

Sept. 15, 1942.

C. M. O'LEARY

2,295,803

CEMENT SHOE

Filed July 29, 1940

2 Sheets-Sheet 1

Fig. 1.

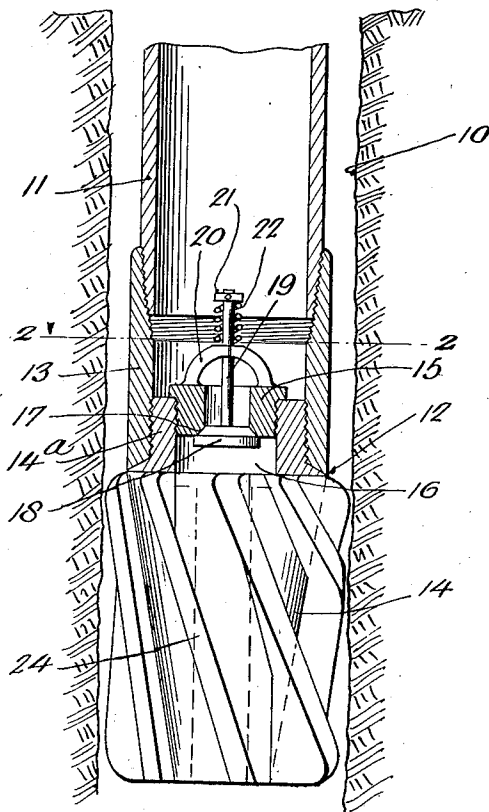


Fig. 2.

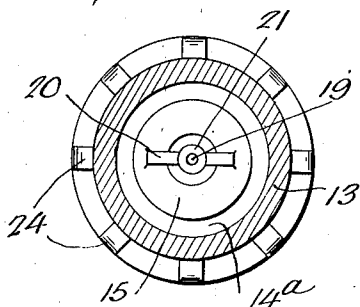
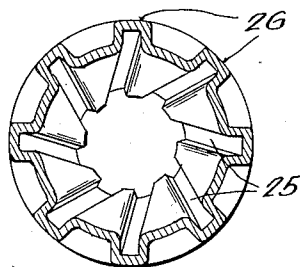


Fig. 3.



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Fig. 4.

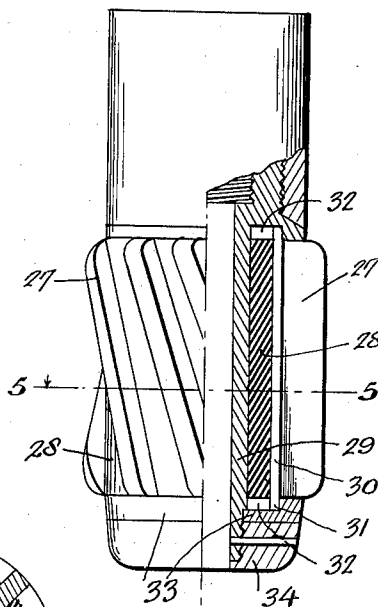


Fig. 5.

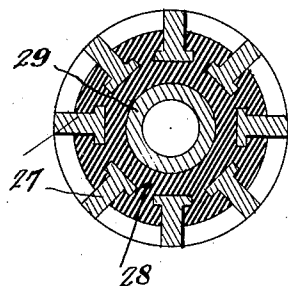


Fig. 7.

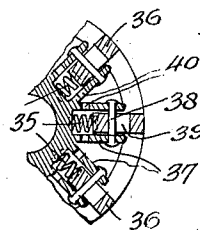
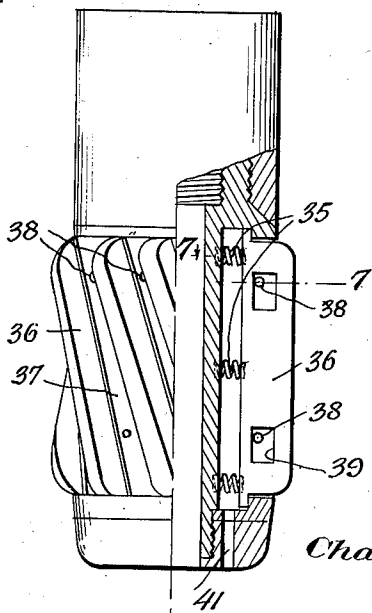


Fig. 6.



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CEMENT SHOE

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Application July 29, 1940, Serial No. 348,198

9 Claims. (Cl. 166—9)

The present invention relates generally to the setting and cementing of casing in the drilled bore of an oil well and has for its general purpose the provision of a cement or casing shoe of the guide shoe or float shoe type which will act to guide the casing into the well bore and also as a centralizer to hold the lower end of the casing spaced from the wall of the well bore when the position at which the lower end of the casing is to be set has been reached.

The invention has for a further object the provision of a cement shoe of the nature to impart a rotary motion to fluid emitted from the lower end of the casing as such fluid passes upwardly in the well bore around the casing, for the purpose of efficiently removing the mud sheath from the wall of the bore during circulation, as well as to evenly distribute cement around the casing during cementing operation.

A further object of the invention is the provision of a cement or casing shoe in the nature of a reamer adapted and arranged to reduce the normal clearance between the casing and the bore wall as the casing is run into the bore whereby the fluid in the well bore, prevented from passage upwardly in the casing, is forced to pass the restricted area between the reamer or shoe and the bore wall and, in so doing, is directed powerfully in a swirling manner against the wall, serving as an efficient means to coat with the reaming shoe in the removal of mud coating from the wall as well as to continuously wash the helical vanes of the shoe and maintain the same in a clean efficiently cutting condition.

A still further object is the provision of a cement shoe having the above mentioned useful advantages during the run in of the casing and the setting and cementing thereof in the bore, and which has the further advantage of yieldable contraction in the event constricted portions or tight spots of the bore wall are encountered, so as to avoid the possibility of sticking in the presence of swelling rock or other hard formation which circulation will not readily clear away.

With the above general objects in mind, other and further objects as well as the manner and means of carrying out the invention and its resulting advantages may be well understood and thoroughly appreciated in the course of the following detailed description thereof and by reference to the accompanying drawings, which form a part of the specification, and in which,

Figure 1 is a vertical longitudinal sectional view through a portion of a well bore showing

my improved shoe therein at the lower end of a casing string, partly in elevation and partly in section.

Figure 2 is a horizontal sectional view through the shoe of this invention taken substantially on line 2—2 of Figure 1.

Figure 3 is a detail horizontal sectional view through the guide nose showing a modified construction presenting internal flutes as well as external vanes.

Figure 4 is a side view of a modified shoe, partly in elevation and partly in section, along the line of one of the vanes in a solid yieldable bed.

Figure 5 is a cross section taken substantially on line 5—5 of Figure 4.

Figure 6 is a side view of another modified construction in which provision is made for vanes yieldable against springs, and

Figure 7 is a partial cross section taken substantially on line 7—7 of Figure 6.

Referring now to the drawings and particularly to Figure 1, the wall of the well bore is indicated at 10 and shown with a casing 11 suspended therein at the point selected for setting the lower end of the casing and also shown with the combination shoe of the present invention, generally indicated at 12, secured to the lower end of the casing, and comprising a collar portion 13 and a nose portion 14.

For the above purpose the nose of the shoe 12 has an upper threaded neck portion 14a within collar 13, which may also serve as a support for a valve cage 15, having an opening in line with the axial fluid passage 16 through the shoe.

While a back pressure valve may be disposed at any point within the casing 11, the lower end of cage 15 is shown as provided with a valve seat 17 around the lower end of its opening, against which a valve 18 seats to prevent upward or back flow from the well bore into the casing. This valve may be located at the lower end of a stem 19 which passes upwardly through a bridge 20 supported by cage 15. The stem 19 is also shown with an upper head 21 between which and the bridge 20 a spring 22 is compressed to normally hold valve 18 in upper seated position and at the same time permit the valve to yield downwardly for allowing outflow of circulating fluid as well as cement through the bore or flow passage of the shoe.

The nose portion 14 of the shoe as seen in Figures 1 and 2 is of downwardly tapering form below the collar 13 and has thereon external,

spaced, helically inclined vanes 24, whose external surfaces form substantially a cylindrical guide, the diameter of which is substantially greater than the outside diameter of the collar 13 and the casing 11, to closely approach the inside diameter of the well bore and thus among other things hold the lower end of the casing 10 substantially centered in the well bore.

As seen in Figures 1 and 2, the axial flow passage 16 of the shoe is plain, the external vanes 24 being solid ribs. However, as shown in Figure 3, the wall of the flow passage may be fluted by virtue of internal grooves 25 which preferably follow the external vanes 26 in this instance and act to impart a swirling motion to downwardly discharging fluid from within the casing.

In operation, the cement or casing shoe of the present invention, as thus far described, is screwed on the lower end of the casing and is run in on a series of tubular joints of the casing to the desired point in the well at which the casing is to be set. The nose portion of the shoe with its helical vanes acts to guide the casing around any bends or through rough places in the well bore during the run in and, when the casing is finely positioned, also acts to hold the lower end of the casing away from the wall so as to substantially centralize it in the well bore. Mud is then pumped down the casing through the valve cage on out at the bottom of the shoe through flow passage 16, which passage may be fluted, as above described in connection with Figure 3, with helically inclined grooves to cause the fluid discharged therefrom to be emitted in a swirling turbulent mass to clean the well bore ahead of or below the shoe. If bridges in the well are encountered this optional internally fluted structure enables them to be more readily washed away.

During the above circulating operation the fluid pumped down the casing returns up to the surface in the space between the casing and the wall of the well bore and, as the fluid rounds the nose of the guide shoe in its upward travel, its course is changed by the helically inclined vanes on the outer surface of the guide nose so that under the pressure and volume of the fluid being discharged past the shoe, great force is imparted to the fluid for scouring the wall of the well bore.

If there is any tendency for the shoe and the casing to lay toward one side of the well bore more than the other, fluid will be directed from the opposite side and will wash a channel and finally open up a space completely around the casing, allowing a full and complete encirclement of cement, and cleaning the mud from the wall of the well bore so as to insure a perfect water shut off.

With the back pressure valve closed, wherever such valve is located in the lower portion of the casing string as the casing is lowered into the well bore, the fluid in the well bore is prevented from upflow in the casing and is thus displaced upwardly between the shoe and the bore wall and is given a swirling movement by the helically inclined vanes. Furthermore, since the vanes extend outwardly beyond the casing and closely approach the wall of the well bore, the fluid in passing the same is given a substantially increased velocity which, with the swirling movement thereof, causes substantially a jetting action of the fluid against the mudded wall so as to effectively accomplish removal of the mud sheath.

It is obvious from the foregoing that the guide vanes also help to remove the mud sheath by a washing, scraping or reaming contact with the

bore wall, and that the jetting fluid passing upwardly around the shoe keeps the guide vanes clean of mud and maintains them operative and effective as a wall scraper or reamer at all times.

While materials have not thus far been referred to, it will be understood that the nose of the shoe, and any parts thereof, are to be formed of any suitable drillable material so that such parts may be readily drilled out after the cementing operation incident to the setting of the casing, has been completed.

As before referred to in a general way, it may be desirable to have the helical ribs or vanes of the shoe nose capable of inward yielding movement so that contraction of the overall diameter of the shoe nose may be possible when encountering tight spots in the bore. To prevent sticking of the tool under such circumstances, the ribs or vanes may be formed entirely of rubber, or may as seen at 27 in Figures 4 and 5, be made of any suitable material partially embedded in rubber 28 molded around a tubular nose 29. If made of a rigid material, it is preferable that the ribs or vanes 27 be provided with side flanges 30 along their inner longitudinal edges embedded in the rubber 28, and with end flanges 31 to extend into cavities 32 in the shoe nose and a ring 33, the latter held by a threaded and pin-locked end piece 34.

It is, of course, possible to dispense with the use of molded rubber by utilizing small springs as shown at 35 in Figures 6 and 7, beneath the ribs or vanes 36 movably supported in this instance between radial walls 37 of the shoe nose. Through such walls 37 cross pins 38 may be fixed to extend through enlarged slotted openings 39 of the vanes 36, permitting the latter to yield inwardly against the tension of springs 35.

With the above construction it is preferable to have openings 40 through the walls 37 and possibly also through the end piece 41, to avoid any danger of entrapping well pressure or fluid behind the vanes which might otherwise prevent their freedom of movement to contract whenever necessary during run in.

As there is a tendency for the helically vaned shoe to rotate, going into the well bore, as well as in circulation and pumping operations, it will be understood that the vanes should incline in a direction calculated to tighten, rather than loosen, the threaded joints of the casing sections.

Having thus fully described the invention, what is claimed is:

1. A cement or casing shoe for the lower end of well casing in the setting thereof, including a nose portion having a downwardly tapering body below the casing provided with flexible helically inclined external surface vanes outstanding substantially beyond the diametrical limits of the casing.

2. A cement or casing shoe for the lower end of well casing in the setting thereof, including a nose portion having a downwardly tapering body below the casing provided with flexible helically inclined surface vanes outstanding substantially beyond the diametrical limits of the casing and whose outer edges present a cylindrical casing guiding and bore wall scraping surface of substantially the same diameter throughout the length of the nose.

3. A cement or casing shoe for the lower end of well casing during run in and setting of the casing within a well bore, said shoe having a body portion below, and of substantially greater overall diameter than the casing, said body being pro-

vided with an internal flow passage and external helically inclined vanes, the wall of said flow passage having helically arranged grooves.

4. A cement or casing shoe for the lower end of well casing in the setting thereof, having a flow passage lengthwise thereof and having a nose portion below the casing provided with external vanes for causing swirling of fluid or material forced upwardly between the shoe and the wall of a well bore and a molded rubber bed on the said nose portion in which said vanes are partially embedded and yieldingly supported.

5. A cement or casing shoe for the lower end of well casing in the setting thereof, having a flow passage lengthwise thereof and having a nose portion below the casing provided with external vanes for causing swirling of fluid or material forced upwardly between the shoe and the wall of a well bore and means yieldingly supporting said vanes on the shoe whereby the series of vanes may contract to pass a tight spot in a well bore.

6. A cement or casing shoe for the lower end of well casing in the setting thereof, having a flow passage lengthwise thereof and having a nose portion below the casing provided with external vanes for causing swirling of fluid or material forced upwardly between the shoe and the wall of a well bore, means on the shoe for supporting said vanes in radially shiftable relation with respect thereto, and means yieldingly holding said vanes against inward movement.

7. A cement or casing shoe for the lower end of well casing in the setting thereof, having a flow passage lengthwise thereof and having a nose portion below the casing provided with external vanes for causing swirling of fluid or material

forced upwardly between the shoe and the wall of a well bore, and means on the shoe for supporting said vanes in radially shiftable relation with respect thereto and limiting their movement in an outward direction, and springs between the shoe and the vanes for yieldingly resisting their inward movement.

8. A cement or casing shoe for the lower end of well casing in the setting thereof within a well bore, said shoe having a flow passage there-through forming with the interior of the casing an inner circulation channel including a back pressure valve, and said shoe having a lower nose portion provided with external helical vanes whose outer faces present substantially a cylindrical surface of considerably greater diameter than that of the casing and closely approaching the diameter of the well bore.

9. A cement or casing shoe for the lower end of well casing in the setting thereof within a well bore, said shoe having a flow passage there-through forming with the interior of the casing an inner circulation channel, and said shoe having a lower nose portion provided with external helical vanes whose outer surfaces present substantially a cylindrical yielding surface of considerably greater diameter than that of the casing, said helical vanes being arranged relative to one another to form substantially narrow channels therebetween, for thus substantially increasing the velocity of upflowing well fluid past the shoe nose whereby to bring about a jetting action of such fluid against the mud sheath of the bore wall.

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