United States Patent [19]

Mott

[11] **3,842,914**

[45] **Oct. 22, 1974**

[54] **SAFETY JOINT METHOD AND APPARATUS**

[75] Inventor: **James D. Mott,** Houston, Tex.

[73] Assignee: **Hydril Company,** Houston, Tex.

[22] Filed: **May 14, 1973**

[21] Appl. No.: **359,753**

[52] **U.S. Cl.** **166/315,** 175/320, 285/34, 285/DIG. 23

[51] **Int. Cl.** **E21b 43/00,** E21c 15/00

[58] **Field of Search** ..... 166/315; 175/320; 285/3, 285/18, 33, 34, DIG. 23, DIG. 24

[56] **References Cited**

UNITED STATES PATENTS

2,059,175	10/1936	Myracle	285/3
2,422,223	6/1947	Church	285/3
2,670,927	3/1954	Edwards	285/DIG. 23
2,940,730	6/1960	McClintock et al.	285/DIG. 23
3,148,894	9/1964	Schwab	285/DIG. 23

Primary Examiner—James A. Leppink

Attorney, Agent, or Firm—Pravel & Wilson

[57] **ABSTRACT**

A method and apparatus for a subsurface safety joint connectable in a well conduit to effect positive separation of the well conduit when such separation is desired. The safety joint release is effected alternatingly by a predetermined fluid pressure in the bore of the well conduit or by rotation of a portion of the well conduit.

12 Claims, 8 Drawing Figures

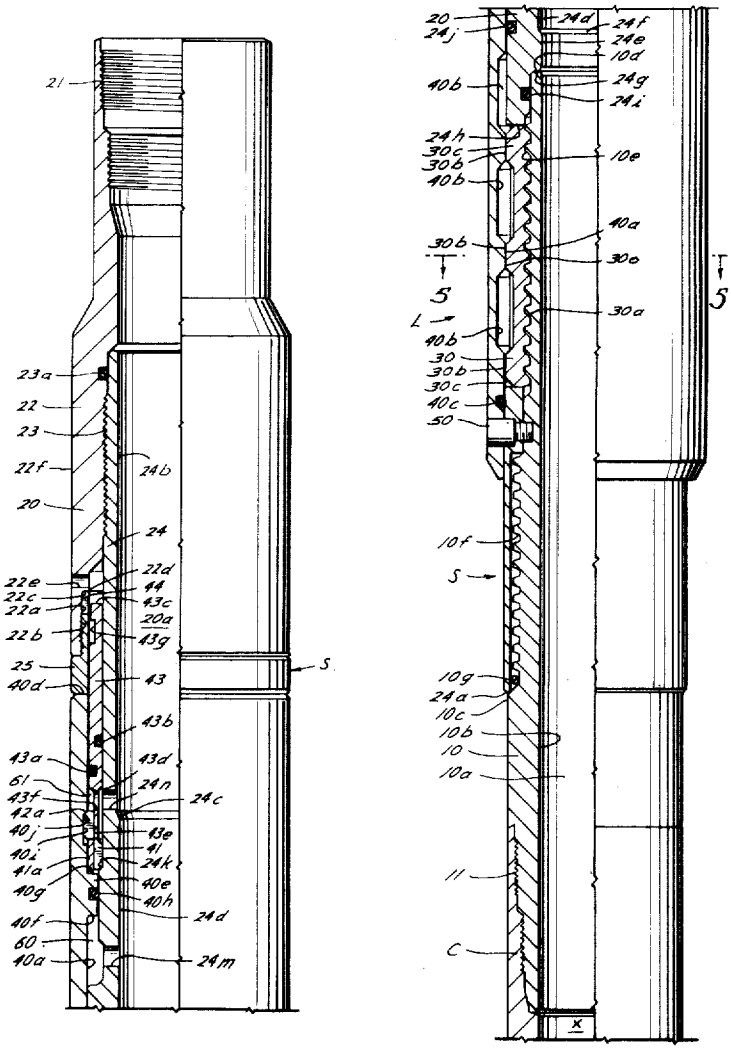


Fig. 1A

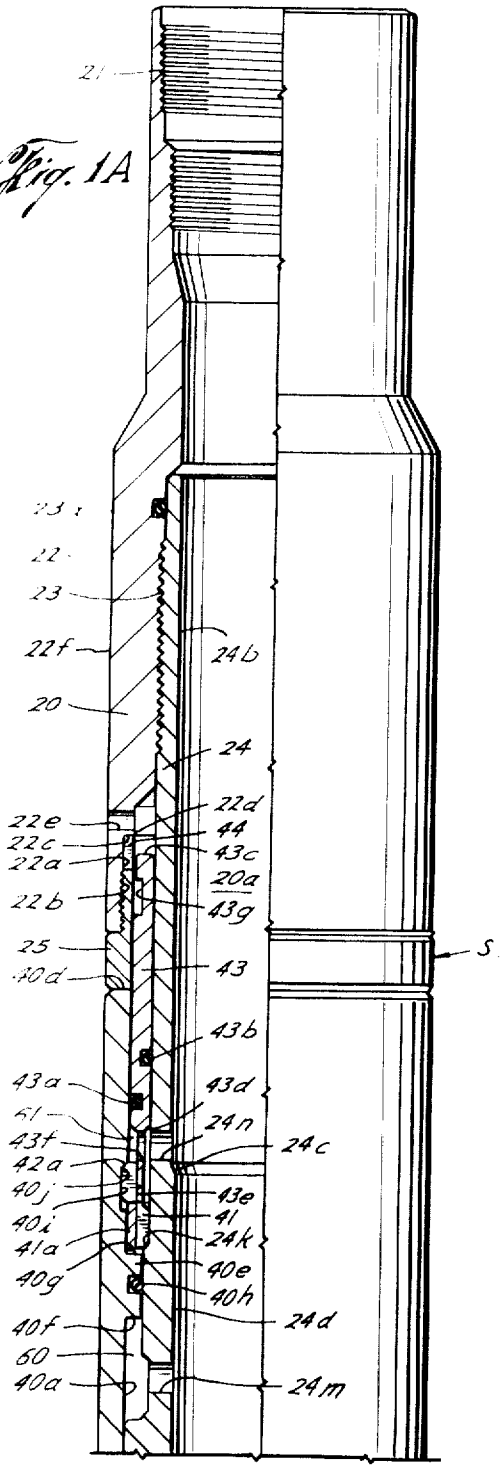
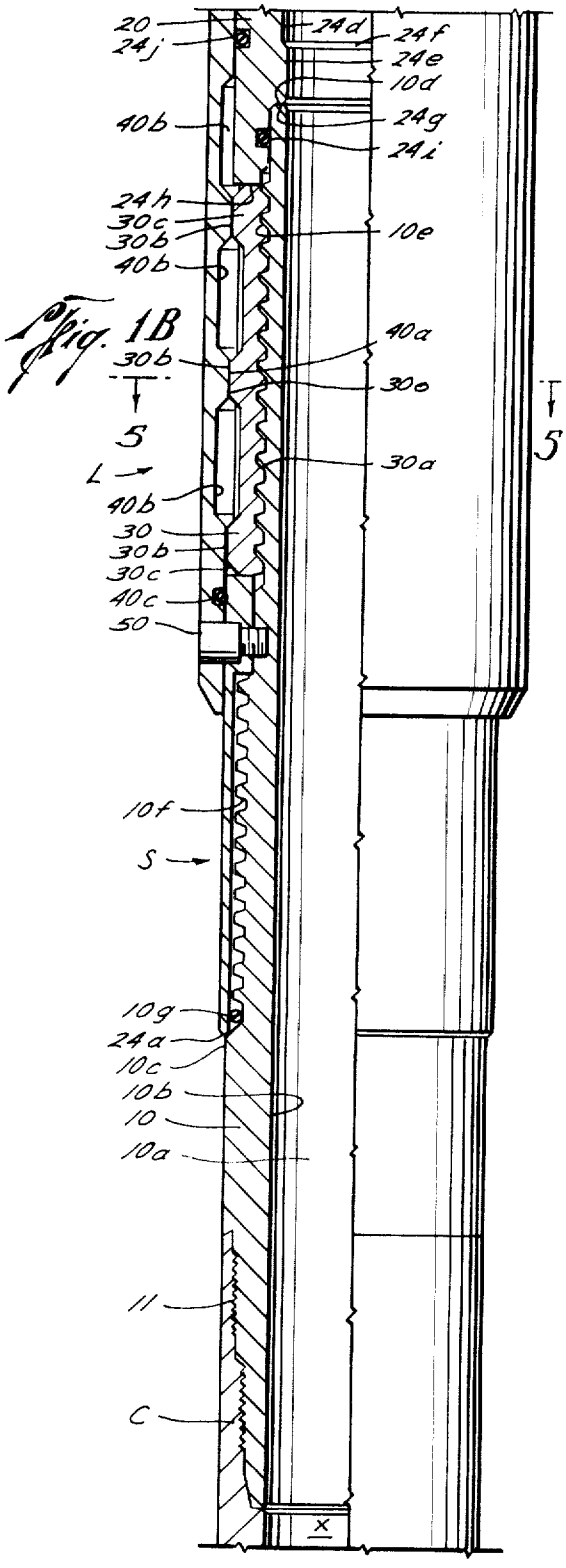

21
23a
22
23
22f
24b
20
24
22d
22e
44
22c
43c
22a
20a
22b
43g
25
S
40d
43
43b
43a
43d
61
24n
43f
24c
42a
40j
43e
41
40i
24k
41a
40e
40g
40h
40f
24d
60
40a
24m

Fig. 1B


20
24j
24d
24f
24e
10d
40b
24g
24i
24h
30c
10e
30b
40b
40a
30b
30e
T
S
T
S
L
30a
40b
30
30b
30c
40c
50
10f
S
10g
24a
10c
10b
10
10a
11
C
X

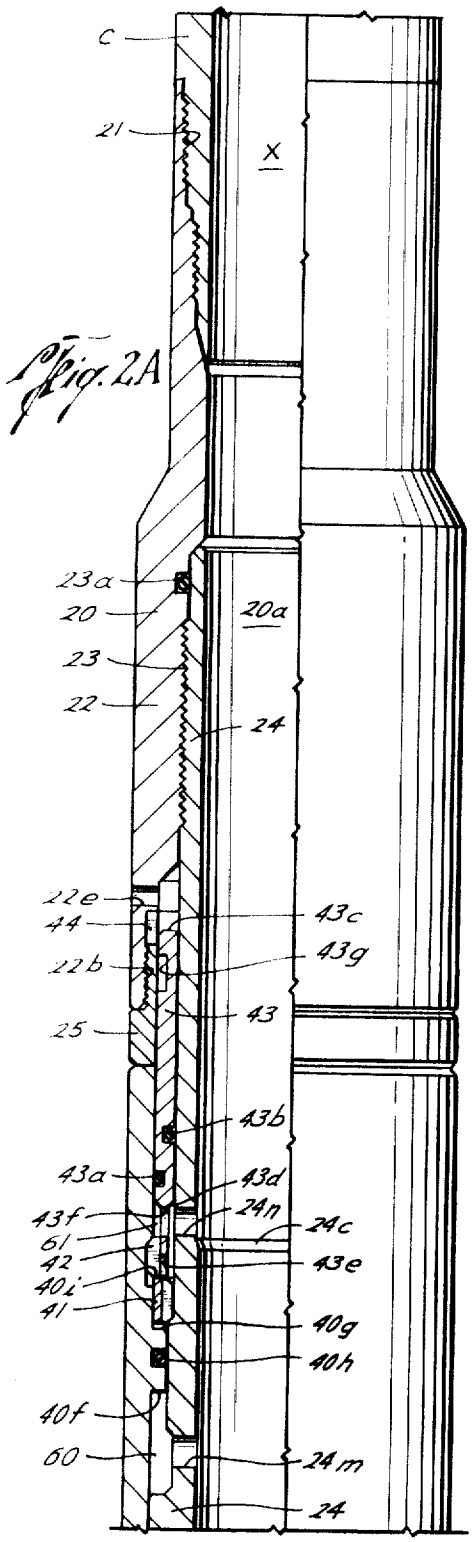

C
21
X
23a
20
20a
23
22
24
22e
44
43c
22b
43g
43
25
43b
43a
43d
43f
24n
24c
61
42
43e
40i
41
40g
40h
40f
60
24m
24

Fig. 2A

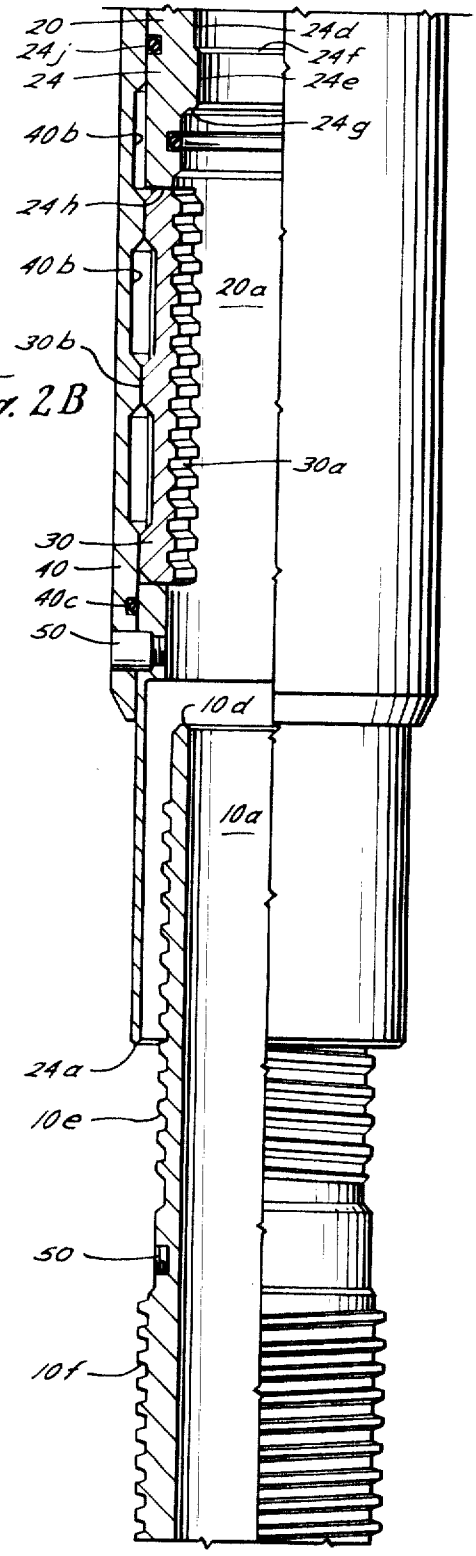

20
24j
24
40b
24h
40b
30b
24d
24f
24e
24g
20a
30a
30
40
40c
50
10d
10a
24a
10e
50
10f

Fig. 2B

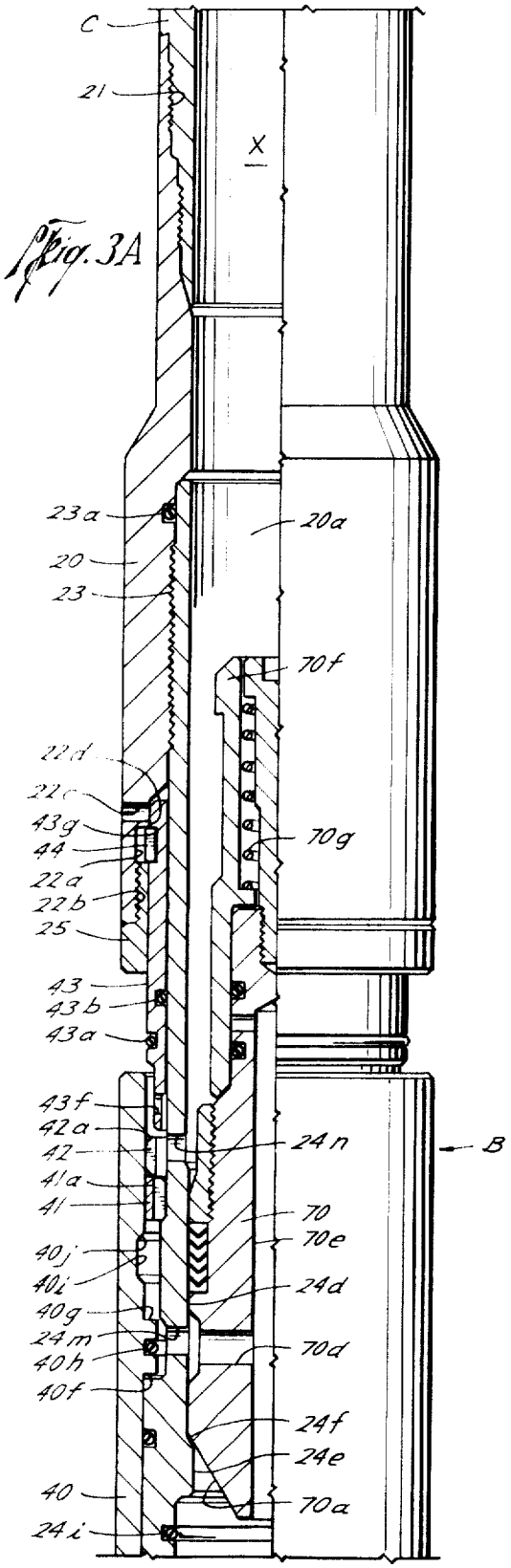

C
21
X
23a
20a
20
23
70f
22d
22c
43g
44
70g
22a
22b
25
43
43b
43a
43f
42a
42
24n
B
41a
41
70
70e
40j
40i
24d
40g
24m
70d
40h
40f
24f
24e
40
70a
24i

Fig. 3A

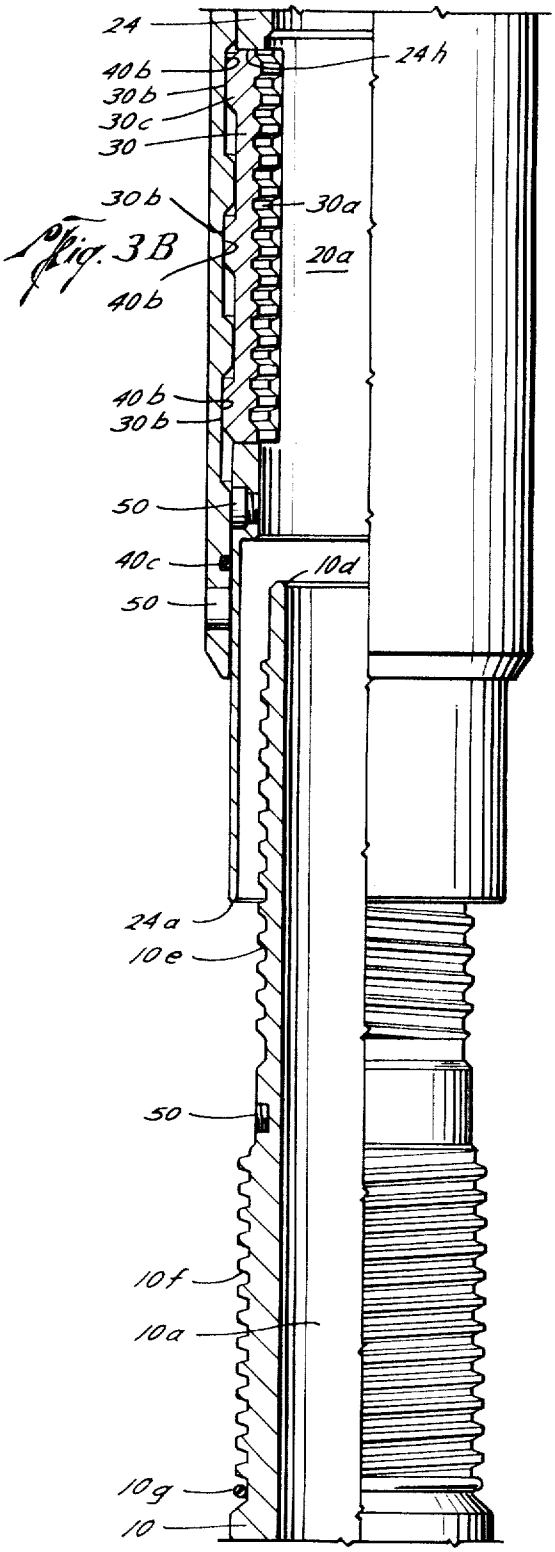

24
24h
40b
30b
30c
30
30b
30a
20a
40b
40b
30b
50
40c
10d
50
24a
10e
50
10f
10a
10g
10

Fig. 3B

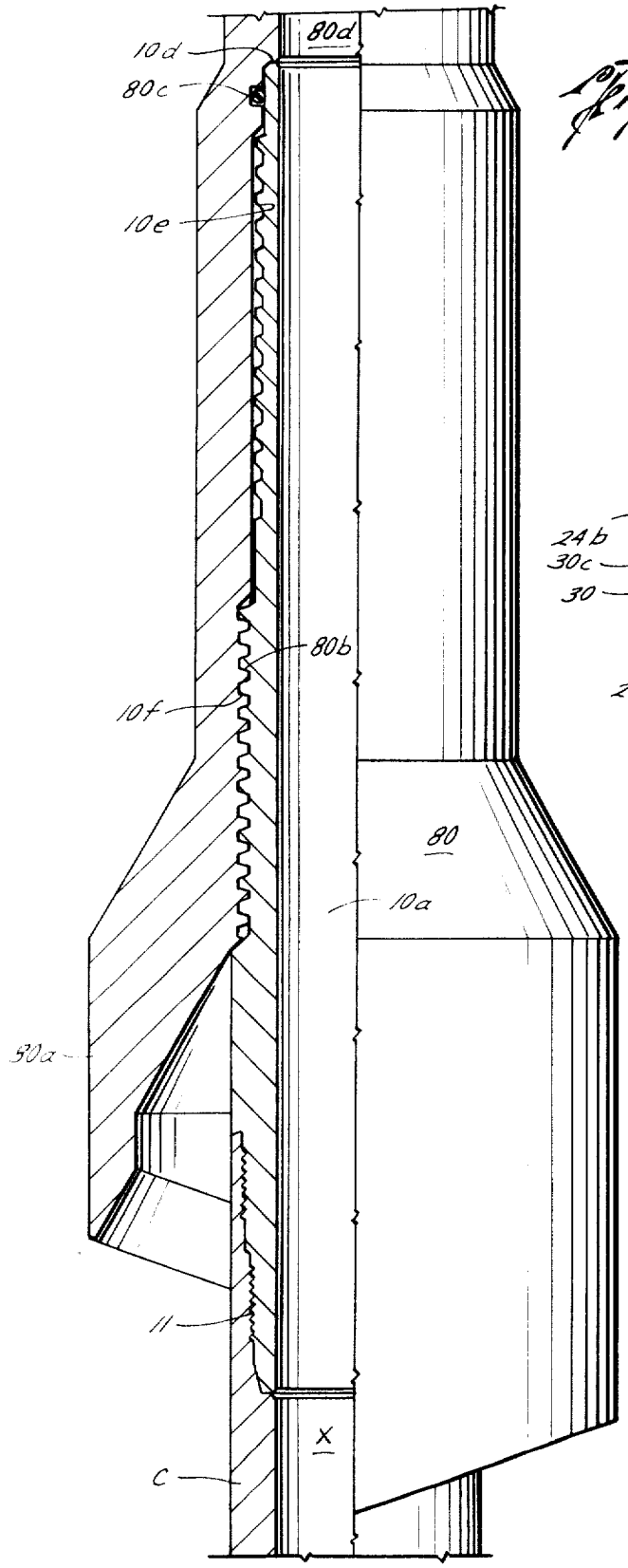

10d
80d
80c
10e
80b
10f
80
10a
30a
11
X
C

Fig. 4

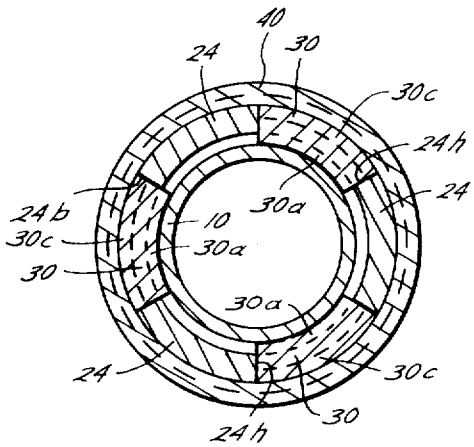

40
24
30
30c
24h
24
24b
30c
30
10
30a
30a
24
30c
30
24h

Fig. 5

SAFETY JOINT METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to the field of a method and apparatus for a releasable subsurface safety joint in a well and more particularly to a safety joint that may be operated either by fluid pressure or by mechanical movement to effect release of the safety joint.

Some subsurface well tools connectable in a well tubing string have neither a symmetrical shape nor a concentric relationship with the tubing string. Such tools often required employment of special connecting joints, called safety joints, below the tool for detaching the tool and a portion of the tubing when it was desired or necessary to retrieve the tool to perform maintenance work thereon. Some safety joints were released by either right-hand or left-hand rotation of the portion of the tubing above the safety joint, while other joints required reciprocation in conjunction with rotation to effect release. Safety joints requiring rotation of the well tubing were undesirable because of insufficient clearance to enable the necessary rotation to operate the joint which was often not available in plural completion wells and, in addition, the risk of threadedly disengaging a threaded joint of the well conduit was great. Other joints utilizing partial rotation have not been widely received because the torsion deformation of the tubing made determination of the relative position of the tubing at the joint from the well surface unreliable.

Still others have employed reciprocation of the tubing to shear a connecting pin to release the joint, but well pressure may effect undesired shearing under certain well pressure conditions. Other safety joints were released by applying fluid pressure in a certain manner. While these often had the desirable feature of not requiring rotation to release or separate the tools, they were rendered inoperative if the tubing string developed a leak. It was then necessary to pull the entire string to retrieve the tool.

The advent of subsurface safety valve controlled by the use of one or more small lines run in parallel with the tubing string to operate the valve has made it even more imperative that reliable safety joints be provided. The likelihood of damage to the control lines during the retrieval and setting of the valve rendering the valve inoperative emphasizes the need for a reliable, nonrotating, positive release safety joint and apparatus and method.

SUMMARY OF THE INVENTION

A method and apparatus for a subsurface safety joint connectable in a well conduit to effect desired release of a portion of the well conduit by either communication of a predetermined fluid pressure to the joint to free a plurality of connecting latch dogs or by a left-hand rotation of a portion of the well conduit. Means are provided with the portion of the safety joint left in the well to reconnect the well conduit with the safety joint.

An object of the present invention is to provide a new and improved safety joint apparatus.

Another object of the present invention is to provide a new and improved method for effecting positive release of a safety joint.

A further object of the present invention is to provide a new and improved safety joint having alternate means for effecting release of the safety joint.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1A** and **1B** are side views, partially in section, from top to bottom of the safety joint of the present invention prior to effecting separation of the safety joint;

FIGS. **2A** and **2B** are views similar to FIGS. **1A** and **1B** respectively, with the safety joint separation effected by left hand rotation;

FIGS. **3A** and **3B**, are views also similar to FIG. **1A** and **1B**, respectively, with the safety joint separation effected by a predetermined fluid pressure communicated by the bridge plug positioned in the bore of the safety joint;

FIG. **4** is a side view, partially in section, illustrating the lower half of the safety joint reconnected with the well conduit above the safety joint; and

FIG. **5** is a view taken along line **5—5** of FIG. **1B**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter S generally designates the safety joint of the present invention which is adapted to be connected in and form a part of a casing, tubing or other well conduit C, whereby the upper portion of the conduit C can be released from the lower part of the conduit C. The lower portion of the conduit C is suitably supported (not illustrated) in the well by a hanger and the like to remain fixed in position when the safety joint S is released. As set forth hereinbelow, means are provided with the safety joint S for reconnecting the well conduit C with the safety joint S after separation thereof.

As illustrated in FIGS. **1A** and **1B**, the safety joint S includes a first or lower tubular member **10** and a second or upper tubular member **20** having aligned longitudinal bores **10***a* and **20***a*, respectively, formed therethrough. The lower tubular member **10** includes a threaded pin connection **11**, formed thereon adjacent the lower or first end which is adapted for connecting the tubular member **10** with the well conduit C below the safety joint S. The upper tubular member **20** has a threaded box connection **21** formed in the bore **20***a* adjacent the upper for first end of the tubular member **20** for connecting the tubular member **20** with the well conduit C (FIG. **2A**) above the safety joint S. When connected in the well conduit C, the safety joint S forms a portion thereof for communicating the flow through a bore X of the well conduit C and through the bores **10***a* and **20***a* of the tubular members **10** and **20** respectively. The bores **10***a* and **20***a* are slightly smaller in diameter than the box X of the well conduit C for a purpose to be more fully described hereinafter, but essentially provide a full opening through the safety joint S for effecting a minimum flow restriction. The tubular member **10** has a constant diameter inner surface **10***b* which defines the flow passge bore **10***a* an outer partially threaded surface **10***c* concentrically spaced from the surface **10***b*. The surface **10***b* extends upwardly adjacent the upper or second end of the tubular member **10** to an annular shoulder **10***d*. A tapered left hand thread **10***e* forming a continuous helical groove or recess in the tubular member **10** is formed in the outer surface **10***c* adjacent to the shoulder **10***d* and which

also provides a continuous helical groove or recess below the thread **10***e*.

The upper tubular member **20** includes an outer sleeve **22** secured by threads **23** to a concentric inner tubular member **24.** Suitable anti-rotation pins, not illustrated, may be employed to block rotational disengagement of the sleeves **22** and **24.** The sleeve **22** mounts an O-ring **23***a* adjacent threads **23** to block leakage of fluid between the sleeve **22** and the sleeve **24.**

Sleeve **22** includes a stepped lower inner surface **22***a* having threads **22***b* formed therein for releasably securing a cap ring **25** therewith. The sleeve **22** also includes a downwardly facing annular shoulder **22***c* connecting the surface **22***a* and a smaller constant diameter surface **22***d* which is concentrically spaced from the sleeve **24.** The sleeve **22** has a port **22***e* formed therethrough above the annular shoulder **22***c* for communicating the annular space between the sleeve **24** and the surface **22***d* with the area adjacent the exterior surface **22***f* of the tubular member **22.**

The inner sleeve **24** extends from the outer threads **23** to a downwardly facing annular shoulder **24***a* adjacent the threads **10***f*. The bore **20***a* is partially defined by the surfaces of the sleeve **24** including a full diameter conduit bore upper portion **24***b*, a bore restricting upwardly facing annular shoulder **24***c* and a constant diameter bore portion **24***d* having an inwardly projecting annular collar **24***e* formed thereon. The collar **24***e* provides an upwardly facing annular shoulder **24***f* for a purpose to be described more fully hereinafter and a downwardly facing annular shoulder **24***g* which is adapted to engage the upwardly facing annular shoulder **10***d* of the tubular member **10** for positioning the tubular members **10** and **20** with respect to each other in the connected position.

As illustrated in greater detail in FIG. **5,** a plurality of three windows or apertures **24***h* are formed through the sleeve **24** adjacent the thread **10***e* of the tubular member **10.** The inner sleeve **24** mounts an O-ring **24***i* for effecting a seal with tubular member **10** between the annular shoulder **10***b* and the connecting threads **10***e* to block leakage of fluid therebetween. Mounted below the threads **10***f* is an O-ring **10***g* effecting a seal between the lower portion of the sleeve **24** and the tubular member **10** to block passage of fluid therebetween.

The safety joint S includes a lug means L for connecting the upper tubular member **20** with the lower tubular member **10.** The lug means L includes a plurality of latch dogs **30** mounted in the corresponding plurality of windows **24***h* which are radially moveable between an inner or engaging position (FIG. 1B) for connecting or securing the tubular member **20** with the tubular member **10** and to and from an outer or free position (FIG. 3B) for enabling separation or release of the tubular member **20** from the tubular member **10.** The latch dogs **30** include a tapered threaded segment or portion **30***a* corresponding and threadedly engaging the left hand threads **10***e*.

The safety joint S further includes a piston means P operably connected with the latch dogs **30** for enabling separation of the safety joint S when a predetermined pressure urges on the piston means P. The piston means P includes a piston sleeve **40** concentrically mounted about the sleeve **24,** such sleeve **40** being moveable longitudinally between an upper or locking position (FIG. 2B) for retaining the latch dog threads **30***a* in engagement with the threads **10***e*, and a lower or release position (FIG. 3B) to enable the latch dogs **30** to move to the free position for effecting separation of the safety joint S. The piston sleeve **40** has a constant diameter inner surface **40***a* which engages a constant diameter locking outer surface **30***b* of a plurality of spaced annular collars **30***c* formed on the latch dogs **30** when the piston sleeve **40** is in the locking position. When in this position, the piston sleeve **40** locks the threads **30***a* of the latch dogs **30** in engagement with the threads **10***e* of the tubular member **10** for connecting the tubular member **10** and the tubular member **20.** The inner surface **40***a* of the piston sleeve **40** includes a plurality of correspondingly spaced annular recesses **40***b* formed therein adapted to receive the annular collars **30***c* of the latch dogs **30** therein when the piston sleeve **40** moves to the release position which enables the latch dogs **30** to move outwardly for releasing the engagement of the threads **10***e* and **30***a*. The piston **40** carries an O-ring **40***c* to slideably seal between the piston sleeve **40** and the sleeve **24** adjacent the lower end of the piston sleeve **40** to block leakage of fluid therebetween. The sleeve **24** carries an O-ring **24***j* for slideably sealing with the piston sleeve **40** to prevent leakage of fluid therebetween above the recesses **40***b*.

As illustrated in FIG. **1,** the piston sleeve **40** has an upwardly facing annular shoulder **40***d* engaging a downwardly facing annular shoulder **25***a* of the cap ring **25** to provide a movement stop when the piston sleeve **40** is in the locking position. The surface **40***a* of the piston sleeve **40** has an inwardly projecting annular collar **40***e* formed thereon having a downwardly facing annular shoulder **40***f* and an upwardly facing annular shoulder **40***g*. The collar **40**e mounts an O-ring **40***h* thereon for slideably sealing the collar **40***e* with the sleeve **24** to prevent leakage of fluid therebetween.

The sleeve **24** has an annular shoulder **24***k* formed thereon above the collar **40***e* for receiving a ring stop member **41** between the sleeve **22** and the piston sleeve **40.** The engagement of the stop ring **41** with the annular shoulder **24***k* blocks downwardly movement of the stop ring **41** relative to the inner sleeve **24** and the ring stop member **41** is fluted at the outer portion **41***a* where it engages the piston sleeve **40** to enable communication of the fluid pressure across the member **41.** As illustrated, a gapped radially expansible detent ring **42** having a tapered upper surface **42***a* is positioned immediately above the ring **41** and an annular recess **40***i* having a tapered upper portion **40***j* corresponding to the tapered surface **42***a* is formed in the surface **40***a* of the sleeve **40.**

The detent ring **42** engages the tapered portion **40***j* to block or resist inadvertent downwardly movement of the piston sleeve **40** from the locked position to the release position. When the predetermined pressure for operating the piston sleeve **40** is applied, the tapered portion **40***j* will cam or wedge the detent ring **42** from the recess **40***i* to enable the piston sleeve **40** to move to the release position. A latch ring **43** is positioned between the piston sleeve **40** and the tubular member **24** above the stop ring **41** and carries a pair of O-rings **43***a* and **43***b* for slideably sealing the longitudinally moveable latch ring **43** with the piston sleeve **40** and the sleeve **24,** respectively. The latch ring **43** includes an upwardly facing pressure responsive annular shoulder surface **43***c* and a downwardly facing pressure respon-

sive shoulder surface 43*d* with the pressure responsive surface 43*c* communicating with the pressure adjacent the exterior surface 22*f* of the outer sleeve 22 through the port 22*e*. The latch ring 43 moves in response to the differential pressure urgings thereon between a lower position (FIG. 1A) and an upper position (FIG. 3A). The pressure responsive surface 43*d* has a ring-shaped extension 43*e* extending downwardly therefrom which fits within the detent ring 42 when the detent ring 42 expands into the recess 40*i* to block inadvertent movement of the detent ring 42 from the recess 40*i*. The extension 43*c* has a flow port 43*f* formed therethrough to enable communication of fluid pressure to the pressure responsive surface 43*d*.

The latch ring 43 includes an annular recess 43*g* formed adjacent the cap ring 25 which aligns with a gapped radial expansible snap ring 44 carried on the surface 22*a* of the sleeve 22 chich contracts into the recessed 43*f* when aligned therewith. The recess 43*g* and the snap ring 44 are provided with square shoulders in order that the snap ring 44 will not be wedged out of the recess 43*f* to free the latch ring. By securing the latch ring 43 in the upper position in this manner, the latch ring 43 will not drop down to re-lock the detent ring 42 in the recess 40*i* with the downwardly extending extension 43*e* or otherwise interfere with the release of the safety joint S. The operation of the detent ring 42 and the snap ring 44 block inadvertent release and insure positive release of the safety joint S, respectively.

The piston sleeve 40, the sleeve 22 and the tubular member 10 are also secured together by a threaded shear pin 50 to block inadvertent or undesired separation of the safety joint S.

The concentric spaced relationship of the piston sleeve 40 and the sleeve 22 adjacent the collar 40*e* forms a first annular expansible chamber 60 between the seals effected by the O-rings 40*h* and 24*j* below the downwardly facing annular shoulder 40*f*. The piston sleeve 40 and the sleeve 22 also form an expansible annular chamber 61 in the space therebetween sealed by the O-rings 40*h*, 43*a* and 43*b* above the upwardly facing annular shoulder 40*d* of the piston sleeve 40. Fluid pressure in the chamber 60 will urge on the pressure responsive surface 40*f* to urge movement of the piston means 40 upwardly to the locking position with the shoulder 40*d* in engagement with the cap ring 28. The pressure of the fluid in the annular expansible chamber 61 urges on the pressure responsive surface 40*g* to urge downwardly movement of the piston 40 to the release position and on the surface 43d of the latch 43 to urge movement of the latch 43 to the upper position. The inner sleeve 24 has a pair of flow ports, 24*m* and 24*n* formed therethrough for communicating the pressure in the bore 20*a* into the chambers 60 and 61 respectively. By having the pressure responsive surfaces 40*f* and 40*g* of the piston 40 of the same effective surface area, the piston will have offsetting pressure urging thereon in normal operation and will remain in the locked position until it is desired to apply the predetermined pressure for effecting movement of the piston sleeve 40 to the release position. One skilled in the art may vary the relative size of these areas without departing from the spirit of the present invention. The ports 24*m* and 24*n* are spaced a sufficient distance to receive a bridge plug means B therebetween for communicating a predetermined pressure through the flow port 24*n* while blocking its communication through the flow port 24*m*.

As illustrated in FIG. 3A, the bridge plug means B includes a tubular plug assembly 70 which is properly dimensioned to move freely through the bore X of the well conduit C and the bore 20*a* in the tubular member 20. The tubular assembly 70 has a downwardly facing annular tapered lower seating surface 70*a* which engages the upwardly facing annular shoulder 24*f* of the collar 24*e* to operably position the tubular unit 70 in the bore 20*a*. The tubular assembly 70 mounts a set of chevron packing 70*c* to effect a seal with the surface 24*d* of the sleeve 24 to block leakage of fluid therebetween. When the tubular unit 70 is operably positioned by the seating shoulder 70*a*, the packing 70*c* effects the seal with the surface 24*d* between the spaced flow ports 24*m* and 24*n*. Thus, the tubular plug assembly 70 when operably positioned in the bore 20*a* enables communication of the port 24*n* with the bore 20*a* and the bore X of the conduit C above the assembly 70 while blocking communication of this area with the port 24*m*. The tubular unit 70 has a flow port 70*d* formed therein adjacent the port 24*m* for communicating the flow port 24*m* with a bore 70*e* of the tubular plug assembly 70. The flow port 70*d* enables the venting or exhausting of the expansible chamber 60 into the bore 20*a* of the tubular member 20 below the plug assembly 70 when the piston 40 moves to the release position. The tubular plug assembly 70 includes a fishing neck 70*f* moveably secured thereto to enable retrieval of the plug assembly 70 when desired by a fishing operation. The fishing neck 70*f* is normally urged by a spring 70*g* to block communication through the bore 70*e* but which moves to vent through the assembly 70 when retrieving the assembly 70 by the fishing operation as is well known in the art.

As illustrated in FIG. 4, a reconnection tool 80 provides a means for connecting the tubular member 10 with the well conduit C above the tubular member 10 after release of the safety joint S is effected. The reconnection tool 80 is provided with the standard threaded box connection (not illustrated) for connecting the tool 80 with the well conduit C above the tool 80. The reconnection tool 80 has a positioning skirt 80*a* properly dimensioned to center the tool 80 in the well to center and align the tool 80, with the threads 10*f* of the tubular member 10. Right-hand rotation of the conduit C and reconnection tool 80 will then reconnect the well conduit C by engaging right-hand threads 80*b* with the threads 10*f*. The right-hand rotation to connect is preferred in that it eliminates the possibility of a threaded well conduit C connection becoming disengaged during employment of the reconnection tool 80. The reconnection tool 80 carries an O-ring 80*c* in a recess formed therein to seal with the tubular member 10 adjacent the annular shoulder 10*d* to block leakage of fluid therebetween when the threads 80*b* and 10*f* are fully engaged. The reconnection tool 80 has a bore 80*d* therethrough aligned with the bore X of the well conduit C and the bore 10*a* of the tubular member 10 to enable production of hydrocarbons and the like therethrough.

In the use and operation of the present invention, the safety joint S is prepared for use in a well by assembling the joint S in the condition illustrated in the FIGS. 1A and 1B. The piston sleeve 40 is in the dog 30 locking position and secured therein by the detent ring 43 and

the latch ring extension **43***e* as well as by the shear pin **50.** The threaded portions **30***a* of the dogs **30** engage the threads **10***e* of the tubular member to connect the tubular members **10** and **20** of the safety joint S. The safety joint S is connected in the well conduit C at any desired location using the threaded pin **11** and box **21** connections as is well known in the art. When connected in the well conduit C, the safety joint enables the flow of hydrocarbons and the like through the bore X of the well conduit C from a producing formation to the wall head.

When it is desired to remove a portion of the well conduit C, above the safety joint S, the positive release of the safety joint S may be effected in either of two alternate ways. The preferable mode is hydraulic release in that rotation of the well conduit C above the safety joint S is not required to effect release thereby reducing the likelihood of damage to non-concentric tools connected in the well conduit C, and safety valve control lines. To effect hydraulic release, the tubular plug assembly **70** is positioned in the bore X of the well conduit C at the surface and allowed to flow, drop, fall or otherwise move down the bore X of the conduit C until it engages the seating shoulder **24***f* of the sleeve **24** with the seating shoulder **70***a* to operably position the tubular plug assembly **70** in the bore **20***a*. By connecting a pump or other pressure generating means to the bore X of the well conduit C at the surface, the pressure in the bore **20***a* above the plug may be increased to any desired predetermined value. The plug assembly **70** enables the pressure in the bore **20***a* above the plug **70** to be communicated through the port **24***n* into the annular expansible chamber **61** while blocking the communication of this pressure through the flow port **24***m* into the chamber **60.**

The predetermined pressure communicated into the chamber **61** urging on the surface **43***d* for urging the latch ring **43** to move upwardly is greater than the pressure communicated through the port **22***e* urging on the surface **43***c* for urging movement of the latch ring **43** downwardly, hence the latch ring **43** will move to the upper position. When the recess **43***f* of the latch ring is aligned with the snap ring **44,** the snap ring will contract into the recess **43***f* to maintain the latch ring **43** in the upper position. The upwardly movement of the latch ring **43** moves the detent locking extension **43***e* from within the detent ring **42** to release the detent **42.** When the recess **43***g* of the latch **43** aligns with the snap ring **44,** the snap ring **44** will contract to move into the recess **43***g* for holding the latch **43** in the upper position.

The pressure in the chamber **61** also urges downwardly on the upwardly facing pressure responsive surface **40***g* of the piston sleeve **40** for effecting movement of the piston sleeve downwardly to the release position. Since the increased pressure in the bore **20***a* above the plug assembly **70** is not urging upwardly on the pressure responsive surface **40**f for urging the position to move upwardly to the lock position, downward movement of the piston sleeve **40** to the released position will be effected by the predetermined pressure. As the piston sleeve **40** commences to move downwardly, the detent ring **42** will be wedged inwardly by the tapered edge **40***j* of the recess **40***i* to enable the piston sleeve **40** to move downwardly. The shear pin **50** will also be sheared by the initial pressure responsive movement of the piston sleeve **40.** The piston sleeve **40** will continue to move downwardly until the O-ring **40***h* no longer effects a seal with the sleeve **22** and communication between the chambers **60** and **61** is thus enabled and which results in an equalization of pressure about the plug assembly **70.** This pressure equalization effects a pressure drop monitorable at the surface to indicate to the operator that positive hydraulic release has been effected by the movement of the piston to the release position.

The movement of the piston sleeve **40** to the release position aligns the annular recesses **40***b* with the locking collars **30**c of the latch dogs **30.** When the well conduit C above the joint is manipulated by pulling upwardly, the taper of the engaged threads **30***a* and **10***e* will wedge or cam the latch dogs **30** outwardly to effect a release or separation of the upper tubular member **20** from the lower tubular member **10.**

Should the hydraulic release not operate for any reason, release of the safety joint S can still be effected by manipulating the well conduit C. By rotating the well conduit C in a right-hand direction, the left-hand engagement of the threads **30***a* and the threads **10***e* will be disengaged. The initial rotation will shear the shear pin **50** between the sleeve **22** and the tubular member **10.** While the right-hand rotation for release is preferred in that the threaded well conduit C connections will not be disengaged, the rotation of the well conduit C may damage the connected well tools and is thus employed as a back-up only when the hydraulic pressure release cannot be effected.

After separation of the safety joint S has been accomplished, the well conduit C may be connected with the upper end of the tubular member **10** by the use of the tool **80.** The tool **80** is secured to the lower end of the wall conduit C and lowered down the well until the tool **80** engages the threads **10***f* of the tubular member **10.** Right-hand rotation of the well conduit C and the reconnection tool **80** will engage the threads **80**b and **10**f for connecting the tubular member **10** with the tool **80.** Thereafter, the well may be produced through the aligned and communicating boxes X, **10***a* and **80***d* as is well known in the art.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

What is claimed is:

1. A safety joint for well conduits, including:

a. a first tubular member having a bore therethrough adapted for connection at a first end to a well conduit and having a surface with a locking recess formed therein;

b. a second tubular member having a bore therethrough adapted for connection at a first end to another section of the well conduit with said bores of said first tubular member and said second tubular member communicating therebetween;

c. lug means mounted with said second tubular member for movement relative to said second tubular member to an engaging position within said locking recess for connecting said first and said second tubular members and to a free position spaced from said locking recess enabling separation of said first and said second tubular member;

d. piston means operably connected with said lug means for movement to a locking position to retain said lug means in said locking recess and to a release position enabling said lug means to move to said free position, said piston means moving to the release position when a predetermined pressure urges thereon; and

e. means operably engaging said lug means for effecting release of said lug means from said locking recess when said first and said second tubular members are rotated relative to each other wherein the safety joint is releasable by relative rotation or the urging of a predetermined fluid pressure.

2. The apparatus as set forth in claim **1**, including:

means with said first tubular member for connecting said first tubular member with another section of the well conduit after said second tubular member is released wherein said first tubular member is connectable to a well conduit.

3. The apparatus as set forth in claim **1** wherein said means for effecting release of said lug means from said locking recess, including:

a. a helical groove formed in said first tubular member; and

b. said lug means moving along said groove when said first and said second tubular member are rotated relative to each other until said lug means moves from said locking recess wherein the safety joint is released.

4. The apparatus as set forth in claim **3**, wherein:

said helical groove effecting a left-hand engagement with said lug means wherein relative right-hand rotation between said first and said second tubular members releases the safety joint.

5. The apparatus as set forth in claim **1**, wherein:

said piston means having first pressure responsive surface and second pressure responsive surface, said piston means moving to the locking position in response to the pressure urging on said first pressure responsive surface and moving to the released position in response to the pressure urging on said second pressure responsive surface.

6. The apparatus as set forth in claim **5**, wherein:

said first pressure responsive surface and said second pressure responsive surfaces have the same pressure urging thereon to block movement of said piston means until the predetermined pressure urges movement of the piston means to the release position.

7. The apparatus as set forth in claim **5**, wherein:

a. said piston means is a sleeve concentrically mounted about said second tubular member and forming a first expansible chamber and a second expansible chamber therebetween;

b. said first pressure responsive surface forming a portion of said first expansible chamber for urging movement of said piston sleeve to the locking position in response to the pressure in said first chamber; and

c. said second pressure responsive surface forming a portion of said second expansible chamber for urging movement of said piston sleeve to the released position in response to the pressure in said second chamber wherein the piston moves to release the safety joint when the predetermined pressure is communicated into said second chamber.

8. The apparatus as set forth in claim **7**, wherein:

a. said second tubular member having a first flow port and a second flow port formed therethrough in spaced relationship to receive a bridge plug therebetween;

b. said first flow port communicating said first expansible chamber with said bore of said second tubular member;

c. said second flow port communicating said second expansible chamber with said bore of said second tubular member; and

d. bridge plug means positioned in said bore of said second tubular member for communicating the presetermined pressure in said bore of said second tubular member through said second flow port while blocking communication of the predetermined pressure through said first flow port wherein the predetermined pressure urges on said second pressure responsive surface to release the safety joint.

9. The apparatus as set forth in claim **1**, wherein:

movement of said piston means to the released position vents said predetermined pressure to indicate that positive release has been effected.

10. The apparatus as set forth in claim **1**, wherein said lug means includes:

a plurality of moveable dogs mounted with said second tubular member for movement to and from the engaging and free positions wherein said dogs engage said recess at a plurality of locations.

11. A method of alternately effecting release of subsurface safety joint having first and second tubular members for connecting portions of a well conduit for removing a portion of the well conduit from the well, including the steps of:

lowering a bridge plug down the well conduit to a location within the safety joint;

increasing the pressure in the well conduit above the bridge plug to a predetermined pressure for urging one of the tubular members to move relative to the other tubular member to effect release of the safety joint in response to the predetermined pressure; and

rotating one of the tubular members of the safety joint relative to the other tubular member to selectively effect release of the safety joint when the urging of the predetermined pressure fails to effect release of the safety joint wherein the safety joint is released by rotation when the pressure urging fails to effect release.

12. The method as set forth in claim **11**, wherein the step of rotating includes:

rotating one of the tubular members in right-hand direction to selectively effect release of the safety joint when the urging of the predetermined pressure fails to effect release of the safety joint.

* * * * *