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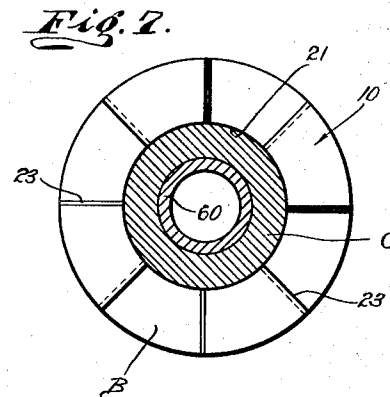
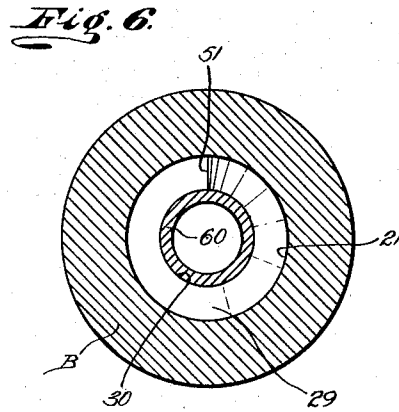
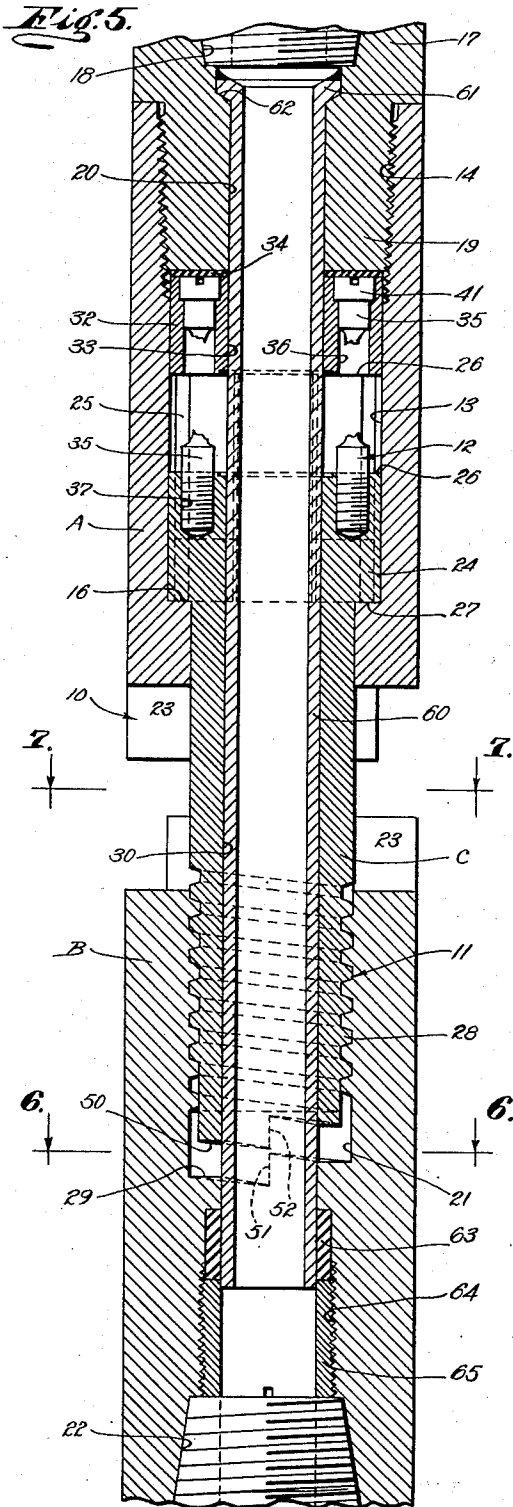
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SAFETY JOINT

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2 Sheets-Sheet 2



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SAFETY JOINT

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17 Claims. (Cl. 255—28)

This invention relates to a coupling or connecting device, and relates more particularly to a safety joint connecting parts of a string of drill pipe, or the like.

5 In the course of drilling wells, and while carrying on fishing operations, the tool on the lower end of the operating string sometimes becomes caught or stuck in the well so that it cannot be withdrawn. A coupling devices or connection
10 commonly known as a safety joint is usually inserted in the operating string to permit of disconnecting of the major portion of the operating string from the tool in the event that the tool becomes stuck in the well. The safety joints now
15 in general use usually embody parts connected by heavy, coarse threads designed so that they may be easily unthreaded. In practice, it has been found that these heavy threads often become galled or jammed by the torsional strains
20 to which the operating string is subjected, and/or by the solid matter in the circulation fluid, so that they are very difficult to unthread, with the result that other threaded connections higher in the drilling string are broken or released when
25 an attempt is made to disconnect the operating string at the safety joint.

A general object of the present invention is to provide a simple, practical and dependable safety joint that may be easily disconnected when
30 desired.

Another object of the invention is to provide a safety joint for use in an operating string of drill pipe, or the like, that cannot become jammed or made inoperative by the strains to which the
35 operating string is subjected, or by the presence of solid matter.

It is another object of the invention to provide a safety joint that is adapted to transmit heavy counter-clockwise, as well as clockwise torsional
40 strains without danger of disconnection, and without becoming jammed or made difficult to release.

Another object of the invention is to provide a safety joint that may be easily and quickly released or disconnected by a tensile strain followed
45 by rotation.

It is another object of the invention to provide a safety joint for insertion in an operating string of drill pipe, or the like, that is capable of transmitting heavier torsional and compression strains
50 than the other parts of the operating string, and that cannot be accidentally or unintentionally disconnected.

Other objects and features of the invention will be best and more fully understood from the

following detailed description of a typical form and application of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a longitudinal detailed sectional view 60 of the joint provided by the present invention. Fig. 2 is a transverse detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a transverse detailed sectional view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is a fragmen- 65 tary side elevation of the clutch parts, being a view taken substantially as indicated by the line 4—4 on Fig. 3. Fig. 5 is a view similar to Fig. 1 showing the frangible means broken and the sections partially released. Figs. 6 and 7 are trans- 70 verse detailed sectional views taken as indicated by lines 6—6 and 7—7 respectively on Fig. 5.

The safety joint provided by this invention includes, generally, two sections A and B having opposing complementary clutch parts 10, a central or inner section C, having a threaded connection 11 with the section B, and a connection 12 75 between the central section C and the section A normally holding the sections A and B against relative longitudinal movement in positions where their clutch parts 10 are in mesh, which connection is releasable by given tensile strain to permit disengagement of the clutch parts so that the threaded connection 11 may be released or unthreaded. 80

The sections A and B constitute an assembly that is adapted to be inserted or connected between two parts of an operating string of drill pipe. The main body sections A and B are tubular and are preferably cylindrical as illustrated 85 in the drawings. The opening 13 in the upper body section A is provided at its upper end with a screw threaded socket 14 and has a restricted portion at its lower end providing an upwardly facing internal shoulder 16 in the section A. A 90 sub or connecting member 17 is attached to the upper end of the section A. The member 17 is provided to facilitate connection of the section A with a suitable part of the operating string and is provided at its upper end with a screw threaded 95 socket 18 adapted to receive the pin of an adjoining part of the operating string. A pin 19 on the lower end of the member 17 is threaded into the socket 14 in the upper end of the section A. A longitudinal fluid passage 20 is provided in the connecting member 17 to pass the circulating fluid downwardly through the safety joint. The lower section B may be of the same 100 external diameter as the section A, and may be a comparatively short member as illustrated in 110

Fig. 1 of the drawings. The section B is tubular, having a central longitudinal opening 21 extending through it from one end to the other. A screw threaded socket 22 may be provided in the lower end of the section B to receive a suitable connecting member or part of the operating string.

The clutch parts 10 are provided on the opposing or adjoining ends of the sections A and B, that is, they project downwardly from the lower end of the section A and upwardly from the upper end of the section B. The clutch parts 10 are adapted to effectively mesh or fit one between the other, and are adapted to effectively transmit rotational or torsional strains from one section to the other.

It is a feature of the present invention that the cooperation between the clutch parts 10 of the two sections automatically breaks or starts the threaded connection 11 when the clutch parts are disengaged. The engaging or cooperating ends or faces 23 of the clutch parts 10 are pitched or inclined. The inclined faces 23 of the clutch parts are preferably flat and smooth, so as to have effective sliding engagement when the body sections A and B are moved longitudinally relative to one another. The inclination of the faces 23 causes relative turning between the sections A and B when the sections are moved apart. When the section B is connected with the part of the operating string that is held fast in a well, the cooperation between the clutch faces 23 causes the section A to be turned when it is moved upwardly relative to the section B. The direction of inclination of the clutch faces 23 is related to the direction of pitch of the threads in the connection 11 so that the section A is turned in a direction to cause breaking or starting of the threads when moved upwardly relative to the section B. In the particular case illustrated in the drawings, the clutch faces 23 are pitched so as to cause the section A to be turned in a left hand or counter-clockwise direction when the clutch parts 10 are disconnected.

The central section C is arranged within the sections A and B and normally forms a connecting link between the sections A and B holding them against relative longitudinal movement. The inner or central section C is an elongate tubular member extending through the openings 13 and 21 of the outer sections. In accordance with the invention, the inner section C terminates at its upper end at a point spaced below the end of the pin 19. A sliding spline or key connection is provided between the section A and the inner section C. In the embodiment of the invention illustrated in the drawings, dove-tailed splines 24 are provided on the upper end portion of the section C to cooperate with correspondingly shaped splines 25 on the walls of the opening 13. The upper ends of the splines 25 are in the nature of upwardly facing shoulders 26 spaced below the end of the pin 19. The lower ends of the splines 24 form downwardly facing shoulders 27 normally spaced above the body shoulder 16. When the parts are in their assembled positions illustrated in Fig. 1 of the drawings, the shoulders 26 are in register with or in alignment with the upper end of the inner section C.

The threaded connection 11 between the inner section C and the body section B consists of comparatively heavy threads 28 on the walls of the opening 21, and the lower end portion of the inner section. The threads 28 are preferably pitched in the same direction as the threads of the other connections of the operating string,

that is, they are pitched in a direction opposite to the direction of rotation of the string during drilling operations, etc. In the form of the invention illustrated in the drawings, the threads 28 are right-hand threads adapted to be unthreaded by counter-clockwise rotation of the section A relative to the section B so that they may be started or broken by the turning of the section A caused by cooperation of the clutch faces 23.

In accordance with the invention, means is provided for limiting threading together of the threads 28 so they cannot be too tightly connected when the joint is made, and so that inadvertent turning of the section A in a right hand direction, after the release of the clutch parts, cannot cause excessive tightening of the threads 28. A spiralled face or shoulder 29 is provided in the opening 21 and a complementary spiralled face 50 is provided on the lower end of the section C. The shoulder 29 terminates in or provides a radial stop shoulder 51 and the spiralled face 50 provides a similar radial stop shoulder 52. The spiralled faces 29 and 50 are of the same pitch as and are pitched in the same direction as the threads 28 so that the stop shoulders 51 and 52 are in abutment when the section C is fully threaded into the opening 21. The stop shoulders 51 and 52 prevent the threads 28 from being too tightly engaged and prevent the section A from being turned in a clock-wise direction after the release of the clutch means 10. When the clutch means 10 has been released the stop shoulder 52 passes over the stop shoulder 51 with one turn of the section A in a counter clock-wise direction relative to the section B.

The means or connection 12 normally holds the sections A and B against relative longitudinal movement in positions where their clutch parts 10 are in mesh, and in accordance with the invention, is releasable upon being subjected to a given tensile strain, to permit upward movement of the section A relative to the section B. The releasable connecting means 12 includes a sleeve or block 32 arranged within the section A between the upper end of the inner section C and the lower end of the pin 19. The lower end of the block 32 rests on or engages the spline shoulders 26, and is clamped between the lower end of the pin 19 and the shoulders 26 to be positively connected with the section A. The opening 33 in the block 32 registers with the openings 20 and 30. Suitable packing 34 may be provided to seal around the upper end of the block 32.

A plurality of pins 35 extends through circumferentially spaced vertical openings 36 in the block 32, and are threaded into openings 37, in the upper end of the inner section C. The pins 35 are designed to break or fail under a predetermined tensile strain. The frangible pins 35 form a connection between the sections A and C that is adapted to fail when the safety joint is subjected to a given tensile strain. Each of the pins 35 has one or more portions 40 of comparatively small cross sectional area where they are adapted to fail or part. The several pins 35 are capable of withstanding the tensile strains to which they may be subjected during the usual drilling or fishing operations, but are designed so as to fail under a comparatively heavy tensile strain. The heads 41 on the upper ends of the pins 35 may be counter-sunk in the upper end of the block 32.

The invention includes improved means for conducting the circulation fluid through the joint

and for preventing the leakage of the fluid from may be subjected, or by the presence of solid

between the sections A, B and C. A tube or wash pipe 60 extends through the openings 20, 21 and 30 of the sections A, B and C. The wash pipe 60 may fit or lie against the walls of the openings of the sections and may have comparatively thin walls. An external radial flange 61 is provided on the upper end of the wash pipe 60 and seats against an upwardly facing shoulder 62 on the wall of the opening 20. The flange 61 is welded to the wall of the opening 20, as illustrated in the drawings, which forms a seal between the wash pipe 60 and the section A. The wash pipe 60 extends downward to a point adjacent the socket 22 and its opposite ends are open so that it passes the circulation of fluid through the sections from the socket 18 to the socket 22. Means is provided to seal about the wash pipe 60 in the section B. An annular or tubular body of packing 63 is carried in an enlargement 64 in the opening 21 to seal about the wash pipe 60. A nut 65 is threaded in the enlargement 64 to compress the packing 63. The wash pipe 60 is attached to the section A and slides upwardly out of the openings 21 and 30 when the joint is disconnected.

The safety joint may be connected between suitable parts of an operating string of drill pipe with its parts assembled as illustrated throughout the drawings. During drilling operations and other normal phases of operation, the clutch parts 10 are effective in transmitting heavy rotational strains in both directions between the sections A and B. The sections A and B are normally held against relative longitudinal movement by the means 12 connecting the inner section G with the section A.

In the event that the tool on the lower end of the operating string becomes stuck or immovable, it may be desirable or necessary to release or disconnect the safety joint to disengage the major portion of the operating string from the tool. To release or disconnect the safety joint, an upward strain or tensile strain is put on the joint by pulling upwardly on the operating string. A predetermined comparatively heavy tensile strain on the safety joint causes the pins 35 to fail or part, allowing the section A to move upwardly relative to the section B and the inner section C. The cooperation between the shoulders 16 and 27 limits the upward movement of the section A relative to the sections B and C. This upward movement of the section A is sufficient to disconnect or disengage the clutch parts 10. During the disengagement of the clutch parts 10, their inclined faces 23 cooperate to turn the section A relative to the section B in a direction to cause breaking or starting of the threads 28 of the connection 11. As the inner section C is held against rotation relative to the section A by means of the splines 24 and 25, the initial turning of the section A caused by cooperation of the clutch faces 23, results in turning of the section C relative to the section B to start the threaded connection 11 as just described. The drilling string may then be turned in a direction to complete the unthreading and disconnection of the threaded connection 11 so that the sections A and C are completely disconnected from the section B. The sections A and C may then be withdrawn upwardly through the wall on the lower end of the major portion of the operating string.

It is to be noted that the present invention provides a safety joint in which the threaded connection 11 cannot become galled or jammed through the rotational strains to which the tool

matter in the circulation fluid. The safety joint cannot become unintentionally disconnected, as the clutch parts 10 are adapted to directly transmit torsional strains in either direction between the main body sections A and B. It is extremely easy to disconnect the safety joint when desired. The tensile strain which causes the failure of the shear pins 35 also results in an initial turning of sections A and C relative to the section B through the action of the inclined clutch faces 23. This initial automatic relative turning between the sections insures the easy unthreading of the threaded connection 11 so that the connection may unthread without causing unthreading or loosening of any of the other threaded connections in the operating string.

Having described only a typical preferred form of my invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A safety joint including, two sections having cooperating parts for transmitting torsional strains between the sections, and releasable means holding the sections in positions where said parts are in cooperation and releasable under a tensile strain to permit disengagement of said parts, said means including a third section having a threaded connection with one of said sections, and a frangible connection between the third section and the other of said sections.

2. A safety joint including, two sections, disengageable parts on said sections cooperating to transmit rotational strains between the sections, a third section having a threaded connection with one of said two sections and being connected with the other of said sections to rotate therewith and to have limited longitudinal movement relative thereto, and a connection between the third section and the said other section normally holding them against relative longitudinal movement and releasable under a tensile strain whereby the said parts may be disengaged to permit unthreading of the threaded connection.

3. A safety joint including, two sections, disengageable clutch parts on the sections adapted to cooperate to prevent relative turning between the sections, a third section having a threaded connection with one section and being connected with the other section to turn therewith and to have limited longitudinal movement relative thereto, and means connecting the third section with said other section to hold said clutch parts in engagement and releasable under strain to permit longitudinal movement between the said two sections whereby the clutch parts may be disengaged, said means including a frangible pin.

4. A safety joint including, two sections, disengageable parts on the said sections cooperating to transmit rotational strains between the sections, a third section within the two sections having a threaded connection with one of said two sections and being connected with the other of said sections to rotate therewith and to have limited longitudinal movement relative thereto, and a connection between the third section and the said other section normally holding them against relative longitudinal movement and releasable under a tensile strain whereby the said parts may be disengaged to permit unthreading of the threaded connection.

5. A safety joint including, two sections, dis-

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engageable parts on the opposing ends of said sections cooperating to transmit rotational strains between the sections, a third section having a threaded connection with one of said two sections and being connected with the other of said sections to rotate therewith and to have limited longitudinal movement relative thereto, and a connection between the third section and the said other section normally holding them against relative longitudinal movement and releasable under a tensile strain whereby the said parts may be disengaged freeing the threaded connection for unthreading.

6. A safety joint including, two sections, disengageable parts on said sections cooperating to transmit rotational strains between the sections, a third section having a threaded connection with one of said two sections and being connected with the other of said sections to rotate therewith and to have limited longitudinal movement relative thereto, a connection between the third section and the said other section normally holding them against relative longitudinal movement, and releasable under a tensile strain whereby said parts may be disengaged, and means for automatically turning the third section relative to the first mentioned section to start the threaded connection upon disengagement of said parts.

7. A safety joint including, two sections, disengageable parts on said sections cooperating to transmit rotational strains between the sections, a third section having a threaded connection with one of two sections and being connected with the other of said sections to rotate therewith and to have limited longitudinal movement relative thereto, a connection between the third section and the said other section normally holding them against relative longitudinal movement, and releasable under a tensile strain whereby said parts may be disengaged, and means for automatically turning the third section relative to the first mentioned section to start the threaded connection upon disengagement of said parts, said means including cooperating inclined faces on said parts.

8. A safety joint including, two tubular sections, clutch parts on the sections adapted to cooperate to prevent relative turning between the sections, an inner section within the tubular sections, a screw threaded connection between the inner section and one of said tubular sections, a connection between the inner section and the other tubular section whereby the inner section is rotatable with and is longitudinally movable relative to said other tubular section, and a connection between the inner section and the said other tubular section normally holding them against relative longitudinal movement and releasable under a tensile strain to allow the disengagement of the clutch parts.

9. A safety joint including, two tubular sections, clutch parts on the sections adapted to cooperate to prevent relative turning between the sections, an inner section within the tubular sections, a screw threaded connection between the inner section and one of said tubular sections, a connection between the inner section and the other tubular section whereby the inner section is rotatable with and is longitudinally movable relative to said other tubular section, and a connection between the inner section and the said other tubular section normally holding them against relative longitudinal movement and releasable under a tensile strain to permit disengagement of the clutch parts, the last men-

tioned connection including a block in the said other tubular section and attached thereto, and a frangible pin connecting the inner section with the block.

10. A safety joint including, two tubular sections, clutch parts on the sections adapted to cooperate to prevent relative turning between the sections, an inner section within the tubular sections, a screw threaded connection between the inner section and one of said tubular sections, a connection between the inner section and the other tubular section whereby the inner section is rotatable with and is longitudinally movable relative to said other tubular section, a connection between the inner section and the said other tubular section normally holding them against relative movement releasable under a given tensile strain to allow disengagement of the clutch parts, and means whereby the said other tubular section and the inner section are automatically turned to start the unthreading of the threaded connection upon disconnection of the clutch parts.

11. A safety joint including, two tubular sections, clutch parts on the sections adapted to cooperate to prevent relative turning between the sections, an inner section within the tubular sections, a screw threaded connection between the inner section and one of said tubular sections, a connection between the inner section and the other tubular section whereby the inner section is rotatable with and is longitudinally movable relative to said other tubular section, a connection between the inner section and the said other tubular section normally holding them against relative movement releasable under a given tensile strain to allow disengagement of the clutch parts, and means whereby the said other tubular section and the inner section are automatically turned to start the unthreading of the threaded connection upon disconnection of the clutch parts comprising cooperating inclined faces on the clutch parts.

12. A safety joint including, two sections having cooperating parts for transmitting torsional strains between the sections, and releasable means holding the sections in positions where said parts are in cooperation and releasable under a tensile strain to permit disengagement of said parts, said means including a third section having a threaded connection with one of said sections, means for limiting threading together of the threaded connection, and a frangible connection between the third section and the other of said sections.

13. A safety joint including, two tubular sections having cooperating parts for transmitting torsional strains, releasable means for holding the sections in position where said parts are in cooperation, including a third tubular section, a threaded connection between the third section and one of said sections, and a frangible connection between the third section and the other of said sections, and a wash pipe attached to one of said sections and extending through the third section and the other of said sections.

14. A safety joint for use in a string of drill pipe including, two sections to be connected to adjacent parts of the string, an inner section connected with one of said sections to rotate therewith and to be longitudinally movable relative thereto, a threaded connection between the inner section and the other of said sections, parts on the said sections normally cooperating to transmit rotational strains between the sections

in both directions to prevent tightening and unthreading of said threaded connection and releasable by relative longitudinal movement between the said sections, and frangible parts connecting the inner section and the first mentioned section adapted to be broken by a tensile strain on the string to allow disengagement of said parts whereby the threaded connection may be disconnected.

and the other of said sections, a connection between the third section and the first mentioned of said sections normally preventing relative longitudinal movement between them and releasable under a tensile strain to permit disengagement of said parts whereupon the threaded connection may be disconnected, and means preventing tightening of the threaded connection after disengagement of said parts.

15. A safety joint for use in a string of drill pipe including, two sections to be connected to adjacent parts of the string, parts on the sections cooperating to transmit rotational strains between the sections and disengageable by relative longitudinal movement between the sections, and releasable means holding the sections against relative longitudinal movement, said means including a member connected to one section, and a frangible part connecting the member with the other section and adapted to be broken by a tensile strain on the joint to allow relative longitudinal movement between the parts.

17. A safety joint including two sections, disengageable parts on the sections cooperating to transmit rotational strains between the sections, a third section connected with one of said sections to rotate therewith and to have limited longitudinal movement with respect thereto, a threaded connection between the third section and the other of said sections, a connection between the third section and the first mentioned of said sections normally preventing relative longitudinal movement between them and releasable under a tensile strain to permit disengagement of said parts whereupon the threaded connection may be disconnected, and means preventing tightening of the threaded connection after disengagement of said parts, said means including longitudinal cooperating shoulders on the third section and the said other section.

18. A safety joint including two sections, disengageable parts on the sections cooperating to transmit rotational strains between the sections, a third section connected with one of said sections to rotate therewith and to have limited longitudinal movement with respect thereto, a threaded connection between the third section

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