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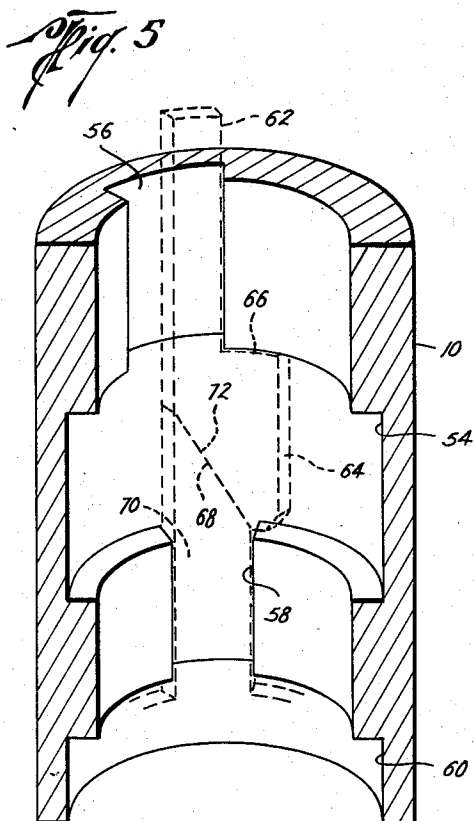
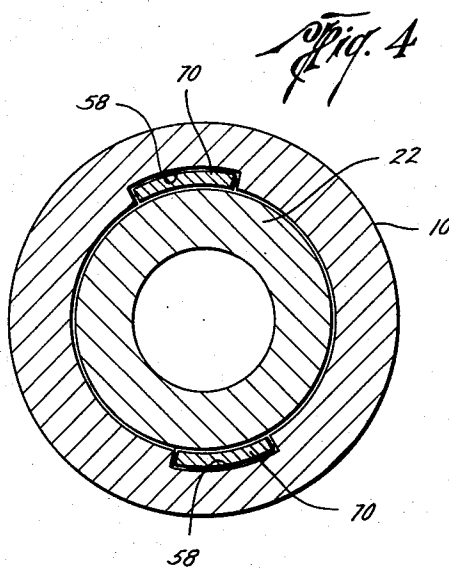
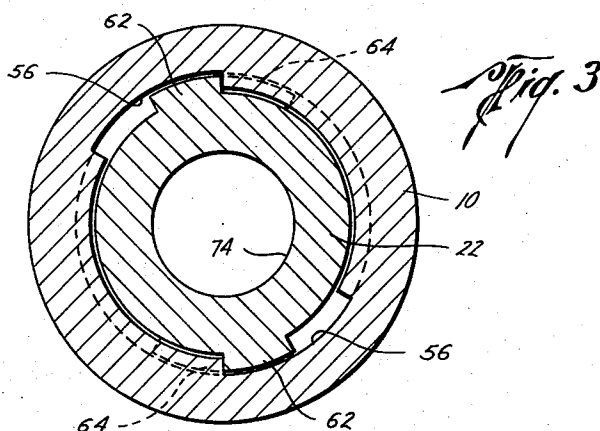
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SAFETY JOINT

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2 Sheets-Sheet 2



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1

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SAFETY JOINT

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4 Claims. (Cl. 255—28)

This invention relates to a safety joint and more particularly to a joint or connection for use in connecting together sections of a drilling or operating string of pipe employed in well drilling operations.

In the drilling of wells, such as oil wells, it is customary to employ in the drilling or operating string a safety joint which may be uncoupled by manipulation of the string in the event of sticking of the drill, in order to release the string. Such safety joints are also incorporated in the operating string used in fishing operations to assure that the string may be released in case it becomes impossible to release the stuck object and the grapple or other fishing tool cannot be released from the stuck object or fish.

Safety joints for this purpose, as heretofore employed, are usually constructed to permit rotation of the string in one direction without uncoupling and are uncoupled by rotation of the string in the other direction. Thus, the rotation of the drill during a drilling operation, or the connecting of the grapple to the stuck object in a fishing operation usually takes place by a right hand or clockwise rotation of the string, and in the event that it becomes necessary to release the string from the drill or stuck object this is accomplished by a left hand or counterclockwise rotation of the string.

In the use of safety joints as heretofore commonly constructed, however, difficulty has been encountered in providing a joint which forms a sufficiently rigid connection and which is also easily released. Moreover, it is frequently desirable to rotate the string in either direction without uncoupling the safety joint, which cannot be accomplished with joints of the type ordinarily used.

The present invention has for its chief object the provision of a safety joint which is constructed to permit rotation of the string in either direction, under certain conditions without uncoupling the joint, but which may be easily released by manipulation of the string when desired.

Another object of the invention is to provide a safety joint which is constructed to permit rotation of the string in either direction without uncoupling the joint, and which embodies latching mechanism operable by rotation of the string in one direction to place the mechanism in condition to permit uncoupling of the joint by the exertion of a pull on the string.

A further object of the invention is the provision of a safety joint embodying latch mechanism by which the parts of the joint are maintained in coupled condition and which may be unlatched by the application of a predetermined relative force on the string in one direction to permit the joint to be released.

A still further object of the invention is to provide a safety joint of the kind referred to embodying latching mechanism requiring the application of a predetermined rotative force on the operating string to release the same and also having means for retarding the movement of the latching mechanism from its latching to its unlatching position.

2

The above and other important objects and advantages of the invention will best be understood from the following detailed description constituting a specification of the same when considered in conjunction with the annexed drawings, wherein—

Figure 1 is a side elevational view of the invention, on a somewhat reduced scale, illustrating the manner in which the same is applied to an operating string, and showing in dash lines the relative positions of the parts with the joint in connected condition;

Figure 2 is a fragmentary view, partly broken away and partly in cross-section, illustrating the invention in assembled condition and showing the relationship of the various parts with the latching mechanism in latching condition;

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 2, looking in the direction indicated by the arrows;

Figure 4 is a cross-sectional view taken along the line 4—4 of Figure 2, looking in the direction indicated by the arrows; and

Figure 5 is a detailed view showing details of the construction and manner of operation of the latching mechanism of the invention.

Referring now to the drawings in greater detail, the invention includes an outer casing formed of upper and lower tubular sections 10 and 12, respectively, threadably connected together, as indicated at 14, the lower section 12 being provided with an externally threaded pin portion 16, for connection to the upper end of a lower section 18 of a tubular operation string. Suitable packing means, such as the O-ring 20, may be disposed between the upper and lower sections, within the threaded connection 14, to provide a fluid tight seal between the sections. An inner tubular mandrel 22 extends within the casing, and beyond the upper end thereof, and this mandrel is provided at its upper end with an internally threaded box portion 24 for connection of an upper section 26 of the operating string. The mandrel 22 is provided with an enlargement 28 located beneath the box portion 24, and of somewhat smaller external diameter than said box portion, which enlargement fits into a counter bore 30 at the upper end of the section 10, and engages the bottom of the counter bore to limit downward movement of the mandrel in the casing. Suitable packing, such as the O-ring, indicated at 32, may be disposed about the enlargement 28 to form a fluid tight seal between the enlargement and the casing section 10.

At its lower end the mandrel 22 extends within the upper end portion of an internal sleeve 34, which is slidably positioned in the lower casing section 12, and which is provided with an external enlargement 36 forming a piston movably positioned in an internal counterbore 38 within the lower casing section. Suitable means, such as a coil spring 40 is positioned in the counterbore 38, in engagement at one end with the bottom of the counterbore, and at the other end bearing against the lower surface of the piston 36, to yieldingly resist downward movement of the sleeve in the lower casing section.

Suitable packing, such as the O-ring indicated at 42, may be positioned between the sleeve 34 and the lower casing section, beneath the bottom of the counterbore 38, to form a fluid tight seal between the sleeve and section. The upper end portion of the sleeve extends above the lower end of the lower casing section 10, and suitable packing, such as the O-ring indicated at 44, may be positioned between the sleeve and the upper casing section to form a fluid tight seal therebetween.

The piston formed by the enlargement 36 is provided with external annular grooves 46, within which piston rings 48 are disposed, the rings being preferably of

3

somewhat less thickness than the depths of the grooves, and the grooves being of greater widths than the rings. The piston may be also formed with grooves 50 in one wall of each of the piston ring grooves 46, to form passageways leading from the exterior of the piston to the bottoms of the piston ring grooves. By this construction and arrangement of the piston ring grooves and piston rings, fluid may readily flow from above the piston 36 into the piston ring grooves, past the piston rings, outwardly through the grooves 50, and thence into the counterbore beneath the piston 36, upon upward movement of the internal sleeve 34, but upon downward movement of the sleeve 34 the piston rings will move into engagement with the walls of the piston ring grooves opposite the grooves 50, to close off the flow of fluid from beneath the piston to above the same. Fluid from beneath the piston will then be forced through the gaps, indicated at 52, between the ends of the piston ring, whereby downward movement of the sleeve will be retarded, in this manner the piston rings act as valves, which are operable to substantially close off the flow of fluid from beneath the piston to above the same upon downward movement of the sleeve 34, to cause the downward movement of the sleeve to be retarded, and which move to positions to permit the fluid to flow from above the piston to below the same when the sleeve 34 moves upwardly. The interior of the casing between the packing 32 on the mandrel and the packing 42 within the lower casing section is filled with suitable liquid, such as oil, which serves as a lubricant and to effectively exclude well fluid or other foreign material from entering the space between the mandrel and the casing and between the sleeve 34 and the casing, the fluid in the counterbore 38 also serving to retard downward movement of the sleeve in the casing.

The upper casing section 10 has an internal annular recess 54, therein, from which diametrically disposed internal grooves 56 extend upwardly into the counterbore 30, and also from which diametrically disposed internal grooves 58 extend downwardly to open at their lower ends into a counterbore 60, in the lower end of the upper section 10, into which the upper end of the sleeve 34 extends. The mandrel 22 is provided with exterior lugs 62, whose upper portions extend into the grooves 56, and which are provided at their lower ends with peripherally extending enlargements 64, forming upwardly facing shoulders 66, positioned to extend into the annular recess 54, in engagement with the upper wall thereof, to hold the mandrel against upward movement in the casing. The lugs 62 are also formed with bevelled lower end surfaces 68, for a purpose later to be made apparent.

Upwardly extending lugs 70 are provided, projecting above the upper end of the sleeve 34, and extending through the internal grooves 58, and formed at their upper ends with bevelled end faces 72, positioned for engagement with the bevelled end faces 68 of the lugs 62 of the mandrel. The internal grooves 56 of the upper casing section are of a width to permit the upper portions of the lugs 62 to move circumferentially within the casing to allow the enlarged lower end portions 64 of these lugs to be moved upwardly through the slots 56. Due to the engagement of the beveled end faces 68 and 72 of the lugs 62 and 70, respectively, and the action of the spring 40, which urges the internal sleeve 34 upwardly, the lugs 62 will be held in their latching positions, with the upwardly facing shoulders 66 in engagement with the upper wall of the recess 54, so that the mandrel will be latched in the casing in the assembled condition of the safety joint, as best seen in Figure 2 of the drawings.

Suitable filling openings 80 and 82 may be provided in the section 10 through which the space between the packing 32 and packing 44 may be completely filled with liquid, these openings being closed with suitable plugs 84 and 86 respectively. Similar openings 88 and

4

90 are also provided in the section 12 for completely filling the space between the packing 44 and packing 42 with liquid, which openings are likewise closed by plugs 92 and 94, respectively.

In making use of the safety joint, constructed as described above, the parts are assembled in the manner illustrated in Figure 2, with the latching mechanism in latching condition and the interior of the casing between the upper packing 32 and the lower packing 42 filled with liquid. The box portion 24 of the mandrel is then connected to the lower end of the upper section 26 of the operating string, and the pin portion 16 of the lower section of the casing is connected to the upper end of a lower section 18 of the operating string. In this condition of the equipment the internal bore 74 of the mandrel is in communication with the interior 76 of the sleeve 34, so that fluid may pass freely upwardly or downwardly through the operating string. Suitable packing, such as that indicated at 78 is provided between the interior of the sleeve 34 and the exterior of the mandrel 22, whereby the escape of fluid from the operating string between the mandrel and sleeve is prevented.

In this condition of the equipment it will also be seen that the piston on the sleeve 34 is in its uppermost position, and the beveled end faces 72 of the lugs 70 are in engagement with the beveled end faces 68 of the lugs 62, which under the force exerted by the spring 40 will retain the latching mechanism in latching position, so that the mandrel is held against withdrawal from the casing.

Upon right-hand or clockwise rotation of the operating string, it will be seen that the lugs 62 will engage one wall of the grooves 56, to cause the casing to rotate with the mandrel, thereby rotating the lower section of the operating string. Should it be desired to impart left hand or counterclockwise rotation to the string, the upper section of the string may be rotated to the left, which will turn the mandrel to the left until the lugs 62 are moved into engagement with the opposite vertical walls of the grooves 56, whereupon the casing will then be rotated with the mandrel to rotate the lower section of the operating string. Such left hand rotation of the string will result in moving the upwardly facing shoulders 66 out of engagement with the upper wall of the recess 54, whereby the latching mechanism will be moved to its unlatched position, but left hand rotation of the operating string may be continued without withdrawing the mandrel 22 from the casing.

Upon such left hand rotation of the string a downward force will be exerted on the sleeve 34, due to the engagement of the beveled end faces 68 and 72 of the lugs 62 and 70, respectively, which will cause the sleeve to move downwardly against the force of the spring 40 which downward movement will be retarded by closing movement of the rings 48, whereby the liquid in the counterbore 38 will be caused to pass slowly through the gaps 52 between the ends of the piston rings thus retarding downward movement of the sleeve. By suitably regulating the size of the spring 40 and the size of the gaps 52 between the ends of the piston rings the rotative force required to move the latching mechanism to its unlatched position may be predetermined in any desired manner.

In the event that the lower end of the operating string should become stuck, the safety joint may be released by exerting a left hand rotative force on the upper portion of the string, whereupon the lug 62 will be rotated to the left against the pressure of the spring 40 and the retarding action of the fluid in the counterbore 38, until the upwardly facing shoulder 66 can move out of engagement with the upper wall of the recess 54, and the mandrel may then be withdrawn upwardly from the casing, the enlarged lower end portions 64 of the lugs 62 passing upwardly through the slots 56.

Due to the opening movements of the piston rings 48, upon upward movement of the internal sleeve 34, the

5

fluid in the counterbore 38 may pass from above the piston to below the same, without substantially retarding the upward movement of the sleeve, so that the latching mechanism may be easily moved from unlatched to latched position.

Should it be desired to reconnect the joint after the same has been released and the mandrel withdrawn, this may be accomplished by lowering the mandrel until its lower end enters the upper end of the casing, and slowly rotating the mandrel in the casing to bring the lugs 62 into alignment with the slots 56 of the upper casing section, whereupon the mandrel may be further lowered in the casing. When the bevelled end faces 68 of the lugs 62 engage the bevelled end faces 72 of the lugs 70, the sleeve 34 will be moved downwardly in the casing to allow the enlarged portions 64 of lugs 62 to move into the annular recess 54, whereupon the mandrel may be rotated to the right to bring the upwardly facing shoulders 66 into engagement with the upper wall of the recess to latch the mandrel in the casing.

It will thus be seen that the invention, constructed as described above, provides a safety joint of simple design and rugged construction, which may be rotated either clockwise or counterclockwise without releasing the joint, but which is easily released by the exertion of a left hand rotative force on the same and an upward pull on the same whenever desirable.

The invention has been disclosed herein in connection with a certain specific embodiment of the same, but it will be understood that this is intended by way of illustration only, and that numerous changes can be made in the construction and arrangement of the various parts, without departing from the spirit of the invention or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent—

1. A safety joint comprising an outer tubular casing, an inner tubular mandrel extending into the casing and movable longitudinally and rotatable relative to the casing, interengageable means on the casing and mandrel positioned for engagement to limit relative rotation of the casing and mandrel and formed with portions shaped for interengagement to hold the mandrel and casing against relative longitudinal movement in a direction to separate the mandrel and casing upon relative rotation of the mandrel and casing in one direction and for disengagement to permit such relative longitudinal movement of the mandrel and casing upon relative rotation of the mandrel and casing in the other direction, a tubular member disposed in the casing for longitudinal movement therein, an annular fluid chamber formed between said member and casing, means sealing the ends of said chamber, said member having an external enlargement forming a piston in said chamber, and means on the piston for restricting the flow of fluid past the piston to cause said fluid to yieldingly resist longitudinal movement of the member in one direction relative to the casing, and means on said member positioned to coact with said interengageable means to cause said member to move in said one longitudinal direction in said casing upon the exertion of a rotative force in said one direction of relative rotation of said casing and mandrel to position said interengageable means to permit withdrawal of the mandrel from the casing.

2. A safety joint comprising an outer tubular casing, an inner tubular mandrel extending into the casing and movable longitudinally and rotatable relative to the casing, interengageable means on the casing and mandrel positioned for engagement to limit relative rotation of the casing and mandrel and formed with portions shaped for interengagement to hold the mandrel and casing against relative longitudinal movement in a direction to separate the mandrel and casing upon relative rotation of

6

the mandrel and casing in one direction and for disengagement to permit such relative longitudinal movement of the mandrel and casing upon relative rotation of the mandrel and casing in the other direction, a tubular member disposed in said casing for longitudinal movement therein and forming with the casing an annular fluid chamber, sealing means at the ends of the chamber, said member having an external enlargement forming a piston in said chamber, means on the piston for restricting the flow of fluid past the piston in one direction to yieldingly resist longitudinal movement of the member in one direction in the casing, and means on said member positioned to coact with said interengageable means to move the member in the other longitudinal direction in the casing upon relative rotation of the casing and mandrel in said one direction to position the interengageable means to permit relative rotation of the mandrel and casing in said one direction of rotation to release the mandrel from the casing.

3. A safety joint comprising an outer tubular casing, an inner tubular mandrel extending into the casing and movable longitudinally and rotatable relative to the casing, interengageable means on the casing and mandrel positioned for engagement to limit relative rotation of the casing and mandrel and formed with portions shaped for interengagement to hold the mandrel and casing against relative longitudinal movement in a direction to separate the mandrel and casing upon relative rotation of the mandrel and casing in one direction and for disengagement to permit such relative longitudinal movement of the mandrel and casing in the other direction, a tubular member disposed in said casing for longitudinal movement therein and forming with the casing an annular fluid chamber, sealing means at the ends of the chamber, said member having an external enlargement forming a piston in said chamber, means on the piston for restricting the flow of fluid past said piston upon movement of the piston toward one end of the chamber, means in the chamber positioned for coaction with the casing and piston to yieldingly urge the piston toward the other end of the chamber, said member being engageable with said interengageable means to cause said piston to move toward said one end of said chamber upon relative rotation of the casing and mandrel in said other direction to position said interengageable means to permit relative rotation of the mandrel and casing in said one direction to release the mandrel from the casing.

4. A safety joint comprising an outer tubular casing, an inner mandrel extending into the casing and movable longitudinally in and rotatable relative to the casing, interengageable means on the mandrel and casing positioned for engagement to limit relative rotation of the casing and mandrel and formed with portions shaped for interengagement upon relative rotation of the casing and mandrel in one direction to hold the casing and mandrel against longitudinal separation and for disengagement upon relative rotation of the casing and mandrel in the other direction to permit such separation, a tubular member in the casing movable longitudinally therein and forming with the casing an annular fluid chamber, sealing means at the ends of the chamber, said member having an external enlargement forming a piston in said chamber, said member being positioned to coact with said interengageable means upon relative rotation of the casing and mandrel in said other direction to move said piston toward one end of the chamber to position the interengageable means to permit relative rotation of the mandrel and casing in said one direction to release the mandrel from the casing, means on the piston for restricting the flow of fluid past the piston as the piston moves toward said one end of the chamber and means in the chamber positioned to coact with the

piston and casing to yieldingly urge the piston toward the other end of the chamber.

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