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Palauro et al.

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[45] **Oct. 10, 1972**

[54] DRILL ROD RETRIEVING TOOL

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[52] **U.S. Cl.** **294/86.24**, 294/86.12, 294/86.22

[51] **Int. Cl.** **E21b 31/02**

[58] **Field of Search**....294/86.1, 86.12, 86.24, 86.25, 294/86.32, 86.22; 166/99, 118, 138, 139, 206, 210, 216, 217

[56] **References Cited**

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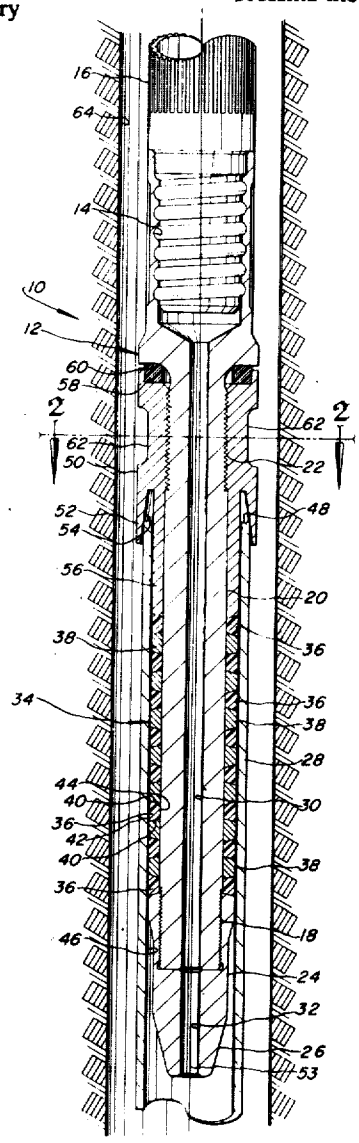
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Assistant Examiner—Johnny D. Cherry
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[57] **ABSTRACT**

A tool for retrieving tubular drill rods or the like from a drill hole. The tool includes an elongated cylindrical member which is dimensioned to be insertable into the broken or disconnected drill rod to be retrieved. The elongated member includes a frictional coupling made up of a plurality of elastically deformable gripping rings which are retained in sleeved relationship on the elongated member. The retrieving tool also includes a drill rod engaging member having a skirt defining a conical surface which surrounds and wedgingly engages the broken end of the drill rod. The drill rod engaging member is threadedly connected to the elongated cylindrical member. In response to rotation of the retrieving tool the two members move axially with respect to each other to compress the stack of deformable rings into frictional engagement with the broken drill rod whereby the broken drill rod may be retrieved from the drill hole. In an alternate embodiment the elongated cylindrical member is formed in two sections threadedly connected and thereby being axially movable with respect to each other for compressing the deformable gripping rings.

9 Claims, 7 Drawing Figures



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SHEET 1 OF 2

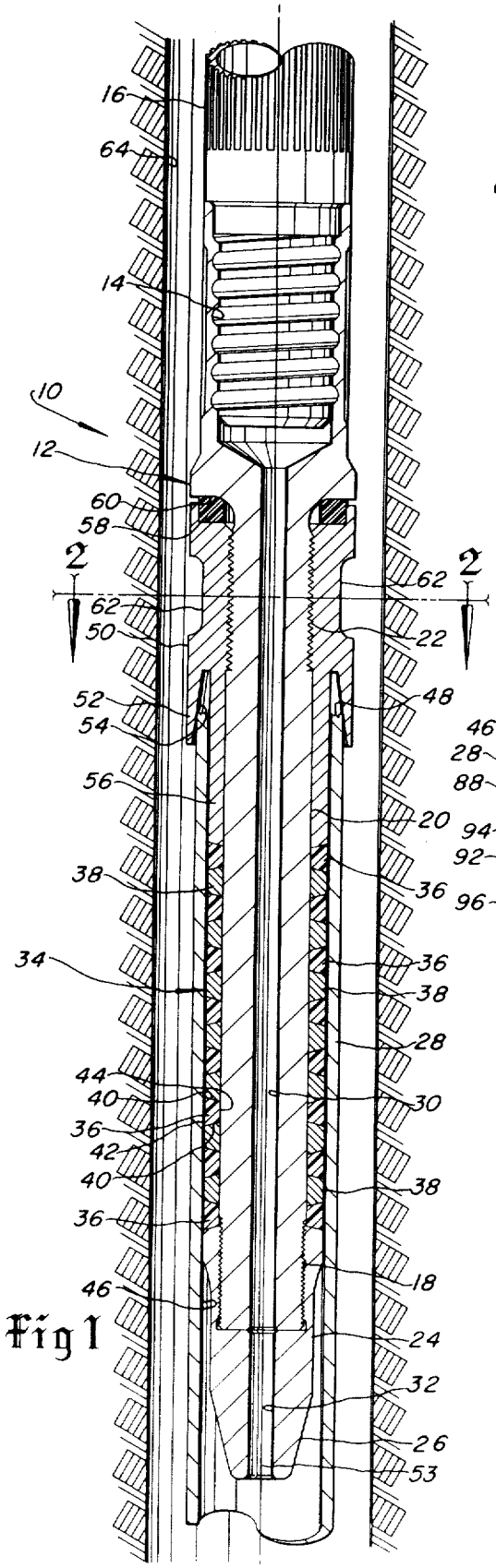


Fig 1

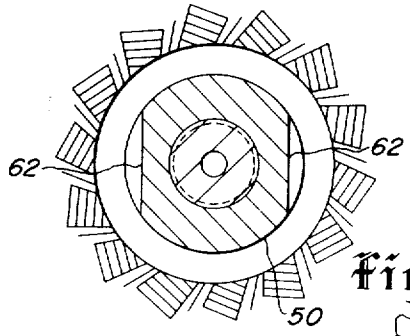


Fig 2

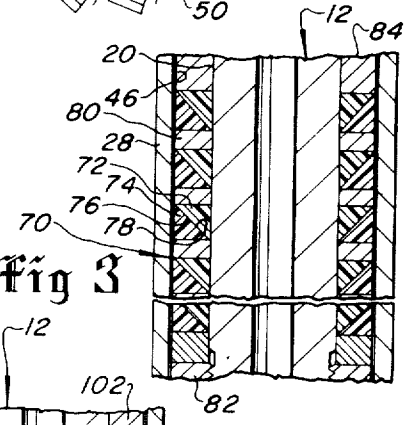


Fig 3

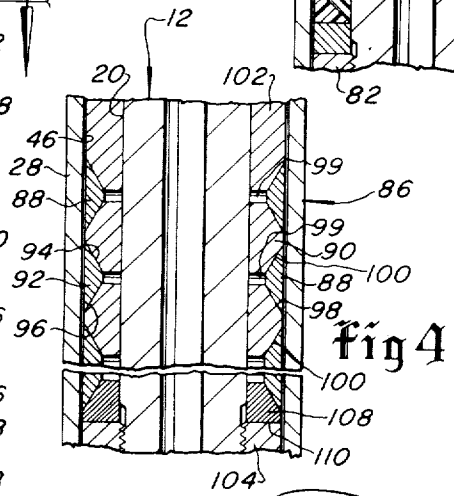


Fig 4

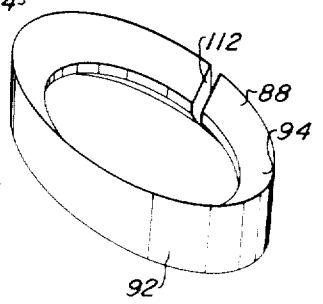


Fig 5

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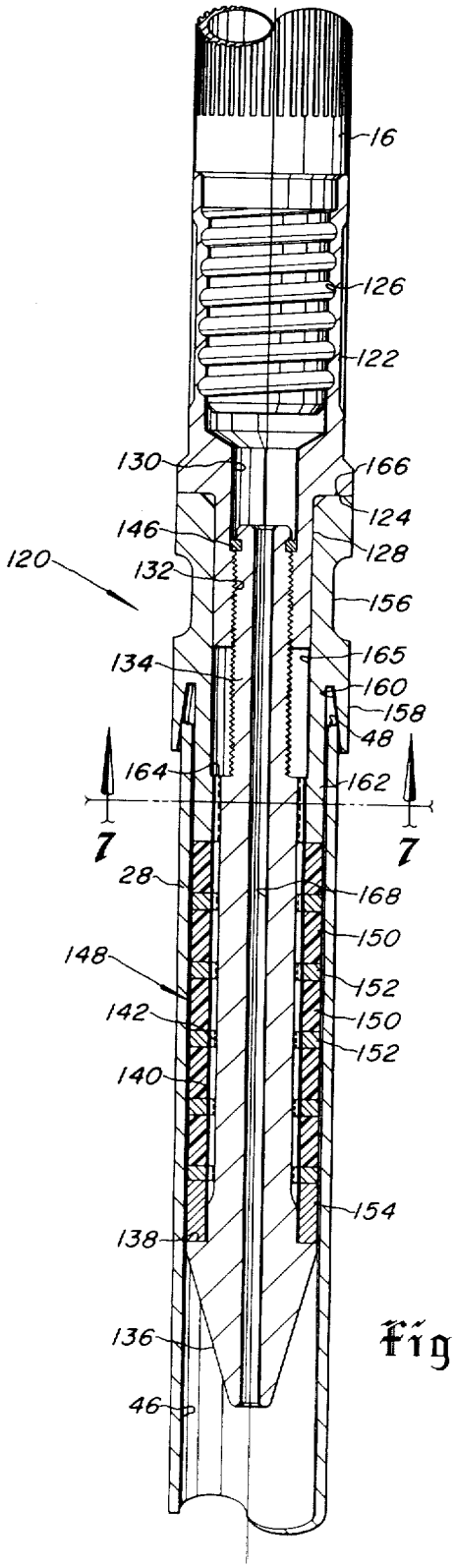

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Fig 6

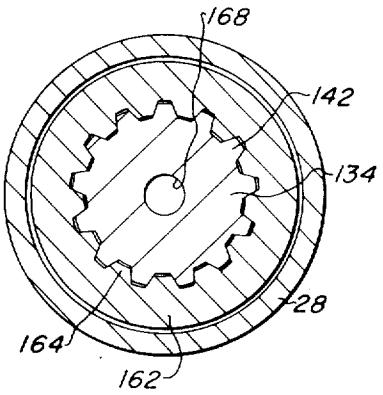

168
142
134
28
164
162

Fig 7

1

DRILL ROD RETRIEVING TOOL

BACKGROUND OF THE INVENTION

In drilling wells, blast holes, and the like the retrieval of broken or disconnected sections of drill rod is often necessary. The cost of lost rod sections and drill bits as well as the necessity of redrilling the hole if broken sections cannot be retrieved is usually prohibitive. Accordingly there has developed in the art of drilling apparatus means for retrieving broken or disconnected sections of drill rod or pipe from the drill hole.

Fishing tools or drill pipe retrieving tools are known which are operable to be inserted in the open end of a tubular drill rod or oil well casing and which include movable members for gripping the inner wall of rod or pipe section to be removed. However, most known devices in the art of retrieving tools are somewhat complicated mechanically and include types which are primarily useful in disconnecting one section of rod or casing from another for removing only part of the extension pipe string located in the drill hole.

SUMMARY OF THE INVENTION

The present invention provides for a retrieving tool for tubular drill rod or the like whereby broken or disconnected portions of an extension drill string may be removed from a drill hole. The retrieving tool of the present invention may be used with the extension drill string members and the drilling equipment used to drill the hole thereby alleviating the need for any additional specialized equipment to be brought into use for retrieving the broken or disconnected drill rod sections.

The present invention further provides for a drill rod retrieving tool which is adapted to be removably connected to the lower end of an extension drill rod for lowering into a drill hole to engage and retrieve a broken or disconnected drill string. The drill rod retrieving tool of the present invention also includes means for positively engaging the broken end of the drill rod section to be retrieved whereby the retrieving tool may then be actuated to frictionally grip the inner wall of a tubular drill rod section sufficiently to enable retrieval of the drill string portion lodged in the drill hole.

Furthermore the present invention provides for a retrieving tool for tubular drill rod or the like which is simple in construction and reliable in operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section view of the drill rod retrieving tool of the present invention.

FIG. 2 is a transverse section view taken along line 2—2 of FIG. 1.

FIG. 3 is a partial longitudinal section of an alternate embodiment of the present invention.

FIG. 4 is a partial longitudinal section of yet another embodiment of the present invention.

FIG. 5 is a perspective view of one of the radially expandable gripping rings of the embodiment of FIG. 4.

FIG. 6 is a longitudinal section view of a third alternate embodiment of a retrieving tool according to the present invention.

FIG. 7 is a section taken along the line 7—7 of FIG. 6.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 of the drawing a drill rod retrieving tool according to the present invention is illustrated in longitudinal section and generally designated by the numeral 10. The retrieving tool 10 includes an elongated member 12 having an internally threaded portion 14 at one end adapted to be threadedly coupled to the lower end of an extension drill rod section 16. The drill rod section 16 is in turn connected to an extension drill string which is adapted, in a well known manner, to be rotatably and longitudinally driven by drilling apparatus, not shown. The member 12 also includes an externally threaded portion 18 at the opposite end thereof. Intermediate the threaded portions 14 and 18 is an elongated portion 20 having a cylindrical cross section and a third threaded portion 22 having external threads but of an opposite hand to the threaded portions 14 and 18 the latter two portions being of the same thread hand.

Threaded over the lower end of the member 12 is a cap 24. The cap has a tapered portion 26 to facilitate insertion of the retrieving tool 10 into the broken or otherwise open end of a hollow drill rod or pipe section such as the tubular drill rod 28 shown in FIG. 1. Longitudinal passageways 30 and 32, centrally located in the member 12 and cap 24, respectively, are operable to conduct drill hole cleansing fluid therethrough.

The retrieving tool 10 includes frictional coupling means generally designated by the numeral 34 for coupling the tool to a drill rod or pipe section or like member having a substantially tubular configuration and an opening into which the retrieving tool can be inserted in close fitting relationship. The frictional coupling means comprises a plurality of elastically deformable ringlike members 36 retained in sleeved relationship over the cylindrical portion 20 of the member 12. Interposed between the elastically deformable members in alternating relationship are ringlike members 38. The elastically deformable members 36 are formed to have sides 40 which slope radially inwardly from their outer diameters 42 to the inner diameters 44. This configuration provides for a greater surface area on the outer diameter 44 for contacting the inner wall 46 of the tubular rod 28 than the surface area of the inner diameters 44, which in the deformed condition of the members 36 grip the cylindrical portion 20. The elastically deformable members 36 are dimensioned so that in the nondeformed condition the inner diameter 44 is in close fitting but relatively movable relationship to the cylindrical portion 20 of the member 12. The ringlike members 38 have radially sloping sides complementary to the sides of the elastically deformable gripping members 36. The gripping members 36 may be formed of an elastically deformable material such as molded polyurethane or the like. The ringlike members 38 are primarily force transmitting members and are more suitably made of a substantially hard material by comparison, such as steel or other metal material.

The retrieving tool 10 also includes means adapted to be nonrotatably engageable with the end 48 of the broken drill rod 28 comprising a member 50 having a skirt 52 defining a conical sloped inner surface 54. The member 50 further comprises a nut having threads en-

gageable with the third threaded portion 22 on the member 12. The nut 50 also includes an integral tubular portion 56 extending in sleeved relationship over the cylindrical portion 20 of the member 12 and engaged with the stack of gripping members forming the frictional coupling 34. As shown in FIG. 1 the sloped surface 54 is engageable with the broken or open end 48 of the tubular drill rod 28 and with sufficient axial force applied, a wedging action is obtained which results in nonrotatable engagement of the nut 50 with respect to the drill rod 28. The surface 54 may be knurled or provided with threads or ridges to further enhance positive engagement of the drill rod 28. A resilient washer 58 is interposed between the nut 50 and the shoulder 60 on the member 12 to aid in preventing the nut from becoming excessively tight against the shoulder should the nut be advanced thereagainst. As shown in FIG. 2 the nut 50 also includes transverse surfaces or flats 62 for engagement with a suitable holding fixture or wrench, not shown.

The retrieving tool 10 is operable to be frictionally coupled to the drill rod 28 to remove the same and additional drill rod extension members connected thereto from the drill hole 64, FIG. 1. Upon being threadedly connected to the drill rod 16, the retrieving tool 10 is lowered into the drill hole 64 whereupon the tapered portion 26 of the cap 24 upon engagement with the broken end 48 serves to guide the retrieving tool into the tubular rod 28. The tool is lowered until the skirt 52 forcibly engages the broken end 48. Normal pull-down force exerted by the drilling apparatus, not shown, to which the drill rod 16 is attached will result in a substantial wedging action of the end of the tubular rod 28 against the surface 54 of the skirt 52 to provide nonrotatable engagement of the nut 50 with respect to the drill rod 28. While maintaining suitable pull down or downward axial force on the drill rod 16 the drilling apparatus is operated to rotate the drill rod and retrieving tool attached thereto in a direction tending to tighten the threaded connection 14. The third threaded portion 22 on the member 12 being of the opposite hand will result in the member 12 tending to move axially with respect to the longitudinal axis 53 of the retrieving tool upward out of the tubular drill rod 28 while the nut 50 remains positively and nonrotatably engaged with the drill rod 28. Normally, the broken drill rod 28 will not tend to rotate due to friction of the remainder of the extension drill string, not shown, therebelow against the side if the drill hole, and due also to the drill bit, not shown, being forcibly engaged with the bottom of the drill hole. The axial movement of the member 12 with respect to the nut 50 will result in compression of the elastically deformable members 36 whereby they will become elastically deformed radially outwardly into frictional gripping contact with the inner wall 46 of the tubular drill rod 28. The members 36 also tend to deform radially inwardly against the cylindrical portion 20 and frictional rubbing occurs. However, the contact area of the inner diameters 44 being less than that of the outer diameters 42 of the gripping members 36 will result in the gripping members tending to remain nonrotatable, although they will undergo some axial movement as the stack is compressed.

When a predetermined amount of resistance to rotation of the drill rod 16, which has been predetermined to be commensurate with suitable gripping of the broken drill rod, is percieved by the drilling apparatus operator the retrieving tool 10 and the broken drill rod frictionally coupled thereto are raised out of the hole 64. When the tool 10 and a sufficient portion of the drill rod 28 are out of the hole suitable holding means may be applied to the flats 62 and the drill rod 16 is then rotated in the opposite direction to relieve the axial force on the stack of elastically deformable gripping members. With the axial compressive force on the gripping members 36 released, said members will again assume their undeformed shape as shown in FIG. 1 whereupon the retrieving tool 10 may be removed from the tubular drill rod 28.

An alternate embodiment of the frictional coupling means is shown in FIG. 3 and designated by the numeral 70. In the embodiment of FIG. 3 the frictional coupling 70 comprises a plurality of pairs of elastically deformable ringlike members 72 and 74 having complementary sloped surfaces 76 and 78, respectively. The pairs of deformable members 72 and 74 are spaced apart by rigid force transmitting members 80 in substantially the same arrangement as shown in FIG. 1. The stack of members 72 and 74 are retained on the cylindrical portion 20 of member 12 by a cap 82 similar to the cap 24 in the embodiment of FIG. 1 and at the opposite end are engaged by the sleeve portion 84 of a nut substantially the same as the nut 50.

In response to the operation of the retrieving tool to compress the deformable members 72 and 74, the axial force applied to the stack of deformable members will act across the interface formed by the surfaces 76 and 78 and will cause the members 72 and members 74, respectively, to deform radially inwardly and radially outwardly. The members 74 will be deformed into frictional gripping relationship with the wall 46 of the tubular drill rod 28. There will be some relative slippage between the members 72 and 74 in both the axial direction and rotationally as the member 12 is rotated to compress the deformable members. The embodiment of FIG. 3 provides for more effective deformation of the members 74 into frictional gripping engagement with the tubular drill rod 28. The members 72 and 74 are suitably made of an elastically deformable material such as polyurethane or the like as in the embodiment of FIG. 1.

In FIGS. 4 and 5 another embodiment of the frictional coupling means of the retrieving tool of FIG. 1 is illustrated. In the embodiment of FIGS. 4 and 5 the frictional coupling 86 comprises a plurality of elastically deformable ringlike members 88 alternately spaced between substantially nondeformable force transmitting members 90 which are slidable on the cylindrical portion 20 of the member 12. The members 88 are defined by an outer cylindrical surface 92 and by the conical surfaces 94 and 96 sloping axially in opposite directions. The members 90 are provided with surface portions 98 and 100 engageable with the surfaces 96 and 94, respectively, on the members 88. A member similar to the nut 50 of FIG. 1 has a sleeve portion 102 modified to engage the endmost member 88. The opposite end of the frictional coupling 86 is retained on the cylindrical portion of the member 12 by a cap 104 similar to the cap 24 of FIG. 1. A member 108 having a sloping surface complementary to the

conical surface of the endmost member **88** is provided for transmitting axial force to the stack of members **88** and **90**. The member **108** also provides a bearing surface **110** for permitting relative rotation between the cap **104** and the frictional coupling arrangement of FIG. **4**.

As shown in FIG. **5** the elastically deformable gripping members **88** include a radial slot **112** formed therethrough. Moreover, the members **88** are preferably made of spring steel although nonmetallic elastic materials may also be used.

The operation of the frictional coupling means of the embodiment of FIG. **4** is substantially the same as the embodiments of FIGS. **1** through **3**. However, in the embodiment of FIG. **4** the axial force imposed on the frictional coupling **86** tends to close the spaces **99** between the members **90** resulting in a force component acting across the interface of surfaces **94** and **100**, and **96** and **98** which expands the members **88** radially outwardly into gripping relationship with the wall **46** of the tubular drill rod **28**. Moreover, if the members **88** are made of spring steel, as preferred, the elastic deformation is not one of substantial plastic flow in the sense of the deformation of the members **36** of FIG. **1** or the members **72** and **74** of FIG. .**3**. Furthermore, the members **88** do not come into forcible contact with the cylindrical portion **20** of the member **12** and hence no frictional rubbing occurs therebetween during the operation of the tool to actuate the frictional coupling **86**. In fact, an advantage of the embodiment of FIG. **4** is that substantially reduced frictional rubbing occurs during the actuation of the members **88** to grip the wall of the drill rod **28**. The members **88** and **90** tend only to move axially and substantial relative sliding normally occurs only between the member **108** and the cap **104**. Therefore, the rotational effort required to turn the member **12** is more efficiently converted into frictional gripping of the drill rod **28**. In the relaxed or nonactuated condition the members **88** and **90** of the frictional coupling of the embodiment FIG. **4** are in the position shown, the members **90** being spaced apart by the radial inward spring bias of the members **88**.

FIGS. **6** and **7** illustrate an alternate embodiment of a drill rod retrieving tool in accordance with the present invention and generally designated by the numeral **120**. The retrieving tool **120** includes a member **222** adapted to be threadedly connected to the lower end of the drill rod **16** in the same manner as the member **12** of the retrieving tool **10**. The member **122** also includes a transverse shoulder **124** formed between the threaded portion **126** and a reduced diameter portion **128**. The reduced diameter portion **128** has an internal bore **130** including a threaded portion **132**. Threadedly engaged with the member **122** is an elongated member **134** having a tapered nose **136** forming a transverse shoulder **138** and an elongated cylindrical portion **140** having longitudinal splines **142** formed thereon. The member **134** is retained in assembly with the member **122** by a retaining ring **146**.

The retrieving tool **120** also includes a frictional coupling **148** for engaging the inner wall **46** of the broken drill rod **28**. The frictional coupling of the retrieving tool **120** includes a plurality of elastically deformable gripping members **150** mounted in sleeved relationship on the splined portion **140** of the member **134**. The gripping members **150** are alternately spaced between substantially rigid force transmitting ring members **152** which are splined to the portion **140** of the member **134**. A spacer **154** is mounted on the portion **140** against the shoulder **138**. The gripping members **150** may be suitably made of molded polyurethane and are provided with a radial slot in the same manner as the members **88** to facilitate assembling them on the retrieving tool of FIG. **6**.

The retrieving tool **120** further includes means adapted to be nonrotatably engaged with the broken drill rod **28** comprising a sleevelike member **156** having a skirt **158** defining the sloped inner surface **160**. The surface **160** is operable to surround and be wedgingly engaged with the end **48** of the broken drill rod. The member **156** includes an integral tubular portion **162** extending in sleeved relationship around the cylindrical splined portion **140**. The member **156** further includes internal splines **164** extending part way into the bore **165** and engaged with the splines **142** on the member **134** whereby the member **156** is axially movable but nonrotatable with respect to the member **134**. The distal end of the tubular portion **162** engages the endmost gripping member **150**. The opposite end of the member **156** includes a bearing surface **166** engaged with the shoulder **124** on the member **122**. The elongated member **134** also includes a longitudinal cleansing fluid passage **168** through which drill hole cleaning fluid may be pumped during operation of the retrieving tool to clear debris from within the tubular drill rod **28** and to facilitate removal of the broken drill rod and portion of the extension drill string remaining in the drill hole.

The operation of the retrieving tool **120** is carried out in a manner similar to that of the retrieving tool **10**. The tool **120** is inserted into the open end of the broken drill rod **28** until the surface **160** on the member **156** is forcibly engaged with the end **48** of the broken rod. As in the tool **10** the surface **160** may be knurled or threaded to improve the wedging and gripping action of the member **156** with respect to the drill rod. With the member **156** nonrotatably engaged with the drill rod **28** the drill rod **16** is rotated to tend to tighten the threaded connection with the member **122** and thereby rotate the member **122**. The threads **126** and **132** being of the same hand will result in the movement of the elongated member **134** axially to compress the stack of elastically deformable gripping members **150** forcing same to deform radially outwardly into frictional gripping engagement with the inner wall of the drill rod **28**. Relative sliding occurs on the bearing surface **166** as the member **122** rotates with respect to the members **134** and **156**. The reduced diameter portion **128** is also rotatably journaled in the bore **165**. As in the operation of the tool **10** any tendency for the broken drill rod **28** and the remainder of the drill string connected thereto to rotate can be countered by increasing the axial or pull-down force on the retrieving tool and the drill string portion left in the drill hole.

Upon retrieving the broken or disconnected drill string from the drill hole, the retrieving tool **120** may be disconnected from the drill rod **28** by holding the member **156** stationary and rotating the drill rod **16** and member **122** connected thereto in the reverse direction. With the retrieving tool **120** there is also

scant loss of energy due to friction in the conversion of turning effort of the drill rod **16** into gripping action of the coupling **148** with the drill rod **28**. As previously mentioned, relative sliding of engaged members takes place across the bearing surface **166** and **124** which can be suitably prepared with coatings of low friction material and lubricant. The frictional resistance to turning of the threaded connection between the members **122** and **134** can also be minimized with accurately formed threads and suitable lubrication before use.

What is claimed is:

1. A tool for retrieving an elongated hollow drill rod or the like comprising:

an elongated member adapted to be coupled to a rotatable drill string and inserted into the interior of a hollow drill rod to be retrieved;

frictional coupling means including elastically deformable means operable to be elastically deformed into frictional gripping engagement with an interior wall of said hollow drill rod; and,

a drill rod engaging member including a portion adapted to surround and wedgingly engage an end portion of said hollow drill rod nonrotatably relative thereto, said drill rod engaging member being cooperable with said elongated member to engage and elastically deform said frictional coupling means.

2. The invention set forth in claim **1** wherein:

said elongated member is responsive to the rotation of said drill string to be cooperable with said drill rod engaging member to elastically deform said frictional coupling means.

3. The invention set forth in claim **1** wherein:

said elastically deformable means comprises a plurality of ringlike members mounted in stacked relationship on said elongated member, said stack of ringlike members being engageable at one end thereof by said drill rod engaging member and in response to the rotation of said drill string said elongated member is operable to move axially with respect to said drill rod engaging member to elastically deform said ringlike members into frictional gripping engagement with said interior wall of said drill rod for coupling said drill rod to said tool to remove said drill rod from a drill hole.

4. The invention set forth in claim **3** wherein:

said elongated member includes a threaded portion and said drill rod engaging member includes a complementary threaded portion engaged with said threaded portion on said elongated member and in response to the rotation of said drill string said elongated member is operable to rotate and thereby move axially with respect to said drill rod engaging member.

5. The invention set forth in claim **4** wherein:

said tool includes a rotatable member coupled directly to said drill string and interposed between said elongated member and said drill string, said rotatable member and said elongated member are threadedly engaged with each other and said elongated member is operable to move axially with respect to said rotatable member to elastically deform said ringlike members in response to the rotation of said rotatable member.

6. The invention set forth in claim **5** wherein:

said elongated member is engaged with said drill rod engaging member for nonrotatable but axial movement relative thereto in response to the rotation of said rotatable member.

7. The invention set forth in claim **6** wherein:

said frictional coupling means comprises a plurality of substantially rigid force transmitting members alternately spaced between said ringlike members and operable in response to the axial movement of said elongated member to elastically deform said ringlike members substantially radially outwardly with respect to the longitudinal axis of said tool.

8. The invention set forth in claim **7** wherein:

said ringlike members are elastically deformable in a radial and axial direction.

9. The invention set forth in claim **7** wherein:

said portion of said drill rod engaging member comprises a skirt defining a conical surface.

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