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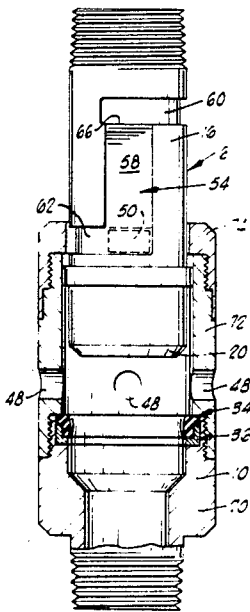
[54] TUBING UNLOADER
9 Claims, 5 Drawing Figs.

[52] U.S. Cl. 166/226
[51] Int. Cl. E21b 33/00
[50] Field of Search 166/224,
226, 237

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ABSTRACT: The present invention relates to apparatus for unloading fluid from a string of tubing disposed in a well bore which comprises a first conduit member having the lower end thereof adapted to be connected to a lower portion of the tubing string and having a fluid port extending through a side thereof, and a second conduit member telescopically mounted within the first conduit member having the upper end thereof adapted to be connected to an upper portion of the tubing string. The first conduit member includes an internal seating surface positioned below the fluid port for sealingly engaging the lower end of the second conduit member. A spring-loaded dog is attached to one of the conduit members facing a peripheral surface of the other of the conduit members, and continuous groove means are provided in the peripheral surface of the other conduit member for slidably engaging the spring-loaded dog. The continuous groove means are of a shape such that the second conduit member may be alternately moved with respect to the first conduit member and locked in positions whereby the interiors of conduit members are communicated with the fluid port, or the second conduit member is engaged by the seating surface of the first conduit member thereby preventing communication between the interiors of the conduit members and the fluid port.



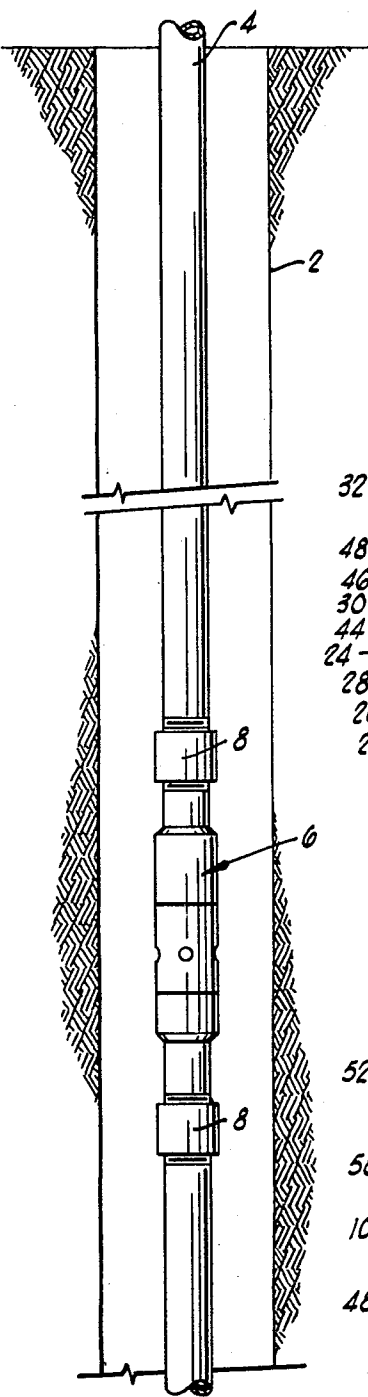


FIG. 1

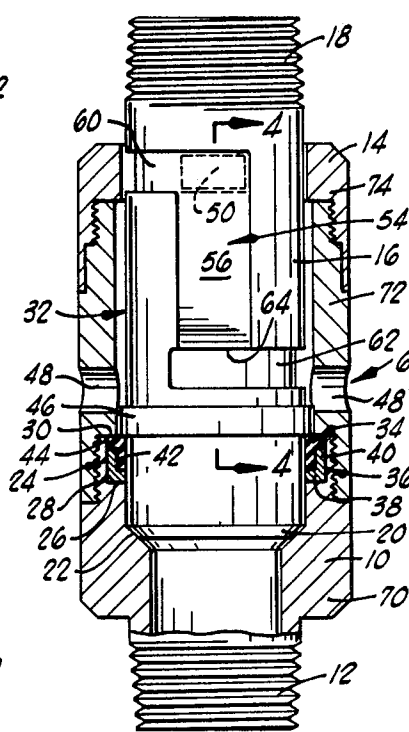


FIG. 2

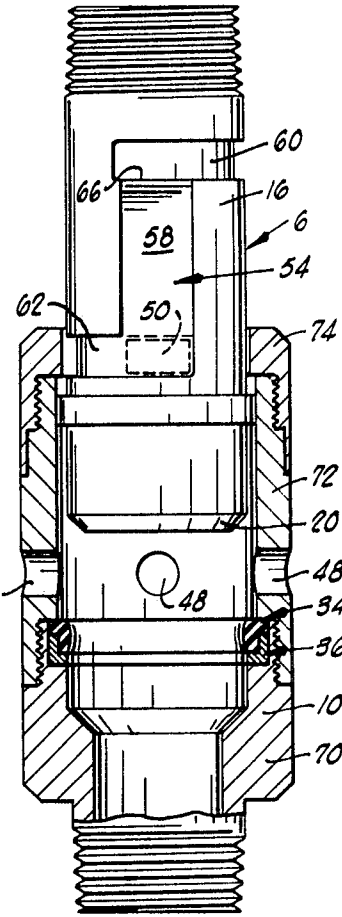


FIG. 3

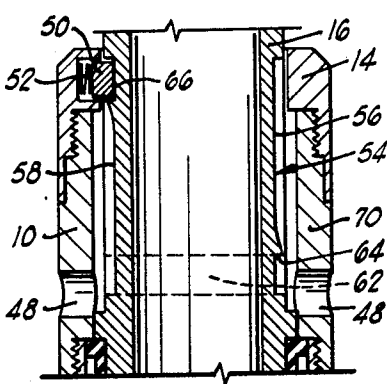


FIG. 4

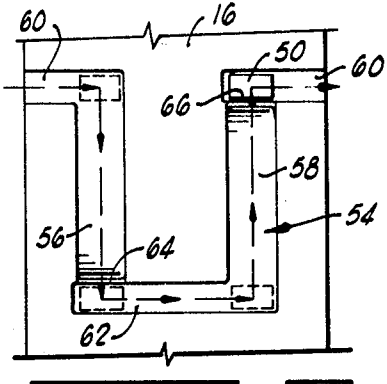


FIG. 5

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TUBING UNLOADER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to tubing unloaders, and more particularly, but not by way of limitation, to apparatus for unloading fluid from a string tubing disposed in a well bore whereby relative movement of the components of the apparatus serves to open or close a fluid port in the apparatus.

2. Description of the Prior Art

In conducting certain operations in wells such as oil, water or gas wells, it often becomes desirable to provide means for selectively controlling fluid flow between the interior of a string of tubing or conduit disposed within the well bore and the exterior thereof. For example, in workover operations where a string of tubing disposed in a well bore must be pulled or extracted therefrom in order to perform an operation on the producing formation, or to repair pumping or other apparatus attached to the lower end of the tubing string, fluid is commonly trapped within the interior of the tubing string. Unless prior to the extraction of the tubing string such fluid is unloaded therefrom, i.e., allowed to pass into the annular space between the outside of the tubing and the well bore periphery, it must be unloaded at the surface of the well bore as the tubing is extracted. This creates numerous problems in the extracting operation as well as wastage of the fluid. Furthermore, in many well operations it is desirable to provide fluid circulation between the interior of the tubing string and the annular space between the string and the well bore. For example, a heavy paraffin component is produced by many oil and gas wells having a tendency to plug the interior of the tubing string as well as apparatus attached to the bottom end of the tubing string. A successful method of unplugging or cleaning paraffin from the tubing string and other apparatus used heretofore has been the circulation of paraffin cutting chemicals therethrough. In this operation, the use of tubing unloader apparatus for unloading fluid from the interior of the tubing string to the exterior thereof located at or near the bottom of the tubing string is desirable in order to facilitate circulation of the paraffin cutting chemicals.

Apparatus have been developed and used heretofore for unloading fluid from the interior of tubing strings. However, such apparatus have generally suffered from one or more structural operational drawbacks and often have been structurally cumbersome and complex. For example, a prior apparatus commonly used includes a shear pin for holding the apparatus in a closed position so that once the apparatus is moved to an open position it must be removed from the well bore and the shear pin replaced.

By the present invention tubing unloader apparatus is provided whereby through movement of the tubing string above the apparatus, the apparatus may be selectively opened or closed and locked in a desired position without the necessity of removing the tubing string from the well bore.

SUMMARY OF THE INVENTION

The present invention relates to apparatus for unloading fluid from a string of tubing disposed in a well bore which comprises a first conduit member having one end thereof adapted to be connected in the tubing string and having a fluid port extending through a side thereof, a second conduit member having one end telescopically mounted within the other end of the first conduit member and having the other end thereof adapted to be connected in the tubing string, the first conduit member including an internal seating surface for sealing engaging the end of the second conduit mounted therein, a spring-loaded dog attached to one of the conduit members facing a peripheral surface of the other of the conduit members, and the other of the conduit members including continuous groove means in the peripheral surface thereof for slidably engaging the spring-loaded dog, the continuous

groove means being of a shape such that the second conduit member may be selectively moved with respect to the first conduit member to positions whereby the interiors of the conduit members are communicated with the fluid port or whereby the second conduit member is engaged by the seating surface of the first conduit member thereby preventing fluid communication between the interiors of the conduit members and the fluid port.

It is, therefore, a general object of the present invention to provide a tubing unloader.

A further object of the present invention is the provision of apparatus for unloading fluid from a string of tubing disposed in the well bore which is of simple construction and simple to operate.

Yet a further object of the present invention is the provision of tubing unloader apparatus which may be selectively operated between open and closed positions through movement of the tubing string above the apparatus and which may be locked in a desired position.

Other and further objects, features and advantages will be apparent from the following description of presently preferred embodiments of the invention given for the purpose of disclosure, and taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic vertically sectioned view of a well bore having a string of tubing disposed therein with the apparatus of the present invention attached thereto.

FIG. 2 is an enlarged vertically sectioned view of the apparatus of the present invention in a closed position.

FIG. 3 is an enlarged vertically sectioned view of the apparatus of the present invention in an open position.

FIG. 4 is a view in cross section taken along line 4-4 of FIG. 2, and

FIG. 5 is a diagrammatic view of a portion of the apparatus of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 schematically illustrates the representative portion of a well bore 2 in which a conduit or tubing string 4 is positioned. The apparatus of the present invention, generally designated by the numeral 6, is threadedly connected in the tubing string 4 by a pair of conventional collars 8. As is well understood by those skilled in the art, the lower end of the tubing string 4 is normally connected to a conventional anchor or other apparatus which functions to anchor the tubing string 4 to the sides of the well bore. In addition, one of a variety of tools for performing various operations in the well bore is attached to the lower end of the tubing string 4.

Referring now to FIGS. 2 and 3, the apparatus 6 is illustrated in vertical cross section. The apparatus 6 basically comprises a first conduitlike member 10 having a lower end 12 and an upper end 14. The lower end 12 of the conduit member 10 is formed of a diameter and includes conventional threads for connection in the tubing string 4 by one of the conventional collars 8. A second conduitlike member 16 having an upper end 18 and a lower end 20 is provided telescopically mounted or interconnected to the first conduit member 10. For example, as shown in FIGS. 2 and 3, the second conduit member 16 may be inserted into the upper free end 14 of the first conduit member 10 so that it is rotationally and axially movable with respect to the first conduit member 10. The upper end 18 of the second conduit member 16 is formed of a diameter and includes conventional threads for connection in the tubing string 4 by the other of the collars 8.

The first conduit member 10 includes an inwardly extending annular shoulder or seat 22 near the lower end 12 thereof for engaging the lower end 20 of the second conduit member 16. The annular shoulder or seat 22 is preferably sloped downwardly at an angle of approximately 45° to the horizontal. The lower end 20 of the second conduit member 16 is

beveled for mated engagement with the annular shoulder or seat 22.

A first annular recess is provided in the internal peripheral surface of the first conduit member 10 a short distance above the annular shoulder 22 thereof. When viewed in cross section, the annular recess 24 includes a bottom horizontal surface 26, a vertical side surface 28 and a top horizontal surface 30. A second elongated annular recess 32 is provided immediately adjacent to and above the annular recess 24.

An elastomer sealing member 34 for sealing engaging the outside peripheral surface of the lower portion of the second conduit member 16 is provided disposed within the first annular recess 24. The sealing member 34 is preferably bonded to a metal retaining ring 36 of L-shape in cross section. The outside surface of the bottom leg 38 of the retaining ring 36 is positioned adjacent to the bottom surface 26 of the recess 24, and the outside surface of the vertical leg 40 thereof is positioned adjacent to the vertical side 28 of the recess 24. The vertical leg 40 of the retaining ring 36 is of a shorter length than the vertical side 28 of the recess 24, and the elastomer sealing member 34, preferably of inverted L-shape in cross section having a vertical leg 42 and a horizontal leg 44, is positioned and bonded to the retaining ring 36 so that the horizontal leg 44 thereof extends into the recess 24 and the vertical leg 42 thereof is adjacent to the vertical leg 28 of the retaining ring 36.

The second conduit member 16 includes an annular flange portion 46 extending outwardly from the outside peripheral surface thereof. The annular flange portion 46 is of an outside diameter such that the outside peripheral surface thereof slidably engages the inside peripheral surface of the recess 32 of the conduit member 10. Further, the annular flange portion 46 is positioned above the lower end 20 of the second conduit member 16 a distance such that when the lower end 20 is seated on the annular shoulder or seat 22 of the first conduit member 10, the bottom horizontal surface 48 of the annular flange portion 46 is seated against the top surface of the horizontal leg 44 of the elastomer member 34. Thus, as will be understood, the elastomer sealing member 34 provides a seal between the inside peripheral surface of the conduit member 10 and the outside peripheral surface of the conduit member 16 immediately below the annular flange portion 46 thereof and the bottom surface of the annular flange portion 46 when the apparatus 6 is in the closed position as illustrated in FIG. 2.

The second annular recess 32 of the first conduit member 10 is of a vertical length such that the second conduit member 16 and the annular flange portion 46 thereof may be moved upwardly with respect to the first conduit member 10 to an open position whereby the lower end 20 of the second conduit member 16 is above and out of engagement with the elastomer sealing member 34 (FIG. 3). A plurality of fluid ports 48 are provided in the sides of the first conduit member 10 which are positioned above the elastomer sealing member 34. Thus, when the second conduit member 16 is moved to its lowermost position with respect to the first conduit member 10 (FIG. 2) the second conduit member 16 is sealingly engaged by the elastomer member 34 and the annular seat 22 preventing communication between the interiors of the conduit members 10 and 16 and the fluid ports 48. When the second conduit member 16 is moved to its uppermost position (FIG. 3) and out of engagement with the sealing member 34, the interiors of the conduit member 10 and 16 are communicated with the fluid ports 48.

As best shown in FIG. 4, a rectangular shaped spring-loaded dog 50 is positioned in a rectangular recess of 52 disposed in the inside peripheral surface of the conduit member 10 at a point near the upper end 14 thereof. As shown in FIGS. 2, 3, and 4, continuous groove means, generally designated by the numeral 54, are provided in the outside peripheral surface of the conduit member 16 above the annular flange portion 46 thereof for slidably engaging the spring-loaded dog 50. The continuous groove means 54 basically comprises a first elongated vertical groove 56 of generally rectangular shape in

cross section and a second elongated vertical groove 58 of generally rectangular shape in cross section positioned on opposite sides of the conduit member 16. A first horizontal semi-annular groove 60 is positioned above and connecting the upper ends of the vertical grooves 56 and 58 and a second horizontal semiannular groove 62 is positioned below and connecting the lower ends of the vertical grooves 56 and 58. The horizontal groove 62 is preferably positioned on an opposite side of the conduit member 16 from the horizontal groove 60. As will be understood, the widths of the grooves 56, 58, 60 and 62 are such that the spring-loaded dog 50 is contained within the sides thereof, but will readily slide therein.

As is best shown in FIG. 4, the bottom surface of the lower end of the first vertical groove 56 progressively increases radially outwardly with respect to the axis of the conduit member 16 terminating in a downwardly facing shoulder 64 at the intersection of the vertical groove 56 and the horizontal groove 62. In a like manner, the bottom surface of the upper end of the vertical groove 58 progressively increases radially outwardly with respect to the axis of the conduit member 16 terminating in an upwardly facing shoulder 66 at the intersection of the vertical groove 58 with the horizontal groove 60.

For convenience in assembling the apparatus 6, the first conduit member 10 is preferably comprised of three parts which are threadedly connected together. Specifically, the conduit member 10 is comprised of a lower member 70 which includes the annular shoulder or seat 22 and first recess 24 described above. An intermediate member 72 is threadedly connected to the lowermost member 70 having the fluid ports 48 disposed in the sides thereof and an upper member 74 is provided threadedly connected to the intermediate member 72.

OPERATION

Referring now to FIG. 1, the apparatus 6 is shown disposed in a well bore 2 connected in a string of conventional tubing 4. As previously described, the portion of the string of conduit below the apparatus 6 is rigidly held within the well bore 2 by a conventional anchor or other apparatus (not shown). The portion of the tubing string 4 above the apparatus 6 extends to the top and out of the well bore 2. During operations such as extraction of the string of tubing 4, the upper end thereof is connected to a conventional rig apparatus which is used in a conventional and well understood fashion to rotate, raise or lower the tubing string 4 within the well bore 2. When it is desired to unload fluid from the interior of the tubing string 4, the tubing string 4 is first rotated 180° in a clockwise direction. As will be understood, since the portion of the tubing string 4 below the apparatus 6 is rigidly held to the walls of the well bore 2, rotation of the string of tubing 4 brings about the rotation of the second conduit member 16 of the apparatus 6, while the first conduit member 10 thereof is held stationary. Thus, as best seen in FIGS. 2 and 3, the second conduit member 16 is rotated 180° with respect to the first conduit member 10 thereby causing the spring-loaded dog 50 to slide within the horizontal groove 60 to the opposite end of the groove 60. Further, the rotation causes the spring-loaded dog 50 to be moved from a position above the upper end of the vertical groove 58 to a position above the upper end of the groove 56. The tubing string 4 is then raised a distance sufficient to cause the spring-loaded dog 50 to slide within the groove 56 to the lower end thereof (FIG. 3) thereby moving the lower end 20 of the conduit member 16 out of sealing engagement with the seat 22 and sealing member 34 so that the interiors of the conduit members 10 and 16 and the interior of the entire tubing string 4 is communicated with the fluid ports 48. As the conduit member 16 is moved upwardly with respect to the conduit member 10, the spring-loaded dog 50 slides from the lower end of vertical groove 56 into the horizontal groove 62. Because the lower end of the vertical groove 56 extends progressively outwardly and terminates in a downwardly

facing shoulder 64, the spring-loaded dog 50 freely slides from the vertical groove 56 into the horizontal groove 64, but is prevented from sliding back into the vertical groove 56 by engagement of the upwardly facing side of the dog 50 with the downwardly facing shoulder 64. Thus, once the conduit member 16 is moved upwardly causing the spring-loaded dog 50 to slide out of the vertical groove 56 into the horizontal groove 62, it is locked in the uppermost position or in the position whereby the apparatus 6 is open allowing fluid from the interior of the tubing string 4 to be unloaded through fluid ports 48.

When it is desired to close the apparatus 6, the tubing string 4 is again rotated 180° in a clockwise direction, thereby causing the conduit member 16 to be rotated while the conduit member 10 is held stationary. The rotation causes the spring-loaded dog 50 to slide within the horizontal groove 62 from a position below the lower end of the vertical groove 56 to a position below the lower end of the vertical groove 58.

The conduit string 4 is then moved downwardly causing the conduit member 16 to move downwardly with respect to the conduit member 10 to the closed position illustrated in FIG. 2. As the conduit member 16 is moved downwardly, the spring-loaded dog 50 freely slides in the vertical groove 58 over the shoulder 66 at the upper end thereof and into the horizontal groove 60. Once the spring-loaded dog 50 has entered the horizontal groove 60, the upwardly facing shoulder 66 engages the downwardly facing side of the dog 50 thereby preventing the upward movement of the member 16 and locking the apparatus 6 in the closed position. As will be understood, when the apparatus 6 is in the closed position (FIGS. 2 and 4) the lower end 20 of the conduit member 16 is engaged by the seat 22 and the lower portion of the conduit member 16 is sealingly engaged by the resilient member 34, thereby preventing communication between the interior of the tubing string 4 and the fluid ports 48 of the apparatus 6.

In order to present a clear understanding of the operation of the continuous groove means 54 and the spring-loaded dog 50, a diagrammatic view thereof is shown in FIG. 5. Referring specifically to FIG. 5, when the spring-loaded dog 50 is positioned in the horizontal groove 60 above the upper end of the vertical groove 58, the apparatus 6 is closed and locked in a closed position since the downwardly facing side of the dog 50 is engaged by the upwardly facing shoulder 66 located at the intersection of the groove 58 with the groove 60. When it is desired to unlock and open the apparatus 6, the conduit member 16 is rotated 180° causing the spring-loaded dog 50 to slide within the groove 60 to a position directly above the vertical groove 56. The conduit member 16 may then be moved upwardly with respect to the conduit member 10 causing the spring-loaded dog 50 to slide downwardly within the vertical groove 56 over the downwardly facing shoulder 64 thereof into the horizontal groove 62. Once the spring-loaded dog 50 slides into the groove 62, the apparatus 6 is locked in the open position since the downwardly facing shoulder 64 at the intersection of the groove 56 with the groove 62 engages the upwardly facing side of the dog 50 thereby preventing the dog 50 from sliding back into the vertical groove 56. When it is desired to unlock and again close the apparatus 6, the conduit member 16 is rotated in a clockwise direction thereby causing the spring-loaded dog 50 to slide within the horizontal groove 62 to a position directly beneath the vertical groove 58. The conduit member 16 is then moved downwardly with respect to the conduit member 10 causing the spring-loaded dog 50 to slide within the vertical groove 58 back into the horizontal groove 60.

Thus, tubing unloader apparatus is provided which may be alternately opened and closed and locked in either an opened or closed position through conventional manipulation of the tubing string. Further, the tubing unloader apparatus of the present invention may be operated while disposed in a well bore without the necessity of removing the tubing from the well bore before or after the operation thereof.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as those inherent therein. While presently preferred embodiments of the invention are given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts can be made which will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. Apparatus for unloading fluid from a string of tubing disposed substantially vertically in a well bore which comprises:

a first conduit member having one end thereof adapted to be connected in said tubing string and having a fluid port extending through a side thereof;

a second conduit member having one end telescopically mounted within the other end of said first conduit member and having the other end thereof adapted to be connected in said tubing string;

said first conduit member including an internal seating surface for sealingly engaging the end of said second conduit member mounted therein;

a spring-loaded dog attached to one of said conduit members facing a peripheral surface of the other of said conduit members; and the other of said conduit members including continuous groove means in the peripheral surface thereof for slidably engaging said spring-loaded dog, said continuous groove means being of a shape such that said conduit members may be alternatively moved with respect to each other and positively locked in positions whereby the interiors of said conduit members are communicated with said fluid port or said second conduit member is engaged by the seating surface of said first conduit member thereby preventing communication between the interiors of said conduit members and said fluid port.

2. The apparatus of claim 1 wherein said spring-loaded dog is attached to the inside peripheral surface of said first conduit member facing the outside peripheral surface of said second conduit member.

3. The apparatus of claim 2 wherein said continuous groove means comprises:

a first vertical groove positioned in a side of said second conduit member;

a second vertical groove positioned in the side of said second conduit member opposite from said first vertical groove;

a first horizontal semiannular groove positioned above and connecting the upper ends of said first and second vertical grooves;

a second horizontal semiannular groove positioned below and connecting the lower ends of said first and second vertical grooves; and

means disposed in the lower end of said first vertical groove for permitting said spring-loaded dog to slide therefrom into said second horizontal groove, but preventing the reverse movement thereof.

4. The apparatus of claim 3 wherein the means for permitting said spring-loaded dog to slide from said first vertical groove into said second horizontal groove but preventing the reverse movement thereof comprises;

each of said grooves being of generally rectangular shape in cross section;

said dog having a surface for slidably engaging the bottom surface of said grooves and having an upwardly facing horizontal shoulder at the upper end thereof;

the bottom surface of said first groove progressively increasing radially outwardly with respect to the axis of said second conduit member at the lower end thereof and terminating in a downwardly facing horizontal shoulder at the intersection of said first vertical groove with said second horizontal groove so that said dog will readily

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slide on the bottom surface of said first vertical groove into said second horizontal groove but will be prevented from reverse movement by engagement of the upwardly facing shoulder of said dog with said downwardly facing shoulder.

5. The apparatus of claim 4 which is further characterized to include means disposed in the upper end of said second vertical groove for permitting said spring-loaded dog to slide therefrom into said first horizontal groove, but preventing the reverse movement thereof.

6. The apparatus of claim 5 wherein the means for permitting said spring-loaded dog to slide from said second vertical groove into said first horizontal groove but preventing reverse movement thereof comprises:

each of said grooves being of generally rectangular shape in cross section;

said dog having a surface for slidably engaging the bottom surface of said grooves and having a downwardly facing horizontal shoulder at the lower end thereof;

the bottom surface of said second vertical groove progressively increasing radially outwardly with respect to the axis of second conduit member at the upper end thereof and terminating in an upwardly facing horizontal shoulder at the intersection of said second vertical groove

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so that said dog will readily slide on the bottom surface of said second vertical groove into said first horizontal groove but will be prevented from reverse movement by engagement of the downwardly facing shoulder of said dog with said upwardly facing shoulder.

7. The apparatus of claim 6 which is further characterized to include resilient sealing means disposed within said first conduit member sealingly engaging the outside periphery of said second conduit member and the inside periphery of said first conduit member when said conduit members are positioned with respect to each other so that communication between the interiors thereof and said fluid port is prevented.

8. The apparatus of claim 1 wherein said continuous groove means includes a pair of vertical grooves, a first horizontal groove extending between the upper ends of the vertical grooves and around a portion of its respective peripheral surface, and a second horizontal groove extending between the lower ends of the vertical grooves and around a portion of the respective peripheral surface opposite to the first horizontal groove.

9. The apparatus of claim 8 wherein the vertical grooves are positioned approximately 180° apart, around said peripheral surface.

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