Sept. 11, 1956 C. C. BROWN 2,762,436

METHODS OF LOWERING PIPE WITHIN A WELL BORE

Filed April 22, 1949 2 Sheets-Sheet 1

Fig. 1

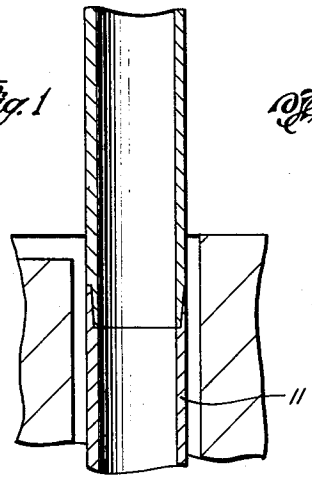


Fig. 2

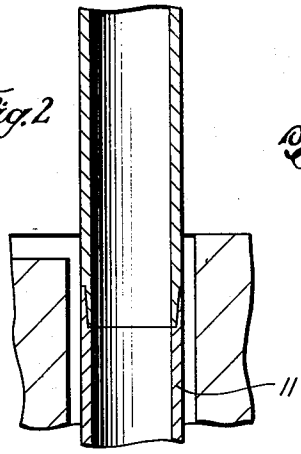
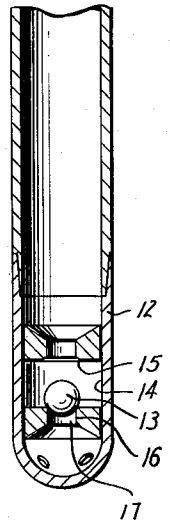
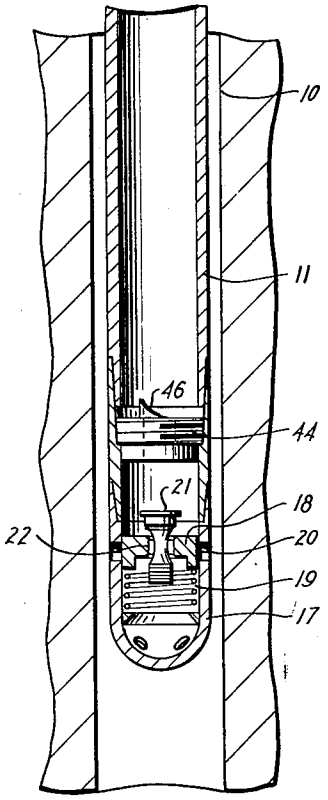


Fig. 3





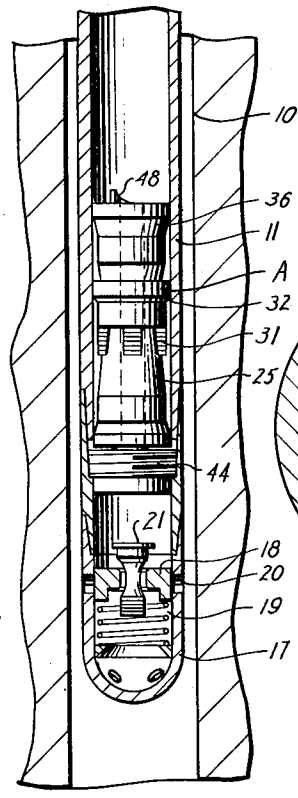
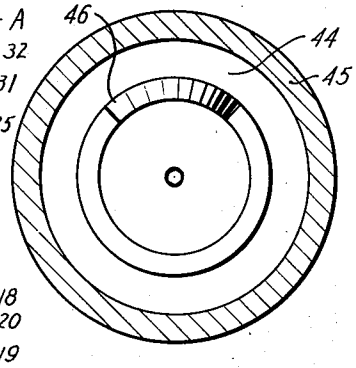


Fig. 6



Cicero C. Brown
INVENTOR,
By J. Vincent Martin
and
Jos E. Edwards
ATTORNEYS

Sept. 11, 1956 C. C. BROWN 2,762,436

METHODS OF LOWERING PIPE WITHIN A WELL BORE

Filed April 22, 1949 2 Sheets-Sheet 2

Fig. 4

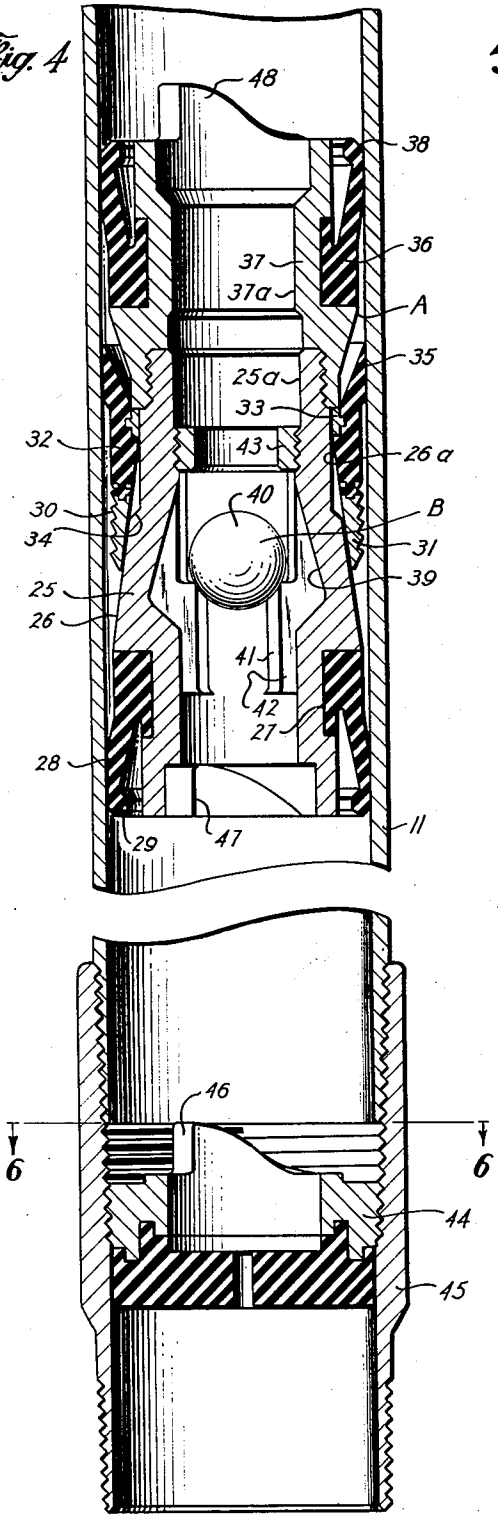
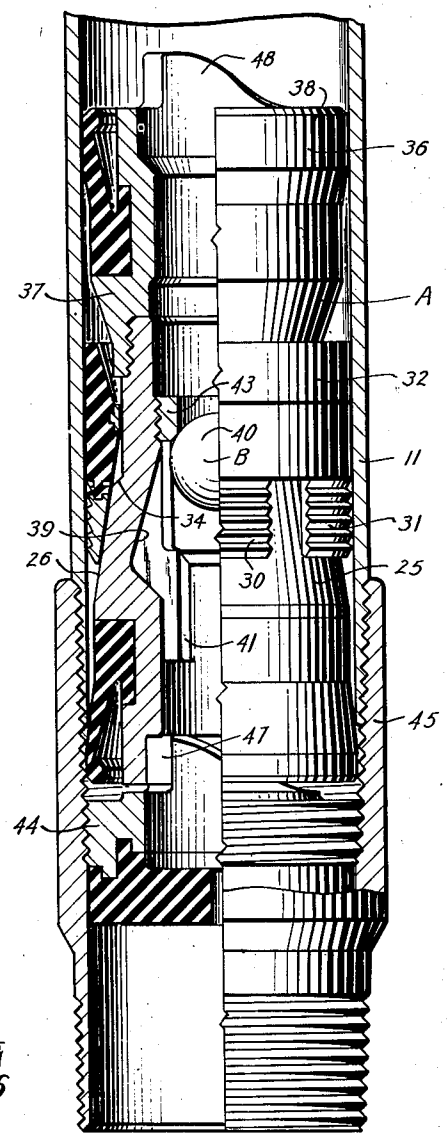


Fig. 5



Cicero C. Brown
INVENTOR
By Vincent Martin
and
Joel E. Edwards
ATTORNEYS

United States Patent Office 2,762,436 Patented Sept. 11, 1956

2,762,436

METHODS OF LOWERING PIPE WITHIN A WELL BORE

Cicero C. Brown, Houston, Tex.

Application April 22, 1949, Serial No. 89,018

5 Claims. (Cl. 166—46)

This invention relates to new and useful improvements in methods of and apparatus for lowering pipe within a well bore and relates particularly to an improved plug for use in such methods and apparatus.

During the lowering or running of well pipe or casing into a well bore, said bore is substantially filled with drilling mud or fluid and said pipe or casing must necessarily be lowered through such mud or fluid. After the pipe or casing has reached its desired final position a cementing operation is carried out through the pipe and the cement is pumped outwardly from the pipe and upwardly around the lower portion thereof to bond said lower portion to the sub-surface formation. Because of the subsequent cementing operation which is carried out through the bore of the pipe, it is necessary that fluid may pass outwardly from the lower portion of the pipe and in some instances, the pipe may be run in or lowered with its lower end open; however, because of the danger of a blowout through the open pipe, it has become the generally accepted practice to mount an upwardly closing back check or cementing valve in the lower portion of the pipe, whereby during the lowering operation the pipe is closed against the possibility of a blowout and yet, after reaching its final position, cement may be pumped into the well bore past the back check or cementing valve.

With the usual type of upwardly closing back check or cementing valve mounted in the lower portion of the well pipe or casing and functioning in the proper manner no fluid can enter the pipe from the bore during lowering movement and it is general practice to alternately float and fill the pipe as it moves downwardly within the well bore. The filling is accomplished from the surface and such surface filling has certain disadvantages in that it requires periodic halting of the lowering movement and also fails to assure that the same fluid which is present within the well bore fills the bore of the pipe. In spite of certain disadvantages, the method which permits floating a portion of the pipe into the well bore is advantageous in running excessively long strings of pipe because in such instance, a portion of the pipe may be floated into the well bore to relieve the supporting lines and derrick of excessive weight. It is thus apparent that it is desirable to eliminate the disadvantages of the ordinary back check valve in the lower portion of the well pipe while retaining the advantage of being able, when circumstances require, to float a portion of the pipe into the well.

The co-pending application of Cicero C. Brown and Ernest L. Potts, Serial No. 73,812, filed January 31, 1949, now Patent No. 2,698,054 issued December 28, 1954, discloses an improved method of lowering the well pipe to overcome the disadvantages of the ordinary back check valve methods wherein filling must be carried out from the surface. In the Brown and Potts application an improved pipe lowering method is provided which permits the pipe to be automatically filled by the fluid from within the well bore to thereby eliminate all of the disadvantages of filling said pipe from the surface. However, in

this type of method a valve is opened to admit fluid from the well bore into the lower portion of the well pipe each time that the pipe is halted in its movement to allow the connection of additional pipe sections and such valve is actuated by the pressure differential thereacross. However, in the Brown and Potts method it is not possible to float any portion of the pipe into the well bore because of the automatically filling feature of that method.

Another disadvantage of all known methods of lowering the pipe or casing into a well bore results from the fact that the back check valve or cementing valve, which closes the lower portion of the well pipe or casing in case of excessive well bore pressures, is the only means provided for preventing a blowout. Thus, if this back check valve becomes inoperative for any reason whatever a blowout may occur through the pipe being lowered.

It is therefore one object of the present invention to provide an improved method of lowering pipe, such as well casing, into a well bore whereby the pipe may be filled with fluid, either automatically from the well bore or periodically from the surface for a predetermined distance and may then have its bore closed in such a manner that the remainder of the pipe string may be subsequently run into the well bore in any desired manner.

An important object of the invention is to provide an improved method of lowering pipe which consists in lowering said pipe within the well bore, filling the bore of the pipe with fluid, continuing this lowering until a predetermined elevation is reached, then closing the bore of the pipe above the filled portion and subsequently completing lowering of the pipe by floating the same into the well bore.

A particular object is to provide an improved plug which may be introduced into the well pipe or casing being lowered and which will function as a back check valve to prevent upward flow of fluids through said pipe, whereby the well is maintained under complete control and blowout thereof is prevented in the event that the usual back check or cementing valve fails to function.

Still another object is to provide an improved plug which is adapted to be locked against upward movement within the well pipe by the pressure acting therebelow and which is adapted to be released for further lowering movement within the pipe by pressure thereabove, said plug having a back check valve incorporated therein which will allow flow only in a downward direction through the plug whereby complete blowout protection is had during lowering and after lowering of the pipe is complete, subsequent pumping operations downwardly through the pipe will not be interfered with.

Still another object of the invention is to provide an improved plug which may be readily introduced into a well pipe or casing at any time that a blowout is indicated and which will be automatically locked to prevent upward flow through the pipe by the pressure acting therebeneath.

Other and further objects of the invention will appear from the description of the invention.

In the accompanying drawings, which form a part of the instant specification, which are to be read in conjunction therewith and wherein like reference numerals are used to indicate like parts in the various views:

Figures 1 and 2 are diagrammatic views of a well pipe or casing being run into a well bore in accordance with the improved method and apparatus with Figure 2 illustrating the improved plug in position within the pipe or casing,

Figure 3 is a sectional detail of the usual type of float shoe and back check valve,

Figure 4 is an enlarged transverse vertical sectional view of the plug illustrating the parts thereof in position during downward movement of the plug,

Figure 5 is a similar view illustrating the plug in a locked position,

Figure 6 is a horizontal cross-sectional view taken on the line 6—6 of Figure 4.

In the drawings, the numeral 10 designates a well bore within which the well pipe or casing 11 is to be lowered. As is well known the bore is drilled and the well pipe is lowered therethrough to a final position after which the lower portion of the pipe is cemented or bonded to the sub-surface formation. The well bore 10 is filled with drilling mud or fluid and the pipe or casing is lowered downwardly through this fluid. The pipe is lowered in the usual manner, that is, by successively connecting additional stands or sections to the pipe string and thereby progressively lowering said string into its final position within the bore.

As has been noted, it is accepted practice in lowering pipe into the well bore to provide the lower end of said pipe with a back check or cementing valve. This valve is usually incorporated within a float shoe 12 illustrated in Figure 3 having a ball valve 13 mounted within a chamber 14 formed within the shoe. The ball 13 is upwardly seating against an annular seat 15 and is thereby upwardly closing, whereby in the event that there is any tendency for a blowout during the lowering of the pipe the ball functions to close the bore of said pipe. After the pipe is in its final position and a cementing operation is to be carried out downward pressure against the ball moves said ball into engagement with supporting ribs 16 which have flow passages 17 therebetween and thus a subsequent cementing operation may be carried out through the pipe. Since the ball is upwardly seating it is obvious that the pipe may be periodically filled from the surface and so long as the pressure exteriorly of the pipe is greater than that within said pipe the valve will remain in a closed position.

In running long strings of pipe it may be desirable to initially carry out an intermittent filling of the lower portion of the pipe and after the weight of the pipe filled with fluid exceeds a point which might place a strain on the rig lines the remainder of the pipe may then be floated into the bore. Thus so long as the check valve 13 functions properly, long string of pipe may be run into the well by either filling the pipe from the surface or by floating the pipe into said bore. However, the main disadvantage of the float shoe 12 having the ball check 13 is that the filling operation, where filling of the pipe is desirable, must be carried out from the surface which results in a loss of time and requires additional labor on the part of the crew.

In order to overcome the disadvantage of filling the pipe from the surface and to permit said pipe to fill automatically a valve mechanism such as illustrated in Figures 1 and 2 is employed. This valve mechanism is clearly disclosed in the co-pending application of Cicero C. Brown and Ernest L. Potts, Serial No. 73,812, filed January 31, 1949, and includes a valve body 17 having a back check valve 18 which is normally held in a raised position by a spring 19 to close cementing ports 20. Automatic filling of the pipe is accomplished by an inner valve 21 which is actuated by the pressure differential within the pipe on one side and the pressure within the bore on its other side, said valve controlling flow through an inlet 22. As is clearly described in the co-pending application of Brown and Potts above referred to, the valve 21 functions automatically so that each time that the pipe is stopped to connect another stand or section of pipe in the string, the valve 21 opens to admit fluid from the well bore to fill the pipe to the desired level after which the valve 21 closes. The valve 21 remains closed during subsequent lowering movement of the pipe and again reopens when the pipe is halted for connection of the next stand or section to the pipe string. Therefore, with the apparatus illustrated in Figures 1 and 2 the pipe string may be lowered within the well bore 10 and may

be automatically filled with the fluid from within the well bore. Upon reaching final position a subsequent cementing operation may be carried out through the pipe and the pressure applied by the pumps will result in an opening of the cementing valve 18 to uncover the cementing ports 20 and allow the cement to be pumped outwardly into the well bore and upwardly around the pipe string.

The apparatus and method of lowering the pipe which involves the automatic filling of the pipe as disclosed in the above referred to Brown and Potts co-pending application overcomes the disadvantage of having to fill the pipe from the surface which must be accomplished when the float shoe 12 of Figure 3 is employed. However, the automatic filling of the pipe by means of the pressure differential valve 21 makes it impossible to float any portion of the pipe into the well bore since filling is automatic in accordance with lowering. Thus in running excessively long strings of pipe into a well bore wherein the weight of the string may place an undue load on the rig lines carrying said pipe it is desirable to render the automatic filling valve 21 inactive whereby a portion of the pipe string may be floated or run dry into the well bore. It has also been found that in employing any type of back check valve either the ball check 13 of Figure 3 or the valve 18 of Figures 1 and 2, there is a possibility of this check valve becoming inoperative during the lowering operation. In other words, for some reason or another the back check may not close in which case there would be a constant throat of blowout upwardly through the pipe during the lowering operation.

In carrying out the present invention a plug A is adapted to be inserted into the well pipe or casing at some point above the back check valve arrangement whether it be the valve 13 of Figure 3 or the valves 18 and 21 of Figures 1 and 2. The plug A is of a construction which permits it to be pumped downwardly within the well pipe and to be locked against upward movement by pressure acting therebelow and said plug includes a back check valve B which will function to prevent upward flow within the pipe. It is noted that although the check valve B is downwardly opening and might be in a lowered or open position during downward pumping of the plug A, the area of the passage, together with the restriction set up by the valve B located therein, are such that fluid pressure acting against the top of the plug will move the plug downwardly within the well pipe to the desired position. Thus, in the event of failure of the back check cementing valve in the lower portion of the pipe, the plug A may be readily inserted into the well pipe 11 and the pressures acting below said plug will lock or set the plug within the pipe. Such pressure will also close the upwardly closing check valve B and thus shut off upward flow within the bore of said pipe to prevent any possibility of a blowout. Because of the back check valve B which forms part of the plug A it is possible to subsequently pump fluid downwardly through the plug and thereby the plug will not interfere with subsequent washing or cementing operations.

The plug A is not only adapted for use in closing the bore of the well pipe in case of the failure of the usual cementing valve at the lower portion of the pipe but is also particularly adapted for use with the valve arrangement illustrated in Figures 1 and 2. In use with this apparatus the well pipe may be lowered into the well to a predetermined position during which time automatic filling of the pipe is accomplished by means of the differential valve 21. If subsequent sections of pipe are to be floated into the hole or if circumstances make it desirable to complete filling of the pipe from the surface, it is only necessary to place the plug A within the well pipe to close the bore thereof above the previously filled portion of the pipe string. The pressure acting below the plug will close the back check valve B to shut off any upward flow through the well bore and thus subsequent

automatic filling by continued lowering of the pipe is prevented. In effect, the differential valve **21** is thus rendered inactive and the remainder of the pipe may either be floated into the well bore or may be filled from the surface, until the final position of the pipe is reached. Obviously, the plug may be employed in the event that the valve **21** should become inoperative for further automatic filling. After reaching final position the fluid may be pumped downwardly through the pipe in the usual manner for washing or cementing operations and will function to unseat the ball check valve B of the plug A and will ultimately be ejected outwardly from the lower portion of the pipe past the cementing valve **18**. It is therefore evident that the plug will not interfere with any of the necessary subsequent operations which may be required after final positioning of the pipe.

The plug A comprises a tubular mandrel or body **25** which has its intermediate external portion formed with a tapered or generally conical slip-expanding surface **26**. Below the surface **26** the exterior of the body is reduced at **27** and an annular flared sealing element or cup **28** is molded or otherwise secured to this portion. This sealing element is constructed of a suitable elastic or flexible packing material such as rubber, rubber compound or the like. The sealing element has an annular sealing lip portion **29** at its lower end and the external diameter of this lip is slightly larger than the bore of the well pipe whereby the element will firmly engage the wall of the pipe bore. It will be apparent that any pressure acting beneath the sealing element will enter the flared sealing lip portion **29** and will further expand said sealing element into tight sealing engagement with the wall of the pipe; the upwardly acting pressure will also tend to move the mandrel in an upward direction within the pipe.

A slip assembly **30** is slidably mounted on the external surface of the tubular mandrel and includes a plurality of arcuate slip members **31** which are carried by an annular resilient collar **32**, said collar having its lower portion molded or otherwise secured to the slip members. A metallic ring **33** is molded within the bore of the collar **32** and is adapted to slide on an axial straight section **26***a* which is formed at the upper end of the mandrel **25**. An annular external shoulder **34** is provided between the straight section **26***a* and the tapered slip-expanding surface **26** on the mandrel and functions to limit the lowering movement of the slip assembly on the exterior of said mandrel. The resilient collar **32** which carries the slips has its upper end flared outwardly to provide a peripheral sealing lip **35** which frictionally contacts and engages the wall of the well pipe to tend to restrict free movement of the slip assembly. Any pressure acting below the mandrel will tend to urge the same upwardly and the slip assembly, being held stationary by the frictional engagement of its collar **32**, will be acted upon by the conical expanding surface **26**, whereby said slips will be moved to their expanded gripping position, as shown in Figure 5.

An upper sealing element **36** which may be constructed of suitable elastic packing material is molder or otherwise secured to a metallic supporting sleeve **37** and this sealing element is of substantially the same construction as the lower sealing element **28** except that it has its peripheral sealing lip portion **38** directed upwardly. The supporting sleeve **37** is threaded onto the upper end of the mandrel **25** and has a bore **37***a* which is of substantially the same diameter as the bore **25***a* of the mandrel **25**. Any pressure above the plug A and acting in a downward direction will act against the upper sealing element **36** and will not only urge the sealing element into tight sealing engagement with the wall of the pipe but will also urge the mandrel **25** in a downward direction. Such downward movement of the mandrel will cause lowering of the mandrel with respect to the slips **31** because said slips

will be maintained substantially stationary by the frictional engagement of the carrying collar **32** of said slips with the wall of the bore. It will be thus apparent that the application of pressure to the upper end of the plug A will cause said plug to be moved downwardly through the end pipe.

The mandrel **25** is formed with a central cavity **39** within which a ball check valve **40** is mounted. Downward movement of the ball **40** is limited by radially disposed supporting ribs **41** which have flow passages **42** formed therebetween. A valve seat **43** is threaded into the bore **25***a* of the mandrel above the cavity **39** and is adapted to be engaged by the ball **40** upon upward movement of said ball to close upward flow through said bore. It will be apparent that the ball **40** is seated or unseated in accordance with pressures acting thereagainst and said ball constitutes an upwardly closing check valve. When the ball is unseated as shown in Figure 2, the passage is open but obviously fluid flow is deflected and restricted and such restriction is sufficient to permit the unit to be pumped downwardly by fluid pressure.

After the plug has served its purpose it is desirable that said plug be drilled out of the bore and it is therefore preferable that said plug be stopped at some point within the lower portion of the well pipe. For this purpose a landing collar **44** is mounted within a special sub **45** which may be connected within the well pipe **11** at any desired point. As illustrated the sub **45** is connected in the well pipe immediately above the lower cementing valve assembly although it is obvious that said sub may be disposed at any desired elevation. The landing collar **44** is preferably provided with an upwardly directed cam shaped lug **46** which is adapted to coact with a recess **47** formed in the lower portion of the mandrel when the plug A has been pumped downwardly into engagement with said collar. When it is subsequently desired to drill out the plug the drill will, of course, be engaged with the upper end of said plug and may initially tend to impart a rotation to the plug which would interfere with proper drilling out thereof. The upstanding lug **46** on the landing collar **44**, being engaged with the recess **47** in the upper end of the mandrel, will prevent rotation of the plug to assure that proper drilling out of the plug may be carried out.

It is also desirable that the metallic supporting sleeve **37** on which the upper sealing element **36** is mounted be formed with an upstanding cam shaped lug **48** which is substantially similar to the lug **46** of the landing collar **44**. The purpose of this lug is to inter-engage with the recess **47** of another plug assembly (not shown) which second plug assembly may be employed as the follower plug in the cementing operation. In other words, the plug is employed to prevent blowout in case of failure of the lower cementing valve or to render the differential filling valve **21** of Figures 1 and 2 inactive and after the pipe has reached its final position and cement is pumped downwardly through the pipe said plug will not interfere with the cementing operation. The pumped cement will pass through the plug A which lands on the collar **44** and the usual cementing follower plug behind the cement will follow the cement downwardly; upon said cement having been pumped through the lower plug the cementing follower plug (not shown) will engage the lug **48** of said lower plug. Upon subsequent drilling out both plugs will be held against rotation by the lugs **46** and **48** to facilitate the drilling out thereof.

From the foregoing, it will be evident that the improved plug A makes it possible to lower the pipe in any desired manner while assuring that a blowout cannot occur. Assuming that the cementing valve **13** (Figure 3) is employed in running pipe the pipe will be filled from the surface. In the event that said valve **13** becomes inoperative for any reason the plug A is inserted into the pipe **11** and is pumped downwardly therein and the pressure acting below the plug will move the mandrel **25** upwardly

with respect to the slip elements 21 and thereby firmly lock the plug against upward movement in the pipe. When this occurs the ball check 40 within the plug functions to prevent a blowout through the pipe and even though the cementing valve 13 has become inoperative the pipe string may be properly lowered and positioned in the well. Because the valve 40 is upwardly closing filling of the pipe from the surface may be carried out and so long as the pressure in the well bore is greater than the fluid within the pipe above the valve 40, said valve will remain closed. Of course, it is possible to discontinue filling when desired of the pipe and float the remainder of the pipe string into position. A subsequent washing or cementing operation may then be carried out through the plug and the pressure acting above the plug during such operations moves said plug downwardly in the well pipe until it finally engages the landing collar. Following the cementing operation the plug may be drilled out in the usual manner.

In practicing the improved method of running the pipe with the apparatus disclosed in Figures 1 and 2 wherein the pipe is automatically filled the well pipe is lowered a predetermined distance without the plug A in position and at such time an automatic filling of the pipe is accomplished by means of the differential valve 21. If the filling valve 21 fails to operate or if the cementing valve 18 becomes inoperative for back check purposes, the plug A may be immediately inserted into the pipe and subsequent lowering of the pipe may continue either by floating the pipe or by filling the same from the surface.

Assuming that the valve in Figures 1 and 2 functions properly until such time as it is desired to discontinue automatic filling of the pipe the plug A is inserted into the well pipe and will move downwardly until the pressure below the plug is sufficient to seat the slips 31. When this occurs the ball valve 40 is moved upwardly by the pressure therebelow and functions to close the bore of the well pipe. After the plug is so positioned the remainder of the pipe string may be floated or run dry into the well bore until it reaches its final position.

Following the final positioning of the pipe a cementing operation may be carried out by pumping the cement downwardly through the pipe and said cement under pressure will unseat the valve 40 to pass said valve. It is possible that the pressure of the pumped cement will also move the plug downwardly by acting against the upper sealing element to release the slips 31 and such downward movement will continue until the plug A engages the landing collar 44. The cement flows through the bore of the plug mandrel and is subsequently discharged through the lower cementing valve 18. The follower plug (not shown) which follows the cement column will eventually engage the plug A and at this time the cement will have been properly placed within the well bore. Any pressure below the plug tending to lift said plug functions to set the slips 31 and thereby firmly lock the plug against upward displacement. Since the plug A engages the lug 46 of the landing collar and the cementing follower plug (not shown) engages the lug 48 of the plug A, both plugs are held against rotation and may be readily drilled out after the cement is properly set.

It is obvious that the use of the plug A prevents blowout through the well pipe or casing during the lowering operation in the event the usual cementing valves fail for any reason. Also, said plug makes possible the practice of the new method of lowering pipe into the well bore whereby a portion of the pipe string may be automatically filled with fluid from the well bore and the remainder thereof may be subsequently floated into said bore. This method provides all of the advantages with respect to selectively filling and floating the pipe without the disadvantages of having to carry out the filling from the surface. The structure of the plug is such that it is automatically locked or set against upward displacement from therebelow and yet may be readily released so that it may be further lowered by the pressure from above.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having described the invention, I claim:

1. The method of lowering a pipe string into a well bore having fluid therein so that automatic filling of the pipe string may be first accomplished and thereafter floating of the pipe string from any selected elevation in the well bore may be accomplished which consists in, lowering a portion of said pipe string into the bore, automatically filling said portion of the pipe string by admitting fluid into said string from the well bore, then from the top of the pipe string bore closing the bore of the pipe string at a selected point in said string against further admission of fluid from the well bore, and subsequently running the remainder of said pipe string by floating the same into the well bore.

2. The method of lowering a well pipe in the fluid within a well bore so that automatic filling of the well pipe may be first accomplished and thereafter floating of the well pipe from any selected elevation in the well bore may be accomplished which consists in, lowering the pipe with its lower portion closed, periodically opening the lower portion of the pipe to permit entry of a predetermined volume of fluid from the well bore into the pipe, then closing the bore of the pipe at a selected point within the pipe bore above the fluid level therein, and subsequently lowering additional pipe into the well bore by floating into said bore that portion of the pipe above the point of closing.

3. The method of lowering a well pipe in the fluid within a well bore so that automatic filling of the well pipe may be first accomplished and thereafter floating of the well pipe from any selected elevation in the well bore may be accomplished which consists in, lowering the pipe with its lower portion closed, periodically opening the lower portion of the pipe to permit entry of a predetermined volume of fluid from the well bore into the pipe, then closing the bore of the pipe at a selected point within the pipe bore above the fluid level therein, subsequently lowering additional pipe into the well bore by floating into said bore that portion of the pipe above the point of closing, then opening the bore of said pipe in a direction to permit flow from the interior of the pipe outwardly therefrom when said pipe has been located in its final position in the well bore, whereby a cementing operation may be performed through the well pipe.

4. The method of lowering and cementing a well pipe in a well bore so that automatic filling of the well pipe may be first accomplished and thereafter floating of the well pipe from any selected elevation in the well bore may be accomplished which includes, lowering the pipe in the fluid within the well bore, periodically permitting the entry of fluid from the well bore into the well pipe during the lowering operation and until a portion of the well pipe string has been lowered, closing the bore of the well pipe against upward flow therethrough at a selected point within the pipe bore above the fluid level within the pipe, then lowering the remainder of the pipe string into the well bore to position the well pipe in its final position in the well bore, and pumping cement downwardly through the well pipe past the point at which the well pipe is closed against upward flow.

5. The method of lowering a pipe string into a well

bore so that automatic filling of the pipe may be first accomplished and thereafter floating of the pipe from any selected elevation in the well bore may be accomplished which includes, lowering the pipe string within said bore, closing the lower portion of said string against entry of fluid during lowering movement of the string, opening the lower portion of the pipe string when the same is stationary to admit fluid into the string to fill the same, continuing the lowering and filling of the pipe until a predetermined portion of the pipe string is within the well bore, then closing the bore of the pipe against upward flow therein at a selected point within the pipe bore above the fluid level therein to shut off further admission of fluid into the pipe string from the well bore, lowering the remainder of the pipe into the well bore and pumping cement downwardly through the pipe string and outwardly therefrom when the pipe string is disposed in its final position in the well bore.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 20,546	Otis	Nov. 2, 1937
2,029,380	Manning	Feb. 4, 1936
2,107,327	Creighton	Feb. 8, 1938
2,120,694	Crowell	June 14, 1938
2,136,015	Nicks	Nov. 8, 1938
2,139,983	Stone	Dec. 13, 1938
2,163,976	Edwards et al.	June 27, 1939
2,191,778	Swart	Feb. 27, 1940
2,211,846	Brown	Aug. 20, 1940
2,212,087	Thornhill	Aug. 20, 1940
2,249,511	Westall	July 15, 1941