Sept. 7, 1965 R. W. WALKER 3,204,992

ROTARY SAFETY JOINT

Filed April 9, 1962

Fig. 1.

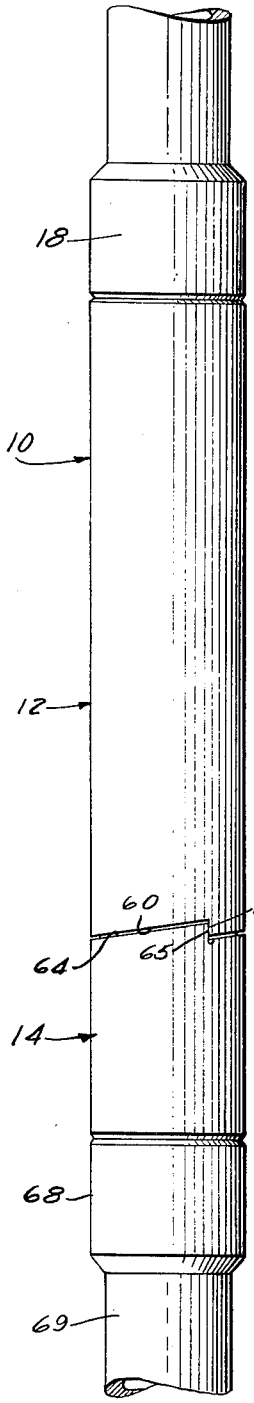
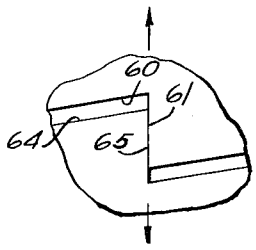


Fig. 3.



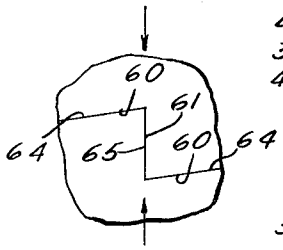


Fig. 4.

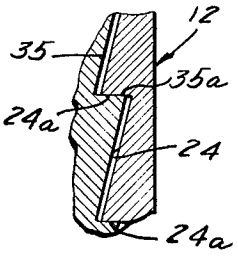
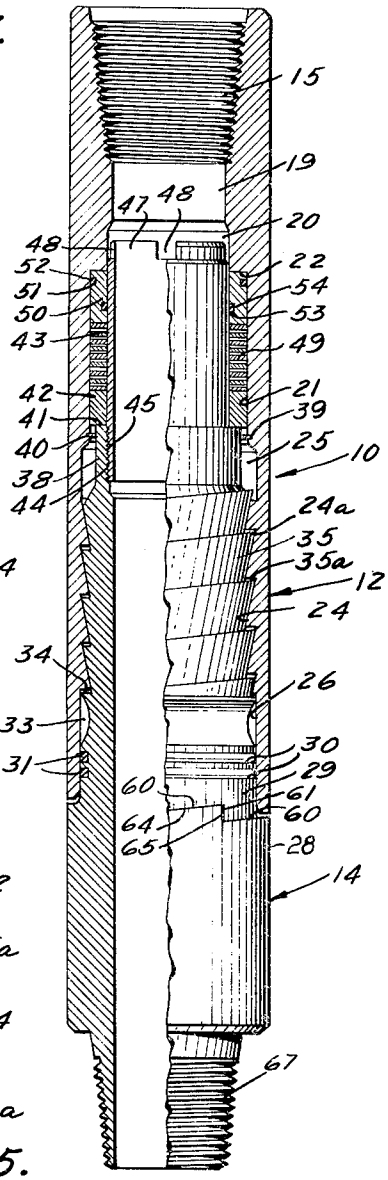


Fig. 5.

Fig. 2.



Raymond W. Walker,
INVENTOR.
WHANN & McMANIGAL
Attorneys for Applicant
by Robert M. McManigal

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ROTARY SAFETY JOINT

Raymond W. Walker, Huntington Beach, Calif., assignor to Shaffer Tool Works, Brea, Calif., a corporation of California

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This invention relates generally to oil well drilling equipment, and relates more particularly to a safety joint.

In rotary well drilling, a drill stem or string is used which includes a number of sections of drill pipe connected together by threads and such string carries an appropriate tool at the lower end, such as, for example, a drill or bit.

The drill string is so made up that a positive drive is effected by exertion of torque upon the drill string in one direction. Under some conditions the drill may become stuck in the well bore and cannot be withdrawn. Reverse rotation of the drill string to unscrew the string from the drill might effect unscrewing of any of the joints of the string and there would be no certainty or selection as to the joint unscrewed.

It is therefore an object of the present invention to pro- a safety joint or instrumentality which may be interposed in the line of drill string at apredetermined selected point so that the string may be broken or separated at that point, the instrument or safety joint preferably being located adjacent the drill so that in case it becomes necessary to separate the stem or string from the drill most of the string or stem may be withdrawn from the well bore and thus recovered.

It is another object of the invention to provide a device of this character having means providing constant resistance to unscrewing of the parts thereof.

A further object of the invention is to provide a device of this character having spring means for maintaining the parts under spring pressure to resist separation of the parts thereof.

It is a still further object of the invention to provide a device of this character having means resisting backing out.

Another object of the invention is to provide a device of this character which has means limiting screwing of the parts together, said means having the same pitch as the threads.

It is still another object of the invention to provide a device of this character that is relatively stable and free from rattle.

It is a further object of the invention to provide a device of this character that is fluid-tight.

It is another object of the invention to provide a device of this character wherein the torque is transmitted through clutches and threads.

It is still another object of the invention to provide a device of this character having clutch means to effect positive drive for the drill.

It is a further object of the invention to provide a device of this character that is relatively inexpensive to manufacture.

A further object of the invention is to provide a mechanism of this character that is relatively simple in construction.

It is a still further object of the invention to provide a device of this character wherein maintenance costs are relatively low.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings, which represent one embodiment. After considering this example skilled persons will understand that variations may be made without departing from the principles disclosed, and I contemplate the employment of any structures, arrangements or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a side view of a tool or safety joint embodying the present invention;

FIG. 2 is a longitudinal section therethrough;

FIG. 3 is an enlarged fragmentary view showing the limiting and driving shoulders in the normal drilling position;

FIG. 4 is a similar view but showing said shoulders in the release position; and

FIG. 5 is an enlarged, fragmentary view of the threads of the box section and the pin section showing said threads in the relative positions thereof so that said sections are free to rotate.

Referring more particularly to the drawings, there is shown a safety joint indicated generally at **10**, comprising a tubular box section or member, indicated generally at **12**, and a tubular pin section indicated generally at **14**.

Box section **12** is provided at its upper end in an outwardly flaring, internally threaded box **15** for reception of a tapered pin, not shown, at the lower end of a drill string or stem **18**.

At the smaller or inner end of the box **15** there is a passage **19** which connects with an enlarged passage portion **20**, the latter extending inwardly and connecting with a further enlarged passage portion **21**, at the outer end of which is a shoulder **22** which is normal to the axis of the box, said shoulder, as viewed in FIG. 2, being horizontal. From the inner end of the passage portion **21** the interior of the box is provided with a shallow angle buttressed-type or scroll-like thread **24**. At the inner end of the threaded part there is an enlarged relieved portion **25** and at the outer end of the threaded portion there is an enlarged part **26**.

Pin section **14** includes a body portion **28** of substantially the same external diameter as the external diameter of the box. From the inner or upper end of the body **28** extends a reduced diameter portion **29**, the external diameter of the portion or part **29** being slightly less than the internal diameter of the part **26** of box section. Part **29** of the pin section is receivable in the passage portion **26** of the box section and said part **29** is provided with a plurality of longitudinally spaced external grooves **30** in which are received sealing elements **31**, said sealing elements being of any suitable character but being shown as O-rings. Inwardly or upwardly, as shown in FIG. 2, the portion **29** is provided with an annular thread runout recess **33** of substantial width and depth and at the upper end of said portion **29** there is an annular shoulder **34** normal to the access of the pin section, which is an element of the thread.

Extending upwardly from the upper end of the portion **29** the pin section is provided with an externally threaded portion **35**, the threads of which are the same character as the threads **24** in the box section and meet therewith. It is to be noted that the passage portion **25** of the box section provides clearance for the upward end of the threaded part of the pin section.

From the upper end of the threaded part **35** of the pin section there extends upwardly an end portion **38** of substantially smaller external diameter than the internal diameter of the passage portion **21**, a portion of the free end of the part **38** of the pin section extending into the lower end portion of the passage portion **21**.

Adjacent the lower end of the passage portion **21** there is provided an internal annular recess **39** in which is disposed a retainer ring **40** which, of course, is removable. Ring **40** has an internal diameter slightly greater than the external diameter of the part **38** of the pin section and

the upper end portion of said pin section part 38 extends upwardly through said retainer ring when said box and pin sections are screwed together or assembled as shown in FIG. 2.

It is to be noted that the upper free end 41 of the pin section portion 38 is spaced upwardly of the retainer ring 40 and seated thereon is an annular thrust washer 42 which is operably disposed in the passage portion 21 of the box section, said thrust washer being disposed on a wash pipe 43 having a lower end portion 44 externally threaded and screwed into internal threads 45 of the portion 38 of the pin section. Wash pipe 43 extends upwardly through the passage portion 21 and has its upper end received within the passage portion 20 of the box section. An upper end portion 47 of the wash pipe is of somewhat reduced external diameter and is provided with notches 48 for reception of a tool whereby said wash pipe may be screwed into and out of the pin section portion 38. It is to be noted that the upper end portion of the wash pipe is accommodated within the passage portion 20.

Disposed above the thrust washer 42 and about the wash pipe 43 are a plurality of Belleville springs 49 and above said springs 49 and about the wash pipe 43 is a seal ring 50, the upper end of which abuts the shoulder 22 at the upper end of the passage portion 21. Seal ring 50 is provided with an external annular recess 51 in which is received a sealing element 52 which, as shown, comprises an O-ring. Seal ring 50 is also provided with an internal annular recess 53 for reception of a sealing element 54, which may be an O-ring. The O-ring 52 provides a seal between the seal ring 50 and the inner wall of the passageway portion 21, while the sealing element or O-ring 54 provides a seal between said seal ring 50 and the wash pipe 43.

The device has means for effecting a positive drive between the box section and the pin section. This means comprises a plurality of clutches, there being three such clutches disclosed herein. Each clutch comprises a helical shoulder 60 having the same helical lead as the threads 24 and 35 and said shoulders each extend throughout 120 degrees of the circumference of the pin section. Consequently the higher end of one shoulder 60 is just above the lower end of the adjacent shoulder, and inter-connecting same is an abutment 61. Thus, there are three shoulders 60 and three abutment surfaces 61. The adjacent end of the box section is correspondingly formed so as to provide shoulders 64 having the same helical lead as the shoulders 60 and engageable with said shoulders 60 respectively. This end of the box section also includes abutment surfaces 65 connecting the adjacent ends of the shoulders 64 and engageable with respective abutments 61.

At the lower end of the pin section 14 there is the usual tapered, externally threaded pin 67 for threadable reception in the usual box 68 of the drill string portion 69 below the safety joint. A drill or bit, or the like, is secured to the lower end of the drill string section 69, the safety joint being incorporated in the drilling string at a predetermined location above the drill or bit. The particular location of the safety joint above the drill or bit is determined by the requirements of the particular drilling operation.

The seal ring 50, Belleville springs 49, and thrust washer 42 are installed in the passage portion 21 of the box section 12. These springs 49 are not under compression until the pin is screwed into the box section, the parts being retained in the passage portion 21 by the snap or retainer ring 40.

When the box section and pin section are screwed together the upper end 41 of the pin section engages the adjacent end of the thrust washer 42 and when said sections are fully screwed together, as shown in FIG. 2, the thrust washer is moved upwardly away from the retainer ring 40 and the Belleville springs or washers 49 are compressed so that they exert their force against the upper end of the pin section through the thrust washer 42, thereby exerting a powerful spring pressure or force which provides friction which resists separation of said sections.

Because the shoulders 60 and 64 have the same helical lead as the threads 24 and 35 the shoulders will come into engagement with each other without binding or sticking and the abutment surfaces 61 and 65 provide a positive drive connection between the box section and pin section when the drill string is rotated in the usual direction for drilling operations.

It is to be understood that the safety joint is located in the drilling string in that portion of said string that is in tension during drilling operations. The parts of the joint are then positioned as shown in FIGS. 2 and 3. Shoulders 60 and 64 are separated somewhat while the shoulders 61 and 65 are in driving contact. It will be noted that there is also frictional contact between the threads 35 of the pin section 14 and the threads 24 of the box section, the adjacent faces 24*a* and 35*a* of the threads 24 and 35, respectively, are in planes substantially perpendicular to the axis of the joints and these faces are spaced longitudinally apart somewhat, as shown in FIGS. 2 and 3. At the same time the shoulders 60 and 64 are correspondingly spaced apart. The driving torque during the drilling operations is transmitted by the cluthes and threads and there is constant resistance to unscrewing by reason of the thread friction resulting from spring force and tension on the joint; that is, the friction between the threads of the pin section and the box section.

When it is desired to break the string at the safety joint the drill string is lowered sufficiently to put the safety joint in compression. When the joint is in compression the shoulders 60 and 64 are in engagement with each other, as best shown in FIG. 4, and the abutment surfaces 61 and 65 are also in engagement with each other, as shown in said FIG. 4. The parts of the buttress threads will then be positioned as shown in FIG. 5, whereat the side surfaces of said threads are separated while the faces 24*a* and 35*a* thereof are in engagement with each other. The frictional grip between the side surfaces or faces of said threads is then broken so that the box section may be unscrewed from the pin section by backing off operation of the drill string.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the embodiment hereinbefore described being merely for the purposes of illustration.

I claim:

1. A safety joint for use in the drilling of oil wells, comprising:

(A) a tubular box section having a passageway therethrough and terminating at one end in a threaded box for threadable reception of the pin of an adjacent end of a drill string;

(B) a shallow angle internal, buttress-type, helical thread extending a limited distance in the passageway in said box section and spaced from the box;

(C) a seal ring in said passageway portion adjacent the threaded box;

(D) sealing means between said seal ring and the inner wall of said passageway portion;

(E) means limiting movement of said seal ring toward said box;

(F) a thrust washer in said passageway spaced longitudinally thereof from said seal ring at the opposite side thereof from said box;

(G) removable means in said passageway limiting longitudinal movement of said thrust washer in a direction away from said seal ring;

(H) a plurality of Belleville springs between said seal ring and thrust washer;
(I) a tubular pin section having a passageway therethrough and including
(a) a body of substantially the same external diameter as the external diameter of the box section;
(J) a threaded pin at one end of the body;
(K) a reduced diameter portion extending from the opposite end of the body and slidably received in an adjacent end portion of the passageway of the box section opposite the box;
(L) an externally threaded part extending axially from the reduced diameter part of the pin section,
(a) the threads of said threaded part corresponding to the buttress threads of the box section and threadably disposed therein;
(M) an internally threaded collar extending axially from the end of the threaded part opposite the body,
(a) said collar engaging the thrust washer to further compress the Belleville springs;
(N) a wash pipe,
(a) said wash pipe having one end removably connected to said collar,
(b) and extending through said thrust washer, Belleville springs and seal rings;
(O) sealing means between the seal ring and said wash pipe;
(P) three helical shoulders at the base of the reduced diameter part of the pin section above the body,
(a) said shoulders extending 120° each,
(b) and having the same helical lead as the buttress threads of the box section and pin section,
(c) there being longitudinally extending abutment surfaces between the upper and lower adjacent ends of said shoulders;
(Q) and corresponding helical shoulders and abutment surfaces at the adjacent end of said box section,
(a) said shoulders of the pin section being out of engagement with the respective shoulders of the box section when the sections are screwed together, and the joint is in tension;
(b) and the abutment surfaces of the pin section being in abutting relationship with respective corresponding surfaces of the box section.

2. A safety joint for use in the drilling of oil wells, comprising:
(A) a tubular box section having a passageway therethrough and terminating at one end in a threaded box;
(B) a shallow angle internal, buttress-type, helical thread extending a limited distance in the passageway in said box section and spaced from the box;
(C) a seal ring in said passageway portion adjacent the threaded box;
(D) means limiting movement of said seal ring toward said box;
(E) a thrust washer in said passageway spaced longitudinally thereof from said seal ring at the opposite side thereof from said box;
(F) removable means in said passageway limiting longitudinal movement of said thrust washer in a direction away from said seal ring;
(G) yielding means between said seal ring and thrust washer;
(H) a tubular pin section having a passageway therethrough and including
(a) a body of substantially the same external diameter as the external diameter of the box section;
(I) a threaded pin at one end of the body;
(J) a reduced diameter portion extending from the opposite end of the body and slidably received in an adjacent end portion of the passageway of the box section opposite the box;

(K) an externally threaded part extending axially from the reduced diameter part of the pin section,
(a) the threads of said threaded part corresponding to the buttress threads of the box section and threadably disposed therein;
(L) a collar extending axially from the end of the threaded part opposite the body,
(a) said collar engaging the thrust washer and compressing the yielding means;
(M) a wash pipe,
(a) said wash pipe having one end connected to said collar,
(b) and extending through said thrust washer, yielding means and seal ring;
(N) a plurality of helical shoulders at the base of the reduced diameter part of the pin section above the body,
(a) and having the same helical lead as the buttress threads of the box section and pin section,
(b) there being longitudinally extending abutment surfaces between the upper and lower adjacent ends of said shoulders;
(O) and corresponding helical shoulders and abutment surfaces at the adjacent end of said box section,
(a) said shoulders of the pin section being in engagement with the respective shoulders of the box section when the sections are screwed together and the joint is under compression,
(b) and the abutment surfaces of the pin section being in abutting relationship with the respective corresponding surfaces of the box section.

3. A safety joint for use in the drilling of oil wells, comprising:
(A) a tubular box section having a passageway therethrough and terminating at one end in a threaded box;
(B) a shallow angle internal, helical thread with a sharply inturned shoulder at the upper edge thereof extending a limited distance in the passageway in said box section and spaced from the box;
(c) a tubular pin section having a passageway therethrough and including:
(a) a body of substantially the same external diameter as the external diameter of the box section;
(D) a threaded pin at one end of the body;
(E) a reduced diameter integral portion extending from the opposite end of the body and slidably received in an adjacent end portion of the passageway of the box section opposite the box;
(F) an externally threaded part extending axially from the reduced diameter part of the pin section,
(a) the threads of said threaded part corresponding to the threads of the box section and threadably disposed therein;
(G) a wash pipe at the upper end of said pin section;
(H) yielding means reacting between parts of the box and pin sections urging said sections apart;
(I) three helical shoulders at the base of the reduced diameter part of the pin section above the body,
(a) said shoulders having the same helical lead as the threads of the box section and pin section,
(b) there being longitudinally extending abutment surfaces between the upper and lower adjacent ends of said shoulders;
(J) and corresponding helical shoulders and abutment surfaces at the adjacent end of said box section in engagement with the respective shoulders and abutment surfaces of the box section when the sections are screwed together and the joint is under compression,
(a) the side surfaces of the helical threads of the box and pin sections then being separated, the faces of said threads which are perpendicular

to the axis of the joint then being in engagement with each other.

4. A safety joint for use in the drilling of oil wells, comprising:

(A) a tubular box section having a passageway therethrough,

(a) a shallow angle internal, helical thread extending a limited distance in an intermediate part of the passageway in said box section;

(B) a tubular pin section having a passageway therethrough and including

(a) a body;

(b) a reduced diameter portion extending from one end of the body and slidably received in an adjacent end portion of the passageway of the box section;

(c) an externally threaded part extending axially from the reduced diameter part of the pin section,

(aa) the threads of said threaded part corresponding to the threads of the box section and threadably disposed therein;

(C) resilient means urging the pin section outwardly of the box section;

(D) three helical shoulders annularly arranged at the inner end of the body,

(a) said shoulders extending 120° each,

(b) and having the same helical lead as the helical threads of the box section and pin section;

(E) and corresponding helical shoulders at the adjacent end of said box section,

(a) said shoulders of the pin section being in engagement with the respective shoulders of the box section when the sections are screwed together and the joint is under compression.

5. A safety joint for use in the drilling of oil wells, comprising:

(A) a tubular box section having a passageway therethrough,

(a) a shallow angle internal, helical thread extending a limited distance in an intermediate part of the passageway in said box section;

(B) a tubular pin section having a pasageway therethrough and including

(a) a body portion;

(b) an integral reduced diameter portion extending from one end of the body and slidably received in an adjacent end portion of the passageway of the box section;

(c) an externally threaded part extending axially from the reduced diameter part of the pin section,

(aa) the threads of said threaded part corresponding to the threads of the box section and threadably disposed therein;

(C) resilient means carried by said box section urging the pin section outwardly of the box section;

(D) and clutch means between the box section and pin section providing a positive driving connection therebetween in one direction, and said resilient means acting in a direction to longitudinally separate parts of said clutch means.

6. A safety joint for use in the drilling of oil wells, comprising:

(A) a tubular box section having a passageway therethrough and terminating at one end in a threaded box;

(B) a shallow angle internal, helical thread with a sharply inturned shoulder at the upper edge thereof extending a limited distance in the passageway in said box section and spaced from the box;

(C) a tubular pin section having a passageway therethrough and including:

(a) a body of substantially the same external diameter as the external diameter of the box section;

(D) a threaded pin at one end of the body;

(E) a reduced diameter portion extending from the opposite end of the body and slidably received in an adjacent end portion of the passageway of the box section opposite the box;

(F) an externally threaded part extending axially from the reduced diameter part of the pin section,

(a) the threads of said threaded part corresponding to the threads of the box section and threadably disposed therein;

(G) a wash pipe at the upper end of said pin section;

(H) yielding means reacting between parts of the box and pin sections urging said sections apart;

(I) three helical shoulders at the base of the reduced diameter part of the pin section above the body,

(a) said shoulders having the same helical lead as the threads of the box section and pin section,

(b) there being longitudinally extending abutment surfaces between the upper and lower adjacent ends of said shoulders;

(J) and corresponding helical shoulders and abutment surfaces at the adjacent end of said box section, said helical shoulders being out of engagement with respective shoulders of the pin section, when said sections are screwed together and the joint is in tension, the abutment surfaces of the respective surfaces being in engagement with each other;

(a) the surfaces of the helical threads of the box and pin sections then being in frictional engagement with each other, the faces of said threads which are perpendicular to the axis of the joint then being out of engagement with each other.

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CARL W. TOMLIN, *Primary Examiner.*