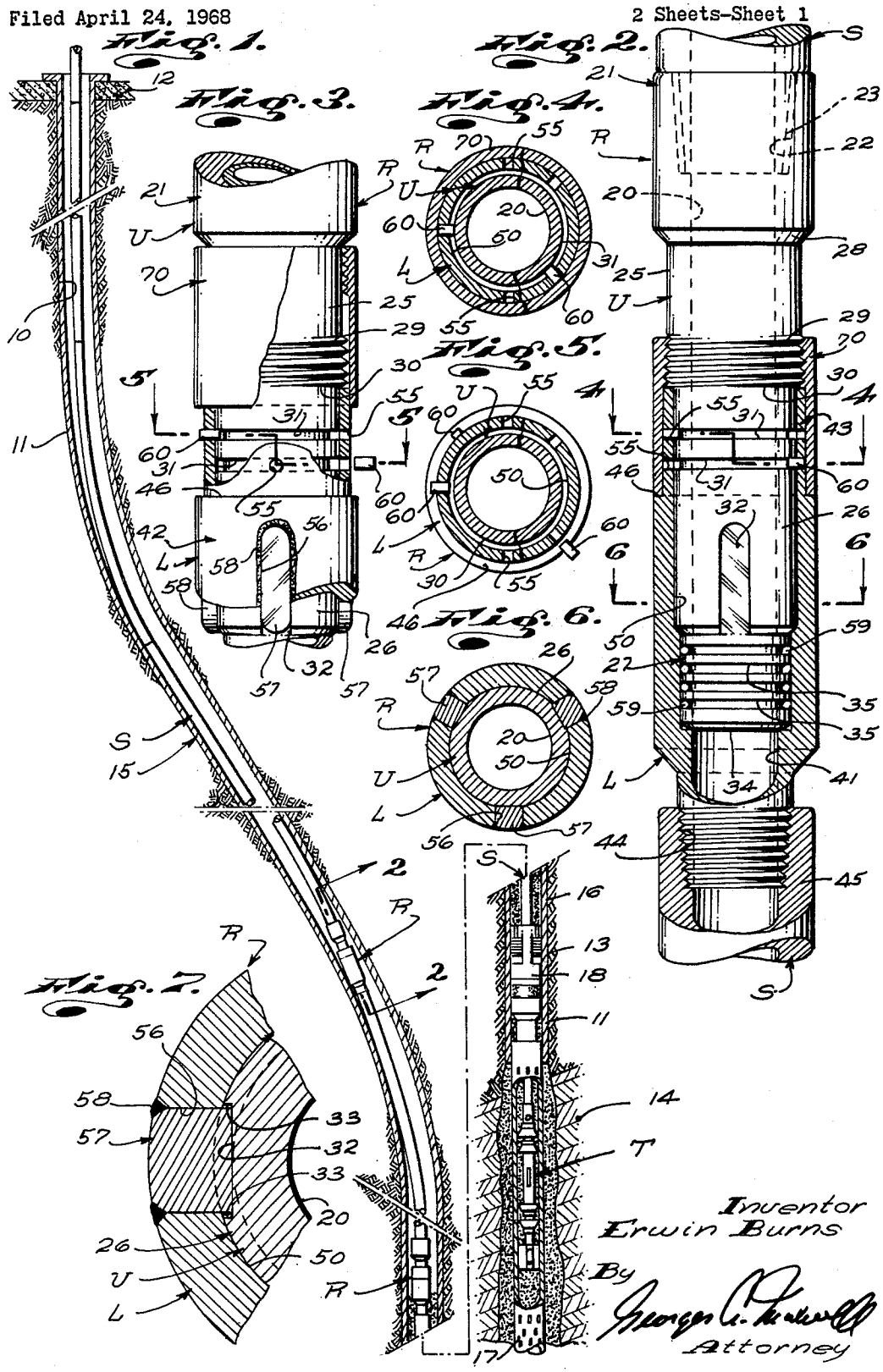
March 24, 1970 E. BURNS 3,502,353

RELEASING COLLAR

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RELEASING COLLAR

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Fig. 8.

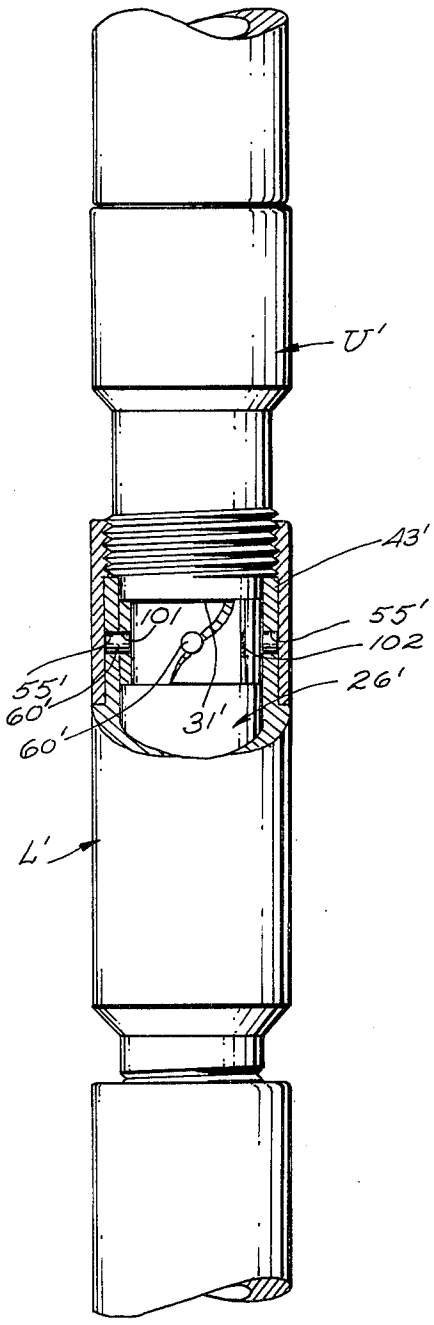
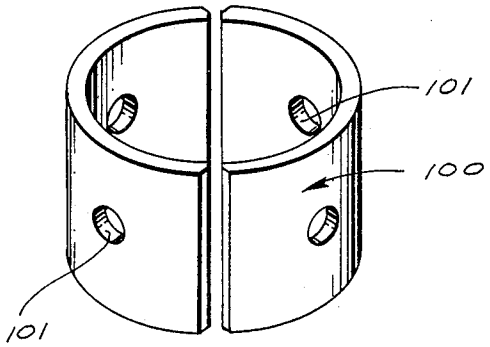


Fig. 9.



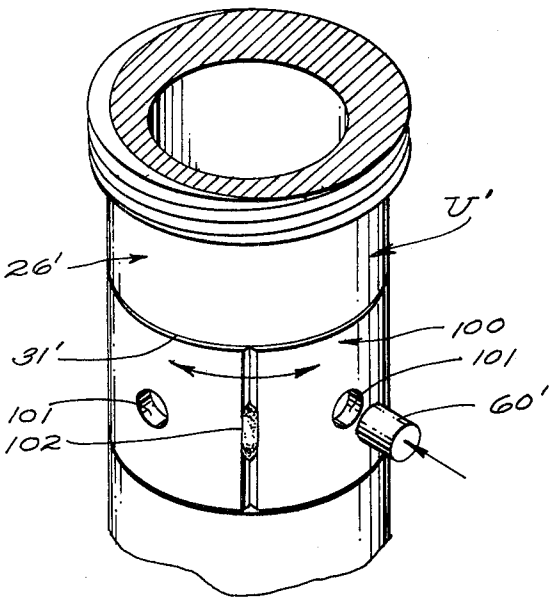


Fig. 10.

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3,502,353

RELEASING COLLAR

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Int. Cl. F16l 35/00
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ABSTRACT OF THE DISCLOSURE

An elongate substantially vertical fluid conducting rotary tubing string for use in oil wells comprising, a plurality of axially aligned, interconnected steel tubing sections of substantially uniform weight and tensile strength, said string being of predetermined length and weight and subjected to varying predetermined deadweight tensile forces which increase uniformly downwardly throughout the longitudinal extent of the string, an elongate, fluid conducting releasing collar with separable upper and lower sections and set releasing means therebetween engaged in the string a predetermined distance below the upper end thereof with its upper and lower sections connected with the opposing lower and upper ends of a predetermined pair of adjacent tubing sections, said set releasing means being set to release the sections of the collar before the cumulative forces of vertical pulling forces applied to the upper end of the string, the deadweight of the portion of the string below the collar and a predetermined maximum of supplemental frictional and holding forces acting on and through the portion of the string below the collar exceeds the tensile limits of the portion of the string above the collar, said upper and lower sections being telescopically engaged for free relative axial shifting, said holding means including one or more shear pins engaged in and extending between the upper and lower sections, said collar further including drive means to prevent relative rotation between the sections and sealing means to prevent the leakage of fluid within the collar outwardly between the sections.

This invention has to do with a novel well tool and is more particularly concerned with a tubing safety joint or releasing collar, the purpose of which is to effect breaking or separation of a string of run-in tubing, in a well structure, at a predetermined point and by the application of predetermined tensile forces in and through the tubing string.

In modern oil well drilling practices, it is common to direct the course of a well laterally and downwardly relative to the surface site of the well. Such directional drilling results in a well bore which is normal or vertical at its upper end and which turns laterally in a single parabolic curve so that the lower end is downwardly and laterally inclined, or results in a well bore normal at its upper end and which turns laterally outwardly and then downwardly again in a compound curve with its lower end substantially vertical, but radially offset from its upper end.

As a result of the above-noted irregular and oftentimes tortuous courses in which oil wells are established, the strings of tubing and the like which must be run into the wells in the course of completion, production and service, do not hang or depend freely in and through the wells, but lay and bear against the sides of the well bores and

are bound or urged into pressure bearing engagement with the bores of the wells when compressive or tensional forces are applied thereto for the purpose of running such strings into or pulling them from their related wells.

The above-noted bearing and binding contact of tubing strings in directionally drilled wells frequently creates drag and frictional resistance on and through the tubing strings which is excessive and which is such that slight, ordinarily acceptable and anticipated binding, packing or freezing of well tools or apparatus on the lower ends of such strings, in the bottoms of the wells, create cumulative frictional and holding forces which exceed the tensile strength of the tubing strings. When such conditions are established and attempts are made to pull such strings from their related wells, the tubing strings break or part. Such breaking or parting of such strings under the above-noted conditions, seldom occurs at or in close proximity to the tools at the lower ends thereof, but normally occurs a substantial distance above the tools and oftentimes several thousands of feet above such tools. After breaking or parting of a tubing string, as noted, it is necessary for the drilling crew to carry out the extremely costly and time-consuming cleaning retrieving operation which consists of cutting and fishing out the left-in tubing and related tool, a piece at a time, and bailing, backscuttling, or otherwise cleaning the bore, as such cutting and fishing operations continue.

In the East Wilmington Oil Field, in the State of California, about twenty-two oil wells are being established or serviced each month. Each month in about five or six of these wells, the tubing string separates as a result of the above-noted conditions and the noted cleaning and retrieving or fishing operations must be performed thereon. The costs of correcting each such failure varies, as a general rule, between $5,000.00 and $30,000.00, with an estimated total cost of approximately $100,000.00 each month in this single oil field.

An object of my invention is to provide a novel releasing collar adapted to be engaged between predetermined sections or stands of tubing making up a run-in string of tubing, which is such that it will break, separate or part when predetermined tensile forces are exerted through the tubing string and said collar whereby the point of separation of the tubing string in the well can be predetermined and controlled so as to make cleaning and retrieving of tubing and equipment left in the well, easier, quicker and less costly than present practices afford.

Another object of my invention is to provide a releasing collar of the character referred to which is such that it can safely and effectively handle all hydraulic pressures to be encountered without failure or leaking and a structure which is such that it will hold and withstand all normal and anticipated torsional forces to be encountered without twisting, turning or otherwise failing.

Still another object of the present invention is to provide a releasing collar of the character referred to which is such that the axial forces required to cause separation of its relatively separable parts and/or portions can be easily and quickly varied, as circumstances required and without requiring extensive, costly and time-consuming overhauling and/or modification of the construction.

It is an object of my invention to provide a novel well servicing appartus, including an elongate run-in string

made up of a plurality of stands of tubing and engageable in a well to extend from the upper end thereof to the lower end thereof, a well servicing tool at the lower end of the run-in string and one or more releasing collars as provided by this invention between predetermined stands of tubing and adapted to separate and effect parting of the run-in string at predetermined points along its longitudinal extent when the run-in string is subjected to predetermined maximum tensile forces.

An object of the invention is to provide a novel run-in string of tubing for well servicing tools including a plurality of axially aligned, interconnected stands of tubing and one or more collars as provided by this invention engaged between predetermined adjacent tubing stands.

The foregoing and additional objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of my invention, throughout which description reference is made to the accompaying drawings, in which:

FIG. 1 is a view of a well structure with a run-in string of tubing engaged therein and having a well servicing tool carried thereby and having my new releasing collars engaged therein;

FIG. 2 is an enlarged detailed sectional view taken as indicated by line **2—2** on FIG. 1;

FIG. 3 is a view similar to a portion of FIG. 2 and showing parts in another position;

FIG. 4 is a sectional view taken as indicated by line **4—4** on FIG. 2;

FIG. 5 is a sectional view taken as indicated by line **5—5** on FIG. 3;

FIG. 6 is a sectional view taken as indicated by line **6—6** on FIG. 2;

FIG. 7 is an enlarged view of a portion of the structure shown in FIG. 6;

FIG. 8 is an elevational view of another form of the invention, with portions broken away to illustrate details of the construction;

FIG. 9 is an isometric view of parts provided in the construction illustrated in FIG. 8; and,

FIG. 10 is an isometric view showing a subassembly of the construction shown in FIG. 8.

In FIG. 1 of the drawings, I illustrate typical well structure W and show a run-in tubing string S engaged therein and carrying a suitable well servicing tool T at its lower end. The string of tubing S is shown provided with two releasing collars R as provided by my invention.

The well structure W illustrated in the drawings is a typical directionally drilled well structure and includes a bore **10** having a straight, vertical upper end portion **11** entering the surface **12** of the earth's formation, a straight, vertical lower end portion **13** extending into an oil producing formation **14** below the earth's surface **12** and on a vertical axis laterally offset from the upper portion **11** and a downwardly and laterally and, thence, laterally and downwardly compound curved central portion **15** between the upper and lower portions **11** and **13**. The well bore is provided with and supported by a casing **16**, which casing extends from the top of the bore into the lower portion **13** thereof and is shown terminating adjacent the top of the production formation **14**. In the case illustrated, the lower end portion of the bore, below the casing and within the formation **14**, is provided with a perforated liner **17** suspended from the lower end of the casing by a liner hanger and packer assembly or tool **18**.

The run-in string S is made of a plurality of elongate lengths or stands of fluid conducting tubing arranged and connected in end-to-end relationship. The tubing string is considerably less in diametric extent than the inside diameter of the casing and the string is greater in longitudinal extent than the casing. The run-in string S enters the top of the well casing and extends downwardly and longitudinally therethrough and is provided at its lower end with a servicing tool T. In the case illustrated, the tool T is a gravel packing tool and is employed to distribute and deposit gravel pumped and circulated downwardly through the string S, into the perforated liner **17** and, thence, into the portion of the well bore in the formation **14** about the liner. The gravel pack is indicated by stippling in FIG. 1 of the drawings.

When gravel packing a well structure with the means illustrated in the drawings and described above, it is not infrequent that the gravel, as illustrated, migrates back up and into the casing and becomes so compacted and lodged in the liner and the casing, about the tool and the lower end of the string S, as to freeze and hold the tool and the lower end of the string S in the well structure with such force as will prevent the withdrawal of the string and tool without breaking and parting the run-in string, some place along its longitudinal extent.

More particularly, the holding force of the compacted gravel on and about the tool and string, while not excessive in itself, is cumulative with the deadweight force of the string itself and with the frictional or dragging forces occurring between the string S and the casing, and the cumulative forces are greater and exceed the tensile limits of the tubing making up the string. As a result of the above, it will be apparent that when in a situation such as illustrated and described develops, the tubing string usually parts in the upper portion of the well structure where the cumulative forces are the greatest.

With present practices, when the string S parts or breaks in the manner set forth above, it is necessary that the portion of the string S and the tool T, left in the well, be removed. Such removal is carried out by disassembly of the string S, a stand at a time, where possible, or cutting the string up, and fishing out or retrieving the stands or cutup sections of tubing from the well. When such retrieving operation reaches that zone in the well where the gravel is packed and is holding the string and tool, the retrieving operation requires bailing or circulating the undesired and trouble-causing gravel out of the well and becomes more complicated and costly.

It is well-known to those skilled in the art and will be readily apparent to those with limited knowledge in the art, that a retrieving or fishing operation such as referred to above is extremely costly and troublesome.

It is to be understood that the particular gravel packing operation referred to above, is only illustrative of one well servicing operation in which tools and related tubing strings can and do become stuck or frozen in wells and which results in breaking and separating of tubing strings and requires fishing or retrieving operations similar to that operation referred to above.

A major difficulty or problem encountered in the well drilling and servicing art, where the above-noted type of adverse situation develops, is: it cannot be readily determined or controlled at which point a run-in string will break or part. Under present practices, when a tool becomes stuck in a well, the driller simply pulls on the run-in string until it parts and in doing so hopes that it will part in its lowermost portion. As noted above, due to the cumulative nature of the forces coming into play, such hopes or wishes of a driller are seldom granted.

In light of the above, it has been determined that by provision of a suitable and proper releasing means, in the lower end portion of a run-in string, parting of the string at the lower end portion thereof, when that portion of the string and a related tool become stuck or frozen in a well, can be assured and that undesired breaking and parting of the string a substantial distance above the bottom of the well can be prevented.

By providing such a releasing means, the necessity of fishing or retrieving is not eliminated, but is effectively controlled and the possible extent of such operations is maintained at predetermined minimal and tolerable levels.

The releasing collar R that I provide and which is illustrated throughout the drawings is adapted to be engaged in a run-in string S, between adjacent tubing stands to become a part thereof. The collar R is such that it allows for free uninterrupted flow of fluid through the string, allows for normal turning of the string and withstands those torsional forces to be encountered. Further, it is such that it will withstand limited predetermined tensile forces in and through the string and will yield and allow for separation or parting of the string when said tensile forces are exceeded.

The collar R is shown as including an upper male section U and a lower female section L. The upper male section U is an elongate vertically extending cylindrical part having a central longitudinal flow passage **20** equal in diametric extent with the flow passage in the tubing stands making up the string S; an upper box portion **21**, a central internally threaded upwardly opening box **22** in said box portion threadedly receiving a pin **23** on the lower end of that stand of tubing **24** related to the upper end of the collar, upper and lower central portions **25** and **26** and a lower portion **27**. The upper central portion **24** is less in diametric extent than the upper box portion **21** and cooperates therewith to define an annular stop shoulder **28**, which shoulder is shown as being downwardly and inwardly inclined.

The portion **24** is of substantial longitudinal extent and is provided with threads **29** about its lower end portion. The threads **29** project radially outward from their related portion of the section U, that is, the minor diameter of the threads **29** is equal or greater than the outside diameter of the portion **25** of the section U.

The lower central portion **26** of the section U is less in diametric extent than the upper central portion **25** and joins the lower externally threaded end portion of the portion **25** to define a downwardly disposed annular stop shoulder **30**. The portion **26** is of considerable longitudinal extent and is provided, in its upper portion with at least one and preferably two or more axially spaced radially outwardly opening shear pin receiving grooves **31**.

The lower portion of the lower central portion **26** of the section U is provided with a plurality (three) of circumferentially spaced, elongate, longitudinally extending, radially outwardly disposed flats **32**, which flats form a part of a modified spline construction for establishing torsional drive means between the sections U and L.

In practice, the flats **32** can extend laterally uninterrupted to converge with the outer cylindrical surface of the portion **26** of the section U or can, as illustrated in FIG. 7 of the drawings, be in the nature of very shallow and very wide longitudinally extending flat bottomed grooves in the exterior of the section U, and such that they define, in addition to the outwardly disposed flats **32**, laterally spaced, laterally inwardly disposed opposing shoulders **33**, at each side of the flats. The lower end portion **27** of the section U is less in diametric extent than the lower central portion **26** and continues or extends downwardly therefrom. The portion **27** is of reduced diameter to facilitate establishment of the flats **32** and is such that the plane of the flats are substantially tangential with the exterior of said portion **27**. The portion **27** terminates at a flat downwardly disposed bottom end **34** and is provided with a plurality of axially spaced, radially outwardly opening sealing ring receiving grooves **35** throughout its longitudinal extent.

From the foregoing, it will be apparent that the upper section of my collar R is an extremely simple, easy and economical to manufacture part and is such that it lends itself to being made extremely rugged and durable.

The lower female section L of my collar R is an elongate, cylindrical, vertically extending part having a lower

pin portion **40** with a central longitudinal flow passage **41**, a central portion **42** and an upper portion **43**.

The lower pin portion **40** is externally threaded and is adapted to be engaged in an internally threaded box **44** in the upper end of a related tool or stand of drill pipe **45** occurring below the collar R.

The flow passage **41** is the same in diametric extent as the flow passage **20** in the upper section U.

The central portion **42** corresponds in outside diameter with the box portion **21** of the section U and is of considerable longitudinal extent.

The upper portion **43** is less in diametric extent than the central portion **42** and is equal or slightly greater in diametric extent than the major diameter of the threads **29** on the upper central portion **25** of the section U. The portion **43** defines an annular, upwardly disposed stop shoulder **46**. The upper end portion **43** defines a flat, axially upwardly disposed upper end **47** on the section L.

The section L is provided with a first, enlarged, upper bore **50** corresponding in diameter and in longitudinal extent with and slidably receives the lower central portion **26** of the upper section U, and a lower, secondary bore **51** continuing downwardly from the upper primary bore **50** corresponding in diametric and longitudinal extent with and slidably receiving the portion **27** of the section U.

The upper portion **43** of the section L is slightly greater in longitudinal extent than that portion of the lower central portion **26** of the section U in which the shear pin grooves **31** occur and normally overlies the shear pin grooves. The portion **43** is provided with a number of axially spaced, annular rows of circumferentially spaced, axially extending shear pin-receiving openings **55**, equal in number with the number of grooves **31** in the section U and in common radial planes with the grooves **31** so that the inner ends of the openings **55** are in register and communicate with the grooves **31**.

The openings **55** of each row of openings are circumferentially offset from the openings in the other row or rows of openings **55** so that the several openings **55** of the several rows of openings are circumferentially offset from each other and none of said openings are in vertical alignment with respect to the longitudinal axis of the construction.

The upper portion of the central portion **42** of the section L is provided with a plurality (three) of elongate, longitudinally extending, radially inwardly and outwardly opening slots **56** corresponding in circumferential placement and longitudinal extent with the flats **32** on the lower central portion **26** of the section U and in which elongate flat engaging keys or blocks **57** are arranged and fixed.

The blocks **57** are equal or slightly less in lateral extent than the flats **32** and have flat, radially inwardly disposed bearing surfaces **58** which establish flat, sliding bearing engagement on related flats **32** of the section U, when the construction is assembled and as clearly illustrated in the drawings.

The blocks **57** are fixed in the openings **56** by welding **58**.

In addition to the foregoing, the construction we provide includes sealing rings, such as O-rings, **59** engaged in the ring grooves **35** in the section U to normally seal in the lower bore of the section L; shear pins **60** in all or a predetermined number less than all of the openings **55** in the section L and entering the grooves **31** in the section U, and a shear pin retaining sleeve **70** carried by the section U and engaging the section L and the pins **60** carried thereby.

The shear pins **60** are simple, cylindrical, elongate metal shear pins corresponding in diametric extent with the diameter of the openings **55** and the lateral extent of the grooves **31** and corresponding in longitudinal extent with the combined longitudinal extent of the openings **55** and depth of the grooves **31**. The pins **60** are

slidably engaged in and through the openings, from the exterior of the section L and into engagement in the grooves **31**.

The retaining sleeve **70** is an elongate sleeve corresponding in longitudinal extent with the upper central portion **25** of the section U and corresponds in inside diametric extent with the outside diameter of the upper portion **43** of the section L. The sleeve is provided with internal threads **71** in its lower portion to cooperatively engage the threads **29** on the section U.

With the structure and the relationship of parts thus provided, it will be apparent that the sleeve **70** can be shifted from a normal down position where it overlies the upper portion **42** of the section L and holds the shear pins captive in the openings **55** and grooves **31**, to an up position, as shown in FIG. 3 of the drawings where the openings **55** and pins **60** are uncovered and accessible so as to facilitate easy and convenient engagement of the pins **60** in the construction.

When the sleeve **70** is in its normal or down position, it is held and retained in that position adjacent the shoulder **46** by the threads **29–71**.

It is to be noted that the seal established between the sections U and L by the sealing rings **59** and which prevents leakage of drilling fluid from within the structure (in the passable fluid course between the sections) occurs downstream of the slots **56** in which the blocks **57** are arranged, downstream of the shear pin openings **55** and downstream of the sleeve **70**. Accordingly, each and all of the parts and portions of the construction which might be adversely affected by the presence of drilling fluid or the fluid pressures within the construction, are downstream from the sealing means between the sections and are unaffected thereby.

It is to be further noted that, rather than providing a single shear pin, I provide a multiplicity of shear pin receiving openings of a common size and in which any desired number of shear pins can be engaged. With such a combination and relationship of parts, the tensile holding force afforded by the collar can be varied as circumstances require without modifying the construction or without having to maintain a supply of shear pins of different strength, which would be required if a single shear pin construction was provided and the holding strength of the construction had to be changed.

Another very important feature found in the provision of a multiplicity of shear pins resides in the fact that the shearing forces are divided up and distributed about the tool at a multiplicity of different points and are not sufficient at any one point to cause collapsing, tearing or scarring of the collar sections, as would be the case in a single shear pin construction.

Circumferential spacing of the shear pin opening in each annular row of openings from the openings in adjacent rows of openings further enhances the above-noted features of dividing and distribution of forces.

In operation, the structure R is assembled and arranged in the string of tubing S in the manner illustrated in FIG. 2 of the drawings.

When and if excessive tension is applied to the string, the upper section U shifts upwardly relative to the lower section L, shearing the pins **60** and allowing for free axial separation of the sections and the portion of the string S occurring above and below the collar.

Following such release of the collar, the upper section U, with its directly related portion of the string S, is removed or pulled from the well in a conventional manner and the lower section L and its directly related portion of the string S and/or tool can be freed for easy removal by backscuttling, bailing or otherwise removing the gravel, or the like, which freezes or holds it in the well and then pulling it from the well. If necessary, the portion of the string left in the well can be cut up and fished from the well.

In either event, the location of the break and the amount of tubing left in the well is predetermined and so that the extent of the retrieving and/or fishing operation, which must be performed, is predetermined and maintained to tolerable and economically feasible levels.

In FIGS. 8, 9 and 10 of the drawings, I illustrate a modified form of the invention, wherein a captive ring **100** with circumferentially spaced shear pin receiving openings **101** is engaged in the groove **31'** in the upper part of the lower central portion **26'** of the upper section U'. The ring **100** is rotatably engaged in the groove **31'** and the openings **101** therein are spaced axially and circumferentially spaced to register with the shear pin opening **55** in the upper portion **43'** of the section L'.

In practice, the ring **100** is made up of two semi-circular half sections, as shown in FIG. 9. The half sections are arranged in the groove **31'** and are suitably welded together, as at **102**.

With the above structure, it will be apparent that the ring **100** is held captive in the groove **31'** and is slidable therein for rotative movement relative to the upper section U'.

The openings **55'** in the section L' and the openings **101** in the ring **100** secure their related ends of the shear pins **60** snugly.

With the above construction, the radial inner end portions, as well as the radial outer end portions of the shear pins **60'** are held captive and in such a manner that they are not permitted or allowed to distort, cold flow and prematurely tear when subjected to major, but less than yielding shearing forces.

In the first form the invention, the inner end portions of the pins **60** are not held captive about their circumferential opposite sides in the grooves **31** and are free to cold flow, distort and tear in such a manner as to become weakened, if and when they are subjected to major, but less than designed yielding shearing forces.

The ring **100** in the modified form of the invention can be provided with any desired number of openings **101**, which openings can be spaced axially and circumferentially of the rings in any predetermined pattern and to cooperate with the pattern of opening **55'** in the section L'.

The modified form of my invention illustrated and described above is the most desirable and preferred form and carrying out of the invention.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any modifications and/or variations thereof that may appear to those skilled in the art.

Having described my invention, I claim:

1. A releasing collar engageable with and between upper and lower, adjacent, axially aligned stands of tubing in a fluid conducting tubing string including, an elongate, cylindrical, vertically extending, upper section with a central, longitudinal flow passage, upper connecting means at its upper end to connect with the upper stand of tubing, threads about the exterior of the section and spaced above the lower end thereof, an annular, radially outwardly opening channel spaced below the threads, a plurality of circumferentially spaced, elongate, axially extending, radially outwardly facing flats below the channel and annular, radially outwardly disposed sealing means about the exterior of the said upper section below said flats, an elongate cylindrical, vertically extending lower section with a central longitudinal flow passage, lower connecting means at its lower end to connect with the lower stand of tubing, a central bore slidably receiving the lower portion of the upper section and cooperatively engaged by said sealing means, a plurality of circumferentially spaced blocks with flat, radially inwardly disposed bearing faces carried by the lower section and normally establishing flat, sliding bearing engagement on the flats, circumferentially spaced, radially extending shear pin openings in said lower section about the blocks and in a common radial plane with said

channel, elongate radially extending shear pins engaged in the shear pin openings and extending radially inwardly into the channel and a retaining sleeve engaged with the threads on the upper section to be carried thereby and engaged about the lower section to overlie said openings and stop radial outward shifting of said shear pins.

2. A structure as set forth in claim 1 wherein the lower end portion of the upper section which carries the sealing means is less in diameter than the portion thereof in which said flats are established and the planes of said flats are substantially tangential with the outer periphery of said lower end portion, said bore having upper and lower portions, said lower portion corresponding in axial and diametric extent with the lower portion of the lower end portion of the upper section and said upper portion corresponding in diametric extent with the upper portion of the bore.

3. A structure as set forth in claim 1 wherein the lower end portion of the upper section which carries the sealing means is less in diameter than the portion thereof in which said flats are established and the planes of said flats are substantially tangential with the outer periphery of said lower end portion, said bore having upper and lower portions, said lower portion corresponding in axial and diametric extent with the lower portion of the lower end portion of the upper section and said upper portion corresponding in diametric extent with the upper portion of the bore, said blocks being engaged in radial slots in the lower section to engage the flats and fixed in said slots by welding.

4. A structure as set forth in claim 1 wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion.

5. A structure as set forth in claim 1 wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion, said flats occurring on planes substantially tangential with the periphery of the lower end portion of the upper section whereby the lower end portion of the upper section can move freely by the blocks upon axial shifting of the sections.

6. A structure as set forth in claim 1 which includes radially outwardly opening channels in the upper section in axial spaced relationship with the first-mentioned channel and said lower section includes annular rows of circumferentially spaced radial openings in common planes with the channels, the openings in each row of openings being circumferentially offset from the openings in the other rows of openings, and shear pins engaged in selected openings in the rows of openings, said shear pins being of uniform shear and establishing uniform sliding bearing engagement in the holes and in the channels whereby the holding force afforded by the several pins is cumulative.

7. A structure as set forth in claim 1 wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the ouside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion, said structure having radially outwardly opening channels in the upper section in axial spaced relationship with the first-mentioned channel and said lower section including annular rows of circumferentially spaced radial openings in a common plane with the channels, the openings in each row of openings being circumferentially offset from the openings in the other rows of openings, and shear pins engaged in selected openings in the rows of openings, said shear pins being of uniform shear and establishing uniform sliding bearing engagement in the holes and in the channels whereby the holding force afforded by the several pins is cumulative.

8. A structure as set forth in claim 1 wherein, said sealing means includes a plurality of axially spaced, radially outwardly opening grooves in the upper section and sealing rings engaged and sealing in the grooves and engaging and sealing in the bore.

9. A structure as set forth in claim 1 wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in

longitudinal extent with the upper intermediate portion, said structure having radially outwardly opening channels in the upper section in axial spaced relationship with the first-mentioned channel and said lower section including an annular row of circumferentially spaced radial openings in a common plane with each channel, the openings in each row of openings being circumferentially offset from the openings in the other rows of openings, and shear pins engaged in selected openings in the rows of openings, said shear pins being of uniform shear and establishing uniform sliding bearing engagement in the holes and in the channels whereby the holding force afforded by the several pins is cumulative, said sealing means including a plurality of axially spaced, radially outwardly opening grooves in the upper section and sealing rings engaged and sealing in the grooves and engaging and sealing in the bore.

10. A structure as set forth in claim **1** wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are establishing and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion, said flats occurring on planes tangential or spaced radially outward of the periphery of the lower end portion of the upper section whereby the lower end portion of the upper section can move freely by the blocks upon axial shifting of the section, said blocks being engaged in radial slots in the lower section to engage the flats and fixed in said slots by welding, said structure having radially outwardly opening channels in the upper section in axial spaced relationship with the first-mentioned channel and said lower section including annular rows of circumferentially spaced radial openings in common planes with the channels, the openings in each row of openings being circumferentially offset from the openings in the other rows of openings, and shear pins engaged in selected openings in the rows of openings, said shear pins being of uniform shear and establishing uniform sliding bearing engagement in the holes and in the channels whereby the holding force afforded by the several pins is cumulative, said sealing means including a plurality of axially spaced, radially outwardly openings grooves in the upper section and sealing rings engaged and sealing in the grooves and engaging and sealing in the bore.

11. A structure as set forth in claim **1** which includes an annular captive ring engaged in said channel for relative rotation therein and having openings registered with the openings in the lower section and slidably receiving the pins.

12. A structure as set forth in claim **1** wherein the lower end portion of the upper section which carries the sealing means is less in diameter than the portion thereof in which said flats are established and the planes of said flats are substantially tangential with the outer periphery of said lower end portion, said bore having upper and lower portions, said lower portion corresponding in axial and diametric extent with the lower portion of the lower end portion of the upper section and said upper portion corresponding in diametric extent with the upper portion of the bore, an annular captive ring engaged in said channel for relative rotation therein and having openings registered with the openings in the lower section and slidably receiving the pins.

13. A structure as set forth in claim **1** wherein the lower end portion of the upper section which carries the sealing means is less in diameter than the portion thereof in which said flats are established and the planes of said flats are substantially tangential with the outer periphery of said lower end portion, said bore having upper and lower portions, said lower portion corresponding in axial and diametric extent with the lower portion of the lower end portion of the upper section and said upper portion corresponding in diametric extent with the upper portion of the bore, said blocks being engaged in radial slots in the lower section to engage the flats and fixed in said slots by welding, an annular captive ring engaged in said channel for relative rotation therein and having openings registered with the openings in the lower section and slidably receiving the pins.

14. A structure as set forth in claim **1** wherein the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion, an annular captive ring engaged in said channel for relative rotation therein and having openings registered with the openings in the lower section and slidably receiving the pins.

15. A structure as set forth in claim **1** wherein, the upper section has an upper end portion in which said upper connecting means is arranged, an elongate upper intermediate portion of reduced diameter and having said threads about the lower end portion thereof, a lower intermediate portion of less diametric extent than the upper intermediate portion and in which said channel and flats are established and a lower end portion which carries said sealing means, said bore having a lower portion corresponding in diametric and longitudinal extent with the lower end portion of the upper section, and an upper portion corresponding in diametric and longitudinal extent with the lower intermediate portion, the minor diameter of the threads being substantially equal to the diameter of the upper intermediate portion, the outside diameter of the upper end portion of the lower section being substantially equal to the major diameter of the threads, said retaining sleeve having an upper threaded portion to engage the threads and a lower skirt portion slidably engageable with and about the said upper portion of the lower section, said sleeve being substantially equal in longitudinal extent with the upper intermediate portion, said flats occurring on planes substantially tangential with the periphery of the lower end portion of the upper section can move freely by the blocks upon axial shifting of the sections, an annular captive ring engaged in said channel for relative rotation therein and having openings registered with the openings in the lower section and slidably receiving the pins.

(References on following page)

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References Cited

UNITED STATES PATENTS

1,414,207	4/1922	Reed	285—2
1,849,075	3/1932	Dardelet	287—125
2,698,761	1/1955	Claypool et al.	285—3
2,988,145	6/1961	Clark	285—2
3,387,863	6/1968	Treese	285—2

14
FOREIGN PATENTS

121,739	3/1958	U.S.S.R.

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U.S. Cl. X.R.
285—330, 351, 286