July 28, 1936. E. BURNS ET AL 2,049,289

SAFETY JOINT

Filed April 7, 1933 2 Sheets-Sheet 1

Fig. 1.

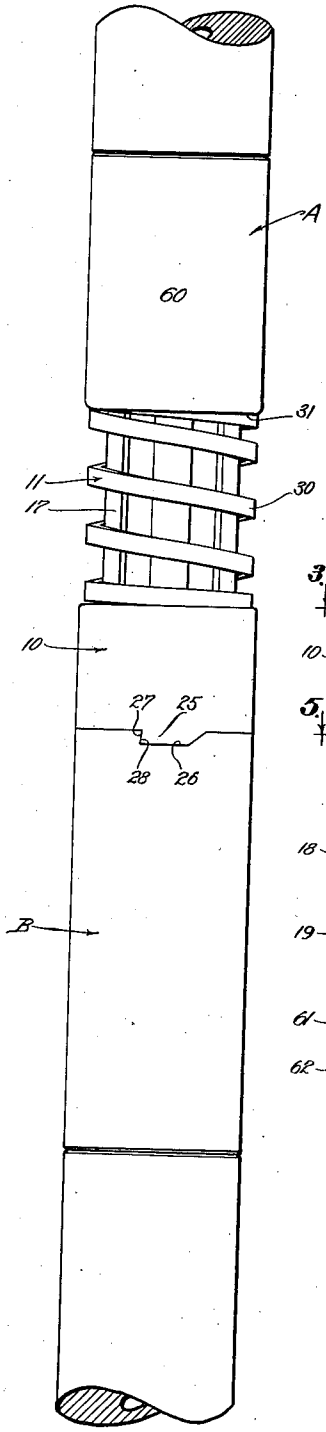


Fig. 2.

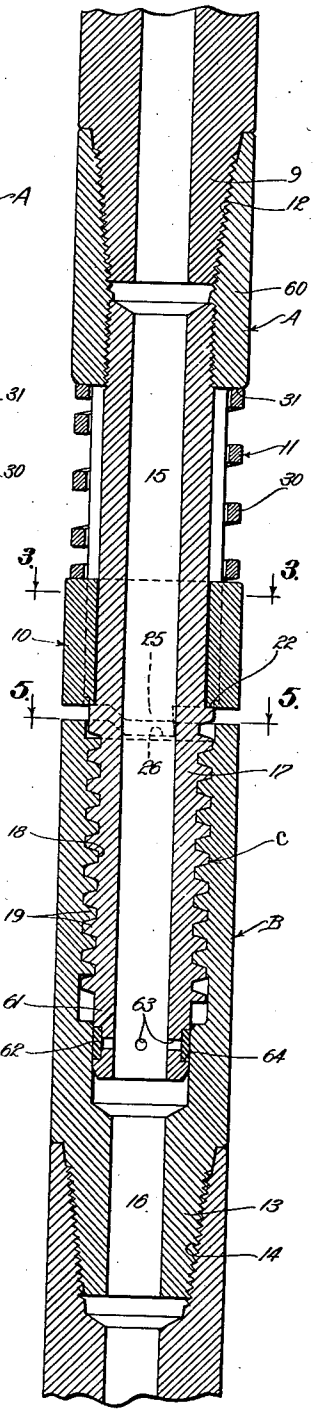


Fig. 3.

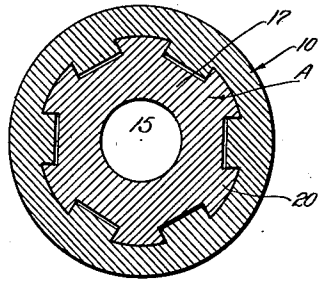


Fig. 4.

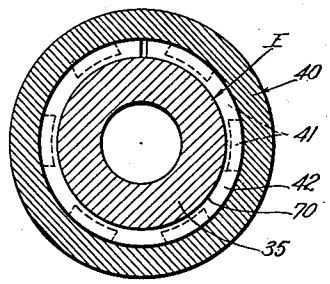
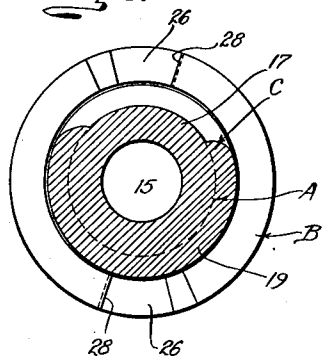


Fig. 5.



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Fig. 6.

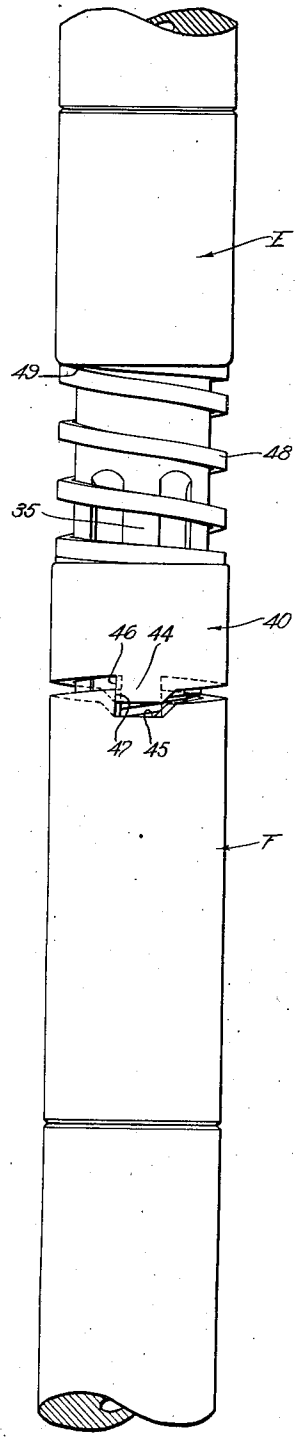


Fig. 7.

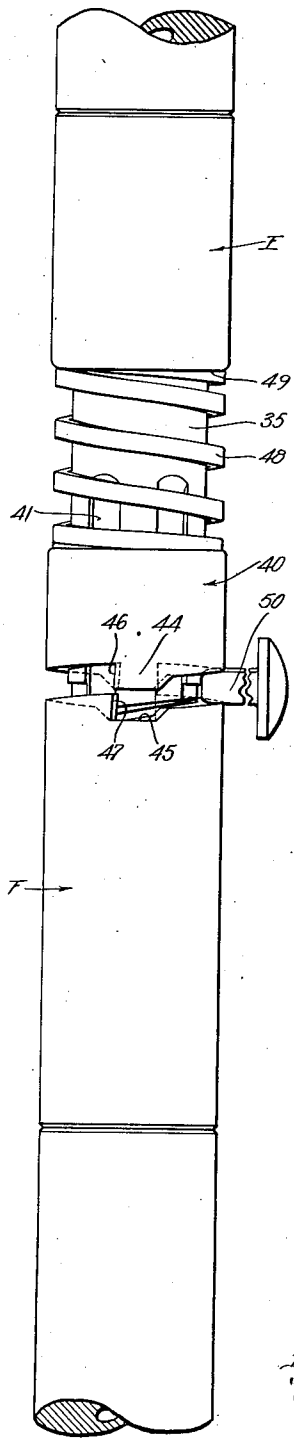
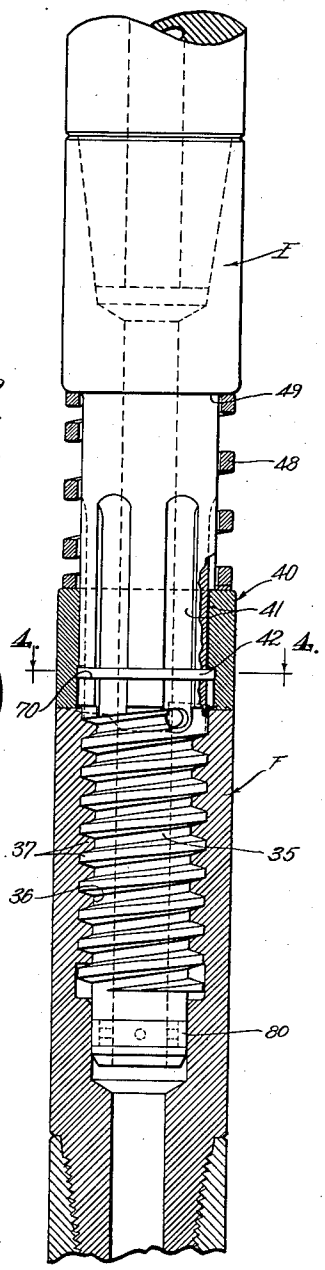


Fig. 8.



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UNITED STATES PATENT OFFICE

2,049,289

SAFETY JOINT

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Application April 7, 1933, Serial No. 664,900

7 Claims. (Cl. 255—28)

This invention relates to a releasable coupling or connection, and relates more particularly to a safety joint. It is a general object of the present invention to provide a simple, practical and dependable safety joint for use in a rotary drilling string.

In the rotary method of well drilling, the drilling tool is operated on the lower end of a drilling string made up of lengths of pipe connected by threaded couplings and tool joints. The drilling tool quite frequently becomes caught in the well so that it cannot be withdrawn. When this occurs it is desirable to disconnect the drilling string or the major portion of the drilling string from the tool and remove it from the well so that the tool may be accessible for fishing operations, etc. In order to provide for disconnection of the drilling string or the greater portion of the drilling string from the tool, a safety joint is interposed in the lower portion of the string that is capable of being disconnected if it becomes desirable or necessary to disengage or separate the drilling string from the tool. A practical and successful safety joint must be capable of dependably and positively transmitting heavy tensile and compression strains, and torsional or rotation strains in one direction, and be adapted to be disconnected by simple manipulation of the drilling string that will not break or disconnect any of the other joints or connections in the string.

It is an object of this invention to provide a safety joint that normally forms a strong dependable and positive connection, and that may be easily and quickly released by turning the drilling string in a reverse or left hand direction.

It is another object of the invention to provide a safety joint that is adapted to dependably and positively transmit any compression, tensile or right hand torsional strains to which the drilling string may be subjected.

It is another object of the invention to provide a safety joint that cannot become jammed or locked against easy disconnection.

It is another object of the invention to provide a safety joint of the character mentioned having an improved and simplified construction and arrangement of parts.

It is another object of the invention to provide a safety joint of the character mentioned that includes two threadedly connected sections or members and a spring pressed sleeve slidable but nonrotatable on one member and having a lug and notch connection with the other member that transmits torsional strains between the members in one direction and that is releasable against the action of the spring by torsional strain in the other direction.

It is another object of the invention to provide a safety joint of the character mentioned involving a novel and effective means for locking or retaining the slidable sleeve on one of the body members.

It is a further object of the invention to provide a safety joint of the character mentioned that is operable to transmit rotary or torsional strains in a right hand direction after being partially released or disconnected.

Further objects and features of the invention will be better and fully understood from the following detailed description of typical forms and applications of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevation of one embodiment of the invention. Fig. 2 is a longitudinal detailed sectional view of the joint illustrated in Fig. 1 showing the parts in partially released positions. Figs. 3 and 5 are enlarged transverse detailed sectional views taken as indicated by lines 3—3 and 5—5 respectively on Fig. 2. Fig. 4 is an enlarged transverse detailed sectional view taken as indicated by line 4—4 on Fig. 8. Fig. 6 is a side elevation of another form of the invention illustrating the sleeve or ring in partial engagement with the lower body member. Fig. 7 is a view similar to Fig. 6 illustrating the manner of disconnecting the lugs from the notches to permit the parts to be fully connected, and Fig. 8 is a longitudinal detailed sectional view of the safety joint illustrated in Figs. 6 and 7 showing the parts in a fully connected position, and illustrating the upper body section in elevation.

The form of my invention illustrated in Figs. 1, 2, 3, and 5 of the drawings, includes, generally, two body sections or members A and B having a releasably screw threaded connection C, a sleeve or ring 10 shiftable longitudinally on the member A and having a releasable connection with the member B limiting relative rotation between the members A and B in one direction, and means 11 yieldingly holding the ring 10 in its operative position in cooperation with the member B.

The body sections or members A and B constitute a separable assembly adapted to be interposed in an operating string or drilling string of drill pipe, or the like. The member A which will be termed the upper member is adapted to be connected with the upper or major portion of the drilling string, being provided at its upper end with means for connecting with the string. The

member A may be sectional and may include a stem 17 and a connecting member or sub 60 on the upper end of the stem. The stem 17 is threaded into the lower end of the sub 60 and the sub is provided at its upper end with a tapered screw threaded socket 12 for receiving a pin 9 of a connecting member on the string. The lower member B is provided at its lower end with a projecting pin 13 which is adapted to be screw threaded into a socket 14 in a drill collar or connecting part in the drilling string. While we have illustrated the device disposed so that the member A is the upper member and the member B is the lower member, it will be apparent that the device may be inverted if desired or found practical. The body members A and B are tubular, having aligned longitudinal fluid passages 15 and 16, respectively.

The releasable threaded connection C between the members A and B includes a thread on the stem 17 of the male or upper member A adapted to cooperate with a thread in a socket 18 in the lower member B. The threads 19 on the stem 17 and the walls of the socket 18 are preferably comparatively heavy and have a substantial pitch. In the particular embodiment of the invention illustrated in the drawings, the threads 19 are right hand threads so that the stem 17 may be screwed into the socket 18 by rotation of the member A in a right hand direction relative to the section B and may be unthreaded or removed from the socket by left hand or counter clock-wise rotation of the member A relative to the member B. The socket 18 is comparatively deep and the stem 17 is of considerable length so that the releasably threaded connection C between the members A and B is sufficiently strong to dependably transmit heavy tensile and compression strains and so that after release a considerable number of turns are required to unscrew the parts.

In accordance with the invention packing means is provided to seal between the members A and B. A plain or cylindrical portion 61 is provided on the inner end of the stem 17 to fit the socket 18. Packing 62 is arranged in an annular groove 64 in the portion 61 and is adapted to seal with the wall of the socket 18. In the form of the invention being described the packing 62 is fluid pressure operated. Spaced openings 63 extend from the fluid passage 15 to the groove 64 so that fluid pressure in the passage 15 may act on the packing to normally hold it in effective sealing engagement with the wall of the socket 18 to prevent leakage between the members A and B.

The sleeve or ring 10 surrounds the upper member A and is provided to cooperate with the member B to limit turning of the member A in a right hand direction relative to the member B. In accordance with the invention, the ring 10 is slidable or shiftable longitudinally on and is keyed to the member A. Cooperating dove-tailed splines or keys 20 are provided on the interior of the ring 10 and on the stem 17 to prevent rotation of the ring 10 on the member A. The lower end of the ring 10 is adapted to engage an upwardly facing shoulder 22 on the stem 17 to limit the downward movement of the ring on the member A and to prevent the displacement of the ring A from the body member.

A lug and notch connection between the ring 10 and the body member B prevents turning of the member A relative to the member B after the stem 17 has been threaded a pre-determined distance into the socket 18 so that the threads 19 cannot become jammed and so that right hand rotational or torsional strains are transmitted from the body member A to the body member B independently of the threads 19. The disengageable bearing or thrust connection between the ring 10 and the body member B includes one or more lugs 25 on the ring 10 for cooperating with notches or recesses 26 in the upper end of the body member B. In the particular embodiment of the invention illustrated in the drawings, there are two diametrically opposite lugs 25 for cooperating with two correspondingly shaped recesses 26 in the upper end of the body member B. The forward ends 27 of the lugs 25, relative to the right hand direction of rotation, are flat and extend downwardly and slightly forwardly from the lower end of the ring 10. The forward ends of the recesses 26 present rearwardly facing shoulders 28 extending upwardly and slightly rearwardly to the upper end of the member B. The rear ends of the lugs 25 and the rear end walls of the recesses 26 are inclined upwardly and rearwardly relative to the right hand or clock-wise direction of rotation. The lower end of the ring 10 and the upper end of the body member B are flat and normal to the longitudinal axis of the joint and are adapted to cooperate with one another when the parts are in the positions illustrated in Fig. 1 of the drawings.

The lugs 25 and the recesses 26 are proportioned and related so that the lugs 25 are fully received in the recesses when the ring 10 is in cooperation with the upper end of the body member B. When the lugs 25 are fully engaged in the recesses 26, the forward ends 27 of the lugs cooperate with the forward end walls 28 of the recesses to prevent relative rotation between the ring 10 and the body member B in a right hand direction and in being pitched in the manner described above, positively prevent the lugs 25 from jumping or slipping from the recesses when the joint is under heavy right hand rotational strains or heavy longitudinal strains. The cooperating faces 27 and 28 are pitched rearwardly so that they resist upward shifting of the ring 10 relative to the body section B. The inclined rear ends of the lugs 25 and recesses 26 are related so that the lugs are adapted to snap into the recesses when the joint is assembled and readily ride out of the recesses when the body member A is turned in a left hand direction relative to the body member B.

The means 11 yieldingly holds the ring 10 down in engagement with the upper end of the body member B so that the lugs 25 are maintained in cooperation with the recesses 26. The means 11 is in the nature of a spring means acting on the ring 10. A spiral or helical spring 30 surrounds the stem 17 of the body member A and is arranged under compression between the upper end of the ring 10 and the lower end of the sub 60. The spring 30 is sufficiently strong to prevent accidental or undesired upward movement of the ring 10 on the member A.

During the normal use or operation of the joint its parts are in the position illustrated in Fig. 1 of the drawings, in which position the lugs 25 are in full cooperation with the recesses 26. The ring 10, in being keyed to the body member A and in presenting the lug faces 27 for cooperating with the shoulders 28, is adapted to effectively transmit right hand torsional or rotational strains between the body members A and B. The threaded connection C between the body

members A and B transmits tensile and compression strains between the sections. In the event that it becomes desirable or necessary to disconnect the joint when it is interposed in a drilling string in a well bore, the string is turned in a counter-clockwise or left hand direction so that the member A and ring 10 are turned in a left hand direction relative to the member B. Turning of the body member A in a left hand direction relative to the member B causes the inclined rear ends of the lugs 25 to ride out of the recesses 26. Continued turning of the member A in a left hand direction unthreads the stem 17 from the socket 18. During unthreading of the stem from the socket the threads 19 cause the member A to move upwardly relative to the member B so that the lugs 25 are shifted out of engagement with the member B. The shoulder 22 holds the ring 10 against downward movement in a position where it is fully out of engagement with the member B when the member A has been turned approximately one half revolution in a left hand direction.

The threads 19 cannot become jammed or locked together as the ring 10 in cooperating with the member B, positively limits threading together of the members A and B. Due to the ease with which the stem 17 may be unthreaded from the socket 18, the joint may be disconnected without danger of breaking or loosening any of the other connections in the drilling string. The spring 10 normally operates to retain the ring 10 in the position where the lugs 25 are in full mesh or cooperation with the recesses 26 where they positively prevent further threading together of the members A and B and dependably transmit the right hand rotational strains from the member A to the member B. The slight rearward inclination of the cooperating faces or shoulders 27 and 28 eliminates the possibility of the lugs 25 becoming accidentally or unintentionally disengaged from the recesses 26. The joint is extremely simple and inexpensive of manufacture, and is positive and dependable in operation.

In the embodiment of the invention illustrated in Figs. 4, 6, 7 and 8 of the drawings, the body members E and F are similar to the body members A and B. The upper body member E is adapted to be connected with the drilling string while the lower body member F is adapted to be connected with the drilling tool. The member E is illustrated as being integral and the lower end portion of the member E is in the nature of a stem 35 adapted to be threaded into a socket 36 in the member F. The threads 37 of the stem and socket are comparatively heavy and have a substantial pitch. Fluid pressure actuated packing 80 is provided in a groove in the stem 35 to seal with the wall of the socket 36 and to present leakage between the members E and F. A ring 40 surrounds the upper member E at a point above the threaded stem 35 and is adapted to cooperate with the member F to limit rotation of the member E in a right hand direction relative to the member F. Splines or keys 41 on the ring 40 and member E hold the ring against rotation on the member. The ring 40 is adapted to shift or slide longitudinally on the member E and its downward movement is limited by a retaining ring 42. The ring 42 is in the nature of a split ring or spring arranged in an annular groove 70 in the stem and adapted to be engaged by the lower ends of the splines 41 of the ring 40.

When the stem 35 is threaded a predetermined distance into the socket 36, the ring 40 cooperates with the upper end of the member F to prevent further threading together of the members A and B and to transmit right hand or clockwise torsional strains between the two members. The lower end of the ring 40 is spiralled or provided with two helicoidal faces terminating at their opposite ends in downwardly projecting lugs 44. The upper end of the body member F is provided with two pitched or spiralled faces which terminate in downwardly extending recesses 45, shaped and proportioned to receive the lugs 44. In accordance with the invention, the spiralled lower end of the ring 40 and upper end of the member F are pitched in the same direction as the threads 37 and have the same inclination as the threads. The forward ends 46 of the lugs 44 and the forward ends 47 of the recesses 45 are flat and extend longitudinally and slightly rearward relative to the right hand direction of rotation. The rear ends of the lugs 44 and the rear walls of the recesses 45 are inclined upwardly and rearwardly and are adapted to cooperate to allow the lugs to ride or slide out of the recesses when the member E is turned in a left hand direction relative to the member F.

In the form of the invention being described, the recesses 45 are comparatively deep and the lugs 44 are comparatively long so that the shoulders 46 and 47 present substantial thrust or bearing surfaces. When the joint is fully made up, the lugs 44 are completely received in the recesses 45 and the lower end of the ring 40 seats on the upper end of the member F. Means is provided for normally yieldingly holding the ring 40 in its down position where the lugs 44 are in full mesh with the recesses 45. A spiralled spring 48 is arranged under compression between the upper end of the ring 40 and a downwardly facing shoulder 49 on the member E to normally maintain the lower end of the ring in engagement with the upper end of the member F.

In assembling the safety joint illustrated in Figs. 4, 6, and 7, of the drawings, the stem 35 is screw-threaded into the socket 36 by turning the member E in a right hand direction relative to the member F until the parts assume the positions illustrated in Fig. 6. When the parts are in this position, the forward ends 46 of the lugs engage the forward walls 47 of the recesses to prevent further turning of the member E in a forward or right hand direction relative to the member F. In order to complete the connection of the joint, a key 50 or other suitable tool is inserted between the upper end of the member F and the lower end of the ring 40 to raise the ring 40 against the action of the spring 48 and move the forward faces 46 of the lugs out of cooperation with the forward ends 47 of the recesses. The upper member E may then be turned approximately one-half of a revolution to bring the lugs 44 into full cooperation with the recesses 45 and the lower end of the ring 40 in cooperation with upper end of the member F. Further rotation of the member E in a right hand direction relative to the member F is then prevented so that the threads 37 on the stem and socket cannot become jammed or tightly set together. With the parts in the position where the lugs 44 are in full engagement with the recesses 45, right hand or clock-wise rotational strains are transmitted from the member E to the member F through the ring 40 and its lugs 44 which cooperate with the recesses 45.

To disconnect the member E from the member F, the member E is turned or rotated in a

counter clock-wise or left hand direction. Turning of the member E in a left hand direction relative to the member F causes the inclined rear ends of the lugs **44** to ride up on the inclined ends of the recesses **45** against the action of the spring **48** and this results in the lower ends of the lugs **44** riding along the spiralled upper end of the member F. When the member E has been rotated about one-half of a turn, the lugs **44**, in being urged downwardly by the spring **48**, snap or pass over the forward ends **47** of the recesses **45** so that the lugs assume the position illustrated in Fig. 6 of the drawings. As the forward ends **46** of the lugs are in cooperation with the forward ends **47** of the recesses when the parts are in this partially released position, clockwise or right hand rotation may be transmitted from the member E to the member F if this is found necessary or desirable. Further rotation of the member E in a left hand direction relative to the member F when the ring **40** is in the position illustrated in Fig. 6, fully disengages the ring **40** from the member F and complete disengagement of the member E from the member F may be had by unthreading the stem **35** from the socket **36**. The retaining ring **42** limits downward movement of the ring **40** and the cooperation between the threads **37** during the disconnection of the joint causes upward movement of the member E relative to the member F so that the ring **40** is fully disengaged from the member F when the member E has been turned approximately one complete revolution in a left hand direction relative to the member F.

The safety joint illustrated in Figs. 4, 6, 7 and 8 of the drawings is particularly dependable and sturdy, as the lugs **44** are comparatively long and have large thrust surfaces **47** for cooperating with the forward ends **47** of the recesses to transmit right hand rotational strains from the member E to the member F. The joint may be easily and quickly disconnected when desired or found necessary but is not subject to accidental or unintentional disconnection or failure. The lugs **44**, in cooperating with the recesses **45** positively prevent rotation of the member E in a right hand direction relative to the member when the joint is fully made up so that the threads **37** cannot become tightly set or jammed.

Having described only typical forms and applications of our invention, we do not wish to limit ourselves to the specific forms and applications herein described, but wish to reserve to ourselves any modifications or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described our invention, we claim:

1. A safety joint including two sections, clutch parts on adjacent ends of said sections to limit relative rotation of the sections in one direction, a tubular member extending through one of the sections and into the other of said sections, a threaded connection between said tubular member and said last named section, a positive slidable connection between said tubular member and the section through which it extends, and means acting between a shoulder on the tubular member and the section through which it extends to hold the clutch means in positive engagement for rotation in one direction and for yieldable releasing engagement for rotation in the opposite direction to completely unscrew the threaded connection by continuous rotation.

2. A safety joint including two complementary sections, clutch parts on adjacent ends of the sections adapted to cooperate to limit turning between the sections, a third section within the tubular complementary sections, a threaded connection between the third section and one of said complementary sections, a splined connection between the third section and the other of said complementary sections, packing on the third section forming a seal with the first mentioned complementary section, and expanding means acting between the third section and the second mentioned complementary section to control the disengagement of the clutch parts of the complementary sections.

3. A safety joint including two complementary members, clutch shoulders formed on contiguous faces of said members, said shoulders abutting against each other to prevent rotation in one direction and having complementary inclined back faces whereby rotation in the opposite direction would cause relative longitudinal shifting of the complementary sections with relation to each other, a central tubular member splined to one of said complementary members and having a threaded connection with the other of said complementary members, yieldable means acting between the central member and the complementary member to which it is splined for permitting relative longitudinal movement between said members and for maintaining the shoulders of the complementary members in driving engagement when said central member is threaded into the other complementary members.

4. A safety joint including two complementary members, clutch shoulders formed on contiguous faces of said members, said shoulders abutting against each other to prevent rotation in one direction and having complementary inclined back faces whereby rotation in the opposite direction would cause relative longitudinal shifting of the complementary sections with relation to each other, a central tubular member splined to one of said complementary members and having a threaded connection with the other of said complementary members, yieldable means acting between the central member and the complementary member to which it is splined for permitting relative longitudinal movement between said members and for maintaining the shoulders of the complementary members in driving engagement when said central member is threaded into the other complementary member, and packing means between the central member and the complementary member into which it is threaded to produce a fluid seal therebetween.

5. A safety joint including two tubular sections, clutch parts on adjacent ends of the sections adapted to limit relative turning of the sections, a third section releasably threaded into one of said sections and extending into the other of said sections, there being a fluid passage through the sections, means for sealing between the first mentioned section and the third section and means governing the release of the clutch parts normally holding the clutch parts in engagement and yieldable to permit disconnection of the clutch parts after limited unthreading of the third section from said other section by the application of an external torsion strain to said other section.

6. A safety joint including two tubular sections, clutch parts on adjacent ends of the sections adapted to coperate to limit relative turning of the sections, and releasable means holding

the sections against relative longitudinal movement, the said means including a third section threaded into one of the said sections, and shoulders on the third section and the other of said sections normally preventing longitudinal movement between the sections in one direction, the clutch parts being disengageable after limited unthreading of the third section and said other section by the application of an external torsion strain to said other section.

7. A safety joint including two tubular sections, clutch parts on adjacent ends of the sections adapted to cooperate to limit relative turning of the sections, and releasable means holding the sections against relative longitudinal movement, the said means including a third section threaded into one of the said sections and having a key connection with the other of said sections, and shoulders on the third section and the said other section normally preventing longitudinal movement between the sections in one direction, the clutch parts being disengageable after limited unthreading of the third section and the said other section by the application of an external torsion strain to said other section.

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