

Aug. 26, 1958

M. B. CONRAD
CIRCULATION VALVE

2,849,025

Filed Nov. 21, 1955

2 Sheets-Sheet 1

Fig. 1.

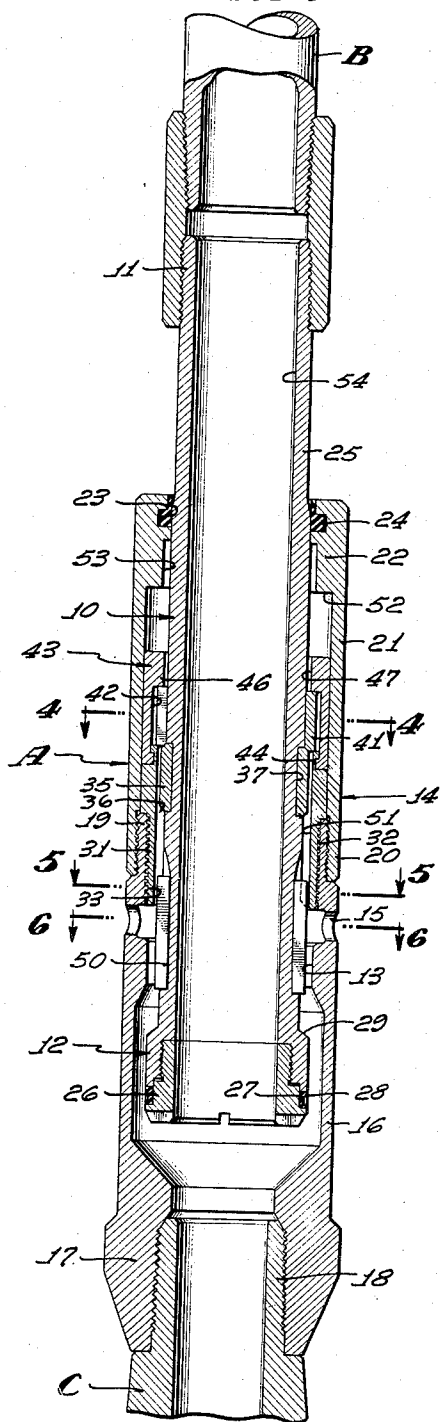


Fig. 2.

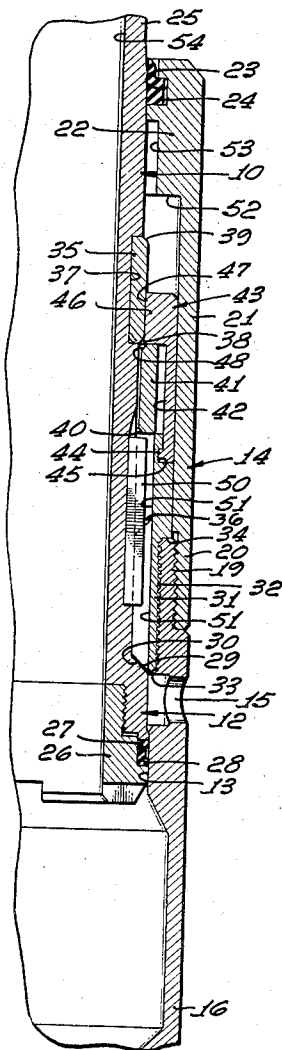
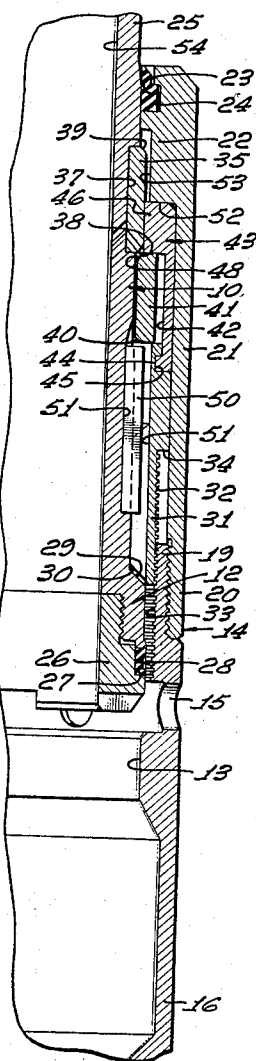


Fig. 3.



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Fig. 4.

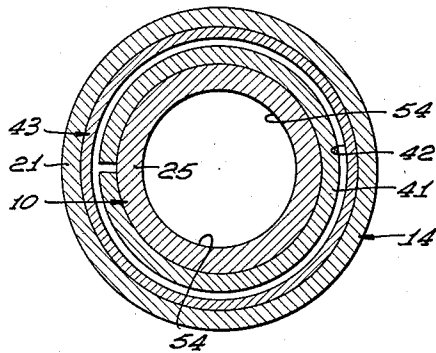


Fig. 7.

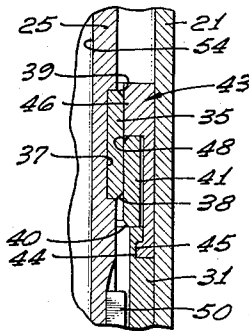


Fig. 8.

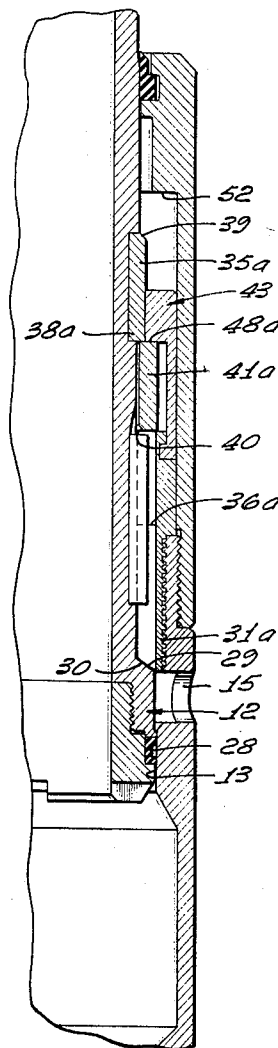


Fig. 5.

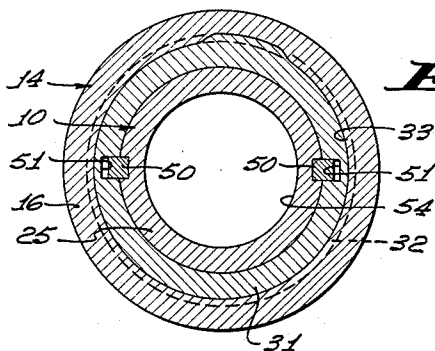
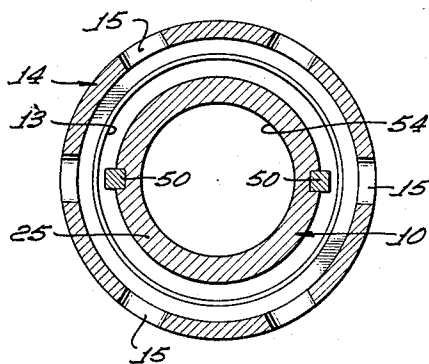


Fig. 6.



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CIRCULATION VALVE

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Application November 21, 1955, Serial No. 548,060

6 Claims. (Cl. 137—625.48)

The present invention relates to valve devices, and more particularly to valve devices operable between open and closed conditions while disposed in well bores.

An object of the invention is to provide a subsurface valve device which can be manipulated between open and closed conditions while in a well bore, and which gives the operator at the top of the well bore positive indication of the fact that the valve has been shifted to its open or its closed condition.

Another object of the invention is to provide a subsurface valve device capable of being run in a well bore by means of a running-in string and of being shifted between open and closed conditions by manipulating the running-in string, the valve device requiring a substantial force to effect its shifting between such conditions, to prevent its inadvertent operation. The force required to operate the valve device can be utilized to indicate positively to the operator at the top of the well bore that the valve device has been shifted to the desired operating condition.

A further object of the invention is to provide a valve device particularly useful in a tubular string disposed in a well bore, which can be shifted to an open condition without difficulty, despite the existence of a high pressure differential within the valve device tending to hold it in closed position. Although the pressure differential within the valve device is tending to keep it closed, such differential is still caused to assist in shifting the valve device to an open condition.

An additional object of the invention is to provide an improved valve device, particularly useful in a tubular string in the well bore, in which the valve device can possess a passage completely therethrough that has a minimum inside diameter at least equal to the inside diameter of the tubular string, thereby eliminating any restrictions to the movement of fluent materials or objects through the passage.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section through an apparatus embodying the invention, with the valve device in one open condition;

Fig. 2 is an enlarged fragmentary longitudinal section, disclosing the valve in closed condition;

Fig. 3 is an enlarged fragmentary longitudinal section, showing the valve in another open condition;

Fig. 4 is an enlarged cross-section taken along the line 4—4 in Fig. 1;

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Fig. 5 is an enlarged cross-section taken along the line 5—5 in Fig. 1;

Fig. 6 is an enlarged cross-section taken along the line 6—6 in Fig. 1;

Fig. 7 is a fragmentary longitudinal section through a portion of the apparatus disclosed in Figs. 1 to 6, inclusive;

Fig. 8 is a longitudinal section, similar to Fig. 2, of another embodiment of the invention.

The valve device A disclosed in the drawings is adapted to be secured to a tubular string B, such as a string of tubing or drill pipe extending to the top of a well bore, and also to the upper end of a lower tool C, such as a well packer which may be adapted to be set in a well casing against longitudinal movement therein in both directions. The valve device specifically illustrated is designed to control the passage of fluid between the interior of the tubular string and the exterior of the tubular string above the lower tool C.

The valve device A includes an inner tubular mandrel 10 having a threaded pin 11 at its upper end threadedly received in the lower end of the tubular string B that extends to the top of the well bore, and by means of which the valve device A and the apparatus C therebelow are movable through the well casing disposed in the well bore. The tubular mandrel 10 has an enlarged valve head 12 at its lower end adapted to be received within a companion cylindrical seat 13 in a housing 14 in which the mandrel is telescopically arranged, for the purpose of closing side ports 15 in the housing and preventing passage of fluid between the interior of the mandrel 10 and the exterior of the housing 14. When the valve head 12 is disposed in a lower position below the cylindrical seat 13, the ports 15 are open. Similarly, as described below, the location of the valve head 12 above the cylindrical seat 13 will also result in an opening of the side ports 15 in the housing.

The housing 14 specifically disclosed is made in two parts, its lower section 16 having a terminal threaded box 17 threadedly receiving the upper pin end 18 of the body or mandrel of the lower tool C, which can be a well packer adapted to be anchored in packed-off condition in the well casing against movement in both longitudinal directions. This particular well packer C may be of a known retrievable type, or it may be of the fixed type, such as disclosed in Patent No. 2,204,648. When the lower tool C is anchored to the well casing, it will prevent longitudinal movement of the valve housing 14, and will, therefore, permit relative longitudinal movement of the mandrel 10 in both directions within the valve housing.

The upper portion 19 of the lower housing section has an external thread making threaded connection with a lower threaded box 20 provided on an upper housing section 21. The upper end of this upper housing section has an inwardly directed flange 22 adapted to slide along the periphery of the mandrel 10. The flange 22 may have an internal groove 23 therein to receive a rubber or rubber-like wiper ring 24 adapted to slidably seal against the exterior of the mandrel and to prevent downward passage of foreign substances into the housing 14, which might resist proper operation of the valve device.

The mandrel 10 is also made of two sections, including an upper section 25 having the threaded pin previously described, this upper section being threadedly secured onto the upper end of a relatively short lower section 26. The upper and lower sections define a peripheral groove 27 therebetween, in which a seal ring 28 can be disposed for sealing engagement with the cylindrical valve seat 13, thereby insuring against leakage of fluid between the valve head 12 and the valve seat 13 when the head 12 and the ring 28 are disposed within the latter.

The valve head 12 and its seal ring 28 are appropriately located within the cylindrical valve seat 13, to close the

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ports 15 when the mandrel 10 is disposed in an upper position within the housing 14, by a stop shoulder 29 on the mandrel engaging a companion stop shoulder 30 on the lower end of a release member 31. This release member has a left-hand external thread 32 meshing with a companion internal thread 33 formed in the upper portion of the lower housing section 16. Normally, the release member 31 is disposed in a downward position threaded fully within the lower housing section 16, determined by engagement of its shoulder 34 with the upper end of the lower housing section 16.

The downward positioning of the mandrel 10 within the housing 14, with its valve head 12 and seal ring 28 disposed completely out of the cylindrical valve seat 13 is positively determined by engagement of a ring 35 secured in the mandrel with an upwardly facing shoulder 36 provided on the release member 31. It is apparent that the lower housing section 16 below the cylindrical seat 13 has a much greater internal diameter than the internal diameter of the cylindrical valve seat, to permit free passage of fluid between the ports 15 and the mandrel 10 and housing 14, when the valve device is in open condition.

The lock or holding ring, or sleeve 35, is split to permit it to be assembled within an external groove 37 provided in the mandrel 10, the length of the ring 35 being substantially equal to the length of the groove, so that the ring and mandrel move together in both longitudinal directions. The lower end of the ring 35 may be provided with a tapered cam surface 38, which is inclined in an inward and downward direction, the stop shoulder 36 on the release member engaging this surface also preferably being inclined in the same direction to provide surface engagement between the parts. The upper end of the lock or holding ring 35 is also provided with a tapered cam surface 39 inclined in an upward and inward direction, and this surface engages a companion tapered surface 40 formed on the lower end of a split, inherently contractile control ring or sleeve 41, disposed within an internal groove 42 formed between a retainer ring 43 and the upper end of the release member 31.

The retainer ring 43 is made in two halves, to permit its assembly in coupling relation to the upper portion of the release member 31. Thus, the retainer ring has a lower inwardly directed flange 44 received within a companion external groove 45 in the release member 31. The upper end of the retainer ring is also provided with an inwardly directed flange 46, the inner surface 47 of which is spaced from the periphery of the mandrel 10. Actually, as described hereinbelow, the lock or holding ring 35 is movable within and through the upper flange 46. Accordingly, the inside diameter of the upper flange 46 is preferably slightly greater than the outside diameter of the lock or holding ring 35. The retainer ring 43 has an outside diameter substantially equal to the inside diameter of the upper housing section 21, to insure the provision of the annular space between its upper flange 46 in the mandrel 10 into and through which the holding ring 35 can pass. The inside diameter of the retainer ring 43 between its flanges 44, 46 is substantially greater than the external diameter of the split control ring or sleeve 41 when the latter is in engagement with the mandrel 10, to permit outward expansion of this control ring 41 to the extent necessary for the passage of the holding ring 35 upwardly therethrough.

The upper end of the control ring 41 may have an upper tapered or cam surface 48, which is inclined in a downward and inward direction for cooperation with the lower cam surface 38 on the holding ring 35, in the manner described hereinbelow. The length of the control ring 41 is slightly less than the length of the groove 42 between the upper retainer flange 43 and the upper end of the release member 31, so that the control ring

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can only move laterally within the groove 42, and not partake of any longitudinal movement therewithin.

Actually, the split control ring or sleeve 41 constitutes a releasable latch, which engages the holding ring 35 to releasably secure the mandrel 10 in a downward position within the housing 14, in which the ports 15 are open, or to releasably secure the mandrel in an upward position within the housing, in which the valve head 12 and seal ring 28 are disposed within the cylindrical valve seat 13, the ports 15 being closed. To shift the valve from an open to a closed condition, it is necessary to exert a substantial upward force on the mandrel 10 sufficient to cause the upper cam surface 39 on the holding ring 35 to expand the split ring 41 within its groove 42 to an increased diameter, allowing the holding ring to move through the control ring to a position thereabove, as depicted in Fig. 7. The extent of upward movement of the mandrel 10 is determined by engagement of the mandrel stop shoulder 29 with the companion stop shoulder 30 on the lower end of the release member 31. When these shoulders engage, the valve head 12 and the seal ring 28 are appropriately disposed within the cylindrical valve seat 13 to close the ports 15, at which time the lock or holding ring 35 is disposed above the control ring 41 (Fig. 2).

If it is desired to reshift the valve to an open condition, the mandrel 10 is moved downwardly relative to the housing 14. The lower cam surface 38 on the holding ring engages the companion tapered surface 48 on the upper end of the control ring 41 to expand the latter outwardly, the holding ring 35 then being movable through the control ring 41 to its lowermost position in engagement with the shoulder 36 on the release member, which will definitely locate the valve head 12 substantially below the cylindrical valve seat 13, or in a port opening position (Fig. 1).

Assuming the valve to be in a closed position, wherein the holding ring 35 is latched above the control ring 41 (Fig. 2), and difficulties are encountered in again lowering the mandrel 10 within the housing 14 to a port opening position, provision is made for allowing the mandrel 10 to continue its upward movement within the housing, to dispose its valve head 12 substantially above the cylindrical valve seat 13, which will again effect an opening of the ports 15. To accomplish this purpose, the mandrel 10 is provided with longitudinally extending keys 50 suitably secured thereto, extending outwardly from the mandrel and being received within internal longitudinal keyways 51 provided through the release member 31. The keys 50 at all times are at least partially disposed within the keyways 51 of the release member 31. Thus, when the mandrel 10 is in its lowermost position within the housing 14, the upper portion of each key 50 is disposed in a keyway 51, and when the mandrel is in its upper valve closing position with respect to the housing, the lower portion of the key 50 is disposed in the upper portion of the keyway 51.

Assuming the mandrel 10 to be in its upper position within the housing 14, with its head 12 and seal ring 28 disposed within the cylindrical seat 13, and its stop shoulder 29 engaging the stop shoulder 30 on the release member 31, and it is desired to elevate the valve head and seal ring above the cylindrical valve seat, the tubular string B need merely be rotated to the right, which will effect the rotation of the mandrel 10 in that same direction, such rotation being transmitted through the keys 50 to the release member 31. In view of the left-hand threaded connection 32, 33 between the release member and the housing 14, the right-hand rotation of the release member will cause its upward unthreading within the housing. As the release member unscrews from the housing, its lower stop shoulder 30 is also elevated within the housing, which permits the mandrel 10 to move upwardly within the housing. The release member 31 can thread in an upward direction within the housing 14 to the ex-

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tent limited by engagement of the retainer ring 43 with the lower shoulder 52 provided by the inwardly directed flange 22 of the upper housing section. When such engagement occurs, the mandrel head 12 will have been elevated substantially above the cylindrical valve seat 13, assuming that the stop shoulders 29, 30 remain co-engaged, which will effect an opening of the housing ports 13 and establish communication between the interior and the exterior of the valve device. Sufficient upward movement of the release member 31 and the retaining ring 43 is insured without restraint from the holding ring 35, since the latter is capable of moving upwardly into a counterbore 53 provided in the upper housing flange 22. As a matter of fact, the upward unthreading action of the release member 31 within the housing 14 could be limited by the engagement of the holding ring 35 with the upper end of the counterbore 53, rather than by engagement of the retaining ring 43 with the lower flange shoulder 52.

In the use of the valve device A, its lower end is connected to the body or mandrel of the lower tool C and the upper end of its mandrel 10 is threadedly secured to the lower end of the tubular string B extending to the top of the well bore. The combination of apparatus is lowered in the well casing (not shown) to the desired location, preferably with the control valve in the open position disclosed in Fig. 1, in which the valve head 12 and seal ring 28 are disposed substantially below the cylindrical valve seat 13, the holding ring 35 being located below the control or latch ring 41, which will insure the retention of the mandrel 10 in its telescoped position within the housing 14, and the valve in open condition. During the lowering of the apparatus through the fluid in the well casing, such fluid can pass around the exterior of the apparatus as well as into the passage 54 in the housing and the mandrel into the tubing string B thereabove. If there are any restrictions to flow around the tool C secured to the lower end of the valve apparatus A, the fluid can flow through the body of the tool C and out through the ports 15 into the annulus between the tubing string B and the well casing.

When the location in the well casing is reached where the apparatus is to be operated, the lower tool may be set in the well casing in any known manner, as by taking an upward pull on the tubing string B. A very substantial upward force is required to expand the control ring 41, so that such upward pull is transmitted from the mandrel 10 through the holding ring 35 to the control ring 41, and from the latter to the retainer 43, which is connected to the release member 31 secured to the housing 14. From the housing 14 the upward pull is exerted on the body of the lower tool C. Such upward movement will cause the slips or gripping members (not shown) of the lower tool to engage the casing, offering substantial resistance to upward movement of the body of the lower tool C and, of course, resisting upward movement of the valve housing 14 connected thereto.

When a substantial upward force is now taken on the tubing string B and mandrel 10, the control ring 41 is expanded by the lock or holding ring 35, permitting the mandrel 10 to move upwardly within the housing 14 (Fig. 7) until its stop shoulders 29 engage the stop shoulder 30 at the lower end of the release member 31, wherein the valve head 12 and seal ring 28 are disposed within the cylindrical valve seat 13, to close the ports 15 (Fig. 2). The pull necessary to cause the lower ring 35 to expand the split control ring 41, and allow the lower ring 35 to move to a position above the control ring, may be of the order of about ten thousand pounds. In taking such upward pull, the operator is provided with a definite indication at the top of the well bore that the pull is being exerted. Upon expanding of the control ring 41 to a sufficient extent to permit the lock ring 35 to move therethrough, the operator secures another indication, inasmuch as the stop shoulder 29 of the mandrel engages

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the stop shoulder 30 at the lower end of the release member 31 with a hammer-like blow or jar, that can actually be felt by the operator at the top of the well bore. Accordingly, the operator has a positive indication that the control valve is in closed position.

The lower tool C can now be fully set, if it has not been previously fully set, as by the taking of a sufficient upward strain on the tubing string B, which will be transmitted through the mandrel 10 to the housing 14 through the stop shoulders 29, 30, and from the housing to the body or mandrel of the tool C. Fluent substances can now be pumped down the tubing string B, flowing through the mandrel 10 and into the body of the tool C therebelow. It will be noted that there are no restrictions in the mandrel 10 to downward passage of fluent substances, inasmuch as the mandrel and the lower portion of the housing 14 itself have an inside diameter that is at least equal to the inside diameter of the tubular string B, to which the mandrel is connected.

In the event it is desired to reopen the valve, it is only necessary to exert a sufficient downward force on the tubular string B and mandrel 10, since the lower tool is anchored to the casing against downward movement, so that the imposition of a sufficient force (5,000 lbs. to 10,000 lbs.) on the mandrel will cause the holding ring 35 to again expand the control sleeve 41 outwardly, permitting the holding ring to move through the control ring to a position therebelow, accompanied by the mandrel 10, until the lower end of the holding ring again engages the internal shoulder 36 of the release member 31 (Fig. 1). The valve head 12 and seal ring 28 will then be disposed substantially below the cylindrical valve seat 13. Here again, the operator is given a positive indication at the top of the well bore that the valve is in open position by the downward force that must be exerted and by the hammer-like or jarring blow that can be felt through the tubular string B when the holding ring 35 engages the release member shoulder 36.

Accordingly, it is evident that the valve can be shifted between open and closed positions by the taking of a sufficient upward pull on the mandrel 10, or by the imposition of a sufficient downward force thereon, as the case may be. Since a substantial force is required in releasing the control ring 41 from the holding ring 35, inadvertent shifting of the mandrel relative to the housing is precluded. The operator is given a definite indication that the valve has been shifted to its open or closed position.

Assuming the valve to be in the closed position illustrated in Fig. 2, and assuming that there is a high pressure differential within the valve device A, difficulty might be encountered in lowering the mandrel 10 within the housing 14 to a port opening position, inasmuch as the pressure within the apparatus is acting in an upward direction on the lower end of the mandrel 10, and in a downward direction on the housing 14, tending to maintain the valve in a closed position. Should this condition obtain, the valve is easily shifted to the open position merely by rotating the tubing string B and the mandrel 10, this rotation being transmitted through the keys 50 to the release ring 31, causing the latter to thread upwardly within the housing 14, and allowing the mandrel 10 to be shifted upwardly to the position in which its valve head 12 and seal ring 28 are disposed substantially above the cylindrical valve seat 13, as disclosed in Fig. 3, in which position the ports 15 are again open. It is to be noted that during such upward threading of the release member 31 and upward movement of the mandrel 10, the pressure differential within the valve apparatus is actually acting on the lower end of the mandrel 10 and is assisting in its upward movement to a position above the cylindrical valve seat 13, in which the ports 15 are open.

The unthreading action can only occur until either the retainer ring 43 engages the lower flange shoulder 52, or the holding ring 35 engages the upper end of the

flange at the housing counterbore 53, depending upon the specific design of the equipment.

After the release member 31 has been threaded in the upward direction to place the valve head 12 and seal ring 28 substantially above the cylindrical valve seat 13, the valve will remain in its open position during upward movement of the apparatus in the well casing. If desired, the valve could be reclosed, since it is only necessary to exert sufficient downward force on the tubular string B and mandrel 10 to cause the holding ring 35 to expand the control ring 41 outwardly and shift to a position therebelow, the valve head 12 and seal ring 28 again being movable within the cylindrical valve seat 13 to close the ports 15.

In the form of invention disclosed in Fig. 8, a valve device is intended to be run in the open condition shown into the well casing, and can only be closed a single time before it is necessary to come out of the hole. Thus, the lock or holding ring 35a is only provided with an upper cam surface 39 coaxing with a companion tapered surface 40 on the lower end of the control ring or sleeve 41a, the upper surface 48a of this control ring or sleeve being substantially at right angles to the axis of the apparatus; that is to say, the upper tapered surface 48 is not present. The lower end 38a of the holding ring 35a is also at substantially right angles to the axis of the apparatus, being engageable with a companion straight shoulder 36a on the release member 31a.

The apparatus is lowered in the well casing in an open position corresponding to Fig. 1. When it is desired to close the valve, a sufficient upward force is exerted on the tubular string B and mandrel 10 to cause the upper cam surface 39 on the holding ring 35a to expand the control ring 41a, allowing upward movement of the mandrel 10 within the housing 14, until the mandrel stop shoulder 29 engages the release member stop shoulder 30, which definitely locates the valve head 12 and its seal ring 28 appropriately within the cylindrical valve seat 13 (Fig. 8). With the parts in this position, the ports 15 are closed. If it is now desired to open the ports, the mandrel 10 cannot be shifted downwardly within the housing, since the lower end 38a of the holding ring 35a will engage the upper end 48a of the control ring 41a, which then provides a positive stop against downward movement of the mandrel 10 within the housing 14. Accordingly, the only manner in which the ports 15 can be opened is to rotate the tubular string B and mandrel 10 to the right to effect an upward unthreading of the release member 31a within the housing 14, which will elevate the release member stop shoulder 30 and allow the mandrel 10 to move upwardly to the extent in which its head 12 and seal ring 28 are again disposed substantially above the cylindrical valve seat 13, in which position the ports 15 are open. As in the other form of the invention, the upward unthreading is limited by engagement of the retainer ring 43 with the upper flange shoulder 52, or of the holding ring 35a, with the flange 22 at the upper end of the counterbore 53. The tubular string B, valve device A and apparatus C connected therebelow can now be elevated in the well casing to the top of the hole.

The inventor claims:

1. In valve apparatus: inner and outer members telescopically related to each other and movable longitudinally and without rotation with respect to each other, one of said members being adapted for connection to a tubular string for lowering the apparatus in a well bore; a valve seat on one of said members; a valve head on the other of said members adapted to engage said seat when said members are in a first telescoped relation and to be disengaged from said seat when said members are in a second telescoped relation, with said head disposed on one side of said seat; releasable latch means on said members for releasably holding said members in one of said telescoped relations; stop means on said members for

positively locating said members in said first telescoped relation; and means for shifting said stop means to a position permitting said members to be disposed in a third telescoped relation with said head disposed on the other side of said seat.

2. In valve apparatus: inner and outer tubular members telescopically related to each other and movable longitudinally and without rotation with respect to each other, one of said members being adapted for connection to a tubular string for lowering the apparatus in a well bore; a valve seat on one of said members; a valve head on the other of said members adapted to engage said seat when said members are in a first telescoped relation and to be disengaged from said seat when said members are in a second telescoped relation with said head disposed to one side of said seat; releasable latch means on said members for releasably holding said members in one of said telescoped relations; stop means on said members for positively locating said members in said first telescoped relation; and means responsive to relative rotation between said members for shifting said stop means to a position permitting said members to be disposed in a third telescopic relation with the head disposed on the other side of said seat.

3. In valve apparatus: inner and outer tubular members telescopically related to each other and movable longitudinally and without rotation with respect to each other, one of said members being adapted for connection to a tubular string for lowering the apparatus in a well bore; a valve seat on one of said members; a valve head on the other of said members adapted to engage said seat when said members are in a first telescoped relation and to be disengaged from said seat when said members are in a second telescoped relation with said head disposed to one side of said seat; releasable latch means on said members for releasably holding said members in one of said telescoped relations; a stop member threadedly secured to one of said members and engaged by said other member for positively locating said members in said first telescoped relation; and means responsive to rotation of said other member with respect to said one member for threading said stop member along said one member to a position permitting said members to be disposed in a third telescopic relation with said head located on the other side of said seat.

4. In valve apparatus: a housing; a mandrel connectible to a tubular string for lowering the apparatus in a well bore and telescoped within said housing; said mandrel being movable longitudinally and without rotation with respect to said housing; a valve seat on said housing; a valve head on said mandrel adapted to engage said seat when said mandrel occupies a first telescoped position within said housing and to be disengaged from said seat when said mandrel occupies a second telescoped position within said housing with said head disposed on one side of said seat; a laterally movable latch carried by said housing; means on said mandrel engaging said latch to locate said mandrel in one of said telescoped positions, said means being adapted to shift said latch outwardly to a position disengaged from said means in response to a predetermined longitudinal force imposed on said means by said mandrel; stop means on said housing and mandrel for positively locating said mandrel in said first telescoped position within said housing; and means for shifting said stop means to a position permitting said housing and mandrel to be disposed in a third telescopic relation with said head disposed on the other side of said seat.

5. In valve apparatus: a housing; a tubular mandrel connectible to a tubular string for lowering the apparatus in a well bore and telescoped within said housing; said mandrel being movable longitudinally and without rotation with respect to said housing; a valve seat on said housing; a valve head on said mandrel adapted to engage said seat when said mandrel occupies a first telescoped

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position within said housing and to be disengaged from said seat when said mandrel occupies a second telescoped position within said housing with said head disposed on one side of said seat; a laterally movable latch carried by said housing; means on said mandrel engaging said latch to locate said mandrel in one of said telescoped positions, said means being adapted to shift said latch outwardly to a position disengaged from said means in response to a predetermined longitudinal force imposed on said means by said mandrel; a stop member threadedly secured to said housing and engaged by said other member for positively locating said mandrel in said first telescoped position within said housing; and means responsive to rotation of said mandrel within said housing for threading said stop member along said housing to a position permitting said mandrel to be disposed in a third telescopic position within said housing with said head disposed on the other side of said seat.

6. In valve apparatus: a housing; a mandrel connectible to a tubular string for lowering the apparatus in a well bore and telescoped within said housing; said mandrel being movable longitudinally and without rotation with respect to said housing; a valve seat on said housing; a valve head on said mandrel adapted to engage said seat when said mandrel occupies an upper position within said housing and to be disengaged from said seat when said mandrel occupies a lower position in said hous-

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ing; an inherently contractile latch ring carried by said housing; means on said mandrel engaging said ring to releasably hold said mandrel in said lower position; said means having first cam instrumentalities engaging said ring to expand said ring outwardly from engagement with said means to permit movement of said mandrel to said upper position; said means having second cam instrumentalities engaging said ring to expand said ring outwardly from engagement with said means to permit movement of said mandrel to said lower position; a stop member threadedly secured to said housing and engaged by said mandrel for positively locating said mandrel in said upper position within said housing; and means responsive to rotation of said mandrel within said housing for threading said stop member upwardly along said housing to a position permitting said mandrel to be moved within said housing and locate said head above said seat.

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