

Feb. 11, 1958

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2,823,012

WHIP STOCK LOCKING AND RELEASING APPARATUS

Filed Feb. 6, 1956

2 Sheets-Sheet 1

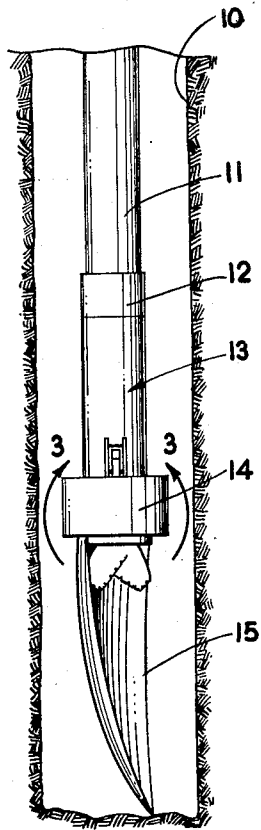


FIG. 1

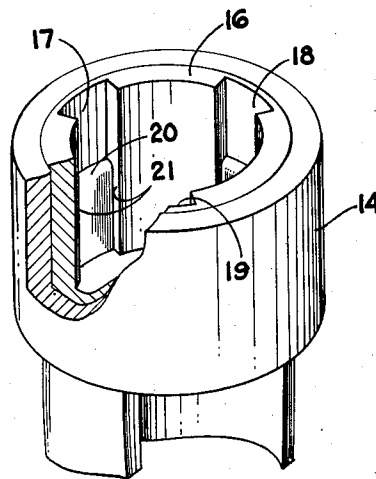


FIG. 2

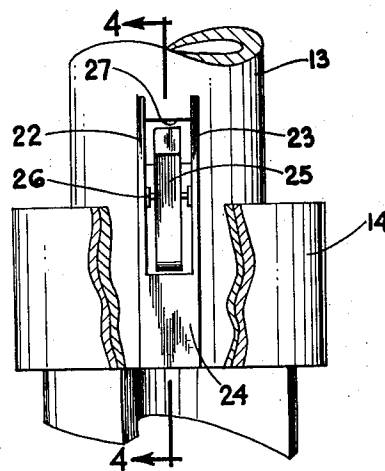


FIG. 3

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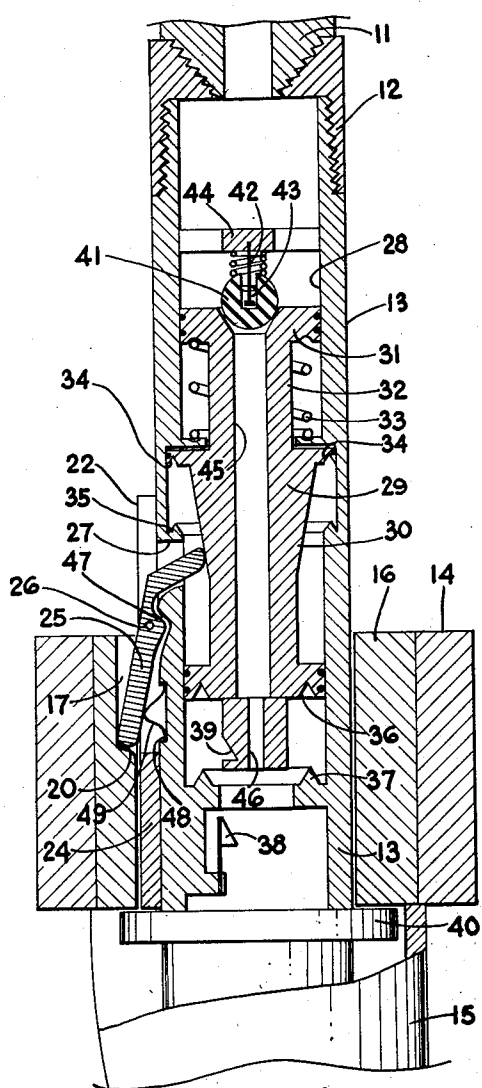


FIG. 4

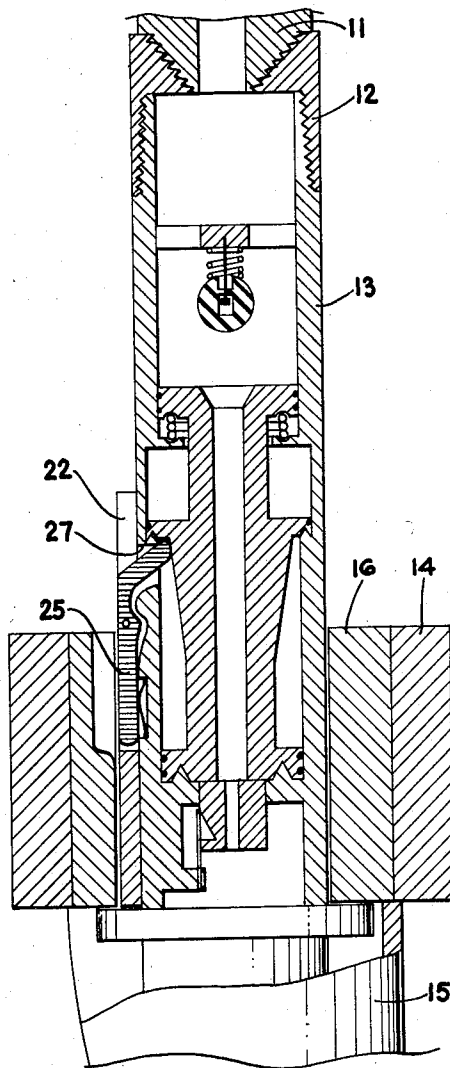


FIG. 5

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WHIP STOCK LOCKING AND RELEASING APPARATUS

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Application February 6, 1956, Serial No. 563,532

12 Claims. (Cl. 255—1.6)

This invention relates generally to oil tools and more particularly to a tool adapted to be inserted between a string of drill pipe and a drill bit for holding a whip stock in a desired position while it is being lowered into an oil well bore hole.

In the lowering of conventional type whip stocks for the purpose of deflection drilling, there is often encountered difficulty in properly positioning the whip stock in the bottom of the bore hole in a desired orientation. Normally, the collar portion of the whip stock is supported by the end of the drill pipe string with one shear pin. After the whip stock is in position at the bottom or at an intermediate location in the bore hole, the pin is intentionally broken or sheared when the drilling commences. After the shear pin is broken, movement of the drill pipe string through the collar portion of the whip stock can often move the whip stock from its desired orientation, although once the drill pipe string has passed through and wedged the whip stock into tight engagement with the side walls of the bore hole, the whip stock will remain in its set position.

Another difficulty in lowering conventional whip stocks is their tendency to arcuately swing about the shear pin as a pivot point. There is thus the possibility of the whip stock becoming caught in cave portions of the bore hole side walls or hung up by bridges and like obstructions during the lowering process.

Bearing the above noted difficulties in mind, it is a primary object of the present invention to provide an improved means for holding a conventional type whip stock to a drill pipe string while it is being lowered into a bore hole in a manner such that swinging movements and the possibility of the whip stock becoming dislocated after once being positioned on the bore hole bottom are avoided.

More particularly, an object is to provide a whip stock locking and releasing means which will hold the whip stock in a rigid position with respect to the drill pipe string while it is being lowered into the bore hole, and which will retain the whip stock in its initially set orientation during the first downward movements of the string through the whip stock collar portion, whereby once the whip stock is set in a desired position, it will remain substantially in such position.

Still another object of this invention is to provide a whip stock securing means which may be operated from the surface of the bore hole for releasing the whip stock from the end of the drill pipe string once it has been lowered into a desired position at the bottom of the bore hole.

These and other objects and advantages of this invention are attained by providing a series of longitudinal channels in the inside collar portion of the whip stock. A pipe section having a series of longitudinal flanges projecting from its side walls adapted to engage the channels of the whip stock collar, is designed to be inserted between the drill pipe string and drilling bit. The whip stock is thus

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secured against rotation with respect to the drill pipe string when it is being lowered in the bore hole.

There is also provided in one or more side walls of the pipe section suitable lever elements pivoted adjacent the flange portions and adapted to swing laterally outwardly to engage mating shoulder portions within the corresponding channels. When the lower ends of the lever elements are seated on the shoulder portions, the drill pipe string is locked against longitudinal or axial downward movement through the collar. An annular ring of sufficient diameter is provided on the lower portion of the pipe section adapted to engage the underside of the collar portion to prevent axial upward movement of the pipe section and pipe string with respect to the collar portion.

Thus, the interengaging flanges and channels prevent rotation and arcuate swinging of the whip stock relative to the drill pipe string, while the various lever elements in their laterally extending positions in co-operation with the annular ring prevent relative longitudinal or axial movement between the whip stock and the drill pipe string.

Within the pipe section there is provided a piston having a central passage for passing mud from the drill pipe string out through the drill bit. The piston is also provided with sloping side wall portions adjacent suitable slot openings arranged to receive the upper ends of the pivoted lever elements. The levers are so designed that their upper ends bear against the sloping side walls of the piston whereby downward movement of the piston cams these upper portions outwardly to retract the lower ends of the lever elements and thus free them from the shoulders in the collar portion channels. A mud passage control means is provided for enabling mud pressure above the piston in the pipe section to build up to a value sufficient to force the piston downwardly when it is desired to move the drill pipe string on through the whip stock collar for commencing an offshoot drilling operation. After the lever elements have been retracted, the entire drill pipe string is lowered on through the collar portion, but relative rotation or a disorientation of the whip stock is prevented during the initial movements of the drill pipe string as a result of the flange members on the pipe section side walls still engaging the longitudinal channels cut in the collar portion. By the time the flanges pass out below the channels, the whip stock is sufficiently wedged into the formation to prevent any serious possibility of becoming angularly moved from its desired orientation.

A better understanding of the invention and its various features and advantages will be had by referring to the accompanying drawings, in which:

Figure 1 is an elevational view of the whip stock locking and releasing apparatus of this invention shown secured to the end of a string of drill pipe in position at the bottom of a bore hole;

Figure 2 is an enlarged perspective cutaway view of a collar portion of the whip stock of Figure 1;

Figure 3 is an enlarged side view partly cut away of a portion of the whip stock locking and releasing apparatus;

Figure 4 is an enlarged cross sectional view of the locking and releasing apparatus in locked position taken in the direction of the arrows 4—4 of Figure 3; and,

Figure 5 is a view similar to Figure 4 showing the locking and releasing apparatus in released position.

Referring to Figure 1, there is illustrated an oil well bore hole 10 within which is shown the lower end portion of a string of drill pipe 11 coupled by a tool joint 12 to a pipe section 13 constituting the whip stock locking and releasing apparatus of this invention. As shown, the pipe section 13 is surrounded at its lower end by the collar 14

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of a conventional whip stock 15. The drilling bit is secured below the collar 14 to the end of the locking and releasing pipe section 13, a portion of the bit being visible in Figure 1.

Referring now to Figure 2, the collar portion 14 of the whip stock is shown in greater detail. In accordance with a feature of the invention, the inside collar portion 16 is provided with a series of longitudinally cut channels 17, 18 and 19. This inside portion 16 may comprise an insert which may be secured within the conventional whip stock collar 14, or the whip stock may be initially provided with a sufficiently thick collar to enable the desired channels to be cut therein. Each of the channels 17, 18 and 19 are circumferentially spaced 120° and are provided substantially midway of their length, with a shoulder 20, the remaining portions of the channels below the shoulders being shallower, but still having side wall portions 21.

Referring to Figure 3, the side wall portions 21 of each of the channels are adapted to receive flange means in the form of two parallel flange projections 22 and 23 secured in a longitudinal direction to the pipe section 13. The two flanges 22 and 23 terminate in a solid block portion 24 at their lower ends as also clearly shown in Figure 3. The distance between the channels 22 and 23 is dimensioned such that the outside walls of the flanges will engage the inside wall portions 21 of the channel in a closely fitting relationship whereby the pipe section 13 is locked against relative rotation with respect to the collar portion 14 when the flanges are engaged within the respective channels. The channels 18 and 19 are similarly adapted to receive corresponding flange means running longitudinally along the side walls of the pipe section 13 (not shown). Since the construction of the flanges and channels are identical for all three, description of one will suffice for all.

Referring again to Figure 3, there is provided a lever element 25 pivoted for swinging movement in a vertical plane as by a pivot pin 26 extending between the flanges 22 and 23. The upper end of the lever element 25 is adapted to be received in a slot opening 27 in the pipe section 13, while the lower end of the lever element is adapted to seat against the shoulder 20 of the corresponding channel within which the flanges 22 and 23 are disposed. This first position of the lever element 25 is best shown by reference to Figure 4 taken in the direction of the arrows 4—4 of Figure 3.

Referring to Figure 4, the pipe section 13 is shown secured at its upper end to the lower portion of the pipe string 11 by the tool joint 12. This joint is in the form of an adapter whereby the inside diameter of the pipe section 13 may be made somewhat larger than the inside diameter of the conventional drill pipe 11. As shown, the upper portion of the pipe section 13 includes an inner cylindrical chamber 28 within which there is mounted for reciprocal up and down movement a piston member 29 elongated in form and provided with sloping or tapered side wall surfaces 30. The sloping surface is juxtaposed the slot opening 27 through which the upper end of the lever element 25 projects. The upper end of the piston member 29 includes a piston head 31 provided with suitable sealing rings for engagement with the sides of the cylindrical chamber portion 28, and a reduced diameter portion below the piston head 31 leaving an annular recess 32 within which is disposed a compression spring 33. The upper end of the spring 33 engages the underside portions of the head 31 while the lower end seats on an annular ledge projecting radially inwardly from the side wall of the pipe section 13 as shown. The compression spring thus biases the piston 29 in an upward direction until an enlarged diameter portion immediately above the sloping side walls 30 engages the underside of the annular ledge projection. This enlarged diameter portion includes an annular groove 34 adapted to receive an annular rib 35 when the piston 29 is moved to its downward position as

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shown in Figure 5, thereby providing a fluid tight seal to prevent mud from passing through the slot opening 27 to regions above the piston member.

Similarly, at the lower end of the piston member 29 there is provided an enlarged diameter portion having an annular groove 36 adapted to engage a rib 37 projecting from the inner side walls of the pipe section 13, when the piston is in its downward position. There is also provided a latch 38 receivable in a detent 39 in the lower body portion of the piston member to hold the piston member in its downward position against the compression of the spring 33, as also clearly shown by reference to Figure 5.

Below the latch means 38 the pipe section 13 includes an annular ring flange 40 of larger diameter than the inside diameter of the collar portion 16 such that the lower end of the collar is engaged by the upper surface of the ring whereby the whip stock 15 is prevented from moving axially off the end of the pipe section 13. Axial movement of the collar with respect to the pipe section in the opposite or upward direction is prevented by the lower end of the lever element 25 bearing against the shoulder 20 of the channel 17.

Referring to the upper portion of the pipe section 13 there is provided a mud passage control means in the form of a ball check valve 41 limited in movement by a stem 42 having an enlarged head vertically movable in a recessed space 43 in the ball. The upper end of the stem 42 connects to a spider support 44 secured rigidly to the inside walls of the pipe section 13. A spring is arranged as shown to normally bias the ball 41 against the upper opening of a conventional mud passage 45 passing through the central portion of the piston 29. By this arrangement, the downward movement of the ball 41 upon downward movement of the piston 29 is limited by the enlarged head portion of the stem 42 engaging the upper end of the recessed space within the ball all as shown clearly in Figure 5. Thus, when the piston 29 is in its downward position, the mud passage 45 is opened to permit circulation of mud through this passage and out the end passage portion 46 on through the pipe section to the drill bit.

An important constructional feature of the pipe section 13 resides in the wall portion adjacent the flanges 22 and pivot point 26 of the lever element 25. As shown clearly in Figure 4, this wall is provided with an undercut portion 47 which is adapted to engage a similarly contoured portion on the lever element 25. By this arrangement, compression forces transmitted through the lever element 25 from the shoulder 20 are borne by the undercut portion 47 rather than the pivot pin 26, thereby relieving the pivot pin of this load. The wall portion immediately below the pivot pin 26 is also provided with a cavity 48 retaining a leaf spring 49 normally biasing the lower end of the lever element 25 outwardly.

The operation of the apparatus will be evident from the above description. In securing the whip stock to the end of the drill pipe, the pipe section 13 with the bit secured to one end thereof, is passed through the collar 14 of the whip stock so that its upper end is in position to be engaged by the last pipe in the drill pipe string shown as 11 in Figures 4 and 5. The piston member 29 is held in its upward position by the compression spring 33. In this position, the biasing spring 49 urges the lever element 25 outwardly against the inside of the channel 17 whereby the lower end thereof is seated on the shoulder 20. The relative position of the whip stock is noted with respect to the drill pipe string so that it may be properly oriented by rotating the drill pipe string when the whip stock has reached the bottom of the bore hole.

With the various components of the pipe section 13 shown in the position of Figure 4, it will be readily appar-

ent that the drill pipe string 11 is locked against relative rotation with respect to the collar 14 in view of the side flanges 22 and 23 within the corresponding channel 17 and the other flanges (not shown) in the other corresponding channels 18 and 19. It will also be clear that relative axial movement of the whip stock and drill pipe string 11 is prevented by the various lever elements such as the lever element 25, in engagement with the shoulders such as the shoulder 20, in the corresponding channels and by the lower ring 40 resting against the bottom portion of the collar.

The collar 14 is of sufficient axial length that the whip stock is held in rigid position against swinging motion while it is being lowered in the bore hole. Thus, the possibility of the whip stock engaging bridges or caves in the bore hole during the lowering process are substantially reduced.

When the whip stock reaches the bottom of the bore hole and is properly oriented, the mud pressure is raised by the mud pump at the surface of the bore hole to increase the pressure within the cylindrical chamber portion 28 of the pipe section 13. This increase in pressure is sufficient to initially move the piston member 29 in a downward direction. A large pressure is built up inasmuch as the mud passage 45 is closed off by the ball 41; however, after initial motion of the piston 29 overcoming the starting friction, not as much pressure is necessary to maintain the piston 29 in its downward movement. Therefore, it is not necessary that the passage 45 continuously remain closed. However, to insure that sufficient mud pressure is established to maintain the piston in its downward movement, a control means in the form of a restricted orifice 46 may be provided in the lower end of the mud passage.

As the piston member 29 moves downwardly, the sloping wall 30 will cam the upper end of the lever element 25 outwardly to swing the element in a counter clockwise direction about the pivot pin 26 as viewed in Figures 4 and 5, thereby retracting the lower end portion of the lever element from the shoulder 20. The retracted or closed position of the lever element 25 is clearly shown in Figure 5 with the piston member 29 in its downward position. The other lever elements spaced 120° about the pipe section are simultaneously retracted in the same manner.

It will be noted that in the downward position the various stops comprising the grooves 34 and 36 and the mating annular ribs 35 and 37 at the upper and lower ends of the piston respectively, are in tight engagement whereby mud is prevented from passing through the open slots, such as the slot 27, into the portions of the pipe section above and below the piston. It will also be noted by reference to Figure 5 that in the downward position, the piston member 25 is retained and locked in position by the latch 38 engaged within the detent 39 at the lower end of the piston. Further, the ball 41 is limited in downward movement by the stem end 43, as shown, whereby the mud passage 45 is open for conventional circulation of mud.

With the various components of the apparatus in the position shown in Figure 5, the drill pipe string 11 may now be lowered thereby sliding the pipe section 13 on through the collar 14 until the various side flanges such as the flange 22 slide past the lower ends of the channels whereby the pipe section 13 is then free to rotate independently of the collar 14 and the drilling operation can commence.

It is thus seen that the locking against relative axial movement is first released by retraction of the various lever elements. A given interval of time thereafter depending upon the downward rate of movement of the drill pipe 11, the locking against relative rotation is released. By the time relative rotation can take place, the pipe section has moved down sufficiently within the whip stock to thoroughly wedge the whip stock into the formation

and thus lessen the possibility of disorientation of the whip stock during the initial axial movements of the drill pipe string.

The drilling can then commence through the collar of the whip stock in a conventional manner, the whip stock wedging the drill bit off the axis of the main bore as desired. To remove the whip stock, the drill pipe string is retracted until the upper ends of the flanges engage the lower portions of the collar. At this time the drill pipe 11 may be rotated until the flanges register with the channel openings and the pipe then raised further so that the flanges slide within the channel openings. This motion will continue until the ring 40 engages the underside of the collar. The whip stock is then locked against relative rotation and swinging movements and the entire assembly may be removed from the bore hole. It is not necessary that the lever elements re-engage the shoulders in the collar flanges in order to remove the whip stock since the annular ring flange 40 serves to lift the whip stock.

In the event it were desired to provide a device in which the lever elements could be re-extended to re-set the whip stock, the latch 38 would be eliminated whereby a lessening of the mud pressure would result in the compression spring 33 urging the piston member 29 upwardly. The lever element 25 would then be free to be moved to its extended position by the leaf spring 49.

Various other modifications within the scope and spirit of the present invention will occur to those skilled in the art. The whip stock locking and releasing apparatus is, therefore, not to be thought of as limited to the particular structure shown for illustrative purposes.

What is claimed is:

1. A whip stock locking and releasing apparatus comprising, in combination: a collar on said whip stock having at least one longitudinal channel formed in its inner wall; a shoulder portion in said channel; a pipe section adapted to pass longitudinally through said collar; longitudinal flange means on said section receivable in said channel whereby said collar is held against rotation with respect to said section; a lever element positioned on said pipe section adjacent said flange means for swinging movement laterally away from said pipe section, the lower end of said lever element engaging said shoulder when in a first position and free of said shoulder when in a second position, said pipe section including a slot opening adjacent said lever element; and means in said pipe section operable through said slot opening for moving said lever from said first to said second position.

2. A whip stock locking and releasing apparatus adapted to be inserted between a string of drill pipe and a drilling bit for holding said whip stock in a desired position while it is being lowered in a bore hole, comprising, in combination: a collar portion on said whip stock; a pipe section adapted to pass longitudinally through said collar portion; longitudinal channel means in said collar portion; longitudinal flange means on a given length of said pipe section receivable in said channel means whereby said collar portion is held against rotation with respect to said pipe section when said given length is in said collar portion; a shoulder in said channel; a lever element pivoted to said flange means for lateral swinging movement, the lower end of said lever being adapted in a first position to seat on said shoulder, and in a second position to be free of said shoulder, a pipe section including a slot opening adjacent said lever element; and means operable through said slot opening in said pipe section responsive to mud pressure for moving said lever element from said first to said second position whereby said pipe section is free to move longitudinally through said collar portion.

3. A tool for holding a whip stock in a desired position and subsequently releasing the whip stock, comprising: a collar portion on said whip stock; a pipe section adapted to axially pass through said collar portion; interengaging

means on said pipe section and collar portion for locking said section and portion against relative rotational movement while said portion surrounds said section; laterally movable lever means on said section for locking said section and portion against relative axial movement while said lever means is laterally extended, said pipe section including an opening to its interior adjacent said lever means; and actuating means operable through said opening in said pipe section for laterally retracting said lever means to free said section for axial movement through said collar portion thereby disengaging said interengaging means, whereby said section is free for both rotational and axial movement.

4. A tool according to claim 3, in which said lever means includes a lever element pivoted intermediate its ends to said interengaging means for arcuate movement in a vertical plane; a shoulder on said collar portion adapted to engaged by the lower end of said lever element when in a first arcuate position and to be free of said end when in a second arcuate position.

5. A tool according to claim 4, in which said actuating means includes: a piston member having a central mud passage, and a sloping side wall portion; said piston member being vertically movable within said pipe section; the upper end of said lever element passing through said slot opening in said pipe section adjacent said sloping side wall to engage the same in camming relationship, whereby downward movement of said piston member cams said upper end of the lever element outwardly to pivot said lever element from said first to said second position.

6. A tool according to claim 5, in which said pipe section is provided with an undercut portion adjacent said slot opening adapted to engage a correspondingly contoured portion on said lever element adjacent its pivot point when said lever element is in its first position whereby compression forces are transmitted through said lever element to said undercut portion to relieve said pivot point of said forces.

7. A tool according to claim 5, including biasing means normally holding said piston in an up position and passage control means in said piston mud passage whereby said piston is responsive to fluid pressure for moving the same downwardly.

8. A tool according to claim 7, including latch means adapted to engage said piston when in its downward position to hold said piston in said position.

9. A tool according to claim 7 including a ball check valve positioned above said piston and adapted to close off said mud passage during initial movement of said piston and to open said passage prior to final positioning of said piston to its downward position.

10. A tool according to claim 5, including axially spaced annular stops adapted to engage annular portions of said piston member above and below said slot opening respectively when said piston is in its downward position to provide fluid tight seals whereby mud is prevented from passing through said slot opening to the interior of said pipe section above and below said piston member.

11. A tool according to claim 10, including spring means normally biasing said lever element to said first position.

12. A tool for holding a whip stock in a desired position and subsequently releasing the whip stock, comprising: a collar portion on said whip stock; a pipe section adapted to axially pass through said collar portion; interengaging means on said pipe section and collar portion for locking said section and portion against relative rotational movement while said portion surrounds said section; laterally movable means on said section for locking said section and portion against relative axial movement while said movable means is laterally extended, said pipe section including a lateral opening through which a portion of said laterally movable means extends; and actuating means operable through said lateral opening in said pipe section for laterally retracting said movable means to free said section for axial movement through said collar portion thereby disengaging said interengaging means, whereby said section is free for both rotational and axial movement.

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