July 3, 1945. W. W. WHATLEY, 2D 2,379,558

RETRIEVABLE SQUEEZING TOOL FOR WELLS

Filed May 21, 1942

Fig. 1.

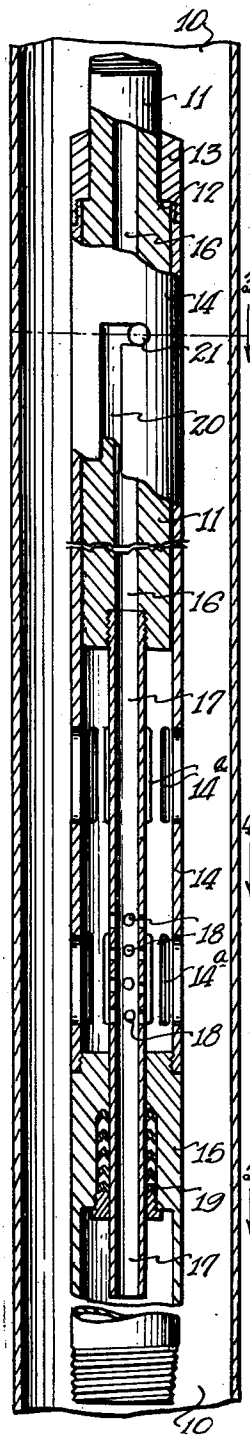


Fig. 2.

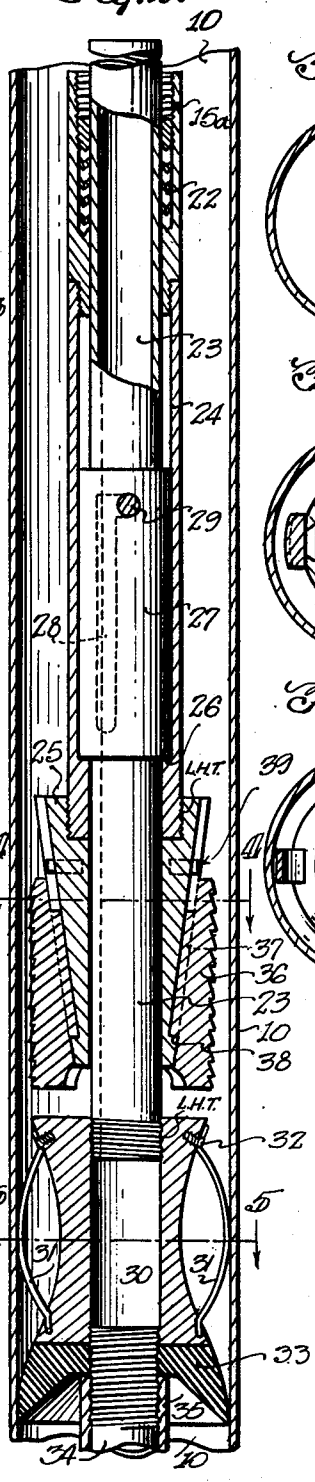


Fig. 3.

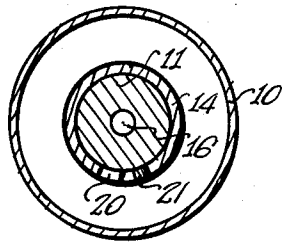


Fig. 4.

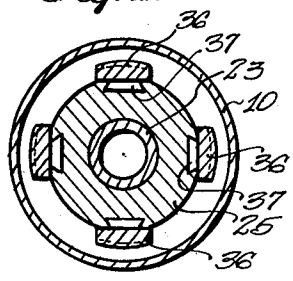


Fig. 5.

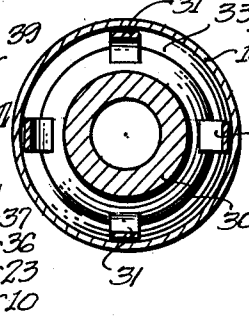
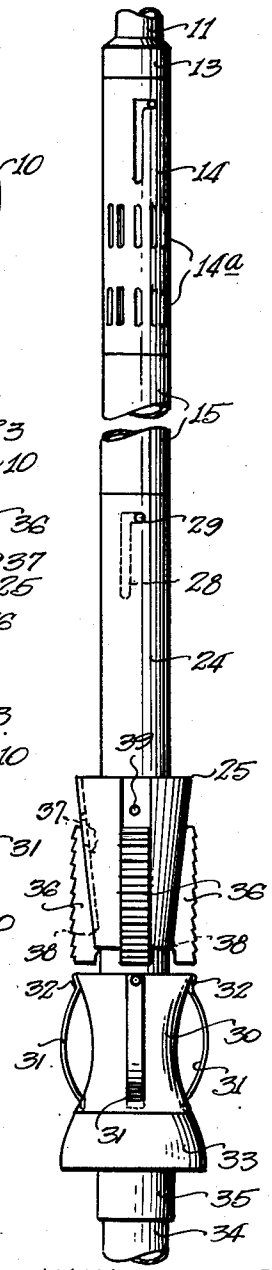


Fig. 6.



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RETRIEVABLE SQUEEZING TOOL FOR WELLS

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Application May 21, 1942, Serial No. 443,905

4 Claims. (Cl. 166—1)

This invention relates to well cementing apparatus and it has particular reference to a retrievable squeezing tool for wells.

The principal object of the invention is to provide a tool, supported from and actuated by a string of pipe in a well and through which a mixture of water and cement may be directed below a cup packer carried by the tool into the formation in one position of the supporting string and upon elevating the string, the tool may be opened to permit pumping the cement out of the well between the casing into which the tool is run and the pipe from which it is suspended. Accordingly, the tool is retrievable and by thus controlling the mixture of cement and water, it is not required that the tool remain in the well to be drilled out as has been the practice in the past. Moreover, the invention provides that when the tool is opened for introduction of the cement into the well below the cup packer by slacking off on the supporting string, the cement contacts the formation and since it will not penetrate the latter, it tends to build up a wall, through which water under pump pressure is squeezed into the formation, leaving the cement in an initial stage of setting, the tool acting as a bridge to concentrate the pressure towards a designated area.

Another and equally important object of the invention is to provide a tool of the character set forth whose construction is such that all parts of the tool are retrievable under any and all conditions which feature is due chiefly to the fact that to pick up the tool after completion of a job, no easing off or rotation of the supporting string is required, hence there is little likelihood that the cement surrounding the tool will prevent its ready withdrawal from the hole.

Another object of the invention is to provide a retrievable squeezing tool having slips whose effectiveness is increased by increasing hydrostatic pressure to prevent the latter from displacing the tool from its position in the hole.

Still another object of the invention is to provide a cup with an attendant packer, serving the dual function of centering the tool in the casing and holding the latter against rotation during operation thereof at the surface.

With the foregoing objects as paramount, the invention has particular reference to certain salient features of construction and arrangement of parts, to become manifest as the description proceeds, taken in connection with the accompanying drawing, wherein:

Figure 1 is an elevational view of the upper portion of the tool, partly in vertical section.

Figure 2 is a continuation of the tool showing the lower portion thereof, also, partly in vertical section.

Figure 3 is a transverse section on line 3—3 on Figure 1.

Figure 4 is a transverse section on line 4—4 on Figure 2.

Figure 5 is a transverse section on line 5—5 on Figure 2, and

Figure 6 is a complete side elevational view of the tool.

Continuing with a more detailed description of the drawing, reference is primarily made to Figure 1 wherein 10 denotes a section of well casing in which the tool is suspended, the latter comprising primarily an upper mandrel 11, threaded at its upper end for suspension from a pipe or tubing string, not shown. An annular shoulder 12 is provided on the mandrel 11 near its upper end to bear against an internal shoulder formed in a collar 13 embracing the mandrel and into which is threaded the upper end of a tubular case 14 having slotted outlet ports 14a in its walls. The lower end of the case 14 supports a valve section 15 to which further reference will be made presently.

The mandrel 11 has an axial fluid passage 16 into the lower end of which is threaded a valve tube 17, the latter extending downwardly through the case 14 and into the valve section 15. Fluid outlet ports 18 are provided in the tube 17 at a point spaced above the lower end thereof. That portion of the tube 17 below the ports 18 which extends into the valve section 15 is slidably embraced by packing means 19.

Continuing with Figure 1, it will be noted that the case 14 has an inverted L-slot 20 in its wall which slidably receives a pin 21 carried by the mandrel 11. It is apparent therefore that when the mandrel 11 is rotated by the supporting string to bring the pin 21 into alignment with the longitudinal portion of the slot 20, with the tool itself held against downward movement, the mandrel can be lowered to position the ports 18 of the valve tube 17 below the packing 19. The results of this action will be made manifest in the description of operation to follow presently.

Referring now to Figure 2, an outer section 15a is shown attached to the lower end of the valve section 15 and contains packing rings 22 which embrace the lower mandrel 23 for obvious reasons. Below the section 15a is suspended a

second or lower case 24 in which the mandrel 23 is slidable, the upper end of the latter being open, as shown. It will also be observed that the axial passage through the lower mandrel is of greater diameter than that of the upper mandrel 11. This is of no importance since the diameter of the passages can be the same.

The case 24 has its lower end threaded into the upper end of a conical shaped expander 25 by means of left-hand threads, so identified on the drawing and at this point, the case is upset to form an internal shoulder 26 upon which rests the lower end of an intermediate section 27 of the mandrel which is of larger diameter than the ends thereof. Intermediate the ends of this section 27, there is provided an inverted L groove 28 in which slides a pin 29 mounted in the case 24. It is apparent therefore that unlike the pin and slot combination earlier described, the mandrel in this instance is actuated by the case instead of the contrary, insofar as manual control is concerned.

Mounted on the extreme lower end of the mandrel 23 by means of left-hand threads is a cup retainer 30 having radially arranged, outwardly bowed leaf springs 31. The lower ends of these springs are retained in recesses provided about the lower end of the cup retainer while the upper ends are secured by screws 32. The midsections of these springs engage the walls of the casing 10 to center the same and to hold the mandrel 23 against rotation while other parts of the tool are being actuated into position.

Immediately below the cup retainer 30 is a packer cup 33 held in secure relation thereto by means of a threaded member 34 and a collar 35.

Mounted for axial sliding movement in the expander 25 are slips 36. These slips are provided with dove-tail tongues 37 (Figure 4) which are received by correspondingly shaped grooves in the walls of the expander but terminate short of either end of the slip as clearly apparent in Figure 2. The lower ends of the tongues rest upon shoulders 38 in the grooves of the expander when the slips are in retracted position, to prevent their release from the grooves. When the slips are expanded, upward movement thereof is limited by pins 39 in the grooves of the expander.

In operation, the tool is lowered into the casing 10 by the tubing string, (not shown) until the packer 33 rests a few feet above the casing shoe. Frictional contact of the springs 31 against the wall of the casing holds the upper case 14 while the mandrel 11 is being rotated to move pin 21 into the vertical portion of slot 20 and which permits subsequent rotative torque to be transmitted to lower case 24 to similarly align pin 29 with the vertical portion of slot 28.

By slacking off on the tubing by which the tool is suspended the slips 36 are expanded against the casing 10 and the valve tube 17 is moved downwardly so that the ports 18 will be disposed below the packing 19. In this position of the valve tube, the mixture of water and cement is directed below the packing 19 into the formation through the hollow mandrel 23 and by picking up the tubing string, the mandrel 11 is elevated, bringing with it the tube 17, disposing ports 18 above the packing 19. In this latter position of tube 17, the mixture of water and cement is pumped out into the well through ports 18 and slots 14a between the casing 10 and the tubing suspending the tool. This method of handling the mixture is herein referred to as controlling the mixture of cement and water.

When the cement and water is directed below the packing 19 by slacking off on the tubing, the cement contacts the formation, as explained, and since the cement is of metallic substance, it will not penetrate the formation but instead, will build up a wall and by pump pressure the water is squeezed through this cementitious wall into the formation, leaving the cement in an initial stage of setting. The tool acts as a bridge to concentrate the pressure on a designated area. By this pump pressure, the water is expelled or squeezed from the cement.

Frequently, when a squeeze job is in progress, the hydrostatic head or pressure is so great inside the suspending pipe or tubing that it is impossible to release this pressure without leaving the tool in the hole to be drilled out. By virtue of the provision for elevating the valve tube 17, as described or, in other words, by passing the mixture, the pressure is automatically released and it is possible to pull the tool out of the casing in which it is run without necessity for backing up since upward movement exerted on the tool by the tubing string automatically releases the slips 36.

Manifestly, the construction as shown and described is capable of some modification and that such modification may be construed to fall within the scope and meaning of the appended claims is also considered to be within the spirit and intent of the invention.

What is claimed is:

1. A retrievable apparatus for use in cementing wells, including in combination with the tubing of a well, an elongated and slotted tubular case having an internal shoulder adjacent its upper end, a vertically reciprocable, hollow mandrel suspended by said tubing and having an external shoulder corresponding to and engageable with the shoulder of said case, by which the apparatus is suspended in said casing, a valve tube depending from said mandrel within said case, having fluid outlet ports, packing means within said case intermediate its ends through which said tube is constrained to slide upon reciprocation of said mandrel, a second hollow mandrel reciprocable in said case below said packing means, a casing packer on the lower end of said second mandrel having spring means frictionally engaging said well casing to hold said second mandrel against rotation, an expander and slips embracing said second mandrel above said casing packer and means effective upon limited rotation of said tubing to release said first and second mandrels successively for reciprocal movement in said case to actuate said slips and to move said valve tube in relation to said intermediate packing means.

2. Apparatus of the character described including in combination with a string of tubing in a well, an elongated, tubular body having an internal shoulder at its upper end, slots intermediate its ends and a centrally bored packing means below said slots, a hollow, reciprocable mandrel in said case, connected to said tubing string and having an external shoulder engaging that of said case to support the latter for relative rotation, a perforated valve tube depending from said mandrel, a second hollow and reciprocable mandrel in and extending below said case, a casing packer on the extended end of said latter mandrel having means frictionally engaging said casing and holding said second mandrel against rotation, expandable means on

said latter mandrel above said casing packer and means effective upon rotation of said tubing string for releasing said mandrels successively for downward movement to respectively actuate said expandable means and to reciprocate said valve tube in the bore of said packing means.

3. Apparatus of the character described including in combination with the tubing string of a well, an elongated, slotted case, centrally bored packing means in said case below said slots, a hollow mandrel connected to said tubing string and shouldered to suspend said case exteriorly thereof for relative rotative and reciprocative movement, a tube depending from said mandrel within said case, having perforations adjacent the lower end thereof and slidable in the bore of said packing means, a second hollow mandrel in said case below said packing means and extending below said case, a casing packer carried by the lower end of said second mandrel having means for holding the latter against rotation, expandable slips embracing said mandrel above said packer and means effective upon rotation of said tubing string to release said mandrels successively for downward displacement to respectively actuate said slips and to move said perforated tube in the bore of said packing means.

4. Apparatus of the character described including in combination with the tubing string in a well, a hollow mandrel suspended by said tubing string, an elongated and slotted case rotatably enclosing said mandrel and having a centrally bored packing means therein below said slots, a perforated tube depending from said mandrel and adapted to reciprocate in the bore of said packing means to dispose the perforations thereof above and below said packing means, a second hollow mandrel in said case and extending below the latter, a casing packer on the extended end of said mandrel, means thereon for holding the latter against rotation during limited rotation of said tubing, first mandrel and case, expanding slips also carried by said second mandrel and means effective upon limited rotation of said first mandrel and case to release said mandrels successively for reciprocation to actuate said expanding means and said perforated tube in relation to said packing means.

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