Jan. 12, 1937. E. BURNS ET AL 2,067,377

SAFETY JOINT

Filed April 2, 1935

Fig. 1

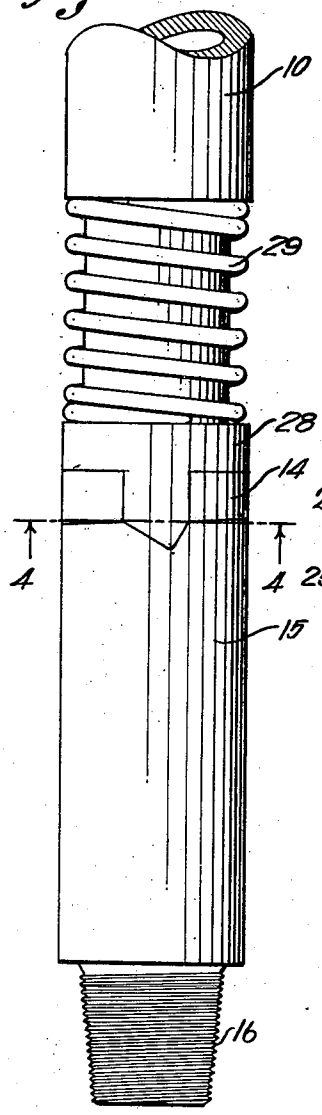


Fig. 2

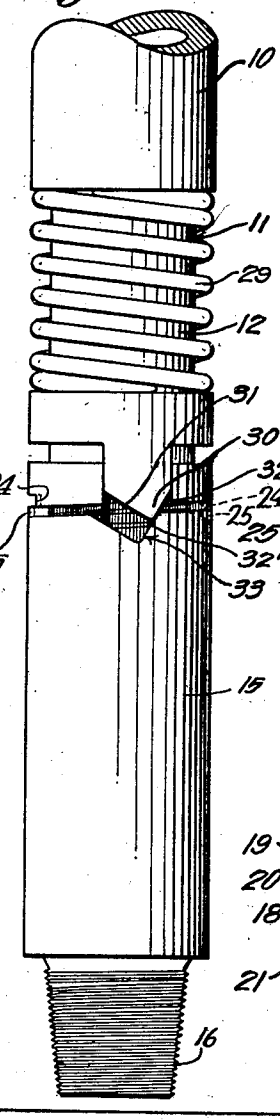


Fig. 3

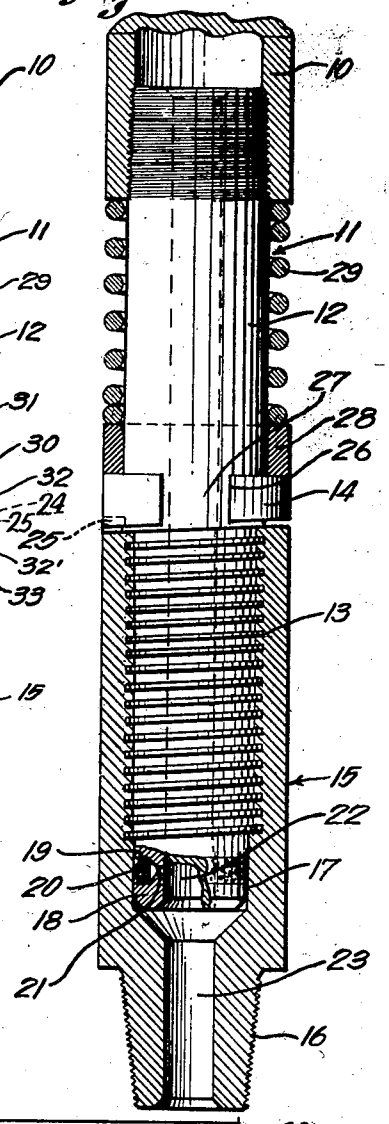
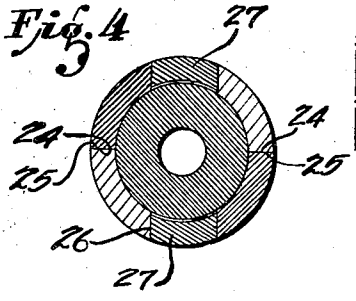


Fig. 4



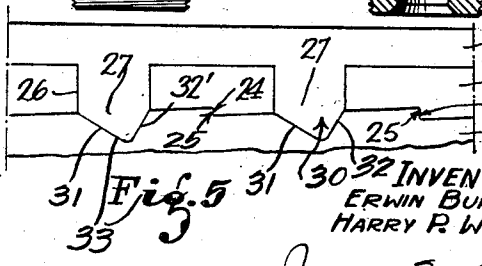


Fig. 5

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SAFETY JOINT

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9 Claims. (Cl. 255—28)

This invention relates to oil well drilling equipment and particularly pertains to a safety joint.

In the operation of oil well drilling which includes a string of drill pipe carrying some appropriate tool at the lower end it is the usual practice to thread the joints of the drill strings together and to set the threads as the drill string is assembled and lowered into the well, so that a positive drilling action may be accomplished by exertion of torque upon the drill string in one direction, and by the additional exertion of tension and compression in the drill string as occasion demands. Under some conditions it becomes necessary to disconnect an upper section of drill string from a lower section, and since it might be possible by reverse rotation of the drill string to unscrew the string at one of its joints, it will be recognized that there would be no certainty or selection as to the joint unscrewed, and it is the object of the present invention to provide an instrumentality which may be interposed in the line of drill string at a predetermined point and which will permit separation of the drill string at that point without requiring the imposition of sufficient torque upon the drill string to unscrew the drill string at any of its joints, the structure having the additional advantages or providing a positive lock between the sections of the string between which it is positioned so that a positive driving action, as well as torque and tension forces, may be applied to the drill string without throwing a strain on the parts of the structure, the lock being so designed as to permit its proper release upon reverse rotation of the drill string only.

The invention contemplates the provision of a pair of tubular members, one threaded into the other and adapted to positively engage each other when rotated in a driving direction, which members are provided with a temporary positive lock by which the members may be moved to a released position and their separation may then take place by unscrewing.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in elevation showing the completely assembled and locking device.

Fig. 2 is a view in side elevation showing the safety joint in an intermediate position incident to release.

Fig. 3 is a view in longitudinal section and elevation through the safety joint showing the elements of its assembled structure.

Fig. 4 is a view in transverse section through the structure as seen on the line 4—4 of Fig. 1, showing the positive lock means.

Figure 5 is a fragmentary view in elevation showing the developed circumference of the safety joint lock portion particularly disclosing the keys and locking lugs.

Referring more particularly to the drawing 10 indicates a tool joint at the lower end of a section of drill string. A mandrel 11 is threaded into the tool joint at its upper end. This mandrel comprises an upper cylindrical section 12, a lower threaded section 13 and intermediate lugs 14 formed integral therewith. The threaded section 13 is preferably formed with square threads having considerable strength and which threads screw into a sleeve or box 15. The lower end of the sleeve is formed with a threaded pin 16 adapted to be positioned within the threaded end of a tool joint not shown in the drawing. The threaded bore of the sleeve 15 terminates in a cylindrical portion 17 which receives a cylindrical extension 18 of the mandrel 13. An annular packing groove 19 is formed around the extension portion 18 and receives a packing ring 20. Fluid ducts 21 are formed through the inner wall of the packing groove 19 so that fluid under pressure may act against the packing rings and form a fluid seal with the cylindrical bore 17. A central fluid circulating bore 22 extends longitudinally through the entire mandrel 11. The pin portion 16 of the sleeve 15 is formed with a central passageway 23 through which fluid may flow from the passageway 22 of the mandrel. The lugs 14 are formed integral with the entire mandrel structure and are interposed between the cylindrical section 12 and the threaded portion 13. The under face of the lugs 14 are disposed at an angle agreeing with that of the thread pitch and the upper face of sleeve 15. It is also formed in stepped planes as shown in Figure 5 causing shoulders 24 to be disposed upon diametrically opposite sides of the under face of the collar, as will be hereinafter explained. These shoulders 24 engage upwardly projecting driving shoulders 25 formed on the upper end face of the sleeve 15, and which face is complementary to the under face of lugs 14. These driving shoulders provide means for positively driving the mandrel 11 and the sleeve 15 in unison. It will be evident that when the threaded member 13 is firmly screwed into the sleeve 15 the lower face or faces of the lugs 14 will register with the upper face or faces of the sleeve 15 and the shoulders 25 will be in engagement with the arcuate recesses 24. Occurring

between the lugs 14 at diametrically opposite sides of the mandrel 11 are longitudinal keyways 26 which extend the entire vertical width of the lugs and receive back-off keys 27 of a lock ring 28. The lock ring 28 is slidably mounted upon the cylindrical section 12 of the mandrel 11 and is held in constant contact with the lugs 14 by a helical spring 29, which circumscribes the cylindrical portion 12 of the mandrel 11 and is interposed between the end face of the tool joint 10 and the upper face of the lock ring 28. The lower end of each of the keys 27 is formed with a V-shaped point 30, having a relatively long flat face 31 in the direction of rotation of the tool and a relatively short sharp face 32 completing the point. Complementary V-shaped grooves 33 are formed in the upper end face of the sleeve 15. This makes its possible for a cam action to be obtained between the keys and the sleeve against the expansive action of the spring 29 when counter rotation of the upper drill string section is brought about.

In operation of the present invention the device is constructed and assembled as shown in Fig. 3 of the drawing. In the locking position all of the elements are as shown in Figs. 1 and 3 of the drawing. Here it will be seen that the spring 29 holds the lock ring 28 in a seated position against the upper face of the lugs 14 and that the lower face of the lugs 14 are in a seated position against the upper face of the sleeve 15. When the tool is being operated it is being driven in a clockwise direction and under such circumstances the radial shoulders 24 of the lugs 14 engage complementary abutting shoulders 25 of the sleeve 15. When in this position compression or tension strains may be exerted upon the drill string without any possibility of creating a disengaging movement between the locked parts of the safety joint. In the event that it is desired to disengage parts of the safety joint, the drill string and the tool joint 10 are rotated in a counter-clockwise direction. This will force the mandrel 11 to rotate counter-clockwise, tending to rotate the ring 28, the keys 27 of which are in engagement with the longitudinal keyways 26 occurring between the lugs 14. The mandrel will be resistant to reverse rotation due to the fact that the inclined faces 32 of the tongues must be forced upwardly along the inclined faces 32' of the notches 33. As this upward movement takes place, as shown in Fig. 2 of the drawing, the shoulders 24 and shoulders 25 will separate as the lugs 14 move upwardly and away from the sleeve 15 due to the threaded engagement of the screw portion 13 with the sleeve 14. The amount of force required to produce this action will be that which is needed to cause the faces 32 and 32' of the keys 27 and the notches 33 to slide with relation to each other against the expansive action of the spring 29. In this manner the driving shoulders 24 of the collar 14 will move out of driving engagement with the shoulders 25 upon the upper face of sleeve 15, after which the mandrel may continue to rotate with the upper string of pipe until the screw 13 is completely unscrewed from the sleeve 15. This will provide a safety joint which is simple as to structural elements and operation, but decidedly rugged in construction, so that it may be readily operated, either as a driving part of the drill string or as a safety joint to release sections of the drill string.

While we have shown the preferred form of our invention, as now known to us, it will be understood that various changes might be made in the combination, construction, and arrangement of parts, by those skilled in the art, without departing from the spirit of the invention as claimed.

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

1. A safety joint including a tubular member carried at the upper end of a string of pipe, a mandrel carried at the lower end of a complementary string of pipe, means producing a positive threaded engagement between the mandrel and the tubular member, means for positively driving the tubular member in one direction by the mandrel when said members are in the aforesaid assembled and threaded position, and separate lock means for temporarily holding the mandrel and the tubular member in their locked position when the mandrel is rotated in a counter-direction until a predetermined torque force has been exerted thereon.

2. A safety joint including two members adapted to be connected with sections of a drill string, a threaded connection between said members by which they are held in assembled position relative to each other, means providing a positive driving connection in one direction between said members when thus assembled, lock means positively engaging one of said members at all times and yieldably engaging the other of said members, and cooperating means between the engaging portion of the lock means and the last mentioned member whereby a movement in a reverse direction from that of driving rotation will cause said members to become disengaged under a predetermined degree of torque to permit unthreading of the two main members with relation to each other.

3. A safety joint including two main sections, a threaded connection between said sections, means providing positive driving engagement between said sections in a driving direction when the sections are assembled in their threaded positions, and yieldable clutch means locking said main members against rotation in a reverse direction until overcome by a predetermined counter-torque and thereafter permitting the main sections to be unthreaded with relation to each other.

4. A safety joint including two main sections, one providing an internally threaded sleeve and the other providing an externally threaded mandrel adapted to be assembled therewith, means carried by the sleeve and the mandrel and assuming positions in positive driving relation to each other when said members are assembled, a clutch member relatively movable with relation to the sleeve and positively engaging the mandrel for holding said mandrel and sleeve against reverse rotation until a predetermined counter-torque has been established in the mandrel, and yieldable means acting in conjunction with said clutch to determine the magnitude of counter-torque required to produce said release.

5. A safety joint including a pair of sections having threaded engagement with each other and disposed in driving relation to drill string sections, a pair of driving shoulders one on each of said sections and adapted to positively engage each other when the sections are in their assembled threaded positions, lock means mounted on one of said sections for yieldable movement relative to the other of said sections, said lock means and said last named section engaging each other in a manner to permit their release

upon counter rotation of one section with relation to the other, and yieldable means acting upon said lock means to establish the counter-rotational force necessary to create disengagement of the lock means and the main section engaged thereby and thereafter to permit disengagement of the drive shoulders and unthreading of the parts with relation to each other.

6. A safety joint including a tubular section connected to a lower length of drill string, a mandrel section connected to an upper length of drill string, a shoulder on the mandrel section, a threaded portion occurring below the shoulder and adapted to be threaded into the tubular section whereby in its assembled position the lower face of the shoulder will abut against the upper face of the tubular section, positive drive shoulders formed upon said abutting sections whereby positive drive torque may be imposed from the mandrel to the sleeve when said sections are in engagement, and yieldable lock means temporarily holding the said driving faces in their engaged position to resist counter-rotation of the mandrel with relation to the sleeve until a predetermined magnitude of counter-torque has been set up.

7. A safety joint including a tubular section connected to a lower length of drill string, a mandrel section connected to an upper length of drill string, a shoulder on the mandrel section, a threaded portion occurring below the shoulder and adapted to be threaded into the tubular section whereby in its assembled position the lower face of the shoulder will abut against the upper face of the tubular section, positive drive shoulders formed upon said abutting sections whereby positive drive torque may be imposed from the mandrel to the sleeve when said sections are in engagement, yieldable lock means temporarily holding the said driving faces in their engaged position to resist counter-rotation of the mandrel with relation to the sleeve until a predetermined magnitude of counter-torque has been set up, said yieldable lock means including means constantly and positively engaging the mandrel and engaging the sleeve with sliding friction, and spring means acting upon the lock means to control the amount of sliding friction required to produce disengagement of the lock means with relation to the sleeve.

8. A safety joint including a tubular section connected to a lower length of drill string, a mandrel section connected to an upper length of drill string, a shoulder on the mandrel section, a threaded portion occurring below the shoulder and adapted to be threaded into the tubular section whereby in its assembled position the lower face of the shoulder will abut against the upper face of the tubular section, positive drive shoulders formed upon said abutting sections whereby positive drive torque may be imposed from the mandrel to the sleeve when said sections are in engagement, yieldable lock means temporarily holding the said driving faces in their engaged position to resist counter-rotation of the mandrel with relation to the sleeve until a predetermined magnitude of counter-torque has been set up, said yieldable lock means including means constantly and positively engaging the mandrel and engaging the sleeve with sliding friction, and spring means acting upon the lock means to control the amount of sliding friction required to produce disengagement of the lock means with relation to the sleeve, said sliding friction being produced by an inclined face on the lock means engaging an inclined face on the sleeve.

9. A safety joint including a tubular member carried at the upper end of a string of pipe, a mandrel carried at the lower end of a complementary string of pipe, means producing a positive threaded engagement between the mandrel and the tubular member, means for positively driving the tubular member in one direction by the mandrel when said members are in the aforesaid assembling and threaded position, separate lock means for temporarily holding the mandrel and the tubular member in their locked position when the mandrel is rotated in a counter-direction until a predtermined torque force has been exerted thereon, said mandrel and tubular member being formed with circulation passageways for permitting fluid to pass directly through the safety joint and packing means between the mandrel and the tubular member to prevent leakage of said fluid.

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