of the passage 11. Torsion spring portions 28 and 29 are connected respectively with anchor rods 26 and 27 and encircle laterally spaced portions of the pivot shaft 24. A generally U-shaped, valve biasing, spring portion 30 extends laterally of the torsion spring means 26 and 29 and interconnects these torsion spring portions. As shown in FIGURE 3, U-shaped portion 30 generally circumscribes a vertically extending port 31 formed in the valve body 15. Thus, the port 31 is located generally between the outer extremity 32 of the U-shaped spring portion 30 and the torsion spring means 26 and 29.

Assembly 12 additionally includes a second, disclike, flapper valve 33. As shown in FIGURE 1, flapper valve 30 is disposed in valving cooperation with the valve port 31 defined and carried by the first valve member 15.

A second pivot mounting means 34 serves to pivotally support the first valve member 33 on the first valve member 15.

Pivot mounting means 34, as shown in FIGURES 1 and 2, includes horizontally spaced and valve body carried, apertured lugs 35 and 36. Lugs 35 and 36 are interposed horizontally between mounting flanges 37 and 38 which are carried by and project outwardly from the valve body 15. A pivot shaft 39 intersects apertured portions of the mounting flanges 37 and 38 and the lugs 35 and 36 so as to support the valve member 33 for pivotal movement on the valve member 15.

Counterclockwise pivotal movement of the valve member 33 brings it intovalving engagement with the upper lip or valve seat 40 engaging the port 31. This cooperation between the port 31 and the valve member 33 serves to control limited or “differential” filling of the conduit string supporting the float shoe 1.
A second elastically yieldable biasing means 41 serves to yieldably bias the valve member 33 in a counterclockwise direction.

Second biasing means 41 includes a pair of horizontally spaced anchor rods 42 and 43. Anchor rods 42 and 43 extend generally longitudinally of the passage 11 and are embedded in longitudinally extending and horizontally spaced sockets formed in the upper portion of the valve body 15 between the port 31 and the pivot shaft 19. This longitudinal orientation of anchor rods and sockets exists in the closed valve configuration shown in FIGURE 1.

A portion of horizontally displaced, torsion spring portions 44 and 45 are connected with the anchor rods 42 and 43 respectively and encircle the pivot shaft 39. A generally U-shaped spring portion 46 projects generally laterally of the spring portions 44 and 45 and interconnects these.

U-shaped spring portion 46 biasingly engages the upper surface of the valve member 33 and serves to urge the valve member 33 in a counterclockwise direction into valve cooperation with the port lip 40.

As shown, U-shaped spring portion 46 generally circumferentially encircles the central longitudinal axis of the port 31. That is, this axis is interposed between the outer extremity 47 of the biasing means 41 and the torsion spring means 44 and 45, when the valve components are disposed as shown in FIGURE 1.

As will be appreciated, the pivot mounting arrangement described might be modified, in some instances, by deleting the mounting portions 22, 23, 37 and 38. This would leave the pivot shafts 39 and 24 supported respectively by the lugs 35-36 and 20-21. With this arrangement, the torsion spring means 44 and 45 would serve to pivotally support the shaft 39, while the torsion spring means 28 and 29 would serve to pivotally support the shaft 24.

A valve assembly receiving resector or pocket 48 projects laterally outwardly of the resector 11 immediately beneath the pivot member 19. The valve assembly 12, including the valve discs 15 and 33, may thus pivot downwardly and be substantially, or at least partially, received within this resector 48 so as to leave an unobstructed passage portion extending longitudinally through at least a substantial portion of the port 49 defined by the sleeve 17.

STRUCTURAL DETAILS OF FLOAT VALVE

FIGURES 1, 4 and 5 illustrate structural details of the float valve 14.

FIGURE 14 includes a dislike valve member 50 having a generally frustoconical valve surface, including an elastomeric gasket portion 50a. Valve disc 50 is supported for pivotal movement by pivot means 50a within the housing means 9. Clockwise pivotal movement of the valve 50 brings the frustoconical valve surface 51 into valve cooperation with a frustoconical valve seat 52 encircling a port 53 within passage 11. An elastically yieldable spring means 54 serves to yieldably bias the valve 50 in a clockwise direction toward the seat 52, where the port 53 will be effectively closed so as to prevent an upward flow of fluid past the valve 50.

Pivot mounting means 50a may be substantially the same as pivot mounting means 19, but serves to pivotally support the valve 50 on the insert 6, instead of the insert 7. In view of this similar character of these two pivot mounting units, the structural details of the mounting unit 50a are not described.

The spring biasing means 54 may also be essentially the same as the spring means 25 and, for this reason, its structural details need not be discussed in detail. As should also be noted, the pivot and biasing arrangement for the valve 50 is substantially the same as described in the previously noted United States Holden Patent 3,148,731.

A valve-retaining sleeve 55 is mounted within a cylinderlike wall portion 56 of insert 7. A shear pin 57, as shown in FIGURE 1, initially supports the sleeve 55 in a first or upper position where the upper end of the sleeve 55 serves to hold the valve 50 in an open valve position. In this open valve position, the valve member 50 is substantially recessed within a valve-receiving pocket 58 extending laterally or radially of the passage 11. By dropping a ball downwardly through the conduit string supporting the shoe 1, so that the ball moves through the upper portion of the passage 11 and into sealing engagement with an annular lip 59 formed at the lower end of the sleeve 55, the lip may be moved downwardly. This may be accomplished, with the ball in place, by applying pump pressure at the wellhead so as to increase the pressure of fluid injected from the wellhead into the interior of the conduit and the passage 11.

This pressurization of fluid will apply sufficient force to the ball 60, shown in phantom line in FIGURE 4, so as to cause the pin 57 to shear and allow the force transmitted through the ball 60 to move the sleeve 55 downwardly to its lower position shown in FIGURE 4. In this lower position, the sleeve 55 engages an annular seat 61a provided by the insert 7. Further intensification of fluid pressure within the conduit string, applied by wellhead pumps in a conventional fashion, will serve to deform the lip 59 downwardly, as shown in FIGURE 4, so as to allow the ball 60 to move downwardly out of the sleeve 55. This ball may then pass downwardly, entirely out of the float shoe 1, by moving through the unobstructed passage portion defined by the opening of the valve assembly 12, when the valve assembly 12 moves substantially into the resector 48.

With the sleeve 55 disposed into this lower position, the float valve body 14 is free to pivot clockwise into sealing engagement with the seat 52 and thus close the port 53. With the float valve components thus disposed, as shown in FIGURE 4, fluid flow from the well annulus, upwardly through the float shoe and into the conduit string interior, is positively prevented.

The sleeve is retained in its lower position by a unique locking mechanism 61 which is characterized by basic structural simplicity and virtual invulnerability to sediment clogging.

Sleeve retaining means 61 includes one or more latching mechanisms 62. Each such latching mechanism 62 includes a longitudinally extending resector 63 formed in insert 7 immediately contiguous with the exterior of the sleeve 55. A leaf spring 64 has a base portion 65 anchored to the upper end of insert 7 by a conventional, naillike, fastening pin 66. A detent portion 67 of spring 64, biased toward the central axis of the sleeve 55, is contained within the resector 63 when the sleeve is in its upper position, as shown in FIGURE 1. The detent portion 67 fully occupies the resector 63 so as to prevent sediment from accumulating in this area of the mechanism 61.

When the sleeve 55 moves to its lower position, shown in FIGURE 4, the detent portion 67 springs outwardly toward the central axis of the sleeve 55 so as to overlap the upper end 68 of the sleeve 55. This overlapping by the detent 67 serves to restrain the sleeve 55 and prevent it from moving upwardly within the cylinderlike portion 56 of the insert 7.

GENERAL MODE OF OPERATION OF APPARATUS

FIGURES 6, 7 and 8 schematically illustrate the disposition of apparatus components during various stages of a casing string lowering operation.

FIGURE 6 illustrates the components arranged to effect controlled, "differential" filling of a conduit string which supports float shoe 1.

As shown in FIGURE 6, float shoe 1 is threadably attached to the lower end of a conduit string 69. Conduit string 69 and its associated float shoe 1 are shown in the process of being lowered within a well bore 70. The
annulus 71 of the well bore 70 is at least substantially occupied by fluid. The biasing strength of the coil spring means 41 is such as to maintain the valve body 33 closed until a predetermined fluid force is exerted across the valve body 33 by the hydrostatic pressure of fluids in the annulus 71, tending to move the valve body 33 in a clockwise or valve opening direction. As fluid moves into the interior 72 of the conduit string 69, the valve opening force acting across the valve body 33 will be diminished. At some point, where there is a predetermined difference in height 73 between fluid within the conduit string and fluid within the well annulus 71, the biasing force of the spring 41 will overcome the fluid force imposed by the hydrostatic pressure of fluid in the well annulus 71 and allow the valve 33 to close.

Thus, the valve 33 will serve to maintain a differential in height 73 between fluid within the conduit string interior 72 and the well annulus 71. FIGURE 7 illustrates the disposition of components when it is desired to circulate fluid downwardly through the conduit string 69.

In order to effect such downward circulation, pressurized fluid is injected into the conduit string interior 72 in the wellhead. By building up the pressure of this fluid by surface pumps, the biasing effect of the spring means 25 will be overcome so as to cause the valve assembly 12, i.e. the valves 15 and 33, to pivot downwardly and thus open the port 49. With the port 49 thus open, fluid may be circulated downwardly through the conduit string passage 72 and outwardly of the mouth 13 and into the well bore.

FIGURE 8 illustrates the disposition of components when it is desired to "float" a conduit string during a portion of its lowering operation (usually the terminal portion). In the FIGURE 8 disposition of components, the float valve retaining sleeve 55 has been moved downwardly to its FIGURE 4 position so as to allow the valve 50 to pivot clockwise and close the ports 53. With the ports 53 thus closed, an upward flow of well fluid into the conduit string passage 72 is affirmatively prevented. Thus, with the components disposed as shown in FIGURE 8, lowering of the string 69 will continue without further inflow of well fluid into the conduit string interior 72.

SUMMARY OF PRINCIPAL ADVANTAGES AND OVERALL SCOPE OF INVENTION

A principal advantage of the invention resides in the structural simplicity and reliability of the valve assembly 12. The two valve components in this assembly are unitized in a highly compressed location so as to reduce the bulk of the overall apparatus. The two valves of the assembly pivot as a unit into the valve recess 48 so as to provide an unobstructed longitudinal passage portion through which solid articles may freely move.

The unitizing character of the assembly facilitates the initial assembly of the tool and to some extent may facilitate access to the interior valve component 33. As may be apparent, for example, with the valve assembly 12 pivoted downwardly, the valve 33 is exposed for inspection and access purposes with reference to the passage portion 13.

The utilization of oppositely acting flapper valves in the assembly 12 entirely avoids the problems of precision manufacture and vulnerability to sediment clogging which are associated with fluid pressure actuated, sleeve valve units.

The leaf spring and body recess arrangement provide a mechanism for securing the sleeve 55, which arrangement is virtually immune to clogging prior to the time that the mechanism is to be actuated.

As will also be appreciated, this sleeve latching mechanism requires no alteration or deformation of the sleeve body itself and may be readily incorporated in the body portion of the housing with nominal expense.

In describing the invention, reference has been made to a preferred embodiment. However, those skilled in the art and familiar with this disclosure may well recognize additions, deletions, substitutions or modifications which would fall within the purview of the invention as defined in the appended claims.

I claim:

1. An apparatus for controlling fluid flow through a conduit string in a well, said apparatus comprising:
   a conduit body portion mounted for axial movement through a well;
   wall means defining a passage extending longitudinally of said body portion;
   a first valve member;
   first pivot mounting means supporting said first valve member within said body portion for pivotal movement in one pivot direction about an axis extending transversely of said passage;
   biasing means urging said first valve member in a direction generally opposite to said one pivot direction;
   first port means carried by said conduit body portion;
   said first valve member, in combination with said first port means, being operable to control fluid flow in one flow direction through said longitudinal passage;
   a second valve member;
   second mounting means supporting said second valve member on said first valve member for valving movement;
   second port means carried by said first valve member;
   said second valve member, in combination with said second port means, being operable to control fluid flow through said longitudinal passage in a second flow direction generally opposite to said one flow direction;

2. An apparatus for controlling fluid flow through a conduit string in a well, said apparatus comprising:
   a conduit body portion mounted for axial movement through a well;
   wall means defining a passage extending longitudinally of said body portion;
   a first valve member;
   first pivot mounting means supporting said first valve member within said body portion for pivotal movement in one pivot direction about an axis extending transversely of said passage;
   first elastically yieldable biasing means urging said first valve member in a direction generally opposite to said one pivot direction;
   first port means carried by said conduit body portion;
   said first valve member, in combination with said first port means, being operable to control fluid flow in one flow direction through said longitudinal passage;
   a second valve member;
   second pivot mounting means supporting said second valve member on said first valve member for pivoting movement in a second pivot direction about an axis extending transversely of said longitudinal passage;
   second elastically yieldable biasing means urging said second valve member in a direction generally opposite to said second pivot direction;
   second port means carried by said first valve member;
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said second valve member, in combination with said second port means, being operable to control flow through said longitudinal passage in a second flow direction generally opposite to said one flow direction;

float valve means independent of said first valve member and second valve member;

means mounting said float valve means in said passage, with said float valve means being spaced longitudinally from said first valve member and second valve member; and

selectively operable retaining means independent of said first valve member and second valve member and operable to release said float valve means and permit said float valve means to close said passage against a generally upward flow of fluid in said well.

3. An apparatus for controlling fluid flow through a conduit string in a well, said apparatus comprising:
a conduit body portion mounted for axial movement through a well;

wall means defining a passage extending longitudinally of said body portion;
a first valve member;

first pivot mounting means supporting said first valve member within said body portion for pivotal movement in one pivot direction about an axis extending transversely of said passage;

first elastically yieldable biasing means urging said first valve member in a direction generally opposite to said one pivot direction;

first port means carried by said conduit body portion;
said first valve member, in combination with said first port means, being operable to control fluid flow in one flow direction through said longitudinal passage;
a second valve member;

second pivot mounting means supporting said second valve member on said first valve member for pivotal movement in a second pivot direction about an axis extending transversely of said longitudinal passage;
a second elastically yieldable biasing means urging said second valve member in a direction generally opposite to said second pivot direction;

second port means carried by said second valve member, in combination with said second port means, being operable to control fluid flow through said longitudinal passage in a second flow direction generally opposite to said one flow direction;
said first elastically yieldable biasing means including:
spaced, first anchor rod portions embedded within said body portion and extending generally longitudinally of said longitudinal passage;
said first elastically yieldable biasing means including:
spaced, anchor rod portions embedded within said body portion and extending generally longitudinally of said longitudinal passage;
torsion spring means connected with said anchor rod portions, and

a generally U-shaped portion connected with said torsion spring means and disposed in biasing engagement with said first valve member, said U-shaped portion generally circumscribing said second port means such that said second port means is disposed generally between the outer extremity of said first, generally U-shaped portion and said first torsion spring means;
said second elastically yieldable biasing means including:
spaced, anchor rod portions embedded within said first valve member, second torsion spring means connected with said second anchor rod portions, and

a second, generally U-shaped portion connected with said second anchor rod means disposed in biasing engagement with said second valve member, said second, generally U-shaped portion circumscribing a central longitudinal axis of said second port means such that said central longitudinal axis is disposed generally between the outer extremity of said second, generally U-shaped portion and said second torsion spring means.

4. An apparatus for controlling fluid flow through a conduit string in a well, said apparatus comprising:
a conduit body portion mounted for axial movement through a well;

wall means defining a passage extending longitudinally of said body portion;
a first valve member;

first pivot mounting means supporting said first valve member within said body portion for pivotal movement in one pivot direction about an axis extending transversely of said passage;

first elastically yieldable biasing means urging said first valve member in a direction generally opposite to said one pivot pivot direction;

first port means carried by said conduit body portion;
said first valve member, in combination with said first port means, being operable to control fluid flow in one flow direction through said longitudinal passage;
a second valve member;

second pivot mounting means supporting said second valve member on said first valve member for pivotal movement in a second pivot direction about an axis extending transversely of said longitudinal passage;

second elastically yieldable biasing means urging said second valve member in a direction generally opposite to said second pivot direction;

second port means carried by said first valve member;
said second valve member, in combination with said second port means, being operable to control fluid flow through said longitudinal passage in a second flow direction generally opposite to said one flow direction;
said first elastically yieldable biasing means including:
spaced, first anchor rod portions embedded within said body portion and extending generally longitudinally of said longitudinal passage;

first anchor rod portions connected with said first valve member, first second anchor rod portions, and

a second generally U-shaped portion connected with said second anchor rod means disposed in biasing engagement with said second valve member, said second generally U-shaped portion circumscribing a central longitudinal axis of said second port means such that said central longitudinal axis is disposed generally between the outer extremity of said second, generally U-shaped portion and said second torsion spring means.

5. An apparatus as described in claim 4 further comprising:
a third valve member supported for valving operation within said longitudinal passage;
sleeve means supported within said longitudinal passage for movement between first and second positions;
said sleeve means, in said first position, being operable to restrain said third valve member from valving movement;
said sleeve means, when displaced from said first position to said second position, being operably disconnected from said third valve member;
recess means formed in said body means and including a portion extending longitudinally of said sleeve means and disposed in contiguous relation to the exterior of said sleeve means;
spring means including a portion substantially fully occupying said portion of said recess means lying contiguous with said sleeve means;
said spring means portion occupying said portion of said recess means being elastically biased toward the axis of said sleeve means and operable, when said
sleeve means is moved to said second position, to project across an end portion of said sleeve means and prevent said sleeve means from moving from said second position to said first position.

6. An apparatus for controlling fluid flow through a conduit string in a well, said apparatus comprising:

- body means;
- wall means defining a passage extending through said body means;
- first flapper valve means mounted within said passage; first port means contained within said passage, with said first valve means and said first port means cooperating to control fluid flowing in one flow direction through said passage;
- second valve means supported within said passage; second port means carried by said first flapper valve means, with said second port means and said second valve means being operable to control fluid flowing through said passage in a direction opposite to said one flow direction;
- said first port means and said second port means coinciding in a plane extending transversely of said one flow direction;
- float valve means independent of said first flapper valve means and second valve means;
- means mounting said float valve means in said passage, with said float valve means being spaced longitudinally from said first flapper valve means and second valve means; and
- selectively operable retaining means independent of said first, flapper valve means and second valve means and operable to release said float valve means and permit said float valve means to close said passage against a generally upward flow of fluid in a well.

7. A well tool comprising:

- body means;
- wall means defining a passage extending through said body means;
- first flapper valve means operable to control flow in one direction through said passage;
- second flapper valve means carried by said first flapper valve means and operable to control flow in a direction opposite to said one direction through said passage; and
- valve receiving means extending laterally of said passage means and operable to at least partially receive said first and second flapper valve means; said first and second flapper valve means, when at least partially received within said valve receiving means, being operable to yield a continuous, uninterrupted passage portion extending axially of said passage; float valve means independent of said first flapper valve means and second flapper valve means; means mounting said float valve means in said passage, with said float valve means being spaced longitudinally from said first flapper valve means and second flapper valve means; and
- selectively operable retaining means independent of said first flapper valve means and second flapper valve means and operable to release said float valve means and permit said float valve means to close said passage against a generally upward flow of fluid in a well.

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DAVID H. BROWN, Primary Examiner

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