April 11, 1939. M. A. NEWTON 2,153,812

REMOVABLE FLOAT VALVE

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Fig. 1.

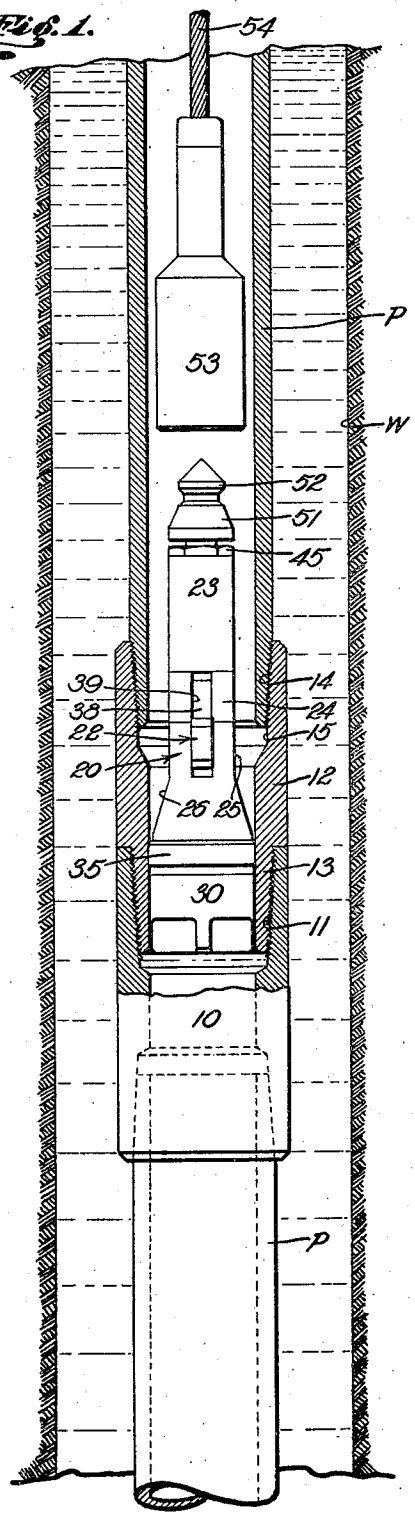
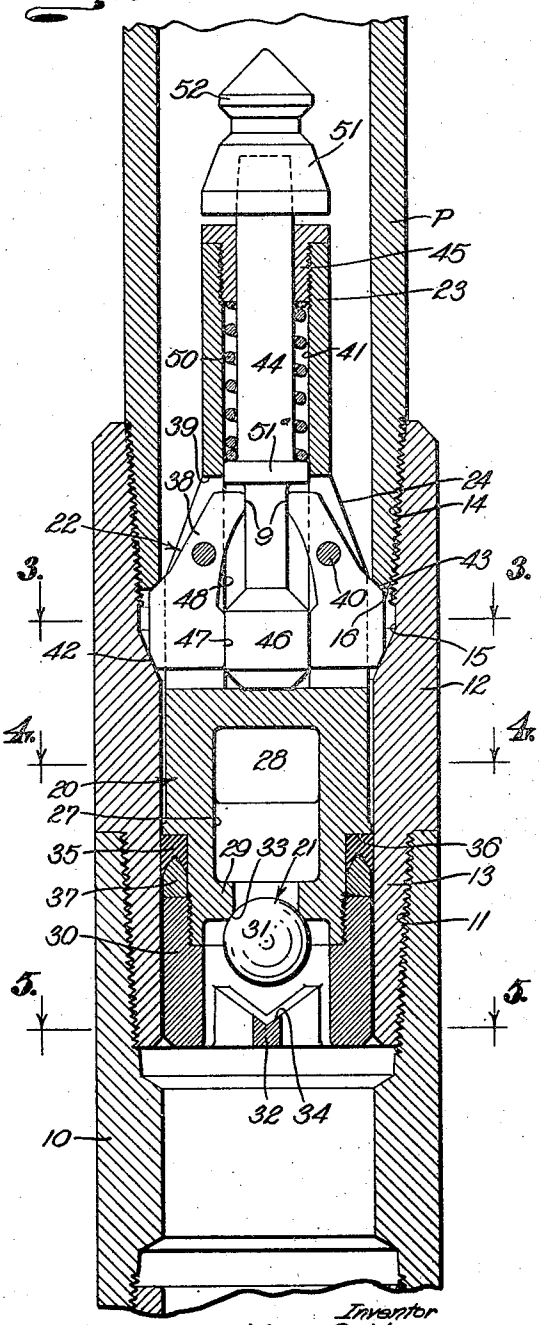


Fig. 2.



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Fig. 3.

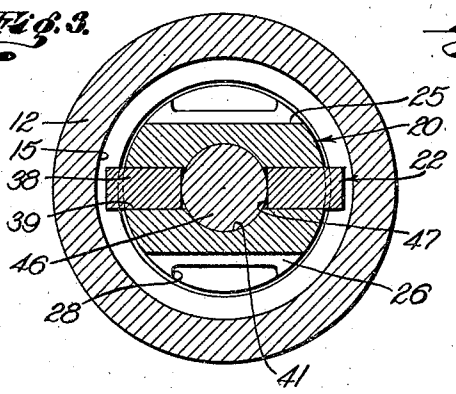


Fig. 4.

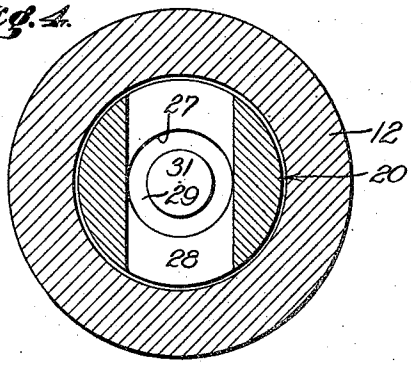


Fig. 5.

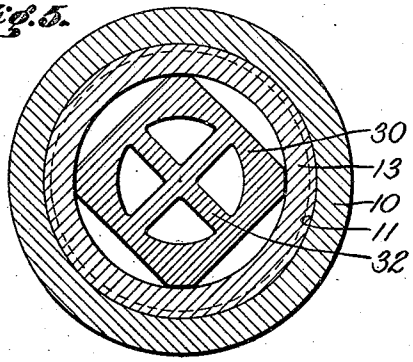


Fig. 6.

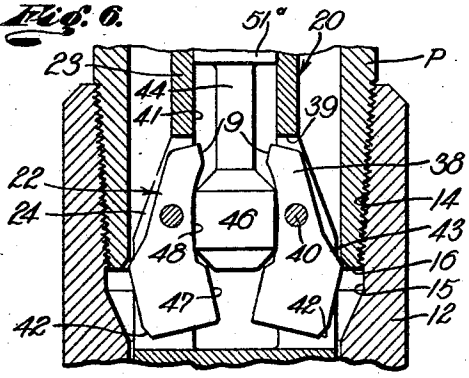
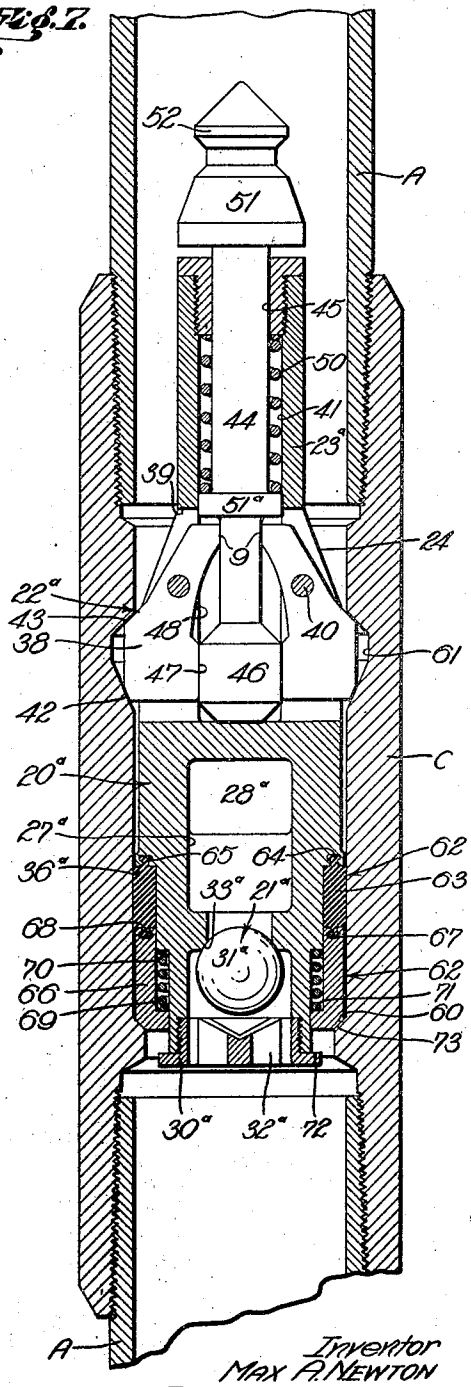


Fig. 7.



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UNITED STATES PATENT OFFICE

2,153,812

REMOVABLE FLOAT VALVE

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Application May 14, 1937, Serial No. 142,610

4 Claims. (Cl. 255—23)

This invention relates to well drilling equipment and relates more particularly to float valves for use in well drill pipe, well casing, etc. A general object of this invention is to provide a practical and effective float valve that may be easily removed from the string of pipe or casing after said string has been lowered into the well.

In the drilling of deep wells it is sometimes necessary to float the drill pipe or the casing into the well to prevent it from parting through its own weight. In lowering a long string of drill pipe into a well a device known as a float valve is sometimes provided in the string to prevent the fluid in the well from flowing upwardly in the pipe so that the fluid in the well buoys up the hollow pipe. The float valves that have been employed for this purpose have been such that they could not be withdrawn from the pipe or embodied parts that could not be withdrawn from the pipe after the string was lowered in the well. A float valve or the parts of a float valve thus left in a string of pipe interfered with the flow of the circulation fluid through the pipe and interfered with or prevented the passage of wire line core barrels and like tools through the string. For these reasons the typical float valves have not proven practical or successful in many instances.

Another object of this invention is to provide a float valve that may be easily removed from the drill pipe or well casing in its entirety when the pipe or casing is in the well to leave the pipe or casing entirely free and unobstructed.

Another object of this invention is to provide a removable float valve that is adapted for use in what is known as a "full hole drill pipe".

Another object of this invention is to provide a removable float valve that is adapted to be arranged in a tool joint of a string of drill pipe without alteration or modification of the joint or pipe.

Another object is to provide a float valve of the character mentioned that may be easily assembled in the operative position in a string of drill pipe or the like when the string is being made up as it is run in the well.

Another object of this invention is to provide a removable float valve that embodies a packing means for sealing with the interior of the drill pipe or casing that is automatically released when the valve is withdrawn from the pipe or casing.

A further object of this invention is to provide an improved float valve of the character mentioned that is simple and inexpensive to manufacture and that is easy and convenient to employ.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of a portion of a well containing liquid, showing one form of float valve of the present invention in a string of drill pipe within the well and showing a fishing tool about to engage the float valve. Fig. 2 is an enlarged longitudinal detailed sectional view of the float valve illustrated in Fig. 1 showing it in its operative position in a tool joint of the drill pipe. Figs. 3, 4 and 5 are transverse detailed sectional views taken as indicated by lines 3—3, 4—4 and 5—5, respectively, on Fig. 2. Fig. 6 is a fragmentary longitudinal detailed sectional view of the float valve illustrated in the preceding figures showing the latch dogs in the released positions and Fig. 7 is a longitudinal detailed sectional view of another form of the invention illustrating it in position in a coupling of a string of casing.

The present invention is adapted to be embodied in valve for use in drill pipe, well casing, or any other tubular elements that may be lowered into deep wells. In the following detailed description I will describe a typical form of the invention for use in well drill pipe and a typical embodiment of the invention for use in well casing, it being understood that the invention is not to be construed as limited or restricted to the specific forms and applications about to be described.

In Fig. 1 of the drawings I have illustrated a portion of a typical string of drill pipe of the type known as full hole drill pipe. The portion of the string illustrated in Fig. 1 includes two lengths of drill pipe P connected by a tool joint. The tool joint includes a box section 10 threaded on the upper end of the lower length of pipe P. The box section 10 has an upwardly facing threaded socket 11. The tool joint further includes a pin section 12 having a pin 13 threaded into the socket 11. A socket 14 is provided in the upper end of the pin section 12 and receives the threaded lower portion of the upper length of pipe P. It will be observed that there is an annular recess 15 in the pin section 12 at the lower end 16 of the upper length of pipe P. The recess 15 is the lower portion of the socket 14 where its thread dies out and the upper wall of the recess 15 is the lower end 16 of the upper length of pipe P. The wall or surface defining

the lower end of the recess is at a lesser angle to the vertical than the upper wall portion of the recess and in accordance with the usual practice the lower end 16 of the upper length of pipe P is partially chamfered or beveled off. It is to be understood that the structure described above is typical of the full hole type of drilling strings.

The float valve of the present invention illustrated in Figs. 1 to 6, inclusive, of the drawings, includes, generally, a body 20 adapted to be inserted or arranged in the drilling string, valve means 21 carried by the body 20 to prevent an upflow of fluid through the drilling string, and releasable means 22 for holding the body 20 in the drilling string.

The body 20 is an elongate member or structure proportioned to be movable longitudinally through the drilling string with suitable clearance. The upper portion 23 of the body 20 is reduced in diameter and is joined or connected with the lower portion of the body by a tapered or downwardly flaring part 24. In the preferred construction the body 20 has two diametrically opposite flat vertical faces 25, resulting from cuts made through the tapered part 24, and inclined faces 26 extending from the lower ends of the faces 25 to the periphery of the body proper. The body 20 is ported for the passage of fluid. A longitudinal passage 27 enters the body 20 from its lower end. Lateral ports 28 extend outwardly from the upper portion of the passage 27 to the inclined faces 26. The above described faces 25 and 26 provide or leave ample fluid conducting space at the exterior of the body for the fluid that flows through the ports 28. An annular inwardly projecting ridge 29 is provided on the wall of the fluid passage adjacent its lower end.

The valve means 21 is preferably located at the lower end of the body 20 and includes a cage 30 and a ball 31 in the cage. The cage 30 may be a tubular nut-like part and may be threaded on the lower end of the body 20 to have its exterior substantially flush with the exterior of the body. The interior of the cage 30 forms a continuation of the body passage 27. A perforated web 32 extends across the lower end of the cage 30 to prevent the loss of the ball 31 from the cage. The ball 31 within the cage 30 is adapted to seal upwardly against a suitably shaped seat 33 on the ridge 29. The web 32 has a central depression 34 for holding the ball 31 when it is in its open position. When the string of drill pipe is run into the well W the fluid in the well tends to flow into or upwardly through the string and raises the ball 31 against the seat 33. The ball 31 seating upwardly against the seat 33 is adapted to prevent the upward entrance of fluid into the string above the float valve and is retained in cooperation with the seat by the hydrostatic pressure in the well.

It is preferred to provide packing means on the valve body 20 for sealing with the interior of the drilling string. As will be subsequently described the body 20 extends through the pin section 12 of the tool joint when the valve is in position in the drilling string and the packing means may seal against the interior of the pin section. In the form of the invention illustrated in Figs. 1 to 6, inclusive, of the drawings the packing means includes a ring 35 of packing material surrounding the body 20 and engaging upwardly against an annular downwardly facing shoulder 36 of the body. An expanding gland or follower 37 surrounds the body 20 and cooperates with the lower end of the packing ring 35. The follower 36 has its upper end shaped to cause inward and outward distortion of the packing ring 35 when it is forced upwardly against the packing ring. In practice the lower end of the packing ring 35 may be shaped to conform generally to the upper end of the follower 37. The upper end of the valve cage 30 engages against the lower end of the follower 37 and when the cage is threaded onto the body 20 it forces the follower 37 upwardly against the packing ring 35 to distort or actuate the packing ring. The packing ring 35 expanded or distorted in this manner is operable to effectively seal between the body and the interior of the tool joint section 12 to prevent the leakage of fluid upwardly around the body.

The means 22 is an important feature of the invention. It is an outstanding feature of the invention that the means 22 is releasable to permit the float valve to be withdrawn from the string of drill pipe when the string is in the well. The means 22 is in the nature of a latch means including latches or dogs 38. The dogs 38 are pivotally supported in longitudinal slots 39 in the body 20. In practice the dogs 38 may be supported in two diametrically opposite slots 39. Substantially horizontal pivot pins 40 may pivotally support the dogs 38. The dogs 38 are pivotally supported between their ends to have upper and lower arms as clearly illustrated in Figs. 2 and 6. A longitudinal opening 41 extends through the reduced upper portion 23 of the body 20 and communicates with the slots 39. In accordance with the invention the lower arms or parts of the dogs 38 are adapted to project outwardly into the recess 15 to lock or secure the body 20 in the drilling string. The lower outer corners of the dogs 38 are in the nature of inclined faces 42 adapted to engage against the inclined wall of the recess 15. Each dog 38 has an upwardly and outwardly facing shoulder 43 adapted to cooperate with the above described bevelled lower end 16 of the upper length of pipe P.

A retractable means is provided to hold the dogs 38 in positions where their faces 42 cooperate with the wall of the recess 15 and their shoulders 43 cooperate with the lower end 16 of the pipe P. This means includes a stem or mandrel 44 extending longitudinally through the opening 41. The mandrel 44 is guided for vertical movement by a bearing nut 45 threaded in the upper end of the opening 41. The mandrel 44 passes downwardly between the two dogs 38 and has an enlargement 46 on its lower end. The enlargement 46 of the mandrel may be cylindrical and its upper and lower ends may be conical or bevelled. Each dog 38 has a straight inner edge 47 and a curved inner edge 48 extending upwardly from the edge 47. The mandrel enlargement 46 is adapted to cooperate with the straight edges 47 to hold the dogs 38 in active positions where their faces 42 engage the lower wall of the recess 15 and their shoulders 43 cooperate with the lower end 16 of the upper length of pipe P. When the mandrel 44 is in the position illustrated in Fig. 2 with its enlargement 46 in cooperation with the edges 47 its lower end may bear on the lower wall of the opening 41. The dogs 38 may have edges or faces 9 above their pivotal axes for engaging inwardly against the mandrel 44 to limit the outward swinging of the lower arms of the dogs. Means is provided for yieldingly holding the mandrel 44 in its lowermost position to maintain the dogs 38 in their active positions. This means may comprise a

spring 50 arranged in the opening 41 and surrounding the mandrel 44. The spring 50 may be arranged under compression between the lower end of the bearing nut 45 and a flange 51a on the mandrel 44 to urge the mandrel downwardly.

In accordance with the invention the latch means 22 described above is adapted to be released by a grappling tool or fishing tool run into the string of drill pipe. The mandrel 44 projects upwardly beyond the nut 45 and its projecting upper end carries a head 51. The head 51 is provided with an annular flange 52 adapted to be gripped by a suitable fishing tool such as a socket or overshot passed downwardly over the head 51. In Fig. 1 of the drawings I have illustrated a socket or similar fishing tool 53 about to pass downwardly over the head 51 to obtain a hold on the flange 52. The tool 53 is suspended on a rope or cable 54 by means of which it is lowered downwardly through the string of drill pipe. When the tool 53 has obtained a grip on the flange 52 the cable 54 may be pulled upwardly to release the means 22 and to withdraw the float valve from the drill pipe. As will be subsequently described this upward force exerted on the mandrel 44 through the medium of the tool 53 and the flange 52 retracts the dogs 38 from the recess 15 freeing the float valve for removal from the string of drill pipe.

When the drilling string is made up as it is being run into the well W a float valve of the character described above, or a plurality of such valves, may be installed in it. Where more than one float valve is to be used it is preferred to space the valves vertically of the drilling string. In the case of the float valve illustrated in the drawings the entire valve may be easily arranged in the tool joint section 12 so that the dogs 38 cooperate with the recess 15, as illustrated in Fig. 2 of the drawings. The valve is preferably arranged in the tool joint section 12 at the surface of the ground before the section 12 is connected with the box section 10. The stand of pipe carrying the float valve is connected in the drilling string in the usual manner and the string is run into the well.

As the string moves downwardly in the well W the fluid or liquid present in the well of course tends to flow upwardly into the pipe from its lower end. The ball 31 is moved upwardly by this entering fluid and seals against the seat 33. The ball 31 cooperating with the seat 33 prevents further upward passage of fluid into the drilling string and is held in tight cooperation with the seat by the hydrostatic pressures in the well. Thus the device or float valve prevents the well liquid from entering the string or at least the portion of the string of pipe above the valve so that the string is buoyed up by the liquid. The buoyant action of the liquid removes or partially removes the great tensile strain on the pipe resulting from its own weight.

When the drilling string has been fully run into the well it may be deemed necessary or advisable to withdraw the float valve. To accomplish this the tool 53 may be lowered into the drilling string on the cable 54. The tool 53 is adapted to pass downwardly over the head 51 and the reduced upper portion 23 of the body 20 to obtain a grip on the flange 52. When the tool has obtained a proper engagement or grip on the flange 52 the line or cable 54 is raised. This moves the mandrel 44 upwardly. Upward movement of the mandrel 44 moves its enlargement 46 out of engagement with the edges 47 and allows the dogs 38 to retract or move inwardly from the recess 15. Continued upward movement of the mandrel 44 brings the enlargement 46 into cooperation with the curved edges 48. The mandrel enlargement 46 cooperating with the edges 48 may pivot the dogs 38 so that their lower arms move inwardly. This inward movement of the lower parts of the dogs 38 disengages the faces 42 from the wall of the recess 15 and disengages the shoulders 43 from the lower end 16 of the pipe P and fully retracts the dogs from the recess 15. Further upward force applied to the mandrel 44 through the cable 54 and the tool 53 of course tends to move the body 20 and the parts thereon upwardly. After the dogs 38 have been released from the recess 15 the body 20 and the parts carried thereby are free to be withdrawn upwardly by the tool 53 and cable 54. In this manner the float valve of the invention may be easily withdrawn from the string of drill pipe.

It will be noted that the float valve is removed in its entirety leaving the interior of the drill pipe or drilling string clear and unobstructed so that the circulation fluid may flow through it without obstruction and so that wire line core drills, etc. may be operated through the drilling string. It is to be understood that the float valve may be left in the drilling string if desired, in which case the circulation fluid pumped downwardly through the string passes through the ports 28, the passage 27 and the cage 30, the ball 31 being opened by the pump pressure on the circulation fluid.

Fig. 7 of the drawings illustrates another form of the invention adapted to be used in a string of well casing. The casing in which the float valve or valves of the invention are arranged may be typical well casing for lining or casing a well. However, the couplings of the casing for receiving the valves are in the nature of subs of characteristic formation to cooperate with certain parts of the float valves. In the drawings I have shown one of these couplings C. The casing coupling C is threaded on the end portions of the adjacent lengths of casing A in the usual manner. An internal upwardly facing annular shoulder 60 is provided in the coupling C. The shoulder 60 preferably slopes downwardly and inwardly with respect to the vertical axis of the coupling and is preferably provided in the lower portion of the coupling. An annular internal recess 61 is provided in the coupling C at a point spaced above the shoulder 60. The upper and lower walls of the recess 61 are preferably inclined, as illustrated.

The form of float valve of the invention illustrated in Fig. 7 of the drawings includes, generally, a body 20a, valve means 21a on the body 20a, releasable means 22a for holding the body 20a in position in the coupling C and releasable packing means 62 for sealing with the interior of the coupling C.

The body 20a may be substantially the same as the body 20 described above. The body 20a is an elongate member having a reduced upper portion 23a and a passage 27a entering its lower end. Lateral ports 28a extend from the upper portion of the passage 27a at the exterior of the body. The body 20a is proportioned to pass or move through the casing sections A and the several couplings of the casing with suitable clearance.

The valve means 21a may be substantially identical with the valve means 21 described above. The means 21a includes a cage 30a threaded into

the lower end of the passage 27ª and a ball 31ª for sealing upwardly against a seat 33ª on the interior of the body 20ª. The cage 30ª has suitable webs 32ª for preventing the loss of the ball 31ª. The ball 31ª sealing against the seat 33ª is adapted to prevent the upward passage of fluid through the casing.

The releasable means 22ª for securing the valve body 20ª on the coupling C may be identical with the means 22 described above and corresponding reference numerals designate parts of the means 22ª corresponding to the parts of the means 22. The dogs 38 of the means 22ª are pivoted in slots 39ª of the body 20ª and are normally held in their extended positions by the enlargement 46 of the mandrel 44 so that their faces 42 and shoulders 43 cooperate with the lower and upper ends respectively of the recess 61. The mandrel 44 is urged downwardly by the spring 50 so that its enlargement 46 normally holds the dogs 38 in the position just mentioned. The mandrel 44 carries the head 51 provided with the flange 52 that is engageable by a tool such as a socket or overshot. When the valve is in position in the coupling C the dogs 38 cooperate with the recess 51 as just described and the body 20ª extends longitudinally through the coupling C to have its reduced portion 23 and the head 51 project into the upper length of casing A.

The packing means 62 illustrated in Fig. 7 of the drawings is releasable, that is it automatically frees itself from the interior of the coupling C when the valve body 20ª is moved upwardly with respect to the coupling. The packing means 62 includes a body or ring 63 of packing material surrounding the body 20ª below the downwardly facing body shoulder 36ª. A dove tailed tongue 64 is provided on the upper end of the packing ring 63 and fits in a correspondingly shaped groove 65 in the shoulder 36ª. The releasable packing means 62 further includes a shiftable follower 66. The follower 66 surrounds the body 20ª and is shiftable longitudinally with respect to the body. The upper end of the follower 66 engages against the lower end of the packing ring 63. A dove-tailed tongue 67 on the lower end of the packing ring 63 fits a correspondingly shaped groove 68 in the upper end of the follower 66. A spring 69 surrounds the lower portion of the body 20ª and is arranged under compression between a downwardly facing body shoulder 70 on the body 20ª and an upwardly facing shoulder 71 on the follower 66. The spring 69 is operable to move the follower 66 downwardly with respect to the body 20ª. The cage 30ª may have an outwardly projecting flange 72 engageable by the lower end of the follower 66 to limit the downward movement of the follower with respect to the body 20ª. The follower 66 is provided with an annular face 73 adapted to cooperate with the shoulder 60 on the interior of the coupling C.

When the float valve is arranged in the coupling C the face 73 is engaged against the shoulder 60 and the body 20ª is then moved downwardly to bring the dogs 38 to positions where they may project into the recess 61. This downward movement of the body 20ª with respect to the coupling C compresses the spring 69 and subjects the packing ring 63 to compression. This compressing of the packing ring 63 distorts it outwardly into tight sealing engagement with the interior of the coupling C and distorts it inwardly into effective sealing engagement with the exterior of the body 20ª. In this manner the packing means 62 is automatically made operative when the float valve is assembled in the coupling C.

The use and operation of the float valve illustrated in Fig. 7 is substantially the same as that of the previously described form of the invention. When the casing string is being made up the coupling C may be arranged in it at the selected point and the float valve may be inserted in the coupling C. As described above the valve body 20ª is inserted in the coupling C so that the face 73 engages against the shoulder 60 whereupon the body may be moved downwardly to bring the dogs 38 to positions where they may cooperate with the recess 61. When the dogs 38 are in proper cooperation with the recess 61 the float valve is in its operative position in the casing. As the casing is lowered in the well the ball 31ª may be held upwardly against the seat 33ª by the liquid in the well tending to flow upwardly into the casing string from its lower end. In this manner the ball 31ª serves to prevent the entrance of liquid to the casing string and the casing may be floated into the well so that it does not fail or part through its own weight.

When it becomes desirable or necessary to remove the float valve a suitable tool such as a socket or overshot is lowered into the casing and engaged over the head 51 to grip its flange 52. The socket or overshot is then pulled upwardly to remove the float valve from the casing. Upward movement of the socket or overshot results in upward movement of the mandrel 44 with respect to the body 20ª to release the dogs 38 from the recess 61. Continued upward movement of the mandrel 44 with the socket or overshot results in upward movement of the body 20ª with the mandrel. When the body 20ª moves upwardly the spring 69 is free to expand and resists upward movement of the follower 66 with the body 20ª. Thus there is a relatively longitudinal movement between the body 20ª and the follower 66 which results in elongation of the packing ring 63. This elongation of the packing ring 63 reduces the external diameter of the packing ring and frees it from the interior of the coupling C. In this manner the packing ring 63 is released or retraced so that it is not injured through contact with the interior of the casing string when the float valve is withdrawn from the casing.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A float valve for use in a tubular well string having spaced opposed internal shoulders, said valve comprising, a body to be arranged in the string and having a fluid passage, valve means on the body for controlling fluid flow through the passage, retractable dogs carried by the body to cooperate with said shoulders to retain the body in the string, a shiftable mandrel carried by the body and normally preventing disengagement of the dogs from the shoulders and movable to a position out of holding cooperation with the dogs, a part on the mandrel engageable by a tool run into the string to effect such movement of the mandrel and for moving the body upwardly from the string, and packing means on the body for sealing with the interior of the string

released by such upward movement of the body.

2. A float valve for use in a tubular well string having spaced opposed internal shoulders, said valve comprising, a body to be arranged in the string and having a fluid passage, valve means on the body for controlling fluid flow through the passage, retractable means for cooperating with said shoulders to retain the body in the string, means for retracting the retractable means from the shoulders and moving the body upwardly from the string, packing on the body for sealing with the interior of the string, and means for releasing the packing from the string upon upward movement of the body.

3. In combination, a tubular well string including, a tubular element having an upwardly facing shoulder and an internal recess, and a float valve including, a body in the string, means on the body for controlling fluid flow through the string, a retractable member on the body for cooperating with the recess to hold the body in place, packing means on the body operable through cooperation with said shoulder to seal with the interior of the said element, means operable from the top of the string retracting said member and for moving the body upwardly through the string, and means for retracting the packing means when the body is moved upwardly.

4. In combination, a tubular well string including, a tubular element having an upwardly facing shoulder and an internal recess, and a float valve including, a body in the string, means on the body for controlling fluid flow through the string, a retractable member on the body for cooperating with the recess to hold the body in place, packing means on the body operable through cooperation with said shoulder to seal with the interior of the said element, means operable from the top of the string for retracting said member and for moving the body upwardly through the string, and means for retracting the packing means when the body is moved upwardly, the last mentioned means including a spring for elongating the said means.

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