

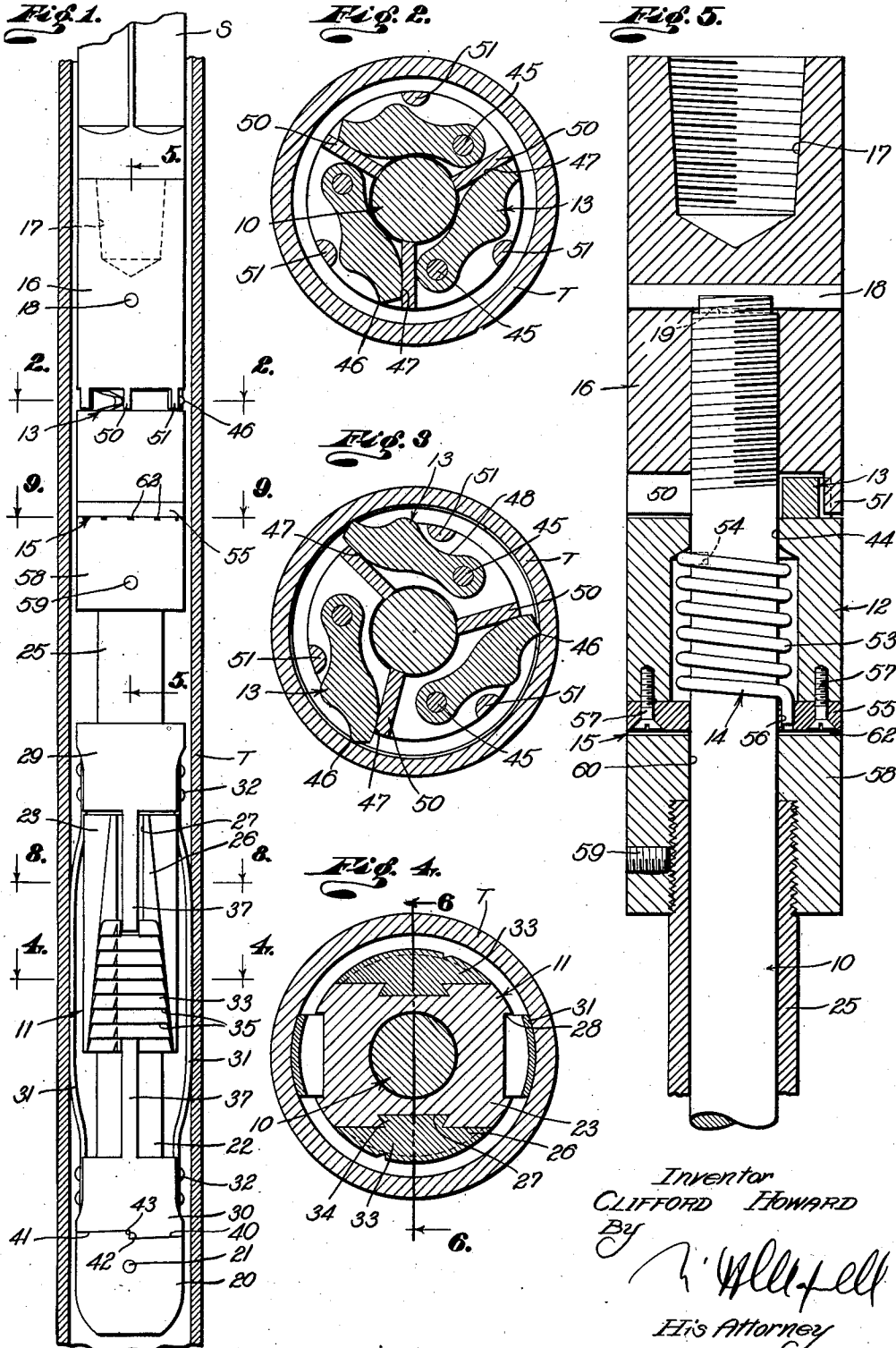
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C. HOWARD
TUBING CUTTER

2,200,172

Filed July 10, 1937

2 Sheets-Sheet 1



Inventor
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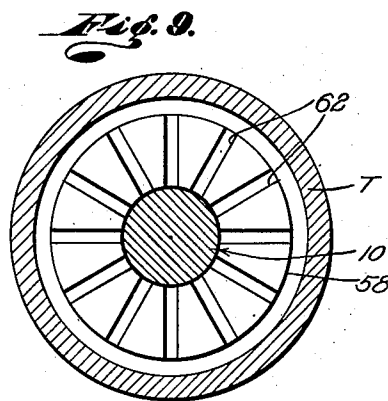
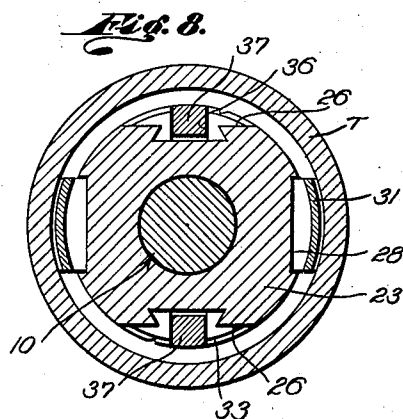
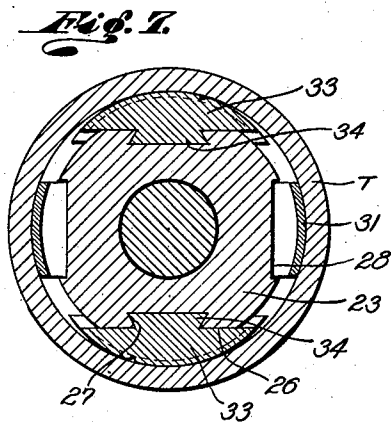
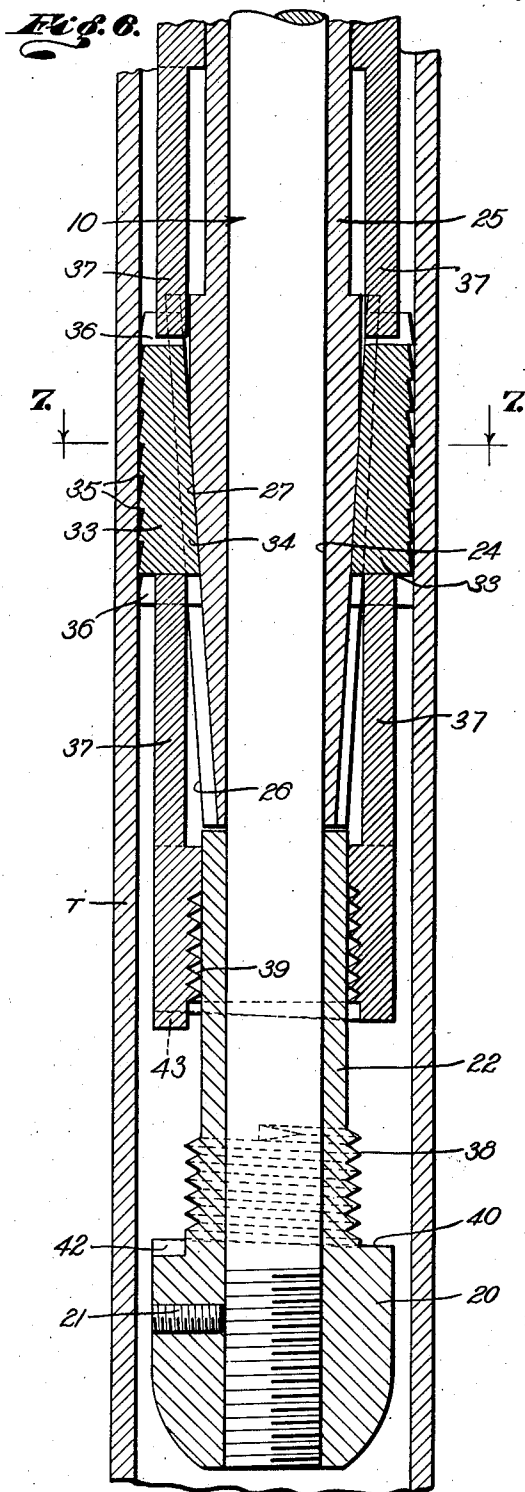
C. HOWARD

2,200,172

TUBING CUTTER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,200,172

TUBING CUTTER

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15 Claims. (Cl. 164-0.7)

This invention relates to well tools and relates more particularly to a tool for cutting well tubing and other tubular objects in wells. A general object of this invention is to provide a practical, dependable and compact well tubing cutter.

Another object of this invention is to provide a tool for cutting or severing tubing and the like in a well that is under the full control of the operator at all times and that may be successively operated any required number of times before being withdrawn from the well.

Another object of this invention is to provide a tubing cutter in which the cutting knives are fed outwardly and then maintained in cutting contact with the pipe or tubing in such a manner that they are not subjected to excessive forces and do not jump, chatter or bite into the pipe or tubing.

Another object of this invention is to provide a tubing cutter in which the feed pressure applied to the cutters or knives may be varied at will by the operator at the well derrick.

Another object of this invention is to provide a tubing cutter of the character mentioned embodying a novel friction control means for effecting the actuation and the outward feeding of the cutters or knives.

Another object of this invention is to provide a tubing cutter of the character mentioned in which the knives are actuated and fed outwardly by rotation of the operating string and by the application of a downward pressure on the tool and the cutting action of the knives may be governed as desired by varying the rate of rotation and the intensity of the downward force.

Another object of this invention is to provide a tubing cutter of the character mentioned that is simple and inexpensive to manufacture and recondition.

A further object of this invention is to provide a simple, practical and improved slip assembly or tail-piece for a well tool.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation of the tool provided by this invention in position in a well tubing showing the parts in the normal or retracted positions. Fig. 2 is an enlarged transverse detailed sectional view taken as indicated by line 2-2 on Fig. 1 showing the knives in the retracted positions. Fig. 3 is a view similar to Fig. 2 showing the

knives in cutting engagement with the tubing. Fig. 4 is an enlarged transverse detailed sectional view taken as indicated by line 4-4 on Fig. 1. Fig. 5 is an enlarged longitudinal detailed sectional view of the upper portion of the tool being a view taken substantially as indicated by line 5-5 on Fig. 1. Fig. 6 is an enlarged fragmentary longitudinal detailed sectional view of the lower portion of the tool showing the parts in the actuated positions. Fig. 7 is a transverse detailed sectional view taken as indicated by line 7-7 on Fig. 6, and Figs. 8 and 9 are enlarged, transverse detailed sectional views taken as indicated by lines 8-8 and 9-9, respectively, on Fig. 1.

The present invention may be embodied in tools for cutting tubular objects of various sizes and natures and is concerned primarily with a tool for cutting tubular objects in wells. In the following detailed description I will describe the invention embodied in a tubing cutter for cutting well tubing in a well. It is to be understood that the invention is not to be construed as limited or restricted to the specific form or application of the invention about to be described, but is to be taken as including any features or modifications that may fall within the scope of the claims.

The improved tubing cutter provided by this invention includes, generally, a stem or mandrel 10, a slip assembly or tail-piece 11 on the mandrel 10 operable to grip the interior of a tubing T to remain stationary therewith, a knife carrier 12 turnable on the mandrel 10, knives 13 on the carrier 12 operable outwardly against the tubing T upon relative turning between the mandrel 10 and the carrier 12, means 14 normally holding the knives 13 retracted and a friction means or friction brake means 15 between the knife carrier 12 and the tail-piece 11 operable to resist turning of the carrier 12 whereby the knives 13 may be operated by rotation of the mandrel 10.

The mandrel 10 supports the various other parts of the tool and is adapted to be connected with the lower end of an operating string S of pump rods, or the like. In practice the mandrel 10 may be a length of rod or cylindrical stock of uniform diameter. A sub 16 is threaded on the upper end of the mandrel 10 and has a socket 17 in its upper end to receive the threaded end of the operating string S. A pin 18 is passed through a transverse opening in the sub 16 and cooperates with a notch 19 in the upper end of the mandrel 10 to prevent unthreading of the sub 16 from the mandrel. A nut 20 is threaded on the lower end of the mandrel 10. The nut 55

20 is shaped to guide the tool through the tubing T and may be locked in place on the mandrel by a set screw 21. An upwardly projecting tubular extension 22 is provided on the nut 20 and surrounds the lower portion of the mandrel 10.

The slip assembly or tail-piece 11 is arranged around the lower portion of the mandrel 10. The tail-piece 11 includes a body 23 having a central longitudinal opening 24 shiftably and rotatably receiving the mandrel 10. The body 23 has an extension 25 of reduced diameter extending around the mandrel 10. The body 23 of the tail-piece is provided with downwardly and inwardly inclined external surfaces 26. In the particular construction illustrated there are two diametrically opposite inclined surfaces 26 provided on the body 23. Longitudinally extending dove-tailed grooves 27 are provided in the surfaces 26. The bottom walls or inner walls of the dove-tailed grooves 27 are inclined and are parallel with the surfaces 26. Two flat faces or flat walled grooves 28 are provided in the body 23 and are spaced substantially 90° from the surfaces 26. The slip assembly or tail-piece 11 further includes an upper ring 29 and a lower ring 30. The upper ring 29 surrounds and is shiftable on the body extension 25. The lower ring 30 surrounds and is shiftable on the nut extension 22. Outwardly bowed leaf springs 31 extend between the rings 29 and 30. There are two springs 31 arranged at diametrically opposite sides of the assembly. The springs 31 are located in radial alignment with the grooves 28 to be received in the grooves when in a collapsed or retracted condition. Screws 32 may secure the opposite end portions of the springs 31 to the rings 29 and 30.

The slip assembly or tail-piece 11 further includes slips 33 for gripping the interior of the tubing T. The slips 33 are wedge-like members having inclined inner surfaces slidable on the inclined surfaces 26 of the body 23. Dove-tailed tongues 34 are provided on the inner sides of the slips 33 and operate longitudinally in the grooves 27. The outer sides of the slips 33 are shaped to conform to the interior of the tubing T and have horizontal wickers or teeth 35 for gripping the tubing. The teeth 35 point or face downwardly and outwardly and are preferably interrupted by vertical notches to be effective in preventing turning of the body 23, and the parts connected therewith, relative to the tubing.

Means is provided to connect the slips 33 and the rings 29 and 30 against relative vertical movement whereby the vertical movement of the body 23 relative to the rings effects actuation of the slips. Notches 36 are provided in the upper and lower ends of the slips 33 and fingers 37 project axially or longitudinally from the rings 29 and 30 to cooperate with the notches 36. The fingers 37 cooperate with the notches 36 to prevent or limit vertical movement of the slips 33 relative to the rings 29 and 30 and the fingers 37 engaging in the notches 36 hold the rings in position where the springs 31 are aligned with the grooves 28.

A releasable connection is provided between the tail-piece 11 and the mandrel 10 whereby the tool may be run through the tubing T with the slips 33 retracted and may be readily conditioned for operation at the selected position in the well. The connection between the tail-piece 11 and the mandrel 10 includes an external thread 38 on the nut extension 22 and an internal thread 39 on the interior of the ring 30 cooperable with the thread 38. The threads 38 and 39 are coarse or

heavy and preferably have a substantial pitch. The releasable connection further includes a helicoidal face 40 on the upper end of the nut 20 and a complementary face 41 on the lower end of the ring 30. The faces 40 and 41 have substantially the same pitch as the threads 38 and 39. The high and low ends of the face 40 are connected by, or terminate at an abrupt vertical shoulder 42 and the face 41 has a similar shoulder 43. When the threads 38 and 39 are fully made up the shoulder 43 cooperates with the shoulder 42 to prevent tightening of the threads so that the nut 20 may be easily disconnected or unthreaded from the tail-piece ring 30.

Fig. 1 of the drawings illustrates the nut 20 and the tail piece ring 30 threaded together with the shoulders 42 and 43 in cooperation. To release the nut 20 from the ring 30 the mandrel 10 is turned in a right-hand direction to unscrew the threads 38 and 39. During this turning of the mandrel 10 the springs 31 frictionally bear against the interior of the tubing T to resist rotation of the rings 29 and 30. Following the release of the nut 20 from the ring 30 the mandrel 10 is moved downwardly and the inclined surfaces 26 cooperating with the inner sides of the slips 33 force the slips outwardly against the interior of the tubing T. The slips 33 are adapted to tightly grip the interior of the tubing T to hold the body 23 and the parts connected therewith against rotation and downward movement.

The knife carrier 12 is provided to support the knives 13 and is arranged around the mandrel 10 below the sub 16. In the preferred construction the knife carrier 12 is a tubular cylindrical member having a central longitudinal opening shiftably and turnably receiving the stem 10. The upper and lower ends of the carrier 12 are preferably flat and horizontal. The carrier 12 is adjacent the sub 16, the upper end of the carrier being spaced a short distance below the lower end of the sub 16.

The knives 13 are supported by the carrier 12 and are under the control of the means 14 and the friction brake means 15. The knives 13 are arranged at the top or upper end of the carrier 12. In accordance with the invention the knives 13 are pivoted dog-like elements. Pivot pins 45 project from the upper end of the carrier 12 and the knives 13 are pivoted on the pins 45. The knives 13 are alike or identical. In the form of the invention illustrated in the drawings there are three knives 13, the pins 45 supporting the knives being equally spaced about the longitudinal axis of the tool. The knives 13 extend rearwardly from their pivotal mountings relative to the right-hand direction of rotation of the tool. The rear outer corners of the knives 13 are sharpened to form cutting edges 46. The lower sides of the knives 13 may rest on the upper end of the carrier 12 and the rear ends of the knives may have their upper and lower surfaces tapered toward the cutting edges 46. The inner sides or surfaces of the cutters 13 extending forwardly or away from the cutting edges 46 are in the nature of cam surfaces 47. The cam surfaces 47 are curved or convex as best illustrated in Figs. 2 and 3 of the drawings. The outer sides of the knives 13 have depressions 48 adjacent their forward ends relative to the right-hand direction of rotation. The knives 13 are normally confined within the periphery or margin of the upper end of the carrier 12, as illustrated in Fig. 2 of the drawings.

Parts are provided on the sub 16 for cooperat-

ing with the knives 13 to effect their actuation or outward pivoting upon relative turning movement between the carrier 12 and the sub 16. Fingers or blades 50 project downwardly from the lower end of the sub 16 to cooperate with the cam faces 47 of the knives. The blades 50 may be vane-like parts whose forward faces for cooperating with the cam faces 47 are tangent to a small circle concentric with the longitudinal axis of the tool. The blades 50 may extend between the inner and outer peripheries of the sub 16. When the knives 13 are in their normal retracted positions the cam faces 47 may be in cooperation with the blades 50. Upon right-hand turning movement of the sub 16 and mandrel 10 relative to the carrier 12 the blades 50 cooperating with the faces 47 swing the knives 13 outwardly to their active cutting positions.

Stops 51 project downwardly from the lower end of the sub 16 to limit the outward pivoting of the knives 13. The stops 51 are adjacent the outer periphery of the sub 16 and are located to be received in the depressions 48 when the knives 13 are swung outwardly to their active positions. The walls of the depressions 48 are adapted to cooperate with the stops 51 to limit outward swinging of the knives. In practice the outward movement of the knives 13 is sufficiently great for the knives to fully sever or cut through the wall of the tubing T. The lower ends of the blades 50 and the stops 51 are adapted to cooperate with the upper end of the carrier 12 to transmit downward force from the sub 16 to the carrier. The upper end of the carrier 12 is hardened and smooth and the lower ends of the blades 50 and the stops 51 are flat and smooth to bear on the upper end of the carrier with a minimum of friction. The blades 50 and the stops 51 may be integral with the sub 16, as illustrated in the drawings.

The means 14 is provided to normally hold the knives 13 in their retracted positions and to return or retract the knives after actuation. The means 14 is in the nature of a spring means and exerts a torque or turning force on the knife carrier 12. The opening 44 in the carrier 12 is enlarged throughout its major portion to receive the mandrel 10 with substantial clearance. The means 14 comprises a helically wound torsional spring 53 arranged in the opening 44 to surround the mandrel 10. One end of the spring 53 is secured to the mandrel 10 and the other end is secured to the carrier 12. In the construction illustrated the upper end portion of the spring 53 is set or secured in a socket 54 in the mandrel 10. A plate or washer 55 is secured to the lower end of the carrier 12 and the lower end portion of the spring 53 is secured in an opening 56 in the washer 55. The washer 55 may be secured to the carrier 12 by screws 57. The washer 55 forms an element of the friction brake means 15, as will be subsequently described. The spring 53 is normally or initially under torque and holds the carrier 12 in a rotative position where the knives 13 are retracted with their forward pivoted ends in contact with the rear sides of the blades 50 relative to the right hand direction of rotation, as illustrated in Fig. 2 of the drawings. The spring 53 is of sufficient strength to retain the knives 13 in their retracted positions when the tool is being run through the tubing T and to return the carrier 12 and the knives to their normal positions after actuation of the tool, as will be hereinafter described. It will be observed

that the carrier 12 forms a housing for the spring 53.

The friction means or friction brake means 15 forms a brake or drag between the carrier 12 and the tail-piece 11 being operable to resist rotation of the carrier 12 when the mandrel 10 is turned so that the carrier may lag relative to the sub 16 to effect actuation or outward feeding of the knives. The means 15 is responsive to or governed by a downward force on the mandrel 10 which may be varied at the will of the operator to control the outward feeding of the knives 13.

The means 15 includes the washer 55 mentioned above. The washer 55 may be hardened and has a transverse or horizontal lower end. The means 15 further includes a part or collar 58 on the extension 25 of the tail-piece body 23. The collar 58 may be threaded on the upper end of the extension 25 and may be locked in place by a set screw 59. The collar 58 has a vertical opening 60 shiftably and rotatably passing the mandrel 10 and the collar is preferably of the same external diameter as the carrier 12 and the sub 16. The upper end of the collar 58 is engageable by the lower end of the washer 55 and is preferably horizontal or parallel with the lower face of the washer. The lower end of the washer 55 or the upper end of the collar 58, or both, is roughened, serrated, grooved or otherwise finished to constitute a friction surface. In the form of the invention illustrated in the drawings the upper end of the collar 58 is provided with a multiplicity of grooves 62 to provide for the desired movement resisting engagement between the opposing ends of the washer 55 and the collar 58. The lower end of the washer 55 and the upper end of the collar 58 may normally be in contact and the parts may be related so that there is some clearance between the upper end of the carrier 12 and the lower ends of the blades 50 and the stops 51, the spring 53 normally holding the carrier 12 downwardly so that the washer 55 bears against the upper end of the collar 58.

In operation the tool may be assembled with the parts as shown in Fig. 1 of the drawings. The tail piece 11 is collapsed, the ring 30 being threaded on the nut extension 22 and the knives 13 are in their retracted positions as illustrated in Fig. 2. The tool may be run into the tubing T on the lower end of the string S. When the cutter or tool has reached the desired position the string S is turned in a right-hand direction to unthread the nut extension 22 from the ring 30. Following the unthreading of the nut 22 from the ring 30 the string S is moved downwardly. The downward movement of the mandrel 10 with the string S is transmitted to the tail-piece body 23 by the engagement of the washer 55 against the collar 58 on the body extension 25. When the tail-piece body 23 moves downwardly the inclined surfaces 26 cooperate with the slips 33 to force them outwardly into tight engagement with the interior of the tubing T. The slips 33 are operable to firmly engage the interior of the tubing T to effectively resist downward movement and rotation of the body 23, the extension 25 and the collar 58.

Following the setting or actuation of the tail-piece 11 the string S is turned in the right-hand direction and a downward force is applied to the mandrel 10 and the sub 16 by the string S. The downward force on the collar 16 is transmitted to the carrier 12 by the blades 50 and the stops 51 and the lower ends of the blades and stops engag-

ing the upper end of the carrier 12 cause or tend to cause the carrier to turn with the sub 16. The blades 50 engaging the knives 13 assist in urging the carrier 12 to rotate. The downward pressure on the carrier 12 holds the lower end of the washer 55 in frictional engagement with the grooved upper end of the collar 58. This frictional engagement between the lower end of the washer 55 and the grooved upper end of the collar 58 resists or tends to resist turning of the carrier 12, the collar 58 being held stationary with the tail-piece 11, as described above. Thus the engagement between the lower end of the washer 55 and the upper end of the collar 58 causes the carrier 12 to lag relative to the rotating sub 16.

The lagging of the carrier 12 or the relative turning movement resulting from the frictional engagement between the washer 55 and the grooved upper end of the collar 58 results in the outward actuation or feeding of the knives 13. The frictional engagement between the lower end of the washer 55 and the upper end of the collar 58 which may be varied by varying the downward pressure on the mandrel 10 causes the carrier 12 to turn at a slower rate than the sub 16 so that the blades 50 act forwardly against the cam surfaces 47 of the knives 13 relative to the direction of rotation. The blades 50 acting against the cam surfaces 47 swing or pivot the knives 13 outwardly bringing their cutting edges 46 in cooperation with the interior of the tubing T. The knives 13 rotating with the carrier 12 and fed outwardly by the blades 50 are operable to cut an annular groove or cut in the wall of the tubing T. It is to be understood that the outward feeding of the knives 13 may be readily controlled by the operator by varying the downward force on the mandrel 10 and sub 16 to change the intensity of the frictional engagement between the lower end of the washer 55 and the upper end of the collar 58. The rotation of the string S accompanied by the desired downward force on the mandrel 10 and sub 16 may be continued until the knives 13 cut completely through the wall of the tubing T. The stops 51 are adapted to limit the outward feeding of the knives 13.

Subsequent to the making of the cut in the tubing T the string S may be moved upwardly and then rotated in a direction to thread the nut extension 22 in the ring 30. The upward movement of the string S is transmitted to the body 23 from the mandrel 10 by the upper end of the nut extension 22 engaging the lower end of the body. This upward movement of the body 23 retracts the slips 33. Following the threading of the nut extension 22 in the ring 30 and the retraction of the slips 33 the tool may be withdrawn from the well or may be moved to a different position in the well to make another cut in the tubing T.

Having described only a typical preferred form and application 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 variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A tool for use on a well string to cut a tubular object in a well comprising a body adapted to be secured to the string and entered in the object, a member turnably supported on the body, means connecting the member with the body to turn therewith and yieldable to allow relative turning between the body and member, a knife projectable into contact with the object upon relative turning between the body and

member, and means controllable by longitudinal manipulation of the string for resisting turning of the member with the body whereby rotation of the body projects the knife, the last mentioned means including slip means for gripping the object to be stationary therewith, and friction clutch means engaging between the member and the slip means.

2. A tool for use on a well string to cut a tubular object in a well comprising a body adapted to be secured to the string and entered in the object, a member turnably supported on the body, means connecting the member with the body to turn therewith and yieldable to allow relative turning between the body and member, a knife projectable into contact with the object upon relative turning between the body and member, and means controllable by longitudinal manipulation of the string for resisting turning of the member with the body whereby rotation of the body projects the knife, the last mentioned means comprising an assembly having movement resisting engagement with the object, and a friction brake between the member and the assembly.

3. A tool for use on a well string to cut a tubular object in a well comprising a mandrel secured to the string to be entered in the object, a turnable member on the mandrel, a knife initially retracted clear of the object, means transmitting longitudinal force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, means for projecting the knife upon relative turning movement between the mandrel and the member, and means governed by the intensity of the longitudinal force applied to the mandrel by the string for resisting turning of the member whereby rotation of the mandrel effects projection of the knife.

4. A tool for cutting a tubular object in a well comprising a mandrel to be entered in the object, a turnable member on the mandrel, a knife initially retracted clear of the object, means transmitting longitudinal force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, means for projecting the knife upon relative turning movement between the mandrel and the member, and means controllable by applied longitudinal force on the mandrel for resisting turning of the member with the mandrel.

5. A tool for use on a well string to cut a tubular object in a well comprising a mandrel secured to the string to be entered in the object, a turnable member on the mandrel, a knife initially retracted clear of the object, means transmitting longitudinal force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, means for projecting the knife upon relative turning movement between the mandrel and the member, and means controllable by the intensity of the longitudinal force applied to the mandrel by the string for resisting turning of the member with the mandrel, the last mentioned means including a tail piece on the body cooperable with the interior of the object, and a friction brake means interposed between the member and the tail piece.

6. A tool for use on a well string to cut a tubular object in a well comprising a mandrel secured to the string to be entered in the object, a turnable member on the mandrel, a knife initially retracted clear of the object, means transmitting longitudinal force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, means for projecting the knife

upon relative turning movement between the mandrel and the member, and means controllable by the intensity of the longitudinal force applied to the mandrel by the string for resisting turning of the member with the mandrel, the last mentioned means including a slip assembly carried by the mandrel for gripping the object to be stationary therewith, and an element supported by the slip assembly and frictionally engaged by the member to receive longitudinal forces therefrom.

7. A tool for use on a well string to cut a tubular object in a well comprising a mandrel secured to the string to be entered in the object, a turnable member on the mandrel, a knife carried by the member and initially retracted clear of the object, means transmitting longitudinal force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, means for projecting the knife upon relative turning movement between the mandrel and the member, and means governed by longitudinal forces imposed on the mandrel by the string for resisting turning of the member whereby rotation of the mandrel effects projection of the knife.

8. A tool for use on a well string to cut tubing in a well comprising a mandrel secured to the string to be entered in the tubing, a member turnably carried on the mandrel, pivoted knives on the member, parts on the mandrel cooperable with the knives to project them against the tubing upon relative turning movement between the mandrel and member, means yieldingly urging the member to turn with the mandrel, a tail piece carried by the mandrel and operable into gripping engagement with the tubing, and friction means interposed between the member and tail piece governed by longitudinal forces imposed on the mandrel by the string to resist turning of the member.

9. A tool for cutting tubing in a well comprising a mandrel to be entered in the tubing, a member turnably carried on the mandrel, pivoted knives on the member, parts on the mandrel cooperable with the knives to project them against the tubing upon relative turning movement between the mandrel and member, means yieldingly urging the member to turn with the mandrel, yielding means holding the member in a rotative position where the knives are retracted, a tail piece carried by the mandrel and operable into gripping engagement with the tubing, and friction means interposed between the member and tail piece for resisting turning of the member.

10. A tool for cutting tubing in a well comprising a mandrel to be entered in the tubing, a member turnably carried on the mandrel, pivoted knives on the member, parts on the mandrel cooperable with the knives to project them against the tubing upon relative turning movement between the mandrel and member, means yieldingly urging the member to turn with the mandrel, means for returning the knives to their retracted positions after actuation, a tail piece carried by the mandrel and operable into gripping engagement with the tubing, and friction

means interposed between the member and tail piece for resisting turning of the member.

11. A tool for cutting tubing in a well comprising a mandrel to be entered in the tubing, a member turnably carried on the mandrel, pivoted knives on the member, parts on the mandrel cooperable with the knives to project them against the tubing upon relative turning movement between the mandrel and member, means for transmitting downward force from the mandrel to the member and yieldingly urging the member to turn with the mandrel, a tail piece carried by the mandrel operable to grip the tubing, and frictionally engaging parts on the member and tail piece offering resistance to turning of the member proportionate to the intensity of the downward force on the member.

12. A tool for cutting tubing in a well comprising a mandrel to be entered in the tubing, a member turnably carried on the mandrel, pivoted knives on the member, parts on the mandrel cooperable with the knives to project them against the tubing upon relative turning movement between the mandrel and member, means yieldingly urging the member to turn with the mandrel, a tail piece carried by the mandrel and operable into gripping engagement with the tubing, releasable means holding the tail piece inactive, and friction means interposed between the member and the tail piece for resisting turning of the member.

13. In a well tool, a mandrel adapted to be entered in a tubular object, a body related to the mandrel for relative longitudinal movement and having an inclined surface, a slip operable into cooperation with the object by said surface, spaced rings around the mandrel, springs connecting the rings and frictionally cooperating with the interior of the object to resist movement of the rings, and fingers on the rings cooperating with the opposite ends of the slip.

14. In a well tool, a mandrel adapted to be entered in a tubular object, a body related to the mandrel for relative longitudinal movement and having an inclined surface, a slip operable into cooperation with the object by said surface, spaced rings around the mandrel, springs connecting the rings and frictionally cooperating with the interior of the object to resist movement of the rings, there being notches in the ends of the slip and fingers on the rings cooperating with the notches whereby the body is movable relative to the slip.

15. A tool for use on a well string to cut a tubing comprising, a mandrel secured to the string to be entered in the tubing, a member related to the mandrel for relative turning, knives projectable against the tubing by relative turning between the mandrel and member, means for transmitting downward force from the mandrel to the member, and means governed by longitudinal force applied to the mandrel by the string for offering resistance to turning of the member proportional to the intensity of the downward force on the member whereby the turning of the mandrel effects projection of the knives.

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