FLUID PRESSURE LOCKED WELL DRILLING TOOL

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ABSTRACT

A telescopic bumper jar is made up in a string of drill collars in a well drilling pipe string, and fluid pressure holds the tool in a telescopically contracted condition with opposing shoulders abutting to prestress the tool to prevent fatigue during drilling. In one form the tool is locked by a fluid pressure expanded locking sleeve congeaged between the telescopic bodies. In another form a differential piston responsive to pressure in the tool and to hydrostatic pressure in the drill pipe prestresses the tool. In both forms, the pressure is relieved by a tripping plug dropped through the drill pipe.
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FLUID PRESSURE LOCKED WELL DRILLING TOOL

In the drilling of wells, such as oil and/or gas wells, utilizing rotary drilling tools, it sometimes becomes necessary or desirable to be able to apply an impact or jarring action to the bit or to the drill collars above the bit. Various jars or bumper subs are available for such purposes, and, in general, they include an upper body adapted to be made up in the drill collar string and a lower companion body also adapted to be made up in the drill collar string, the bodies having a torque transmitting splined connection enabling relative longitudinal or telescopic movement of the bodies. The bodies provide an anvil and a hammer for producing hammer blows in the drill string above the bit.

During drilling operations such tools are subject to fatigue due to the rotation and axial movements which occur, particularly in the region of the usual shoulders. In the case of the typical jars tension is applied to the drill string to cause the bleeding through an orifice of internal fluid as the tension is increased, the jar having a valve which opens when the tension reaches a given force for sufficient time. Thus, jarring actions are time consuming. Bumper sub devices are also available without the hydraulic jar feature, but such tools are also subjected to stress failures, since the shoulders are not held tightly together during drilling operations.

The present invention provides a well drilling tool of the bumper sub or jar type, including telescopic bodies adapted to be made up in the drill collar string above the drill bit and locked up by fluid pressure in a stressed condition approximately equal to the prestress of the drill collars caused by torquing of the drill collar joints, but the tool can be released, when desired, to enable telescopic movement of the tool body sections. Release of the tool body sections is accomplished by dropping a retrievable or pump through plug in the drill string and operating a release device.

In one form the invention involves a telescopic body the sections of which are splined together for rotation and telescopic movement, and the body sections being adapted to be shouldered up or prestressed before installation in the drill collar string. While prestressed or shouldered the body sections are hydraulically locked together by an intermediate fluid pressure expandable friction sleeve in which fluid is retained under pressure by means releasable when a tripping plug actuates a trigger or shiftable member to relieve pressure in the friction sleeve, thereby enabling relative telescopic movement of the body sections, while the splined connection maintains the torque transmitting capacity of the tool.

In another form, the invention acts as a jar which is initially prestressed by hydraulic pressure applied to a chamber and acting on a differential piston which is also exposed to hydraulic pressure in the drill string, the differential piston pressure responsive area in the chamber being smaller than the differential piston pressure responsive area exposed to pressure in the drill string, whereby the tensioning or stressing force on the tool is boosted by the drill string hydrostatic pressure. When the tool is to be released to enable it to function as a jar, a tripping plug is dropped in the drill string to seat on and actuate means for equalizing the differential action and relieve the pressure stressing the tool, while a jarring strain is maintained on the drill string to effect an initial jarring action.

With drilling tools of the types referred to above, fatigue failure is minimized by the prestressing of the tools, as the tools effectively function merely to transmit torque and locked against relative telescopic movement.

This invention possesses many other advantages, and has other purposes which may be made more clearly apparent from a consideration of the forms in which it may be embodied. These forms are shown in the drawings accompanying and forming part of the present specification. They will now be described in detail, for the purpose of illustrating the general principals of the invention; but it is to be understood that such detailed descriptions are not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings: FIG. 1 is a longitudinal section generally illustrating the invention applied to a drill collar string of a well drilling apparatus, with the drilling tool of the invention locked in a prestressed telescopically contracted condition, and showing the tripping plug traveling through the drill string.

FIG. 2 is a view corresponding to FIG. 1, but showing the tool released;

FIG. 3 is a further view corresponding to FIG. 1, but showing the tool telescopically extended;

FIGS. 4a through 4f, together, constitute a longitudinal section showing, in detail, the structure of the apparatus of FIGS. 1-3 in the condition of FIG. 1, FIGS. 4b through 4f constituting successive downward continuations of FIG. 4a;

FIG. 5 is a transverse section, as taken on the line 5-5 of FIG. 4a;

FIG. 6 is a transverse section, as taken on the line 6-6 of FIG. 4a;

FIG. 7 is a transverse section, as taken on the line 7-7 of FIG. 4b;

FIG. 7a is an enlarged fragmentary detail view in section of the threaded connection embraced by the line 7a-7a of FIG. 4b;

FIG. 8 is a transverse section as taken on the line 8-8 of FIG. 4d;

FIGS. 9a through 9d, together, constitute a longitudinal section through another form of the invention in a prestressed condition, FIGS. 9b through 9d constituting successive downward continuations of FIG. 9a;

FIG. 10 is a transverse section, as taken on the line 10-10 of FIG. 9c; and

FIGS. 11a through 11d, together, constitute a longitudinal section corresponding to FIGS. 9a through 9d, but with the tool in a released condition for effecting a jarring action, FIGS. 11b through 11d constituting successive downward continuations of FIG. 11a.

As seen in the drawings, referring first to FIGS. 1-3, a drilling tool T is shown as installed in a string of drill collars C which are interposed between the lower end of a string of the usual drill pipe P and the usual drill bit B, as is well known in the rotary drilling of wells, such as oil and/or gas wells. The drill collars C are employed to apply weight to the bit during drilling and are heavy tubular bodies internally threaded at one end and having an externally threaded pin 11 at the other end to provide joints between collars adapted to be tightly shouldered up. The drill collars are made up
in a number depending upon the weight desired on the bit, the uppermost drill collar being connected to the drill pipe P to be rotated thereby. The threaded connections between drill collars are made up or shouldered up tightly to prevent fatigue at the joints during drilling. In many drilling operations it is desired to incorporate a drilling tool T in the drill collar string in accordance with the invention, having an internally threaded upper end 12 and an externally threaded lower pin 13 interconnecting the tool T with the upper and lower drill collars C.

As generally illustrated in FIGS. 1 through 3, the tool T is an elongated assembly comprising an upper and outer tubular body 14 and a lower and inner tubular body 15 having a splined connection 16 with the outer body 14, whereby the tool is telescopically extensible and contractable and is capable of transmitting torque for rotating the bit B. Within the outer body 14, the inner body has a downwardly facing shoulder 17 opposing an upwardly facing shoulder 18 internally of the body 14 for limiting telescopic extension of the tool T, and at its lower end, the inner body 15 has an upwardly facing shoulder 19 opposed to the extreme lower surface 20 of the outer body 14, which limit telescopic contraction of the tool T. When desired, the tool T may be operated to enable the upper body 14 to be reciprocated by raising and lowering the drill pipe string P to effect a jarring action upon impacting of the shoulders 17, 18 and 19, 20, but prior to such use of the tool, it is desired that the tool effectively constitute a rigid body corresponding to the drill collar C which will not fail or fatigue during protracted drilling operations.

Accordingly, as will be more particularly described hereinafter, means are provided whereby the body sections are locked with the shoulders 19 and 20 held positively in prestressed engagement and with the inner body 15 in tension, in the condition as shown in FIG. 1. The means for locking up the body, as will also be more fully described hereinafter, is responsive to a tripping plug 21 adapted to be dropped in the drill string and actuated by fluid pressure to shift a trigger or sleeve 22 from the position of FIG. 1, in an upper location in the inner body 15, to the position of FIG. 2, at which the trigger sleeve 22 is in a lower position, and after movement of the trigger sleeve 22 the plug is pumped through the sleeve. Shifting of the sleeve 22 to the position of FIG. 2 releases the means locking up the tool body so that the body sections 14 and 15 are freed for relative longitudinal or telescopic extension and contraction, as previously referred to, the plug 21 moving downwardly into an enlarged cavity 23 in a bit sub 24 and landing on a plug catcher 25, enabling unobstructed circulation of drilling fluid through the bit B. Thereafter, the tool T functions as a conventional bumper sub. The tripping plug, if desired, may be of the wireline retrievable type instead of the pump through type shown and described above.

Referring more particularly to FIGS. 4a through 4f and 5 through 8, an illustrative tool T is shown, wherein the outer body 14 comprises an elongated tubular housing section 30 having at its upper end a threaded connection 31 with a top sub 32 which has the threaded receptacle 12 for receiving the threaded pin 11 of a drill collar C. The threaded connection 31 is made up tight to cause co-engagement between the opposing shoulders indicated at 33 of the body section 30 and the top sub 32. At its lower end, the body section 30 has the downwardly facing shoulder 20, previously referred to. As best seen in FIG. 8, the body section 30 has internal grooves 34 adapted to receive longitudinally extended ribs 35 on the inner body 15 to provide the splined connection 16.

The inner body section 15 of the tool T comprises a bottom sub 36 having the upwardly facing shoulder 19 previously referred to and also having the threaded pin 13 for connecting the inner body 15 to the drill collar C therebelow. Within the bottom sub 36 is a bore 37 threaded at 38 to receive the threaded lower end 39 of an elongated tubular mandrel or inner body section 40. A side sealing ring 41 is disposed between the mandrel end 39 and the wall of the bore 37. Above the upper ends of the ribs 35 on the mandrel 40 is an enlarged section 42 slidable in the outer housing or body section 30 and having suitable sealing ring means 43 slidably end sealingly engaging within the housing 30. Above the enlarged mandrel section 42 the mandrel has a section 44 extending further upwardly in inwardly spaced relation to the housing 30 to form an annular space 45 adapted to receive the means 46 for locking the tool up, with the shoulders 19 and 20 tightly engaged and the mandrel 40 in tension to maintain engagement of the shoulders and minimize fatigue which could occur during drilling in the absence of such a prestressed condition.

This locking means comprises a hydraulic locking sleeve assembly including inner and outer sleeve members 47 and 48 in the annular space 45, and engaged with the housing 30 and mandrel section 44. The sleeves 47 and 48 define a space 49 therebetween adapted to be filled with a fluid, as will be later described. The inner sleeve 47 is internally threaded at 50 so as to be threadedly engaged substantially throughout its length with a companion thread 51 formed externally on the mandrel 44.

The inner sleeve 47 has an external thread 47' extending along its length and engageable with a companion internal thread 48' in the outer sleeve 48. As best seen in FIG. 7a, the space 49 referred to above is defined between the crests and roots of the threads 47' and 48' and by the gap between the unloaded flanks of those threads. The loaded flanks of these threads are straight so as to not interfere with expansion of the outer sleeve 48 but so as to securely connect the sleeves 47 and 48 against relative longitudinal movement. The outer sleeve 48 and the inner sleeve 47 have a lower annular weld 52 formed as a bead between the lower bevelled surfaces 47a and 48a of the sleeves 47 and 48, and at the top of the sleeves 47 and 48 a similar weld 53 is formed between the upper bevelled surfaces 47b and 48b of the sleeves 47 and 48, this upper weld 53 constituting means for attaching to the locking sleeve assembly a pair of tubes including a filled tube 54 and a relief tube 55, the lower ends of which are welded in place and in communication with the space 49 between the sleeves 47 and 48.

The tubes 54 and 55 extend upwardly in an annular space 56 defined between a bore 57 in the top sub 32 and the outside wall of a tubular mandrel extension 58. This mandrel extension has a threaded lower end 59 engaged with an internal thread 60 on a neck portion 61 of the mandrel 44, a suitable side ring seal 62 being disposed between the mandrel extension and the neck 61. At its upper end 63, the mandrel extension 58 has another side ring seal 64 engaged in a reduced bore 65.
of the top sub 32. In the outer wall of the mandrel extension 58 is a cavity 66, in which the upper end of the filler tube 54 is disposed and crimped shut or welded after the filler tube has been employed to fill the space 49 of the hydraulic locking sleeve means 46 with fluid under pressure. The upper end of the relief tube 55 is initially closed and at 67 extends laterally through an opening 68 in the mandrel extension 58 so as to project beyond the inside diameter of the mandrel extension and into an annular groove 69 formed in the trigger sleeve 22 previously referred to. The trigger sleeve 22 is shiftable disposed within the mandrel extension 58 but is initially held in place in an upper position by one or more shear screws 70 engaged between the mandrel extension 58 and the trigger sleeve 22. Above and below the annular groove 69 the trigger sleeve 22 carries upper sealing ring means 71 and lower sealing ring means 72 sealingly engaged within the mandrel extension 58. Below the upper sealing ring means 71 the mandrel extension has a vent opening 73 which is normally closed by the seals described above. The end portion 67 of the relief tube 55 is adapted to be sheared by the sharp corner 74 provided on the trigger sleeve 22 when the trigger sleeve is shifted downwardly, as will be later described.

As seen in FIGS. 4a through 4c, the outer locking sleeve 48 has a long cylindrical surface 75 engaged within the cylindrical inner surface 76 of the housing or body section 30. Normally, in the absence of pressure within the locking sleeve annulus 49 these surfaces 75 and 76 would be relatively longitudinally shiftable, but when the annulus 49 is pressurized via the filler tube 54, the internal pressure acting outwardly on the outer locking sleeve 48 expands the latter outwardly so that the surfaces 75 and 76 on the locking sleeve 48 and in the housing 30, respectively, are forced into tight frictional co-engagement, thereby locking the elements against longitudinal movement, and since the inner locking sleeve 47 is connected to the mandrel 44, it is apparent that when the annulus 49 is pressurized the inner and outer bodies 14 and 15 of the tool are locked against telescopic movement. To enhance the coefficient of friction between the surfaces 75 and 76, the surface 75, prior to assembly, may be dusted with grit, say 600 mesh carburundum.

In the use of the tool T, prior to its installation in the drill collar string, a suitable tool (not shown) of the type generally corresponding to a wheel or bearing puller, that is, a push-pull tool, can be connected to the inner and outer bodies 14 and 15 of the tool T to tension the inner body and push on the outer body, thereby locking and prestressing the abutting shoulders 19 and 20 as previously described. For example, with the top sub 14 and the mandrel extension 58 removed, such a pushpull tool can be connected to the thread 60 of the mandrel neck 61 to pull on the latter while pushing on the upper end of the housing 30. With the tool bodies thus prestressed the locking sleeve annulus 49 can be filled and pressurized to lock the tool bodies together, and escape of the pressurizing fluid through the filler tube may be prevented by crimping or by use of a backflow preventing valve. The mandrel extension 58 is then assembled on the mandrel 44, the tubes 54 and 55 positioned as shown in FIG. 4a, and then the top sub 32 can be applied to the housing 30 to complete the assembly of the tool. The tool T is then ready for installa-

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tion in the drill collar string and for use in the drilling of a well.

When it is desired to release the tool for telescopic movement of the inner and outer bodies to effect a jar-

ring action as described above, the tripping plug 21 traveling downwardly through the drill string initially seats upon the upper inner seat 22a on the trigger sleeve 22, thereby preventing fluid flow through the trigger sleeve. When pressure in the drill string is increased the plug will force the trigger sleeve 22 downwardly shearing the shear screw 70 and the trigger sleeve 22 will move to its lower position engaged with the seat 22b on the mandrel 44 below the mandrel extension 58. As the trigger sleeve moves downwardly it will shear the end from the relief tube 55, thereby relieving the fluid pressure from the annulus 49 of the hydraulic locking sleeve means 46. The tool is then free for telescopic motion.

When the trigger sleeve 22 engages the stop shoulder 22b, the tripping plug 21 is pumped through the sleeve and lands on the plug catcher 25 previously referred to. While the plug catcher may be a sleeve, the plug catcher, as seen in FIG. 4j, is incorporated in a float sleeve 80 having a tubular body 81 held in place in the bore 82 of the blad sub 24 by the threaded pin 83 of the bit B. Reciprocable in a spider 84 in the valve body 81 is the stem 85 of a valve head 86 which is normally biased into engagement with the seat 88 by a spring 87. As the drill string is being lowered into the well, this float valve is held closed by the pressure of fluid in the well, but when drilling fluid is being circulated the valve is open.

Referring to FIGS. 9a through 9d a modified tool T is shown in the form of a hydraulic jar which is initially locked up, but which is released by a tripping plug to allow the tool to be telescopically extended to provide the jarring action. In FIGS. 11a through 11d, the tool is shown in the released, jarring condition.

In this form, the outer body comprises an elongated, tubular upper body section or housing 100 telescopically engaged with the upper, inner body section 101, the body sections 100 and 101 having companion ribs and grooves providing a splined connection at 102. At its lower end, the outer body or housing section 100 is threaded at 103 to a cylinder head 104 having a bore 105 in which a cylindrical section 106 of the inner body section 101 is slidable and sealed by a side ring seal 107. Below the cylinder head 104 is a lower body section 108 threaded on a skirt or annular portion 109 of the cylinder head 104. At the lower end of the annular portion 109 is a shoulder 110 which faces downwardly and which is adapted to be impacted by a hammer 111 carried by the inner body 101. This hammer 111 is threaded onto the inner body 101 at 112 and locked thereon by a pin 113. A side ring seal 114 forms a seal between the body 101 and the hammer 111.

Below the body 101, the hammer 111 has an elongated skirt 115 extending downwardly and disposed in an annular space 116 defined between the inner cylindrical wall of the lower body section 108 and an elongated tubular trigger sleeve 117. This trigger sleeve 117 has an upper sealing ring 118 sealingly and slideably engaged with the skirt 115, and when in its normal or upper position, as seen in FIG. 9c and 9d, the trigger sleeve has an intermediate sealing shoulder 119 engaged with the opposing sealing bevelled surface 120 of the skirt 115. An outer ring seal 14a is provided be-
between the housing 108 and the lower end of the skirt 115. The sealing surfaces 119, 120, when engaged separate the annular space 116 from a lower atmospheric chamber 121 defined between the lower body 108, the trigger sleeve 117, and the upper end of an annular differential piston 122. This piston 122 has an inner sealing ring 123 slidably engaging the cylindrical wall 124 of the trigger sleeve 117, and an outer sealing ring 125 slidably engaging the inner cylindrical wall 126 of a ratio or booster sleeve 127 which extends into the atmospheric chamber 121, and which has a lower flanged section 128 provided with a seal ring 129 engaged with the cylindrical wall 130 of the housing section 108, the lower end of the flanged section 128 of the booster sleeve being disposed in an annular space 131 defined between the cylindrical wall 130 of a reduced mid-section 132 of the differential piston 122. At its lower end, the piston 122 is provided with outer sealing ring means 133 and inner sealing ring means 134, respectively, slidably engaging the cylindrical wall 130 of the housing section 108 and a reduced cylindrical wall portion 135 of the trigger sleeve 117. The lower end of the differential piston 122 is exposed to the pressure of fluid in the drill string through a bore 136 in the lower connector sub 137 to which the housing section 108 is connected at 138.

Passage means are provided in the trigger sleeve 117 whereby oil or other fluid under pressure can fill the annular space 116 in the housing 108. More particularly, the trigger sleeve has an elongated passage 139 having a filler opening 140, the passage 139 extending longitudinally in the trigger sleeve and communicating through a lower radial port 141 with the annular space 142 defined between the trigger sleeve 117 and the mid-section 132 of the piston 122, the piston also having a radial port 143 through which fluid finds access to the outer annular space 131, previously referred to. Adjacent to its upper end, the passageway 139 communicates through another radial port 144 with the annular space 116 in the body section 108, the lower end of the hammer skirt having a radial opening 145 to allow the fluid to fill the annulus 116.

The trigger sleeve 117 is normally held in an upper position with respect to the hammer skirt 115, with the sealing surfaces 119 and 120 in engagement and separating the pressurized fluid in the annulus 116 and acting on the piston 122 in the annular spaces 131 and 142 from the atmospheric pressure in the chamber 121. A coiled compression spring 146 seats on a shoulder 147 in the connector sub 137 and acts upwardly on a shoulder 148 of the trigger sleeve 117.

Pressure fluid applied to the annulus 116 acts upwardly on the pressure responsive area D of the anvil 109 and downwardly on the pressure responsive area E of the hammer 111 causing telescopic contraction of the inner and outer bodies of the tool, thereby axially locking or prestressing the tool and maintaining the tight engagement between the upper shoulder or surface 100a of the outer body 100 and the downwardly facing surface or shoulder 101a of the outer body 101. During drilling with the tool, the pressure of drilling fluid in the drill string, that is, the hydrostatic pressure of the drilling fluid column, is applied to the annular area F of the differential piston 122 which in turn, effects an intensified pressurization of the oil within the annulus 116, depending upon the difference between the annular area F and the net effective area of the differential piston in the annular space 131 designated area G and in the annulus 142 and designated area H. Since the area F of the piston is substantially greater than the sum of the areas G and H, the internal pressure of oil acting on the areas D and E, causing the tool to be locked up tightly, is greatly intensified so that no working of the tool can result from the drilling operations and fatigue is prevented. The intensity of the pressure can be modified by changing the dimensions of the sleeve 127 and the piston 122 so that the effective area G can be increased or decreased. In other words, the substitution of a booster sleeve and piston of different diameters will effect a difference in the intensification of the hydrostatic pressure of drilling fluid.

When it is desired to effect a jarring action, the pipe string is tensioned and a tripping plug 150, of the wireline retrievable type, is dropped through the drill pipe and will come to rest on a bevelled seat 151 within the trigger sleeve 117. The illustrated tripping plug 150 is shown as comprising an elongated body 152 having a retrieving neck 153 at its upper end and a valve ring 154 normally biased upwardly into abutting engagement with the base flange 155 of the retrieving neck 153 by a coiled spring 156. When this tripping plug is on the seat 151 drilling fluid pressure can be applied to cause the trigger sleeve 117 to be forced downwardly, thus disengaging the sealing surfaces 119 and 120, as seen in FIG. 11c. When the pressurized fluid in the annulus 116 is dumped into the atmospheric chamber 121, instantaneously, the pressure acting on hammer and anvil areas A and B is relieved so that in response to the tension in the drill string the inner body 101 will move rapidly upwardly with respect to the outer body 100 and the hammer 111 will strike a blow against the anvil 109 as seen in FIG. 116.

As the trigger sleeve 117 moves downwardly to the position of FIG. 11d, the lower end surface 150a of the tripping plug 150 shoulders on the shoulder 147 of the outer body or connector sub 137. Fluid pressure will then shift the valve ring 154 downwardly overcoming the spring 156 and opening a flow path, as shown by the arrows in FIG. 11d, between the valve ring 154 and the flange 155 and through slots 152a extending longitudinally of the plug 150, to enable the circulation of fluid.

After tripping, the tool will continue to act as a hydraulic jar instead of merely as a bumber sub. This act is accomplished by lowering the drill pipe to close the tool and shutting off the pump which will permit spring 146 to return the trigger sleeve 117 to sealing engagement with skirt 120. At this time, the atmospheric chamber 121 is filled with oil at the same pressure as hydrostatic pressure and therefore there is no longer a compressive force between shoulders 110a and 101a. However, when the drill pipe is again tensioned, the oil in the annular space 116 cannot escape and will be compressed to whatever pressure is required to resist relative movement of the inner and outer members. As pressure increases, it will act over areas G and H tending to return differential piston 122 to its original position. The hydrostatic pressure trapped in the hydrostatic chamber will drop off proportionally to the force developed on differential piston 122 until, if enough pressure is developed in annular space 116, it will fall to zero as this pressure acting on areas G and H overcomes the force acting upward due to hydrostatic pressure acting on area F. The tool would then be essentially in the same condition it was.
in originally and can be released to strike a jarring blow by again applying enough pump pressure to move trigger 117 downward to relieve the pressure in 116.

We claim:

1. In a well drilling tool: a telescopic assembly comprising an elongated inner body and an elongated outer body, means interconnecting said bodies for rotation as a unit and for telescopic movement, said bodies having opposing shoulders limiting telescopic contraction, fluid pressure responsive means for holding said bodies in telescopically contracted condition with said shoulders tightly engaged, said fluid pressure responsive means including means preventing all relative longitudinal movement between said bodies from said contracted condition to retain said shoulders tightly engaged, and trigger means operable by a tripping device for releasing said fluid pressure responsive means to permit disengagement between said shoulders and telescopic extension of said bodies with respect to each other.

2. In a well drilling tool as defined in claim 1, said bodies having additional opposed shoulders spaced apart when said bodies are telescopically contracted and adapted to produce a hammer blow upon telescopic extension of said bodies.

3. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means frictionally holding said bodies against telescopic movement.

4. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising expandable means between said bodies expanded by fluid pressure.

5. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, said sleeves defining a pressure chamber therebetween whereby said sleeves are relatively expanded to frictionally lock said bodies together.

6. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, one of said sleeves being fixed on one of said bodies, the other of said sleeve and the other of said bodies having opposing friction surfaces, said sleeves defining a pressure chamber therebetween for expanding said other sleeve into frictional locking engagement with said other body.

7. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, said sleeves defining a pressure chamber therebetween whereby said sleeves are relatively expanded to frictionally lock said bodies together, and means operable by said trigger means to exhaust said pressure chamber.

8. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, one of said sleeves being fixed on one of said bodies, the other of said sleeves and the other of said bodies having opposing friction surfaces, said sleeves defining a pressure chamber therebetween for expanding said other sleeve into frictional locking engagement with said other body, and means operable by said trigger means to exhaust said pressure chamber.

9. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of metal sleeves, means joining said sleeves in concentric circumferentially spaced relation to form a pressure chamber therebetween, filler means for filling said chamber, and relief means for venting said chamber responsive to said trigger means.

10. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of metal sleeves, means joining said sleeves in concentric circumferentially spaced relation to form a pressure chamber therebetween, filler means for filling said chamber, a relief tube communicating with said chamber and having a free end, said inner body having an opening through which said free end extends, and said trigger means comprising a sleeve shiftable relative to said inner body and having a shearing edge for shearing off said free end upon movement of said trigger sleeve.

11. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising a pair of metal sleeves, means joining said sleeves in concentric circumferentially spaced relation to form a pressure chamber therebetween, filler means for filling said chamber, and relief means for venting said chamber responsive to said trigger means, said inner body and the inner sleeve being threadedly interconnected, the outer sleeve and said outer body having opposed frictional surfaces co-engaged when pressure is applied to said chamber to frictionally lock said bodies together.

12. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, and said trigger means being operable to vent the fluid from said chamber.

13. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, said trigger means and one of said bodies having companion sealing means normally confining said fluid in said chamber, and said chamber being vented upon movement of said trigger means.

14. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, means defining an atmospheric chamber, said piston means having a third pressure responsive area exposed to said atmospheric chamber, and said trigger means being operable to vent the fluid from said pressure chamber to said atmospheric chamber.
15. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, means defining an atmospheric chamber, said piston means having a third pressure responsive area exposed to said atmospheric chamber, said trigger means and one of said bodies having companion sealing means normally confining said fluid in said chamber, and said trigger means being operable to vent the fluid from said pressure chamber to said atmospheric chamber.

16. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, said trigger means being operable to vent the fluid from said chamber, and said first pressure responsive area being smaller than said second pressure responsive area, whereby the pressure of said fluid in said chamber is greater than said hydrostatic pressure.

17. In a well drilling tool as defined in claim 1, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, said trigger means being operable to vent the fluid from said chamber, and said opposing pressure responsive areas of said bodies comprising a hammer and an anvil.

18. In a well drilling tool: a telescopic assembly comprising an elongated inner body having means at one end for connection in a drill string, an elongated outer body having means at one end for connection in said drill string, the other ends of said bodies being telescopically engaged, means interconnecting said bodies for rotation as a unit and for telescopic movement, said bodies having opposing shoulders limiting telescopic contraction, fluid pressure responsive means between said bodies for holding said bodies telescopically contracted with said shoulders tightly abutting, and trigger means shiftably carried by said inner body for relieving said fluid pressure responsive means upon movement of said trigger means, said fluid pressure responsive means including fluid pressure expandible friction locking means interposed between said bodies, and vent means communicating with said expandible means and operable by said trigger means upon movement of the latter.

19. In a well drilling tool as defined in claim 18, said bodies having additional opposed shoulders spaced apart when said bodies are telescopically contracted and adapted to produce a hammer blow upon telescopic extension of said bodies.

20. In a well drilling tool as defined in claim 18, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, said sleeves defining a pressure chamber therebetween whereby said sleeves are relatively expanded to frictionally lock said bodies together.

21. In a well drilling tool as defined in claim 18, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, one of said sleeves being fixed on one of said bodies, the other of said sleeve and the other of said bodies having opposing friction surfaces, said sleeves defining a pressure chamber therebetween for expanding said other sleeve into frictional locking engagement with said other body.

22. In a well drilling tool as defined in claim 18, said fluid pressure responsive means comprising a pair of sleeves, said bodies having walls defining an annular space receiving said pair of sleeves therebetween, thread means fixing one of said sleeves on one of said bodies, thread means mounting the other of said sleeves on said one of said sleeves to prevent relative axial movement of said sleeves while allowing relative circumferential movement of said sleeves, said other of said sleeves and the other of said bodies having opposing friction surfaces, said sleeves defining a pressure chamber therebetween for expanding said other sleeve into frictional locking engagement with said other body.

23. In a well drilling tool as defined in claim 22, said thread means mounting the other of said sleeves on said one of said sleeves comprising a buttress thread having abutting thread surfaces normal to the axis of said sleeves and trailing flanks forming said pressure chamber.

24. In a well drilling tool: a telescopic assembly comprising an elongated inner body having means at one end for connection in a drill string, an elongated outer body having means at one end for connection in said drill string, the other ends of said bodies being telescopically engaged, means interconnecting said bodies for rotation as a unit and for telescopic movement, said bodies having opposing shoulders limiting telescopic contraction, fluid pressure responsive means between said bodies for holding said bodies telescopically contracted with said shoulders tightly abutting, and trigger means shiftably carried by said inner body for relieving said fluid pressure responsive means upon movement of said trigger means, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, said trigger means being operable to vent the fluid from said chamber.

25. In a well drilling tool as defined in claim 24, said trigger means and one of said bodies having companion sealing means normally confining said fluid in said chamber, and said chamber being vented upon movement of said trigger means.

26. In a well drilling tool as defined in claim 24, means defining an atmospheric chamber, said piston means having a third pressure responsive area exposed to said atmospheric chamber, and said trigger means being operable to vent the fluid from said pressure chamber to said atmospheric chamber.
27. In a well drilling tool as defined in claim 24, said bodies having additional opposed shoulders spaced apart when said bodies are telescopically contracted and adapted to produce a hammer blow upon telescopic extension of said bodies.

28. In a well drilling tool as defined in claim 24, said fluid pressure responsive means comprising means defining a pressure chamber containing a body of fluid, piston means having a first pressure responsive area exposed to the fluid in said chamber and a second pressure responsive area exposed to hydrostatic pressure, said bodies having opposing pressure responsive areas exposed to the pressure of fluid in said chamber, and said trigger means being operable to vent the fluid from said chamber, a sleeve removably mounted in said chamber and slidably engaged by said piston, the relationship between the first and second areas of said piston means being determined by the radial thickness of said sleeve.

29. In a well drilling tool: a telescopic assembly comprising an elongated inner body and an elongated outer body, means interconnecting said bodies for rotation as a unit and for telescopic movement, said bodies having opposing shoulders limiting telescopic contraction, fluid pressure responsive means for holding said bodies in telescopically contracted condition with said shoulders tightly engaged, said fluid pressure responsive means including means preventing all relative longitudinal movement between said bodies from said contracted condition to retain said shoulders tightly engaged, and trigger means operable by fluid pressure in said inner body for releasing said fluid pressure responsive means to permit disengagement between said shoulders and telescopic extension of said bodies with respect to each other.

30. In a well drilling tool as defined in claim 29, said bodies having additional opposed shoulders spaced apart when said bodies are telescopically contracted and adapted to produce a hammer blow upon telescopic extension of said bodies.