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E. W. BAGNELL ET AL

2,923,562

LATCH STRUCTURE

Filed Aug. 2, 1955

FIG-1

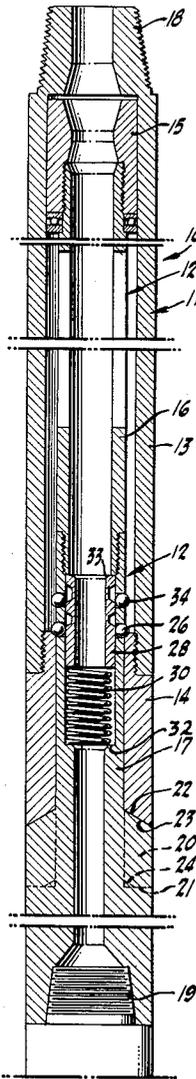


FIG-2

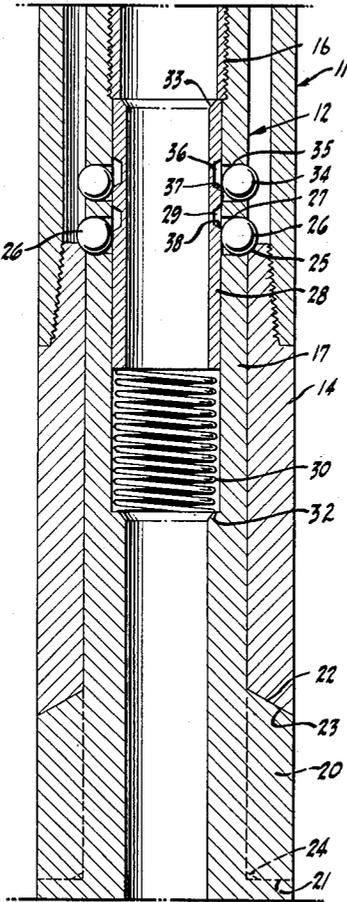


FIG-3

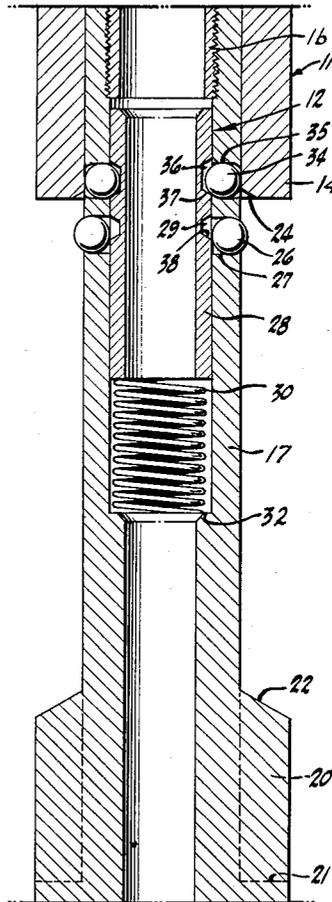


FIG-4

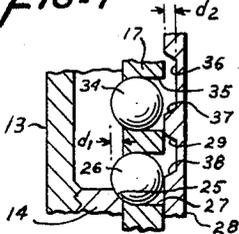
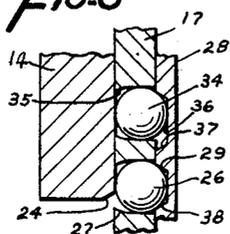


FIG-5



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LATCH STRUCTURE

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Application August 2, 1955, Serial No. 526,012

1 Claim. (Cl. 285-143)

This application relates to a novel latch assembly for use with a telescoping tubular member; for example, the logging sub shown in the application to Montgomery et al., entitled "Logging Sub," Serial No. 458,413, filed September 27, 1954, now Patent No. 2,726,848.

The Montgomery et al. patent cited above shows a logging sub adapted to be inserted in a drill string, wherein the sub may be latched in collapsed relation to transmit torque to a bit, and wherein the latch may be released to permit extension of the sub to uncover suitable openings through which caliper arms may be extended to caliper the well bore diameter as the drill string is withdrawn therefrom.

It is the principal object of this invention to provide a novel form of latch assembly for use in a telescoping sub such as set forth above.

A further object of the invention is to provide a latch for releasably latching a telescoping sub in collapsed relation, wherein the latch may be reset if it should be inadvertently tripped or if it is desired to remove the tool and resume drilling.

The preferred form of our invention is described in the following detailed specification, and illustrated by way of example in the accompanying drawings, wherein:

Fig. 1 shows a longitudinal section of a telescoping sub embodying the principles of the invention.

Fig. 2 is a fragmentary sectional view of a portion of Fig. 1 drawn to an enlarged scale and illustrating the latch in its latched relation.

Fig. 3 is a view similar to that shown in Fig. 2, and illustrates the latch in its released position and the sub partially extended.

Figs. 4 and 5 are enlarged views of the ball engaging portions illustrated in Figs. 2 and 3, in latched and unlatched positions, respectively.

Referring now to the drawings wherein similar reference numerals are used to denote the same elements throughout the various views shown, and referring more particularly to Fig. 1 thereof, 10 generally indicates a telescoping sub embodying the principles of the invention.

The sub 10 is composed of an outer tubular member 11 and an inner tubular member 12 slidable therein. The outer tubular member 11 comprises an upper section 13 and a lower section 14. The inner tubular member 12 comprises an upper head section 15, an intermediate section 16, and a lower section 17. The upper end of the outer tubular member 11 is provided with a threaded pin 18 adapted to be connected to the lower end of a drill string (not shown). The lower end of the inner tubular member 12 is provided with a box 19 adapted to be connected to a bit (not shown).

The lower end of the lower section 14 of the outer tubular member 11 is provided with depending fingers 20, which intermesh with corresponding grooves 21 formed in the lower section 17 of the inner tubular member 12 to prevent relative rotation therebetween when the sub 10 is in its collapsed relation. The meeting surfaces 22 and 23 of the outer member section 14 and the inner

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member section 17, respectively, are tapered downwardly and outwardly, and the lower inner corner of each of the finger 20 is chamfered, as shown at 24, for purposes which will hereinafter be described.

5 The upper annular shoulder of the lower section 14 of the outer member 11 is formed with an annular arcuate depression 25 at its inner edge. A plurality of locking balls 26 are mounted in suitable lateral bores 27 in the walls of the lower section 17 of the inner member 12, and have a diameter  $d$  greater than the thickness of the section wall to project outwardly therefrom a distance  $d_1$  and seat in the arcuate depression 25 to latch the two members 11 and 12 in their collapsed or contracted relation. The balls 26 are retained in their extended or latching position by a locking sleeve 28 slidably received within the section 17 of the inner member 12, the outer periphery of said sleeve maintaining the balls engaged with the arcuate seat 25. The sleeve 28 is provided with a first annular groove 29 relieved from the periphery a depth  $d_2$  at least as great as the projection  $d_1$  of the balls and into which the balls 26 are received to permit extension of the sub 10 when the sleeve 28 is moved downwardly relative to the inner member 12. The sleeve 28 is normally held in its uppermost position by a spring 30 confined between the lower end thereof and an upwardly facing shoulder 32 formed in the section 17 of the inner tubular member 12. The upper end of the sleeve 28 is formed with a downwardly and inwardly tapered shoulder 33 adapted to be engaged by a suitable shoulder on a well tool lowered or dropped within the well string.

In order to permit relatching of the sub after the tool has been withdrawn, a second set of balls 34 is mounted in suitable bores 35 in the section 17 above the balls 26. These balls cooperate with an annular groove 36 formed in the sleeve 28. The groove 36 has a downwardly and outwardly inclined lower wall 37 spaced a distance above lower wall 38 of groove 29 less than the center-to-center spacing of the upper and lower balls 34, 26. The width of the grooves 36, 29 is such that both the balls 26, 34 can be accommodated at the same time to the depth  $d_1$  when alined with the corresponding grooves.

Referring specifically to Figs. 4 and 5, the balls 34 are seen to have their centerline slightly above lower edge wall 37 of groove 36 when sleeve 28 is returned to its upper position. Hence, when balls 34 are forced inwardly, as by chamfer 24 of fingers 20, the sleeve 28 is cammed downwardly to receive the balls 34 in upper groove 36. Such downward camming displaces the lower edge wall 38 of lower groove 29 downwardly from a position slightly above the centerline of balls 26 to a position slightly below such centerline. Accordingly, the lower groove 29 is thus positioned to receive balls 26 when these in turn are cammed inwardly by chamfer 24.

In the use of the device, the elements are assembled in the relationship shown in Fig. 1 and the device is inserted in a well string. When it is desired to extend the sub, a tool is lowered or dropped through the well string and seats in the shoulder 33, thus forcing the sleeve 28 downwardly until the annular groove 29 is in register with the balls 26. The balls 26 then move inwardly and permit the extension of the sub.

The sub may be relatched after the unlatching tool is withdrawn and the sleeve 28 is in its uppermost position by lowering the outer member 11 onto the inner member 12. The chamfer 24 on the lower end of the fingers 20, or the tapered surface 23, will contact the balls 34, forcing them inwardly. The lower edge of the inclined wall 37 of the groove 36 is below the center line of the balls 34 and thus the inward movement of the balls 34 in cooperation with the inclined wall 37 of the groove 36 forces the sleeve downwardly until the lower edge of the

inclined wall 38 of the lower groove 29 moves from its original position above the center line of the balls 26 to a position below the center line of those balls. As the outer member 11 moves further downwardly on the inner member 12, the chamfer 24, or inclined surface 23, contacts the balls 26. These balls will now be moved inwardly against the inclined surface 38 of the lower groove, causing the sleeve 28 to move downwardly slightly further, in order to accommodate the balls 26 within the groove 29. When the sub reaches its fully closed position, as illustrated in Fig. 2, the spring 30 forces the sleeve upwardly, moving the locking balls 26 into seating engagement with the arcuate recesses 25. Since the lower edge of the inclined surface 38 is now above the center line of balls 26, the balls 26 are prevented from re-entering the groove 29.

From the foregoing description it may be seen that we have provided a very simple, efficient latch structure for holding two tubular members in telescoped relation wherein the latch may be released or relatched as desired.

While we have shown and described the preferred form of the invention, it is obvious that various changes may be made in its construction by those skilled in the art, without departing from the spirit of the invention as defined in the appended claim.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

In a well tool for endwise threaded connection in a string of pipe, the combination comprising an outer tubular member having an enlarged bore portion intermediate its ends, an inner longitudinally slotted tubular member extending slidably and rotatably into said outer tubular member for telescopic movement between an extended and a retracted position, said inner tubular member having an enlarged upper end portion engageable with an annular shoulder defining the lower end of said enlarged bore portion when said inner member is in its extended position, said inner and outer members having portions longitudinally interengaging in their contracted position only to co-rotatively secure said members and together defining an unobstructed bore there-through, and latching means for releasably locking said members in their co-rotative position, said latching means comprising a first locking ball retained partially within

a lateral bore of said inner member and positioned along said inner member to engage an arcuate seat in said annular shoulder when said inner member is in its contracted position, a sleeve slidably retained in said inner member and having first and second annular grooves spaced along its periphery, means for biasing said sleeve toward an upper locking position where its periphery below said first groove laterally positions said first ball in engagement with said seat, said sleeve having an upper annular shoulder sized for engagement by a tool lowered through said pipe string whereby said sleeve may be moved to its lower unlocking position, said first groove being opposite said first ball in said unlocking position and sized to receive said first ball out of engagement with said seat, and a second ball retained partially within a lateral bore of said inner member and spaced above said first ball for reception in said second groove in said unlocking position, whereby said inner member may be moved to its extended rotatable position when said sleeve is in its lower unlocking position, said second groove having its lower edge spaced below the center line of said second ball in said locking position a distance such that inward displacement of said second ball upon downward movement of the lower end of said outer member from said extended position cams said lower edge downwardly as said second ball is received in said second groove, said first groove having its lower edge spaced above the center line of said first ball in said locking position and displaced below such center line when said second ball is received in said second groove, whereby the lower end of said outer member may successively displace said second ball into said second groove and said first ball into said first groove as said members are moved into their contracted position.

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