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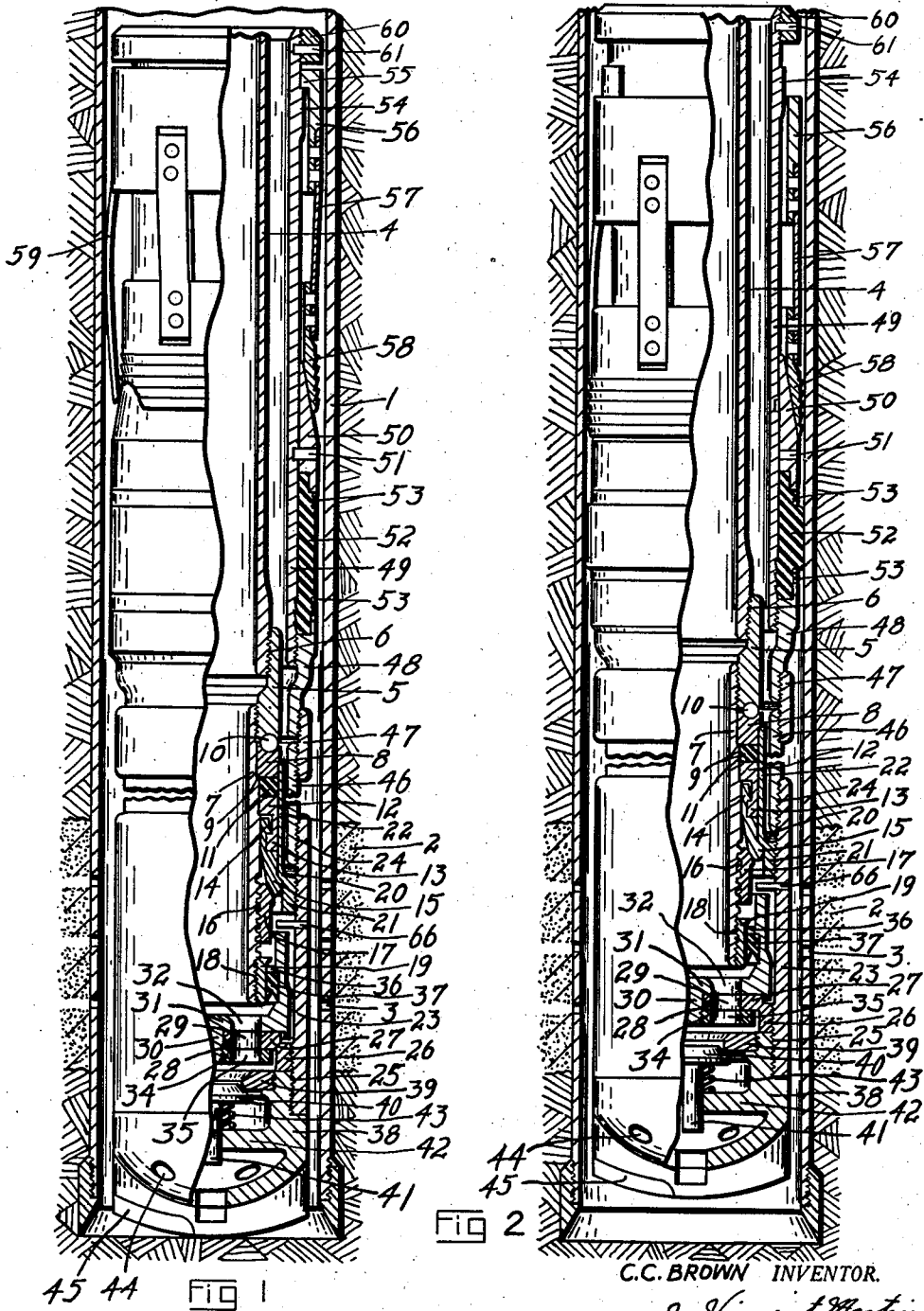
C. C. BROWN

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CEMENTING APPARATUS

Filed April 5, 1938

2 Sheets-Sheet 1



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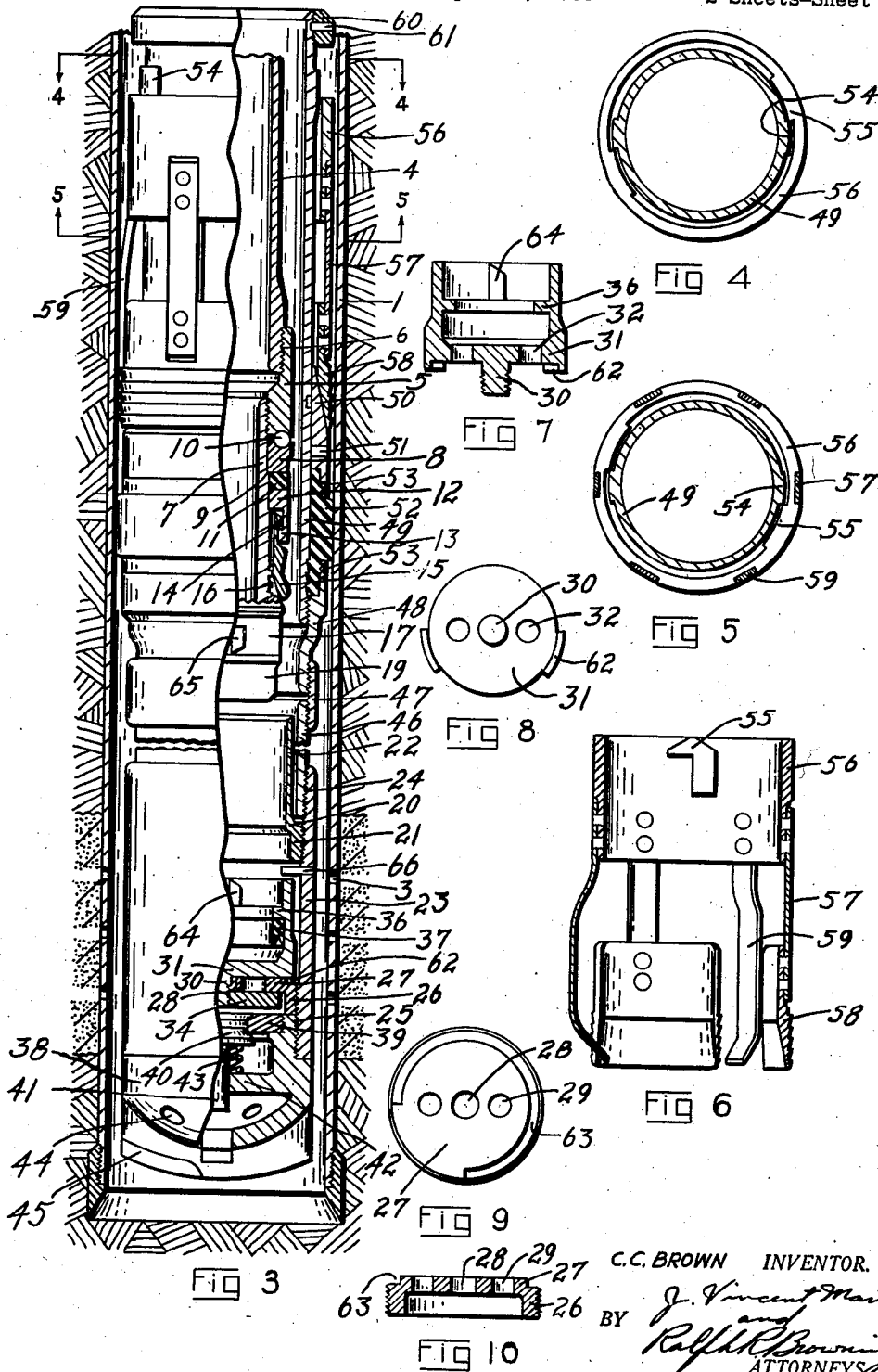
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CEMENTING APPARATUS

Cicero C. Brown, Houston, Tex.

Application April 5, 1938, Serial No. 200,087

5 Claims. (Cl. 166-1)

This invention relates to a device for cementing wells or the like, and particularly to such a device which is adapted to close by cement perforations which have previously been made in the side walls of well casings in search of producing formations.

It is the general object of this invention to provide such a device which is capable of being positively set in position or released as and when desired by the operator.

In cementing a well it is necessary that the cement be applied to the desired zone of the well casing under high pressure so that it may be forced out into the formation either through openings in the side walls of the casing or around the lower end thereof. It is also desirable, however, that any tool devised for so placing the cement and for forcing the cement outside of the casing and into the formation shall be capable of positive setting action to latch it with respect to the walls of the well and form a seal with the walls of the well to hold the pressure under which the cement is placed, and also it is desirable that such a tool be capable of quick and positive release from its anchoring engagement with the well casing so that it may be adjusted or moved to a new position.

It is, therefore, an object of this invention to provide a tool which can be positively anchored and which will provide a positive packing between the tool and the walls of the well casing, but which may likewise at will be released from such anchorage and adjusted or moved to a new position in the well.

Another object of this invention is to provide a means for positively opening the tool so that cement may flow downwardly therethrough, and for closing the tool so that both upward and downward flow are positively prevented after the cement has been placed.

Another object of this invention is to provide a tool which may be readily detached from the tubing or similar device upon which it is lowered into the well, and through which the cement is applied.

Another object of this invention is to provide such a tool which may be easily drilled out so that the well may be deepened if that is desired.

Other objects and advantages of this invention will become apparent from the following description wherein one preferred embodiment thereof is set forth by way of example.

In the drawings:

Fig. 1 is a view partly in vertical cross section illustrating a tool constructed in accordance with

this invention in place within a well prior to the anchoring thereof.

Fig. 2 is a view similar to Fig. 1 and showing the same tool after it has been anchored within a well casing and sealed with respect thereto so that cement can be pumped downwardly through the tool and forced into the formation.

Fig. 3 is a view similar to Figs. 1 and 2, but showing the tool after the cementing operation has been completed, the lower end of the tool positively closed against flow in either direction, and the tubing through which the cement has been forced disengaged from the tool and drawn upwardly in the well.

Fig. 4 is a horizontal cross section looking downwardly and taken along the line 4-4 of Fig. 3.

Fig. 5 is a horizontal cross section looking upwardly and taken along the line 5-5 of Fig. 3.

Fig. 6 is a vertical cross sectional view of the anchoring device forming a part of the structure shown in Figs. 1 to 3, inclusive.

Fig. 7 is a vertical cross sectional view of a part of the positive closing valve forming a part of this tool.

Fig. 8 is a bottom plan view of the element shown in Fig. 7.

Fig. 9 is a top plan view of the element with which the part shown in Fig. 8 cooperates.

Fig. 10 is a vertical cross sectional view of the element shown in Fig. 9.

Referring now more in detail to the drawings, the numeral 1 indicates a casing which has been lowered into a well through a formation 2. This casing has been perforated at 3 opposite this formation for the purpose of determining whether or not the formation is capable of producing the liquid desired.

After a test of the formation has been made and it is desired to close up the perforations 3, there is lowered into the well upon the tubing the tool which will now be described.

Upon the lower end of the tubing there is threadedly mounted a special coupling 5 threaded to the tubing at 6, and threaded at its lower end to receive the special fitting 7.

Surrounding the special fitting 7 below the lower end of the coupling member 5 is a member 8 rotatably mounted with respect to the special fitting 7 and resting upon an external shoulder 9 thereon. The lower end of the coupling 5 and the upper end of the ring member 8 are formed with complementary ball races adapted to receive ball bearings 10. Below the ring member 8 is a packing ring 11 and bearing against the lower side of this packing ring is a compressing ring 55

12 which follows and serves to compress the packing ring. The packing ring 12 is internally recessed adjacent its lower end and provided with a downwardly extending overhanging part 13. Within this recess and behind this part 13 is received the upwardly and outwardly overhanging parts 14 of a plurality of dogs 15 so that these dogs are suspended by the ring 12.

Below the dogs 15 the fitting 7 is provided with a series of coarse threads 16 adapted to receive an expanding nut 17, and below the coarse threads it is provided with finer threads 18 adapted to receive a nut 19 having a substantially smooth exterior.

The dogs 15 are adapted to engage the downwardly facing shoulder 20 of the externally threaded member 21. This member also has an upwardly extending sleeve-like portion 22 adapted to surround the packing ring 11 and form a seal therewith.

The element 21 is threaded into the upper end of the sleeve 23, this sleeve being internally threaded at 24 from its upper end to a point intermediate its ends for the purpose of receiving the element 21.

The sleeve 23 is also internally threaded at its lower end as at 25 and threadedly receives the stationary valve element 26 having a disc-like portion 27 with an opening 28 centrally thereof, and openings 29 spaced radially about the central opening. The central opening 28 receives the stem 30 which projects downwardly from the rotatable valve member 31. This rotatable valve member 31 seats on top of the stationary valve member 26, and has openings 32 on opposite sides of its center so arranged as to register with the openings 29 in one position of the rotary member 31. The rotatable valve member 31 is held in engagement with the stationary valve member 26 by means of a nut 34 threaded onto the lower end of the stem 30 and having openings 35 therethrough adapted to register with the openings 29 and 32 previously mentioned. This rotatable valve member 31 also has an upwardly extending cup-shaped part with an internal flange 36 intermediate its ends below which is inserted a packing ring 37. The nut 19 fits within the flange 36 and a seal between the nut 19 and the rotatable valve member is formed by the packing ring 37.

Below the stationary valve member 26 there is threaded into the interior of the sleeve 23 a shoe 38 having a valve seat member 39 mounted therein. This valve seat member provides a seat for an upwardly closing poppet type check valve 40 which has a downwardly extending valve stem 41 slidably mounted in the support 42. Surrounding the valve stem 41 and cooperating with the valve 40 and support 42 is a combination spring 43 adapted normally to hold the valve in its upper seated position. The shoe 38 is provided at its lower end with openings 44 through which fluid pumped downwardly through the tubing 4 may be permitted to escape, and is provided with blades 45 which are adapted to engage the bottom of a well or the cement within a well and when so engaged to resist rotation of the shoe and the parts secured thereto.

Threaded into the upper end of the sleeve 23 above the element 21 is a pipe section 46 having a collar 47 at its upper end by which it is connected to a swaged fitting 48. The upper end of the swaged fitting forms an abutment for the lower end of a packer element as will presently

be described, and is internally threaded to receive a packer sleeve 49.

Mounted about the packer sleeve 49 at a position spaced above the upper end of the swaged fitting 48 is a downwardly facing packer abutment 50 held against axial movement on the sleeve 49 by means of a shear pin 51. The packer element 52 is interposed between the upper end of the swaged fitting 48 and the lower end of the abutment 50, and its ends are held against the sleeve 49 by means of wire-wrappings 53 or the like.

Adjacent its upper end, the packer sleeve 49 is provided with an external lug 54 adapted to receive an inwardly extending lug 55 on a slip supporting ring 56. Depending from this slip supporting ring at radially spaced points are a plurality of spring arms 57 having slip elements 58 secured to their lower ends and adapted to cooperate with the tapered upper portion of the abutment ring 50. Depending also from the ring 56 are a plurality of gripping springs 59 adapted to frictionally engage the inner wall of a casing or the like within which this tool may be positioned. The upper end of the sleeve 49 is adapted to receive a nut 60 held in place against accidental disengagement by means of a pin 61.

Referring now particularly to Figs. 7 and 8 it will be seen that the rotatable valve element is provided about its lower outer edge with downwardly extending lugs 62 adapted to engage within the groove 63 which extends part-way around the marginal portion of the stationary valve member 26 shown in Figs. 9 and 10. Within its upper end above the internal flange 36 this rotatable valve member is also provided with a rib 64 and the nut 17 is provided on its exterior with a corresponding rib 65. Just above the upper end of the rotatable valve member a radial pin 66 projects inwardly a sufficient distance to engage the rib 65 when the nut 17 is above its lowermost position.

In operation, the device is assembled as illustrated in Fig. 1 of the drawings in which figure the tool is suspended from the tubing 4 by virtue of the engagement of the dogs 15 beneath the internal shoulder 20. The dogs are held in this engagement by means of the nut 17 and the nut 19 projects into the interior of the rotatable valve member and is sealed therewithin by the packing 37. The rotatable valve is preferably open and the slips 58 are held in their upper position by the engagement between the lugs 54 and 55 so that the packer 52 cannot be expanded.

When the device has reached the position where it is desired to perform a cementing operation, the tubing is rotated to the left slightly so as to disengage the lug 54 from the lug 55, and is then pulled upwardly. Inasmuch as the springs 59 will be in frictional engagement with the interior of the casing 1, the ring 56 and the slips 58 will be held stationary, and the ring 50 will move upwardly within the slips 58 until the slips 58 are forced upwardly by the wedging action of the ring 50 and into engagement with the casing 1. As soon as the slips 58 lock into engagement with the casing 1, a force will be exerted upon the ring 50 to prevent further upward movement thereof, and when this force is great enough, the pin 51 will be sheared off, after which the sleeve 49 may be moved upwardly within the ring 50. It will be seen that this upward movement of the sleeve 49 will move the upper end of the swaged fitting 48 against the lower end of the packer 52 and will cause

this packer to be expanded to the position illustrated in Fig. 2 of the drawings.

With the tool held in this position, cement is then pumped downwardly through the tubing 4, out through the openings 29, 32 and 35 in the rotatable valve, past the check valve 40, and through the openings 44 to the exterior of the tool. Due to the fact that the hole below the tool is closed, and that a seal is formed between the tool and the casing by the packer 52, pressure within the space between the tool and the casing will build up until it is sufficient to force the cement out through the openings 3 and into the formation. When sufficient cement has been forced into the formation and the tubing has been emptied of cement by pumping into the tubing mud or some other fluid to take the place of the cement, the tubing may be disconnected from the cementing tool as shown in Fig. 3. This is accomplished by the right hand rotation of the tubing, while the shoe is held against rotation by engagement of the blades 45 with the cement below the shoe. When this rotation is first begun, the lug or rib 65 on the nut 17 will engage the pin 66, thus preventing the rotation of the nut 17 and causing it to move downwardly as the tubing is rotated. This downward movement of the nut 17 will eventually release the dogs 15 so that they can move inwardly and be disengaged from the shoulder 20. When the nut 17 has moved downwardly a sufficient distance the upper end of the lug 65 will pass below the pin 66 while the lower end of this lug has entered the upper end of the rotatable valve member 31. As soon as the lug 65 disengages the pin 66 and comes to a stop against the nut 19, the lug 65 will engage the lug 64 and force a rotation of the rotatable valve member 31. This will move the openings 32 and 35 out of register with the openings 29 and prevent further flow in either direction through this valve. During this process the pumps may be operated very slowly and when the rotary valve is closed this fact will be signaled to the operator by the stoppage of the pumps. The tubing now being free, it may be raised to the position shown in Fig. 3, and as soon as the nut 19 disengages the packing ring 37 the pumps will start again because the fluid can then flow out through the lower end of the tubing and up through the interior of the cementing tool.

Meanwhile, the closure of the rotary valve and the action of the check valve at the lower end of the tool will maintain the pressure upon the cement which has been forced outwardly through the lower end of the tool. This pressure also will hold the tool up against the slips 58 and keep the packer 52 in expanded position.

If it be desired to move this cementing tool to another location after the cement has set slightly so that it will not flow back out of the formation because of the pressure therein, the tubing may be again engaged with the tool by the reverse of the process just described. The weight of the tubing will then be lowered onto the tool until the tool is forced downwardly a sufficient distance to bring the lug 54 below the lug 55 on the ring 55. A rotation to the right will then engage the lug 55 with the lug 54, and the tool may be drawn upwardly by pulling upwardly on the tubing. It may then be set in any new position desired, and further cementing operations may take place. The tool may also be removed from the well entirely if so desired.

In many instances it is desirable that the tool

remain within the well until the cement has thoroughly set in order to avoid any possibility of releasing the pressure on the liquid cement and permitting it to flow out of the formation. Under these circumstances it is of course impossible to thereafter remove the tool from the well except by breaking it up. In the manufacture of the present tool the interior portions of the tool such as the valve parts and the shoe are made of bronze or some similar material which may easily be drilled out. The outer parts are made of steel for strength because they must be relatively thin, but the inner parts which may be made thick enough to withstand the pressures involved are made of a soft material so that they can be easily removed. Then, after the cement has been allowed to set with the tool in place in the well, it is possible to drill out the central portions of the tool and extend the well therebelow to such extent as may be desirable. After the central portions of the tool have been drilled out, the outside portion may be cut up and fished out of the hole so that the entire tool may be removed with a minimum amount of trouble.

In view of the foregoing, it will be seen that a means has been provided for carrying out all of the objects and advantages sought by this invention, and that by the device set forth there is provided a cementing tool which is simple to operate, which has valves and locking device which make it possible for it to be locked and the valves opened or closed at will, and which may be easily removed from a hole by drilling or other similar methods.

Having described my invention, I claim:

1. Apparatus adapted for use as a cement retainer in a cased oil well including, a hollow body, check valve means adjacent the lower end of said body for preventing upflow therein, means for positively closing the lower end of said body against flow in either direction, releasable slip means for engaging the well casing to prevent upward movement of said body within a well, co-operable elements on the slip means and hollow body engageable in one position to maintain the slip means in inactive position and disengageable to permit the slip means to move into active or casing gripping position, sealing means about said body adapted to expand to form a seal between said body and the well casing when said body is urged in an upward direction against the holding action of said releasable slip means, and suspending means for suspending said body, said suspending means being engageable with said positive closing means to selectively open and close the same, co-operable means on the hollow body and suspending means operable to lock the body and suspending means in non-rotatable engagement, said suspending means adapted to be manipulated when in non-rotatable engagement with the hollow body to actuate the body to selectively engage or release said releasable slip means from said hollow body.

2. Apparatus adapted for use as a cement retainer in a cased oil well including, a hollow body, check valve means adjacent the lower end of said body for preventing upflow therein, means for positively closing the lower end of said body against flow in either direction, releasable slip means for engaging the well casing to prevent upward movement of said body within a well, co-operable elements on the slip means and hollow body engageable in one position to maintain the slip means in inactive position and disengageable to permit the slip means to move into active or

casing gripping position, sealing means about said body adapted to expand to form a seal between said body and the well casing when said body is urged in an upward direction against the holding action of said releasable slip means, and suspending means for suspending said body, said suspending means being engageable with said positive closing means to selectively open and close the same, cooperable means on the hollow body and suspending means operable to lock the body and suspending means in non-rotatable engagement, said suspending means adapted to be manipulated when in non-rotatable engagement with the hollow body to actuate the body to selectively engage or release said releasable slip means from said hollow body, said suspending means being hollow and having its lower end in communication with the passageway through the lower end of said body whereby fluid may be pumped therethrough to the space below said body when said positive closing means is in open position.

3. Apparatus adapted for use as a cement retainer in a cased oil well including, a hollow body, check valve means adjacent the lower end of said body for preventing upflow therein, means for positively closing the lower end of said body against flow in either direction, releasable slip means for engaging the well casing to prevent upward movement of said body within a well, cooperable elements on the slip means and hollow body engageable in one position to maintain the slip means in inactive position and disengageable to permit the slip means to move into active or casing gripping position, sealing means about said body adapted to expand to form a seal between said body and the well casing when said body is urged in an upward direction against the holding action of said releasable slip means, and suspending means for suspending said body, said suspending means being engageable with said positive closing means to selectively open and close the same, cooperable means on the hollow body and suspending means operable to lock the body and suspending means in non-rotatable engagement, said suspending means adapted to be manipulated when in non-rotatable engagement with the hollow body to actuate the body to selectively engage or release said releasable slip means from said hollow body, and means for releasably securing said suspending means within said body.

4. Apparatus adapted for use as a cement retainer in a cased oil well including, a hollow body, check valve means adjacent the lower end of said body for preventing upflow therein, means for positively closing the lower end of said body against flow in either direction, releasable slip means for engaging the well casing to prevent upward movement of said body within a well,

cooperable elements on the slip means and hollow body engageable in one position to maintain the slip means in inactive position and disengageable to permit the slip means to move into active or casing gripping position, sealing means about said body adapted to expand to form a seal between said body and the well casing when said body is urged in an upward direction against the holding action of said releasable slip means, and suspending means for suspending said body, said suspending means being engageable with said positive closing means to selectively open and close the same, cooperable means on the hollow body and suspending means operable to lock the body and suspending means in non-rotatable engagement, said suspending means adapted to be manipulated when in non-rotatable engagement with the hollow body to actuate the body to selectively engage or release said releasable slip means from said hollow body, and means for releasably securing said suspending means within said body, said suspending means being hollow and having its lower end in communication with the passageway through the lower end of said body whereby fluid may be pumped therethrough to the space below said body when said positive closing means is in open position.

5. Apparatus adapted for use as a cement retainer in a cased oil well including, a hollow body, check valve means adjacent the lower end of said body for preventing upflow therein, means for positively closing the lower end of said body against flow in either direction, releasable slip means for engaging the well casing to prevent upward movement of said body within a well, cooperable elements on the slip means and hollow body engageable in one position to maintain the slip means in inactive position and disengageable to permit the slip means to move into active or casing gripping position, sealing means about said body adapted to expand to form a seal between said body and the well casing when said body is urged in an upward direction against the holding action of said releasable slip means, and suspending means for suspending said body, said suspending means being engageable with said positive closing means to selectively open and close the same, cooperable means on the hollow body and suspending means operable to lock the body and suspending means in non-rotatable engagement, said suspending means adapted to be manipulated when in non-rotatable engagement with the hollow body to actuate the body to selectively engage or release said releasable slip means from said hollow body, said body being imperforate along its length between said closing means and said means for forming a seal.

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