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UNDER-REAMING TOOL
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Filed May 10, 1966, Ser. No. 548,914

U.S. Cl. 175—270
Int. Cl. E21b 9/26
15 Claims

ABSTRACT OF THE DISCLOSURE

A drilling tool having a tubular body with a sleeve movably positioned therein and adapted when moved in one direction responsive to the pressure of drilling fluid to move cutters to their opposite direction, also responsive to the pressure of drilling fluid, to allow the cutters to retract from their cutting position, a drilling fluid passage to increase the flow area for drilling fluid when the cutters are in their cutting position and a means of positively moving the sleeve in the opposite direction with a wireline tool.

The present invention relates to a new and improved drilling tool adapted to enlarge well bores.

Under-reaming of well bores is generally performed after a surface casing is set to enlarge the well bore to a diameter greater than the internal diameter of the surface casing. This type of drilling tool, therefore, must be sufficiently small in diameter to pass through the interior of the surface casing and also be capable of enlarging the well bore to the desired diameter. Extendable under-reaming tools have been used in the past, but several problems have been encountered. Retraction of the cutters of the under-reamer is essential so that the drill string may be pulled. While prior under-reaming tools have made provision for retraction, failures have been encountered and resulted in difficulties in pulling the drill string. It is desirable for an extendable under-reamer to provide an alternate method of retraction and, thereby, eliminate retraction problems. Further, it has been found desirable in extendable under-reamers to have a positive indication at the surface that the cutters have extended to their extended cutting position before proceeding with the under-reaming.

It is, therefore, an object of the present invention to provide a new and improved drilling tool having extendable cutters which includes a positive indication that the cutters have been extended to cutting position.

A further object is to provide an improved under-reamer having cutters which extend to cutting position responsive to the circulation of drilling fluid.

Another object is to provide an improved extendable drilling tool having cutters which may be extended and retracted responsive to the pressure of the drilling fluid.

Another object is to provide an improved extendable drilling tool having cutters which are extended to hold in cutting position responsive to pressure of drilling fluid and are normally free to retract when the circulation of the drilling fluid is stopped.

Still another object is to provide a new and improved under-reamer having cutters movable to and held in a cutting position responsive to the pressure of the drilling fluid and rendered free to retract by a wire line tool.

A still further object is to provide a new and improved drilling tool which will drill and under-ream a well bore.

These and other objects and advantages of the present invention will be readily understood from the following explanation and description of the structure of the forms of the invention which are illustrated in the accompanying drawings wherein:

FIGURE 1 is a partial longitudinal sectional view of the preferred form of drilling tool of the present invention with the cutters retracted for running;
FIGURE 2 is a similar partial longitudinal sectional view of the tool shown in FIGURE 1 illustrating the cutters in extended or cutting position;
FIGURE 3 is another similar partial longitudinal sectional view of the tool shown in FIGURE 1 and illustrates the action of the pressure-responsive means which allows the cutters to retract;
FIGURE 4 is a longitudinal sectional view of a well bore showing the cutting action of the drilling tool of the present invention;
FIGURE 5 is a transverse sectional view taken along line 5—5 in FIGURE 2;
FIGURE 6 is a transverse sectional view taken along line 6—6 in FIGURE 2;
FIGURE 7 is a partial longitudinal sectional view of a portion of a modified form of drilling tool of the present invention illustrating the running position of the component parts;
FIGURE 8 is a view similar to FIGURE 7 and illustrates the position of the parts of the modified form of tool when the cutters have been extended or moved to cutting position;
FIGURE 9 is another view similar to FIGURE 7 and illustrates the lowering of a wire line device which is used to allow retraction of the cutters;
FIGURE 10 is a view similar to FIGURE 9 and illustrates the wire line device in position to raise the sleeve;
FIGURE 11 is another similar view showing the disengagement of the wire line device after lifting the sleeve;
FIGURE 12 is a sectional view taken along line 12—12 in FIGURE 11 and;
FIGURE 13 is a sectional view taken along line 13—13 in FIGURE 11.

Referring more in detail to the drawings, the drilling tool D of the present invention that is shown in FIGURE 4 is adapted to be mounted on the drill pipe string P and lowered through the surface casing C with a usual drill bit B attached to the lower portion thereof, so that as the drill bit B proceeds downwardly drilling the well bore W—1, the drilling tool of the present invention D will underream and enlarge such well bore to form the well bore W—2. It should be noted that the well bore W—2 is larger than the inside diameter of the well casing C.

The preferred form of the drilling tool D of the present invention is illustrated in FIGURE 1 in the position to be run into the well bore. The drilling tool D includes a tubular body 10 having a central bore 12 therethrough and defining a plurality of windows 14 through which the cutters 16 are adapted to be extended when actuated by the pressure-responsive means. The tubular body 10 is connected through the coupling 18 to the drill pipe string P and is connected by the coupling 20 to the drill bit B.

The pressure-responsive means includes the sliding sleeve 22 which is positioned within the tubular body 10 and slidable longitudinally thereof. The sleeve includes a cam surface 24 on its exterior portion which is adapted to engage with the cam surface 26 on the interior portion of the cutters 16 whereby movement of the sleeve 22 downwardly moves the cutters 16 outwardly into cutting position and holds the cutters 16 in such position until the sleeve is moved upwardly. The lower portion of the sleeve 22 includes an inward projection defining the seat 28 for the ball 30. The lower portion of the sleeve immediately above the seat 28 defines a plurality of passages 32 and immediately thereabove a plurality of restricted passages 34. With the sleeve 22 in its upper-
most position, the passages 32 are closed by the interior portion of the tubular body 10. The restricted passages 34 are, however, when the sleeve is in its uppermost position as shown in FIGURE 1, in communication to conduct the drilling fluid from within the sleeve 22 outward through such restricted passages 34 so that the drilling fluid is discharged through the spaces between the cutters 16 and the portion of the tubular body 10 defining the windows 14.

The pin 36 extends through the wall of the sleeve 22 and across the interior of the sleeve to retain the ball 30, which is adapted to seat on the seat 28, within the interior of the sleeve 22 between the pin 36 and the seat 28. The insert 38 is secured within the tubular body 10 in surrounding relation to the sleeve 22. The pin 40 secures the insert 38 in position with respect to the tubular body 10. The insert 38 is provided with the upwardly facing shoulder 42 for the purpose hereinafter set forth.

The sleeve 22 is provided with an external extension 44 which is adapted to slide against the interior of the upper portion of the insert 38 and to seal thereagainst between the upper pressure chamber 46 and the lower pressure chamber 48 defined by such extension 44, the sleeve 22, the body 10 and the insert 38. Also, the interior of the sleeve is provided with an internal projection 50 which defines the upwardly facing seat 52.

Communication is established between the interior of the sleeve 22 above the seat 52 to the lower pressure chamber 48 by the downwardly and outwardly directed passages 54 defined in the sleeve 22. Communication is also established between the interior of the sleeve below the seat 52 to the upper pressure chamber 46 by the upwardly and outwardly directed passages 56 which extend through the sleeve 22. The extension of the sleeve below the projection 44 includes a shoulder 58. Means, such as the spring 60, is provided to urge the sleeve 22 in an upwardly direction to the position illustrated in FIGURE 1. The spring 60 is positioned in surrounding relationship to the sleeve and engages the shoulder 42 on the insert 38 and the shoulder 58 on the sleeve 22.

To prevent the cutters 16 from extending farther through the window than desired, each cutter is provided with an outwardly facing shoulder 60 adapted to engage the inwardly facing shoulder 62 on the tubular body immediately surrounding the interior portion of the window 14 as best seen in FIGURE 6. Also, the upper edge of the FIGURE 1, is provided with the beveled portion 64 which is adapted to act as a cam surface to cause the cutters to be retracted responsive to a lifting of the body 10 whenever the sleeve 22 is positioned in its uppermost position. This bevel 64 contacts any projection from the well bore when the pipe string P is raised and causes the cutters 16 to be pushed or retracted inwardly to the position illustrated in FIGURE 1.

In operation, the drilling tool D of the present invention is connected onto the drill pipe string P and lowered into the well bore through the surface casing C in the position illustrated in FIGURE 1. The drilling tool D may be used in conjunction with a drill bit B, or, with suitable provision at the lower portion of body 10 for directing the drilling fluid upwardly to the cutters 16, may be used to under-cut a well bore previously drilled. In this position, the drill pipe string P is lowered into the well bore where the drill tool D is to be commenced. The drilling fluid circulation is commenced. The drilling fluid causes the ball 30 to move downwardly through the sleeve 22 and to engage and seal on the seat 28. The drilling fluid passes outwardly through the restricted passages 34 and through the passages 32 adapted to seat on the seat 28, within the interior of the sleeve 22 between the insert 38 and the body 10 defining the windows 14. This restricted flow passage allows the build-up of pressure above the ball 30 within the sleeve 22. Such pressure is conducted through the passages 54 and 56 to the pressure chambers 46 and 48 which substantially equalize each other. This pressure on the ball 30 and seat 28 results in a downward force on the sleeve 22 moving the sleeve downwardly. The downward movement of the sleeve causes the cam surfaces 24 of the sleeve 22 to engage the cam surfaces 26 on the cutters 16 and move the cutters 16 outwardly to the cutting position as illustrated in FIGURE 2. This downward movement compresses the spring 60. Therefore, sufficient force must be provided by the fluid pressure within the sleeve 22 to overcome the force of the spring 60. Whenever the sleeve has moved to almost its lowermost position, the passages 32 are uncovered and these enlarged passages conduct drilling fluid downwardly through the lower portion of the tubular body 10 and the coupling 20 to the drill bit B or when drill bit B is not used, to suitable means for upward deflection of the drilling fluid to the cutters 16. A sufficient difference in the pressure of the drilling fluid occurs when the passages 32 are uncovered so that a pressure gauge on the drilling fluid line at the surface provides a positive indication by a pressure drop that the cutters 16 are in extended or cutting position. With the cutters in cutting position, the drilling and under-reaming or under-reaming if no drill bit is used, proceed in the normal manner.

When it is desired to remove the drilling tool D from the well bore, the circulation of drilling fluid is stopped. Depending on the degree of increased friction to the sliding of the sleeve 22 and its relation to the force of the spring 60 which resists the pressure of the drilling fluid is reduced, the force exerted by spring 60 may be sufficient to move the sleeve 22 upwardly, moving the cutters 16 outwardly past the cutters 16. This movement is in the event that sufficient friction has been developed to prevent the movement of the sleeve 22 upwardly responsive solely to the force of the spring 60, the sleeve may be moved upwardly by dropping the ball 66 downwardly through the drill pipe string P. When the ball 66 is firmly seated on the seat 52 within the upper portion of the sleeve 22, the pressure of the drilling fluid thereabove is increased. This pressure is conducted through the passages 54 to the lower pressure chamber 48. Since the ball 66 is seated on the seat 52, no pressure is exerted within the sleeve 22 below the seat 52. Therefore, the pressure within the chamber of the sleeve 22 is not balanced. The pressure within the upper pressure chamber 46. The effective pressure area of the sleeve 22 acted on by the pressure within the pressure chamber 48 is larger than the pressure area of the sleeve which is acted on by the pressure above the seat 52. With a larger area, the pressure of the drilling fluid then exerts a net upward force on the sleeve 22 causing the sleeve 22 to be moved upwardly. The upward movement of the sleeve 22 moves the cam surfaces 24 of the sleeve out of holding engagement with the cam surfaces 26 on the inner portion of the cutters 16 to allow the cutters to retract when the drill pipe string P is lifted.

Thus, it can be seen that the pressure-responsive means, or sleeve 22, is actuated to extend the cutters to cutting position by pressure of the drilling fluid communicated downwardly through the drill pipe string P. Also, the sleeve 22 may be returned to its uppermost position out of holding engagement with the cutters 16 by allowing the cutters 16 to be retracted through the force exerted by the spring 60. Additionally, by seating the ball 66 on the seat 52, the pressure of drilling fluid communicated through the drill pipe string P may be utilized to create sufficient additional upward force, in addition to the force of the spring 60, to move the sleeve 22 to its upper position which allows the cutters 16 to retract.

Since pressure seals often fail, it is desirable to provide an additional means by which the pressure-responsive means holding the cutters in their extended cutting posi-
tion may be moved out of such holding engagement. For this reason, the modified form of the invention illustrated in FIGURES 7 through 13 has been provided with an engaging means which may be engaged by a suitable wire line device lowered to the pipe string P.

In the drilling tool illustrated in FIGURES 7 through 13, the pressure-responsive means may be provided with the identical structure illustrated in FIGURES 1 through 3 including the two internal seats on the sleeve and the pressure chambers defined by the sleeve. As shown, this modified form includes a tubular body 70 which will have the windows, as previously illustrated and described, through which the cutters may be extended by a longitudinal sliding of the sleeve 72 therein. Since such related structure is identical to the previously described structure, it is not illustrated in the figures showing this modified form. The sleeve 72 is positioned in the central bore of the tubular body 70 and includes a downwardly facing external shoulder 74 which is engaged by the spring 76. The tubular body 70 is provided with an internal upwardly facing shoulder 78 supporting the spring 76. The spring 76, therefore, urges the sleeve 72 toward its uppermost position. The coupling 80, which connects the tubular body 70 to the drill pipe string P, is provided with a lower inner opening 88 into which the upper portion of the sleeve 72 is adapted to slide. The means by which a wire line device is to engage the sleeve 72 for the lifting of the sleeve includes the segment members 84. Such segment members 84 are normally positioned when the sleeve is in its uppermost position partially within the recess 86 in the inner surface of the coupling 80. The upper portion of the sleeve 72 defines windows 88 in which the segment members 84 are free to move a limited distance inwardly as best seen in FIGURE 13. Each segment member 84 includes shoulders 90 adapted to engage the outwardly facing shoulders 92 surrounding the windows 88 to prevent the segments 84 from passing totally through the windows 88. The four corners of the segment members 84 are all beveled for reasons hereinafter discussed. Additionally, the recess 86 is beveled to match the exterior bevels on the segment members 84.

In operation, when it is desired to move the cutters of this form of drilling tool to their cutting position, pressure is exerted by the circulation of drilling fluid downwardly through the drill pipe string P. When sufficient force is developed to overcome the force of the spring 76, the sleeve 72 slides downwardly. This downward movement of the sleeve 72 pulls the segment members 84 downwardly. The mating bevels on the recess 86 and the segment members 84 cams the segment members 84 outwardly until they are slidable on the inner surface 82 of the coupling 80. The lowermost position of the sleeve 72 is illustrated in FIGURE 8.

Upon completion of drilling or whenever it is desired that the drill pipe string P be removed from the well bore being drilled, the force of the spring 76 may be sufficient to move the sleeve 72 upwardly to its uppermost position allowing the cutters to retract. Whenever, through collection of dirt or because of erosion or corrosion or failure of seals, the other methods for moving the sleeve upward fail, a wire line device 94, such as is illustrated in FIGURE 9, is lowered through the drill pipe string P. The wire line device 94 is provided with an upper connection 96 for connecting to the wire line 98 and a lower body 100 surrounded by the cage 102. The cage 102 includes a plurality of windows 104 in which the segments 106 are positioned. The cage is spring-loaded to a downward position by the spring 108. The exterior of the body 100 is provided with grooves 110 which are adapted to receive the internal projections 112 on the segments 106 when the device 94 is lowered past the segments 84 as shown in FIGURE 9 to the position shown in FIGURE 10. The wire line device 94 passes through the segment members 84 as illustrated in FIGURE 9 by the lifting of the cage 102 and the segments 106 allowing the segments 106 to move into the recesses 112 and thereby move below the segments 84. It should be noted that the lower portion of the body 100 of the wire line device 94 then rests on the upwardly facing shoulder 114 of the sleeve 72. Thereafter, lifting of the wire line device 94 causes the segments 106 to engage the segments 84. The segments 106 are supported in their lower position, upward movement of the wire line device 94 is then transmitted by the segments 106 to the segments 84 causing the sleeve 72 to be moved to its uppermost position as illustrated in FIGURE 11. When the segments 84 register with the recess 86 it is a simple matter to pass the sleeves 84 into two segments 84 are forced outwardly, allowing the wire line device 94 to pass through the segments 84 and be removed from the drill pipe string P. In this position, the holding engagement between the cam surfaces on the sleeve 72 and the inner cam surfaces on the cutters has been disengaged and the cutters are free to retract. Upward movement of the drill pipe string will cause the cutters to retract as previously explained.

From the foregoing it can be seen that the present invention provides a new and improved drilling tool which can be adapted to enlarge well bores and which may be used by itself or in combination with a drill bit. This improved extendable drilling tool provides a positive indication that the cutters are extended to cutting position and further holds the cutters in cutting position so long as the pressure of the drilling fluid is maintained during drilling. This improved drilling tool also normally allows the cutters to retract whenever the pressure on the drilling fluid is reduced since the sleeve holding the cutters in extended position are biased to move out of holding engagement with the cutters. Further, a means is provided for the moving of the sleeve out of holding engagement with the cutters which utilizes the pressure of the drilling fluid. This incorporates the use of cross passages 54 and 56 into two pressure chambers formed around the sliding sleeve within the tubular body of the device whereby when the upper seat is closed, the pressure in the lower pressure chamber is sufficient to move the sleeve to its upper position thereby disengaging it from the holding engagement with the cutters to allow the cutters to be retracted when the drill pipe string is raised. The modified form of the present invention also provides a structure in which the extension of the cutters operates in the same manner but further includes the structure necessary for the positive movement of the sleeve to its upper position with a wire line device.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A drilling tool, comprising a tubular body having a central bore therethrough and defining a plurality of windows, a plurality of cutters, one or more cutters movably mounted in each of said windows, each of said cutters adapted to be moved radially outward in said windows a preselected distance, a sleeve having a central bore and slidably mounted within said bore of said tubular body and slidably longitudinal therewith, said sleeve defining a first seat and a second seat surrounding the bore through said sleeve, said seats being spaced longitudinally of said sleeve from each other, each of said cutters having an inner cam surface, a portion of said sleeve defining a cam surface adapted to engage the cam surfaces on said cutters when said sleeve is moved longitudinally in one direction responsive to fluid pressure when said first seat area is closed,
3,433,313

said sleeve adapted to move longitudinally in the opposite direction responsive to fluid pressure when said second seat area is closed, movement of said sleeve in said one direction moving the cam surface on said sleeve with respect to the cam surfaces on said cutters to move said cutters radially outward to cutting position, movement of said sleeve in said other direction moving the cam surface on said sleeve with respect to the cam surfaces on said cutters to allow said cutters to move inward, and fluid passages in said sleeve to direct flow of drilling fluid through said sleeve and said windows when said first seat area is closed and said cutters are retracted and to direct flow of drilling fluid through said sleeve to the central bore of said tubular body when said first seat area is closed and said cutters are held in extended position by the cam surface on said sleeve, said flow of drilling fluid through said sleeve and said windows being restricted with respect to said flow of drilling fluid through said sleeve to said central bore of said tubular body.

2. A drilling tool, comprising a tubular body having a central bore therethrough and adapted to be connected to a drill pipe string, said tubular body defining a plurality of windows at substantially the same level and spaced around said tubular body, a movable cutter mounted in each of said windows, said cutters adapted to be moved radially outward to a cutting position with a portion of said cutters extending outward from said tubular body, a sleeve having a central bore and slidably mounted within the bore of said tubular body, said sleeve including means for moving said cutters to a cutting position responsive to downward movement of said sleeve in said tubular body, means coacting between said sleeve and said tubular body for urging said sleeve inward in said tubular body, the lower end of said sleeve defining a seat surrounding the central bore through said sleeve, closure means contained within the central bore of said sleeve and adapted to engage said seat responsive to the circulation of drilling fluid downward through said sleeve to restrict the flow of drilling fluid and build up a pressure acting on said sleeve to move said sleeve downward, thereby extending said cutters to cutting position.

3. A drilling tool according to claim 2, including an external projection on said sleeve and sealing in sliding engagement against the interior of said tubular body, said sleeve defining a second seat surrounding said central bore through said sleeve and spaced substantially at the same level as said projections, said sleeve being spaced inwardly from said tubular body above and below said projection to define a first pressure chamber above said projection and a second pressure chamber below said projection, said sleeve defining a first fluid passage communicating between said first pressure chamber and the central bore of said sleeve above said second seat and a second fluid passage communicating between said second pressure chamber and the central bore of said sleeve above said second seat whereby fluid pressure is conducted to both pressure chambers when said second seat is open and fluid pressure is conducted only to said second pressure chamber when said second seat is closed to provide a positive force urging said sleeve upward.

4. A drilling tool according to claim 3, wherein the effective pressure area of said second pressure chamber is larger than the remaining effective pressure area of said seat.

5. A drilling tool according to claim 2, including releasable engaging means on the upper portion of said sleeve adapted to be engaged by a wire line device to lift said sleeve to its upper position to allow retraction of said cutters.

6. A drilling tool according to claim 5, wherein said releasable engaging means includes a plurality of windows defined by the upper part of said sleeve, a segment member positioned in each of said sleeve windows, and a recess around the interior of said tubular body adapted to receive a portion of said segment members when said sleeve is in its upper position whereby said segment members so positioned are wholly within said sleeve windows and said recess, downward movement of said sleeve moving said segment members inwardly to a position in which said segment members may be engaged by a wire line device to lift said sleeve to its upper position, said segment members moving outwardly into said recess to disengage from said wire line device when said sleeve windows register with said recess.

7. A drilling tool according to claim 2, including a drill bit, and means connecting said drill bit to the lower end of said tubular body.

8. A drilling tool according to claim 2, wherein said sleeve defines a restricted flow passage extending through said sleeve to direct drilling fluid from the central bore of said sleeve above said first-mentioned seat and through the cutter windows around said cutters when said sleeve is in its upper position, said sleeve also defining a second flow passage extending through said sleeve to direct drilling fluid from the central bore of said sleeve above said first-mentioned seat into the central bore of said tubular member below said sleeve when said sleeve is in its lower position, said tubular body closing said second flow passage when said sleeve is in its upper position.

9. A drilling tool, comprising a tubular body having a central bore therethrough and adapted to be connected to a drill pipe string, said tubular body defining a plurality of windows, a movable cutter mounted in each of said windows for radial movement therethrough to a cutting position with a portion of said cutters extending outward from said tubular body, a sleeve slidably mounted within the bore of said tubular body, said sleeve including means for moving said cutters radially outward to cutting position responsive to longitudinal movement of said sleeve in one direction, means coacting with said sleeve for obstructing the flow of drilling fluids through the central bore of said tubular body to create a drilling fluid pressure moving said sleeve in said one direction, and means coacting with said sleeve and said body for increasing the flow area for the flow of said drilling fluid through said sleeve when said cutters are moved outwardly into cutting position by longitudinal movement of said sleeve in said one direction.

10. A drilling tool, comprising a tubular body having a central bore therethrough and adapted to be connected to a drill pipe string, said tubular body defining a plurality of windows, a movable cutter adjustable mounted in each of said windows for radial movement therethrough to a cutting position with a portion of said cutters extending outward from said tubular body, a sleeve slidably mounted within the bore of said tubular body,
said sleeve including means for moving said cutters radially outward to cutting position responsive to longitudinal movement of said sleeve in one direction, means coating between said sleeve and said tubular body for urging said sleeve in the opposite direction, means coating with said sleeve for obstructing the flow of drilling fluids through the central bore of said tubular body to create a drilling fluid pressure moving said sleeve in said one direction, a projection surrounding said sleeve and adapted to seal against the interior of said tubular body, said sleeve defining an internal seat surrounding the central bore through said sleeve, said sleeve being spaced inwardly from said tubular body above and below said projection to define a first pressure chamber above said projection and a second pressure chamber below said projection, a first passage means for conducting fluid from the central bore of said sleeve above said seat to said second pressure chamber, and a second passage means for conducting fluid from the central bore of said sleeve below said seat to said first pressure chamber whereby on closure of said seat fluid pressure is conducted only to said second pressure chamber to urge said sleeve in said opposite direction, the effective pressure area of said second pressure chamber being larger than the effective pressure area of the remainder of said sleeve.

11. A drilling tool, comprising a tubular body having a central bore therethrough and adapted to be connected to a drill pipe string, said tubular body defining a plurality of windows, a movable cutter mounted in each of said windows for radial movement therethrough to a cutting position with a portion of said cutters extending outward from said tubular body, a sleeve slidably mounted within the bore of said tubular body, said sleeve including means for moving said cutters radially outward to cutting position responsive to longitudinal movement of said sleeve in one direction, means coating between said sleeve and said tubular body for urging said sleeve in the opposite direction, means coating with said sleeve for obstructing the flow of drilling fluids through the central bore of said tubular body to create a drilling fluid pressure moving said sleeve in said one direction, and engaging means carried by said sleeve and adapted to project into the interior of said sleeve when said sleeve has been moved in said one direction for engagement by a fishing device whereby a positive force may be applied to said sleeve to move said sleeve in the opposite direction.

12. A drilling tool, comprising a tubular body having a central bore therethrough and a plurality of windows and being adapted to be connected to a drill pipe string, a movable cutter mounted in each of said windows for radial movement therein between a retracted position within said windows and a cutting position in which a portion of said cutters extends outward from said body, an annular cam mounted for movement between a first position and a second position within the bore of said tubular body, said cam in said first position allowing said cutters to be retracted and in moving to said second position forcing said cutters outward to cutting position, a spring positioned between said cam and said body urging said cam toward its first position, a first means coating with said cam for moving said cam from said first position to said second position responsive to the pressure of drilling fluid within said bore of said tubular body to thereby move said cutters to cutting position, and a second means coating with said cam and operable when said cutters are to be retracted to apply a positive force to said cam to move said cam to its first position and thereby allow said cutters to retract from cutting position.

13. A drilling tool according to claim 12, wherein said second means includes a releasable engaging means connected to said cam and adapted to be engaged by a wireline device to positively move said cam to its first position.

14. A drilling tool according to claim 12, wherein said second means exerts the positive force on said cam responsive to the pressure of drilling fluid within the bore of said tubular body.

15. A drilling tool, comprising a tubular body having a central bore therethrough and adapted to be connected to a drill pipe string, said tubular body also having a plurality of windows, a movable cutter mounted in each of said windows for radial movement therethrough from a retracted position within said tubular body to a cutting position in which a portion of said cutter extends outward from said tubular body, pressure-responsive means slidably mounted between a first position and a second position within the bore of said tubular body, said pressure-responsive means including means for allowing the cutters to be retracted when said pressure-responsive means is in its first position and also including means for moving said cutters radially outward to cutting position when said pressure-responsive means is in its second position, means coating between said pressure-responsive means and said body for urging said pressure-responsive means toward its first position, an actuating means associated with said pressure-responsive means and operated by the pressure of drilling fluid within the bore of the tubular body to move said pressure-responsive means to its second position to thereby move said cutters to cutting position, and a second actuating means associated with said pressure-responsive means and operable when the cutters are to be retracted by utilizing the pressure of the drilling fluid to apply said pressure as a positive force to said pressure-responsive means to move the pressure-responsive means to its first position to thereby allow said cutters to retract.

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