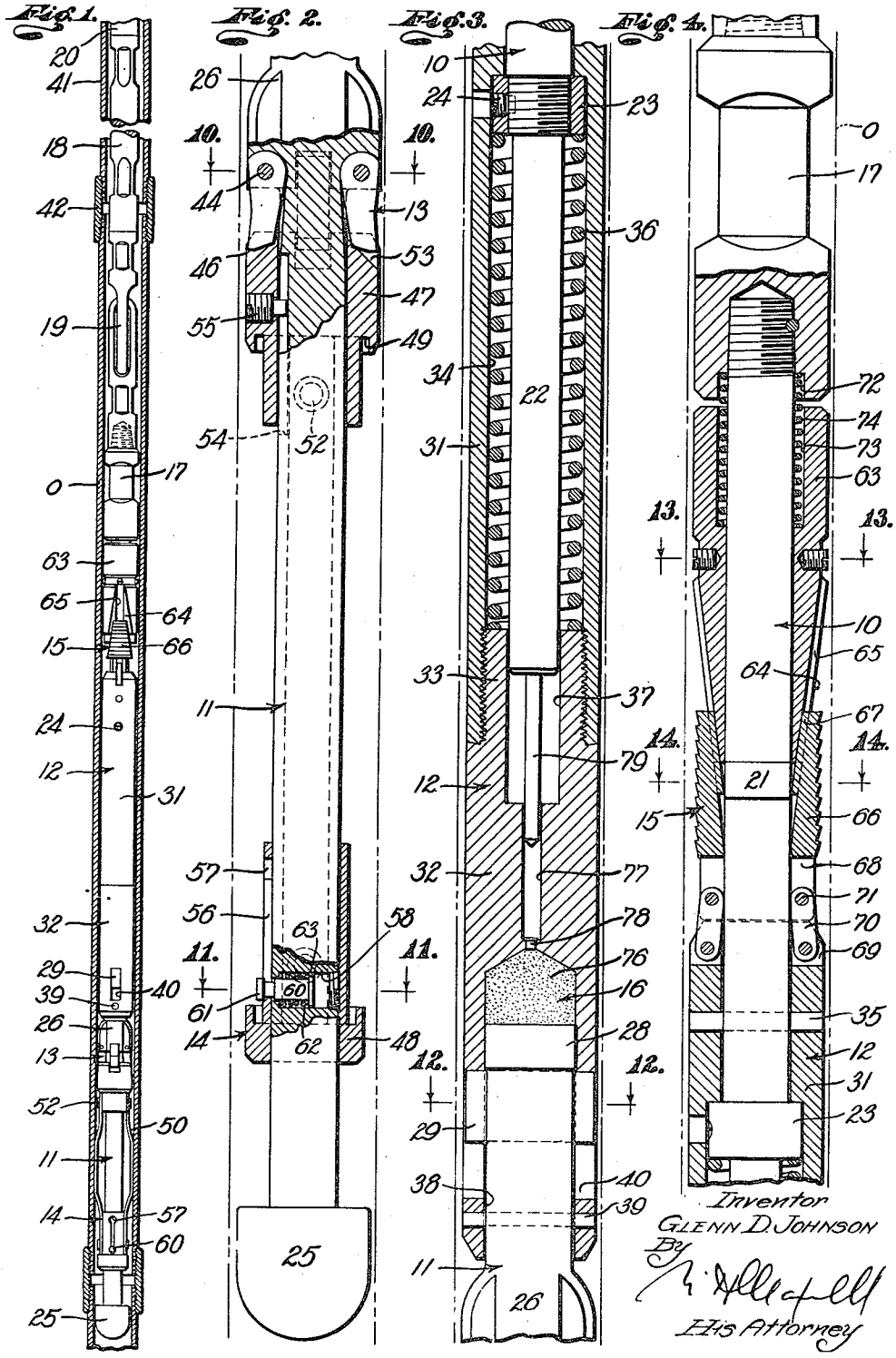
May 27, 1941. G. D. JOHNSON 2,243,099

TOOL USEFUL IN RECOVERING WELL TUBING, WELL CASINGS, ETC.

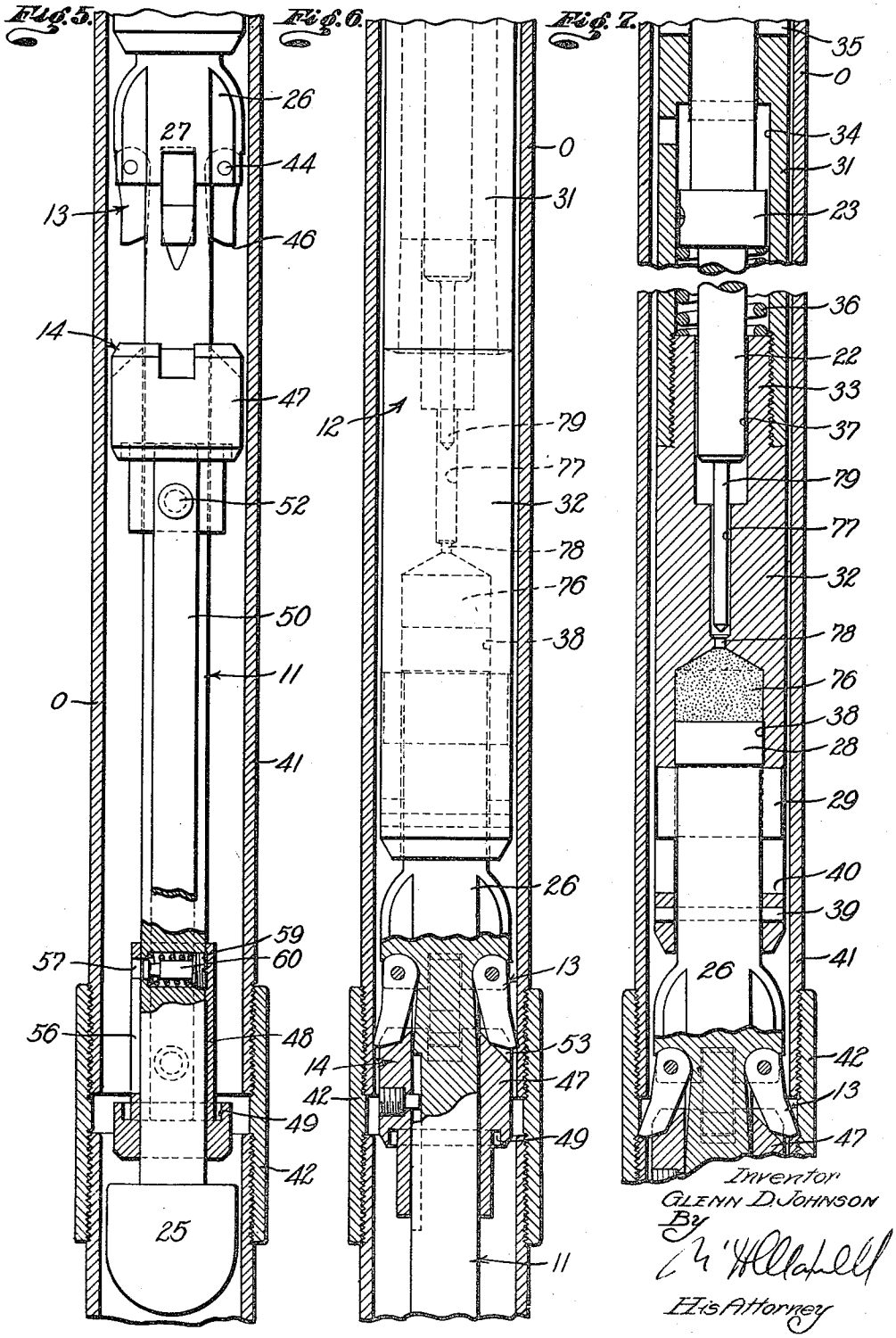
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TOOL USEFUL IN RECOVERING WELL TUBING, WELL CASINGS, ETC.

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TOOL USEFUL IN RECOVERING WELL TUBING, WELL CASINGS, ETC.

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Fig. 8.

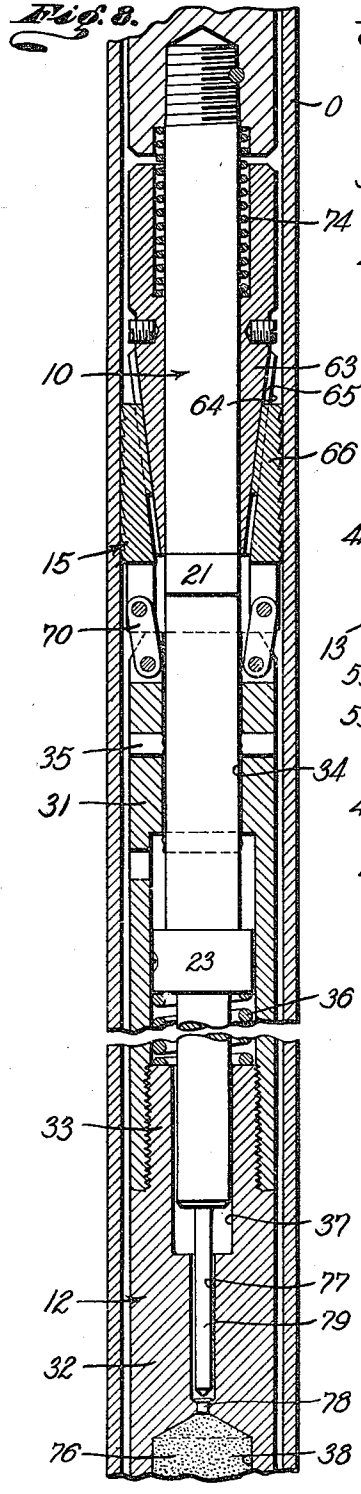


Fig. 9.

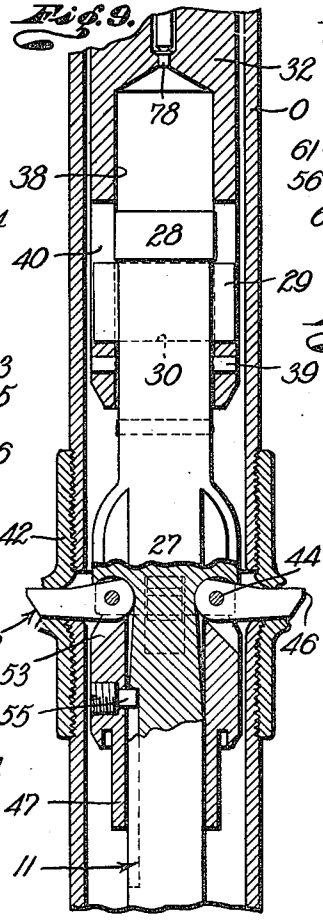


Fig. 11.

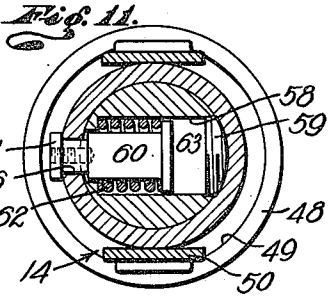


Fig. 12.

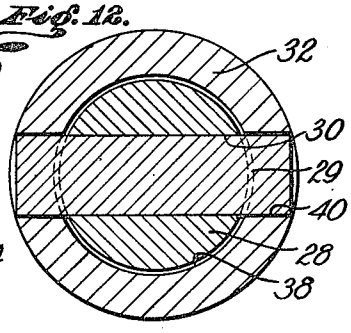


Fig. 13.

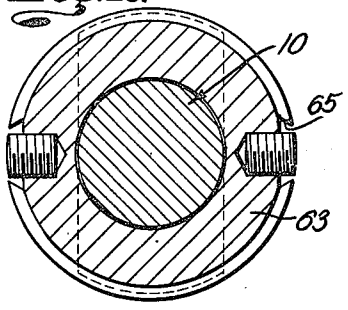


Fig. 10.

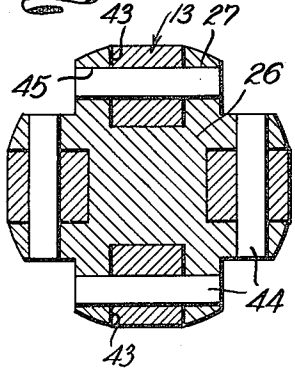
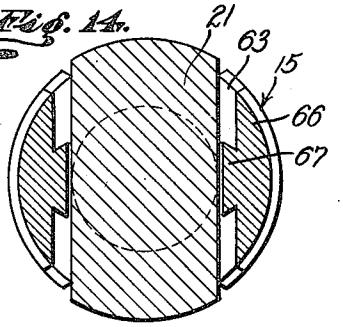


Fig. 14.



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2,243,099

UNITED STATES PATENT OFFICE

2,243,099

TOOL USEFUL IN RECOVERING WELL TUBING, WELL CASING, ETC.

Glenn D. Johnson, Compton, Calif., assignor to Baash-Ross Tool Company, Los Angeles, Calif., a corporation of California

Application August 16, 1938, Serial No. 225,105

18 Claims. (Cl. 164—0.5)

This invention relates to a well tool and relates more particularly to a tool for parting or facilitating the parting of casing, tubing and the like in wells. A general object of this invention is to provide a practical, effective and dependable tool of the character just mentioned.

Another object of this invention is to provide a tool that is operable to split, fracture or burst a coupling of a string of pipe, tubing or casing in a well to weaken or break said coupling so that the portion of the string above the same is free for removal from the well.

Another object of this invention is to provide a tool of the character mentioned in which the knives or parts for splitting, bursting or fracturing the tubular object in the well are actuated by the discharge of an explosive, by pressure generated by a chemical reaction, or by the discharge and resultant expansion of a fluid under pressure. It is a feature of the present invention that the cutters or knives are actuated by a pressure generating means contained in the tool making it unnecessary to apply heavy forces to the string or line handling the tool. The tool of the present invention may be fully operated to burst, split or fracture a collar, or the like, of a tubular string in a well without applying heavy strains to the tool and, therefore, without endangering the tool, the operating string, or the other equipment. This feature of the invention allows the tool to be operated in tubing of small diameter where it would be impractical to apply heavy operating forces to the tool from the ground surface.

Another object of this invention is to provide a tool of the character mentioned that embodies novel controls for preventing premature actuation of the pressure generating means.

Another object of this invention is to provide a practical, dependable means for securing the body or charge carrying member of the tool to the casing or tubing to prevent it from moving under the reaction of the explosion or pressure, which means is readily releasable to provide for the withdrawal of the tool from the well at the completion of its operation.

A further object of this invention is to provide a tool of the character mentioned that may be successfully and fully controlled and operated by a wire line or cable.

A further object of this invention is to provide a tool of the character mentioned that may be designed to burst, cut or otherwise weaken a coupling or other part of a string of well casing or well tubing, or that may be designed to weaken or separate a threaded joint of the string of casing or tubing.

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 portion of a well tubing prior to its operation, showing the tubing in vertical cross section. Fig. 2 is an enlarged side elevation of the lower portion of the tool with certain portions broken away to appear in vertical cross section. Fig. 3 is an enlarged longitudinal detailed sectional view of the intermediate portion of the tool showing the mandrels in elevation. Fig. 4 is an enlarged longitudinal detailed sectional view of the upper portion of the tool with the mandrel in elevation. Fig. 5 is a view similar to Fig. 2 showing the friction means or tail-piece released and illustrating the knives in elevation. Fig. 6 is an enlarged side elevation of the intermediate portion of the tool with certain parts broken away to appear in vertical cross section and illustrating the knives partially expanded. Fig. 7 is a view similar to Fig. 6 illustrating the principal parts in longitudinal cross section and showing the knives engaged in the recess of a coupling. Fig. 8 is an enlarged longitudinal detailed sectional view of the upper portion of the tool showing the mandrel in elevation and illustrating the gripping means in engagement with the tubing. Fig. 9 is a fragmentary longitudinal sectional view of a portion of the tool with certain parts in elevation and illustrating the knives in their fully actuated positions. Figs. 10 and 11 are enlarged transverse detailed sectional views taken as indicated by lines 10—10 and 11—11, respectively, on Fig. 2. Fig. 12 is an enlarged transverse detailed sectional view taken as indicated by line 12—12 on Fig. 3 and Figs. 13 and 14 are enlarged transverse detailed sectional views taken as indicated by lines 13—13 and 14—14 on Fig. 4.

The tool of the present invention may be said to comprise, generally, an upper mandrel 10, a lower mandrel 11, a body 12 interposed between the mandrels 10 and 11 and related to the mandrels for relative vertical movement, cutters or knives 13 carried by the lower mandrel 11, controlled abutment means 14 on the lower mandrel 11 engageable by the knives 13 to effect their expansion upon downward movement of the body 12 and the mandrel 11, means 15 asso-

ciated with the upper mandrel 10 and the body 12 for engaging a tubular object 0 in a well to hold the body 12 against upward movement, pressure generating means 16 contained in the body 12 operable to move the lower mandrel 11 downwardly to effect the sudden expansion of the knives 13, and other parts, the functions and details of which will be hereinafter described.

The upper mandrel 10 is adapted to be connected with an operating string or line. Where the tool of the invention is employed in the recovery of well tubing or the like it is preferred to operate it on the lower end of a wire line or cable. In the present disclosure it will be assumed that a wire line (not shown) is connected with the upper mandrel 10 to manipulate and control the tool. The upper mandrel 10 is an elongate member considerably smaller in diameter than the tubing or object 0. A sub or coupling member 17 of increased diameter is threaded on the upper end of the mandrel 10.

It is preferred to associate a weight element with the mandrel 10 to assure the control or actuation of certain parts by gravity. This weight element may take the form of a stem 18. Jars 19 may be connected between the stem 18 and the upper end of the member 17 and a rope socket 20 may be provided on the upper end of the stem 18 to connect the tool with the operating line or cable (not shown). As best illustrated in Fig. 14 of the drawings the upper mandrel 10 has a flat sided enlargement 21 projecting laterally from its opposite sides at a point between its ends. The lower portion of the upper mandrel 10 is reduced in diameter to constitute a stem 22. A collar 23 is secured to the upper end of the stem 22 and forms an abutment on the mandrel 10 spaced below the above described enlargement 21. The collar 23 may be threaded on the stem 22 and may be locked in place by a set screw 24.

The lower mandrel 11 is an elongate part that carries the knives 13 and the controlled abutment means 14. The lower end of the mandrel 11 is preferably provided with a guide or bull nose 25 to assist in guiding the tool through the tubing or object 0. The lower mandrel 11 has an enlargement 26 spaced below its upper end. This enlargement 26 may be substantially cross-shaped in transverse cross section having a plurality of circumferentially spaced lugs 27, as best shown in Fig. 10. The portion of the lower mandrel 11 above the enlargement 26 constitutes a plunger 28 for the purpose to be hereinafter described. The plunger 28 is provided with two diametrically opposite projections 29. In the preferred construction the projections 29 are the end portions of a block fixed in a horizontal slot 30 in the plunger 28.

The body 12 is an elongate member or assembly interposed between the mandrels 10 and 11 and shiftably connected with the mandrels. In the construction illustrated the body 12 includes two sections, namely, an upper section 31 and a lower section 32. The sections 31 and 32 may be threaded together. In the particular construction illustrated the lower section 32 has a pin 33 on its upper end threaded into the lower end of the section 31. The section 31 is tubular having a central longitudinal opening 34 receiving the lower portions of the upper mandrel 10. The lower major portion of the opening 34 is enlarged in diameter to receive the collar 23 with suitable clearance. The stem 22 extends longitudinally through the enlarged lower portion of the opening 34 with substantial clearance. The invention includes means for initially releasably connecting the upper mandrel 10 and the body 12 against relative vertical movement. This means may comprise a shear pin 35 arranged through transverse openings in the mandrel 10 and the upper portion of the body section 31. Means is provided to yieldingly resist relative longitudinal movement between the upper mandrel 10 and the body 12 following the fracturing of the shear pin 35. This yielding means preferably comprises a helical spring 36 in the enlarged lower portion of the opening 34. The spring 36 is shown arranged under compression between the collar 23 and the upper end of the pin 33 in surrounding relation to the stem 22.

The lower body section 32 is preferably of the same external diameter as the upper section 31, the two sections being proportioned to move through the tubing or object 0 with suitable clearance. An opening 37 is provided in the upper part of the body section 32 to receive the lower portion of the stem 22 with clearance. A vertical opening 38 enters the body section 32 from its lower end and receives the upper portion or plunger 28 of the lower mandrel 11. The upper part of the opening 38 forms the cylinder or chamber of the means 16, as will be hereinafter described. Vertical slots 40 are provided in the lower portion of the body section 32 to slidably or shiftably receive the projections 29. The slots 40 are of sufficient length to provide for limited vertical movement of the lower mandrel 11 with respect to the body 12. Means is provided to releasably connect the body 12 and the lower mandrel 11 against relative vertical movement. This means may take the form of a shear pin 39 arranged through transverse openings in the lower portion of the section 32 and the plunger 28. The shear pin 39 serves to initially hold the parts in the positions where the projections 29 are in the upper ends of the slots 40.

The cutters or knives 13 are provided to cut through, slit or burst the tubular object 0. The knives 13 are preferably such that they operate to either separate or peel apart two threaded together portions of the object 0 or burst, slit or weaken a threaded coupling of the object 0 so that the object is parted or weakened to be readily parted. In the typical construction illustrated in the drawings the object 0 comprises a plurality of lengths or sections 41 connected by threaded collars 42. The particular knives 13 illustrated in the drawings are designed to cut out through or burst a collar 42 of the object 0 to part the collar or to weaken the same. The invention contemplates that the knives 13 be formed or shaped to enter between a collar 42 and the upper portion of a section 41 threaded therein to weaken or break the threaded connection.

The knives 13 are provided on the upper portion of the lower mandrel 11 being supported by the above described lugs 27. In practice there may be any suitable number of knives 13. In the construction illustrated there are four equally spaced lugs 27 and each lug supports a knife 13. The lugs 27 are bifurcated, having vertical slots 43, and the upper portions of the knives 13 are received in the slots. Pins 44 pass through transverse openings in the knives 13 and have their end portions carried in openings 45 in the lugs. The pins 44 serve to support the knives 13 for pivotal movement about horizontal axes. The lower ends of the knives 13 are bevelled down-

wardly and outwardly to provide the knives with cutting edges 46. The cutting edges 46 are preferably quite blunt. It is preferred to make the knives 13 rather broad so that they form large openings in the collar 42. The knives 13 are proportioned to be clear of the interior of the object 0 when they hang free or substantially vertical, as shown in Fig. 2.

The abutment means 14 is engaged by the knives 13 upon downward movement of the mandrel 11 under certain circumstances, to effect the outward expansion or projection of the knives. The means 14 is in the nature of a tail piece or spring assembly. In the form of the invention illustrated the means 14 includes two vertically spaced sleeves 47 and 48 shiftable on the lower mandrel 11. The sleeves 47 and 48 are preferably of substantial length and have oppositely facing or opposing shoulders provided with annular grooves 49. Spaced outwardly bowed leaf springs 50 extend between the sleeves 47 and 48. The end parts of the leaf springs 50 may be secured to the sleeves 47 and 48 by rivets 52 or the like. The end portions of the leaf springs 50 are received in the grooves 49. The springs 50 are bowed outwardly to frictionally engage the interior of the tubular object 0. This engagement of the springs 50 with the interior of the object 0 resists movement of the abutment means 14 through the object.

The upper end portion of the sleeve 47 is preferably enlarged in diameter. Notches 53 are provided in the upper end of the sleeve 47 to receive the lower portions of the knives 13. The lower walls of the notches 53 slope downwardly and outwardly and are engageable by the lower ends of the knives 13 to effect the outward pivoting of the knives. Means is provided to prevent turning of the abutment means 14 with respect to the mandrel 11. A longitudinal groove 54 is formed in the mandrel 11 and the sleeve 47 carries a pin 55 that projects into the groove 54 to prevent turning of the means 14 on the mandrel 11. The pin 55 is freely shiftable vertically in the groove 54.

Releasable means is provided to limit or prevent downward movement of the mandrel 11 relative to the abutment means 14 during movement of the tool down through the tubular object 0. This means includes an elongate slot 56 in the lower sleeve 48. The slot 56 has a portion 57 of increased width at its upper end. A radial opening 58 is provided in the mandrel 11 in a position to register with the slot 56. One end of the opening 58 is closed by a plug 59 and a shiftable pin 60 projects through the other end of the opening. The pin 60 extends through the slot 56 and has a head 61 cooperable with the exterior of the sleeve 48 to prevent inward movement of the pin. A spring 62 is arranged under compression between a shoulder in the opening 58 and a flange 63 on the pin 60 to urge the pin 60 into the opening 58. With the parts in the initial positions the pin 60 is received in the lower part of the slot 56 and is adapted to cooperate with the lower end wall of the slot to prevent downward movement of the mandrel 11 relative to the abutment means 14. When the mandrel 11 is subsequently moved upwardly with respect to the means 14 the pin 60 moves up through the slot 56 until its head 61 is received in the upper enlarged portion 57 of the slot, whereupon the spring 62 moves the pin inwardly withdrawing it from the slot 56 and thus freeing the mandrel 11 for more extensive vertical movement with respect to the means 14.

The means 15 is in the nature of a slip means for gripping the interior of the tubing or object 0. The slip means 15 includes a member 63 arranged on the upper mandrel 10 between the connecting member 17 and the enlargement 21. In the preferred construction the member 63 is slidable or shiftable on the mandrel 10. The lower end of the member 63 normally rests on the enlargement 21 and the upper end of the member 63 is normally spaced below the lower end of the connecting member 17. The member 63 is provided with circumferentially spaced downwardly and inwardly inclined ways 64. Each of the ways 64 has a dove-tailed longitudinally extending groove 65. Slips 66 are slidable on the ways 64 and have dove-tailed tongues 67 movable in the grooves 65. The outer sides of the slips 66 are toothed to grip the interior of the object 0 to prevent upward movement of the slips and the parts connected therewith.

Connections are provided between the slips 66 and the body 12 whereby the cooperation of the slips with the object 0 may prevent upward movement of the body 12. Slots 68 are provided in the lower portions of the slips 66 and similar slots 69 are provided in the upper portion of the body section 31. Links 70 are received in the slots 68 and 69 and are pivotally connected with the slips 66 and the body section 31 by pivot pins 71. The links 70 are substantially vertical.

The invention includes yieldable means for transmitting downward movement from the member 17 to the member 63 to cause the member 63 to move downwardly with the mandrel 10. This means includes aligned longitudinal sockets 72 and 73 in the opposing ends of the members 17 and 63. A helical compression spring 74 is arranged in the opposing registering sockets 72 and 73. The spring 74 surrounds the mandrel 10 and is arranged under compression between the end walls of the sockets. The spring 74 is operable to cause the member 63 to move downwardly with the mandrel 10 during downward movement of the mandrel 10 with respect to the body 12 and the downward movement of the member 63 sets or initiates actuation of the slips 66. Thus the spring 74 may be said to set or actuate the slips 66 into engagement with the interior of the object 0 and to maintain the clearance between the members 17 and 63 when the mandrel 10 is moved downwardly immediately preceding the actuation of the pressure generating means 16, as will be hereinafter described.

The pressure generating means 16 is operable to force or actuate the lower mandrel 11 downwardly with respect to the body 12, subsequent to the release of the abutment means 14 and the actuation of the slips 66, to effect the outward projection of the knives 13. It is a feature of the invention that the means 16 is carried by or contained within the tool to exert its actuating force in such a manner that it is unnecessary to apply a heavy actuating force from the upper end of the well. As previously pointed out, the pressure generating means 16 may take various forms. In accordance with the broader aspects of the invention the means 16 may be any suitable means operable to generate or create pressure within the tool.

In the form of the invention herein described the means 16 includes a charge 76 of explosive. The explosive charge 76 is contained in the upper

portion of the opening 38 above the upper end of the plunger 28. It is preferred that the charge 76 be of a so-called slow-burning powder. The charge 76 contained in the opening 38 above the plunger 28 is operable when ignited to drive the plunger down with respect to the body 12. An opening 77 extends downwardly in the body section 32 from the opening 37 to the upper end of the opening 38. The opening 77 has a reduced lower end portion and a percussion cap 78 is set in this reduced part of the opening 77. The cap 78 is located at the upper end of the charge 76. The means 16 further includes a firing pin 79. The pin 79 extends from the lower end of the stem 22 and projects down in the opening 77. In practice the pin 79 may be a reduced extension of the stem 22. The lower end of the pin 79 is preferably pointed to fire the percussion cap 78. With the parts in the normal or initial positions the lower end of the firing pin 79 is spaced a considerable distance above the cap 78.

In operation the tool is assembled with the parts in the positions illustrated in Figs. 1 to 4, inclusive, and Figs. 10 to 14, inclusive, of the drawings. When the tool is in this condition the shear pin 35 holds the upper mandrel 10 and the body 12 against relative movement and the shear pin 39 holds the body 12 and the lower mandrel 11 against relative movement. The latch pin 60 is in the lower portion of the slot 56. The tool is run down through the tubing or object 0 on the lower end of an operating string or cable in association with the stem 18 and the jars 19. The tool is lowered to a position adjacent the point where it is desired to part the tubing or object 0.

The tool is then raised to release the means 14 from the mandrel 11. During upward movement of the tool the springs 50 cooperate with the interior of the object 0 to resist upward movement of the means 14 and the pin 60 moves up in the slot 56 until its head reaches the enlarged part 57 of the slot, whereupon the spring 62 withdraws the pin from the slot. This frees or releases the lower mandrel 11 from the abutment means 14. The tool is then lowered. During this initial downward movement of the tool the springs 50 resist movement of the means 14 and the mandrel 11 moves down with respect to the means 14. During this relative movement the lower ends of the knives 13 engage the inclined walls of the notches 53 and this engagement causes outward pivoting of the knives 13. The knives 13 move into sliding or dragging cooperation with the interior of the object 0. The tool is lowered until the knives 13 enter the space or groove in a collar 42. When the knives 13 enter the collar 42 their lower ends engage the upper end of a tubing section 41 and the engagement of the knives with the end of the tubing section resists or prevents further downward movement of the knives and the mandrel 11.

The downward movement of the tool is continued following the engagement of the knives 13 in a collar 42. This continued downward movement of the tool results in breaking of the shear pin 35. The knives 13 engaging in the collar 42 hold the lower mandrel 11 and the body 12 against downward movement and the weight element 18 together with the other parts connected with the upper mandrel 10 moves the mandrel 10 downwardly with sufficient force to break the shear pin 35. The shearing or breaking of the pin 35 releases the mandrel 10 from the body 12 so that it may move down with respect to the body.

The mandrel 10 is allowed or caused to move down following the breaking of the pin 35. This downward movement of the mandrel 10 is accompanied by actuation or setting of the slips 33. During the downward movement of the mandrel 10 the spring 36 is compressed and yieldingly resists the downward travel of the mandrel 10. The spring 74 operates to cause the member 63 to move down with the downwardly traveling mandrel 10 and the downwardly moving member 63 actuates the slips 66 out into engagement with the interior of the object 0. The spring 74 maintains the clearance between the upper end of the member 63 and the lower end of the member 17 until the slips 66 have been set or actuated. The downward movement of the mandrel 10 is continued subsequent to the setting of the slips 66. The above described downward movement of the mandrel 10 during the setting of the slips 66 brings the firing pin 79 to a position where its pointed end is adjacent the cap 78, as shown in Fig. 7. The continued downward movement of the mandrel 10 takes up the clearance between the members 63 and 17 and brings the pointed end of the pin 79 into engagement with the percussion cap 78. Thus the explosive charge 76 is fired subsequent to the setting of the slips 66.

When the charge 76 is ignited the pressure generated above the plunger 28 moves the plunger and the mandrel 11 down with respect to the body 12. It is to be observed that the slips 66 gripping the interior of the object 0 positively hold the body 12 against upward movement. The downward movement of the mandrel 11 with respect to the body 12 results in breaking of the shear pin 39 and results in further projection of the knives 13. Prior to the firing of the charge 76 the knives 13 have their lower ends or corners resting on the upper end of a tubing section 41 and when the charge forcibly moves the mandrel 11 downwardly the end of the tubing section forms an abutment for the knives and causes the knives to be pivoted outwardly as they bodily move downwardly with the mandrel 11. Thus the knives 13 are projected to cut through the collar 42 somewhat in the manner shown in Fig. 9. As previously described, the knives 13 may be designed to wedge down between the collar 42 and the lower tubing section 41 connected therewith to release or weaken the threaded section. Where the knives 13 are projected out to cut through the collar 42 as shown in Fig. 9, they break or greatly weaken the collar 42.

Following the actuation of the tool as above described the tool is withdrawn from the object 0 by pulling it upwardly. Upon upward movement of the tool the mandrel 10 moves up and its enlargement 21 engages the bottom of the member 63 to move the member up with respect to the slips 66. This releases or retracts the slips 66 so that the tool is free for upward removal from the object 0. Following the removal of the tool from the well the portion of the object 0 above the collar 42 cut or parted by the knives 13 may be readily pulled from the well.

It is to be observed that the tool of the present invention may be operated while in the well without the imposition of heavy forces from the ground surface. The tool is fully actuated by merely raising and then lowering the operating string or line connected with it. The pressure generating means 16 is contained within the tool and is operable to supply sufficient force

for the actuation of the knives 13 without endangering any of the equipment.

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 well tool useful in parting the couplings of a tubular object in a well comprising a body to be entered in a tubular object in a well, knives associated with the body and operable outwardly to part or weaken the object, means urging the knives against the interior of the object to locate and engage in a coupling of the object, a charge of explosive carried by the body and operable when ignited to further actuate the knives to penetrate or spread the coupling, and means for firing the charge.

2. A tool useful in parting the couplings of a tubular object in a well comprising an assembly to be lowered into the object and including relatively movable members, a knife associated with the assembly and operable outwardly to part or weaken the object upon relative movement between said members, abutment means engaging the interior of the object and engaged by the knife to project the knife to locate and engage in a coupling of the object upon simultaneous movement of the members, means operable to engage the interior of the object to prevent movement of one of the said members, and means carried by the assembly operable to generate fluid pressure to move the other member following actuation of the last mentioned means to complete projection of the knife.

3. A tool useful in parting a tubular object in a well comprising a body to be entered in said object, a section shiftable with respect to the body, a cutting element carried by said section, means operable by downward movement of both the body and section to initiate engagement of the cutting element with the object, said element being further projectable upon relative movement between the body and section, slip means for gripping the interior of the object to positively hold the body against upward movement, and means for generating fluid pressure between opposing surfaces of the body and section to forcibly move the section downward subsequent to actuation of the slip means to further project the cutting element.

4. A tool useful in parting a tubular object in a well comprising a body to be entered in said object, a section shiftable with respect to the body, a cutting element carried by the section, means shiftably carried by the section engaging the object to have its movement resisted thereby and forming an abutment engageable by the cutting element to effect initial engagement of the element with the object, the cutting element being further projectable upon downward movement of the section, and means for generating fluid pressure between opposing parts of the body and section for moving the section downward following said initial engagement of the element with the object.

5. A tool useful in parting a tubular object in a well comprising a body to be entered in said object, a section to be entered in said object, a section shiftable with respect to the body, a cutting element carried by the section, means shiftably carried by the section engaging the object to have its movement resisted thereby and forming an abutment engageable by the cutting element to effect initial engagement of the element ther projectable upon downward movement of with the object, the cutting element being furthe section, means engageable with the object to hold the body against upward movement, and explosive means for moving the section downward subsequent to actuation of the last named means.

6. A tool useful in parting a tubular object in a well comprising a body to be entered in said object, a section to be entered in said object, a section shiftable with respect to the body, a cutting element carried by the section, means shiftably carried by the section engaging the object to have its movement resisted thereby and forming an abutment engageable by the cutting element to effect initial engagement of the element with the object, the cutting element being further projectable upon downward movement of the section, means engageable with the object to hold the body against upward movement, and explosive means for moving the section downward subsequent to actuation of the last named means, the explosive means comprising a cylinder in the body, an explosive charge in the cylinder and a plunger on the section acted on by said charge.

7. A tool useful in parting the couplings of a tubular object in a well comprising a body to be entered in the object, a section shiftably carried by the body, a cutter pivoted on the section to be projectable therefrom into contact with the object, abutment means frictionally engaging in the object engageable by the cutter to initiate projection thereof upon downward movement of the section with respect to the abutment means whereby the cutter may engage in a coupling upon movement of the tool in the object, anchor means operable to hold the body against movement, and fluid pressure generating means in the body for moving the section downward following actuation of the anchor means to complete projection of the cutter.

8. A tool for parting the couplings of a tubular object in a well comprising a body to be entered in the object, a section shiftably carried by the body, a projectable knife on the section engageable with the object and projectable upon downward movement of the section, and abutment means frictionally engaging in the object and engageable by the knife to project the same upon movement of the body relative to the abutment means whereby the knife may locate and engage in a coupling, explosive means in the body for moving the section downward to project the knife to part or weaken the coupling.

9. A tool for use in a tubular object in a well comprising a body to be entered in the object, an upper mandrel shiftable with respect to the body, a lower mandrel vertically shiftable with respect to the body, knives on the lower mandrel engageable with the object and projectable upon downward movement of the lower mandrel, fluid pressure generating means in the body operable to move the lower mandrel down, and means operable upon downward movement of the upper mandrel for actuating the last named means.

10. A tool for use in a tubular object in a well comprising a body to be entered in the object, an upper mandrel shiftable with respect to the body, a lower mandrel vertically shiftable with respect to the body, knives on the lower mandrel engageable with the object and projectable

upon downward movement of the lower mandrel, an explosive charge in the body for moving the lower mandrel down to project the knives, and means operable by downward movement of the upper section for firing the charge.

11. A tool for use in a tubular object in a well comprising a body to be entered in the object, an upper mandrel shiftable with respect to the body, a lower mandrel shiftable with respect to the body, knives on the lower mandrel engageable with the object and projectable upon downward movement of the lower mandrel, an explosive charge in the body for moving the lower mandrel down to project the knives, slip means engageable with the object to hold the body against upward movement, and means operable by downward movement of the upper section for firing the charge.

12. A tool useful in parting a tubular object in a well comprising a body to be lowered into the object, a knife part carried by the body for forcible projection therefrom, means for lowering and suspending the body, fluid pressure generating means carried by the body operable to forcibly project said part to break through or weaken said object, and control means operable by vertical movement of the lowering and suspending means for causing operation of the fluid pressure generating means.

13. A tool useful in parting a tubular object in a well comprising a body to be lowered into the object, a knife part carried by the body for forcible projection therefrom, means for lowering and suspending the body, fluid pressure generating means carried by the body operable to forcibly project said part to break through or weaken said object, means operable by vertical manipulation of the lowering and suspending means for engaging in the object to hold the body against movement when the pressure generating means is in operation, and a control operable by vertical manipulation of the lowering and suspending means for initiating operation of the fluid pressure generating means.

14. A tool useful in parting a tubular object in a well comprising a body to be entered into the object, a carrier shiftable relative to the body, a knife part carried by the carrier for forcible projection therefrom, cylinder and piston elements on the body and carrier, means for generating fluid pressure in the cylinder to cause movement of the carrier relative to the body, means for projecting said part when the carrier is moved relative to the body, means for lowering and suspending the body, and means operable by vertical manipulation of the last named means for operating the pressure generating means.

15. A tool useful in parting a tubular object in a well comprising a body to be entered into the object, a carrier shiftable relative to the body, a knife part carried by the carrier for forcible projection therefrom, fluid pressure generating means carried by the body operable to move the carrier relative to the body, means for projecting said part upon said movement of the carrier, suspending means for lowering and suspending the body in the well, means operable by vertical manipulation of the suspending means for operating the pressure generating means, and means operable by vertical manipulation of the suspending means for holding the body against movement in the object so that the full force of the pressure generated is utilized for the projection of said part.

16. A tool operable to part the couplings of a tubular object in a well and adapted to be operated on a flexible line, the tool comprising a body to be lowered into the object, a pivoted knife part connected with the body for pivotal projection therefrom, means for connecting the body with the line for operation and movement thereby, means operable by vertical manipulation of the line for initially projecting said part to engage in a coupling of the object, fluid pressure generating means carried by the body operable to forcibly project said part through the coupling, and means operable by vertical manipulation of the line for operating the fluid pressure generating means.

17. A tool operable to part the couplings of a tubular object in a well and adapted to be operated on a flexible line, the tool comprising a body to be lowered into the object, a knife part connected with the body for projection therefrom, means for connecting the body with the line for operation and movement thereby, means operable by vertical manipulation of the line for initially projecting said part to engage in a coupling of the object, fluid pressure generating means carried by the body operable to forcibly project said part through the coupling, slip means actuated by vertical manipulation of the line for holding the body against movement in said object so that the full force of the pressure generating means is utilized in the projection of said part, and means operable by vertical manipulation of the line for operating the fluid pressure generating means.

18. A tool useful in parting a tubular object in a well and adapted to be operated on a flexible line, the tool comprising a body assembly to be lowered into the object, means for connecting the body assembly with the line for lowering and operation thereby, gripping means carried by the body assembly operable by manipulation of the line to grip the interior of the object, a knife part carried by the body assembly for projection therefrom, means carried by the body assembly for generating fluid pressure, means operable by the pressure thus generated for projecting said part against the object, a control operable by vertical manipulation of the line for actuating the last named means, and means operable by by vertical manipulation of the line for retracting said gripping means and said knife part.

GLENN D. JOHNSON.