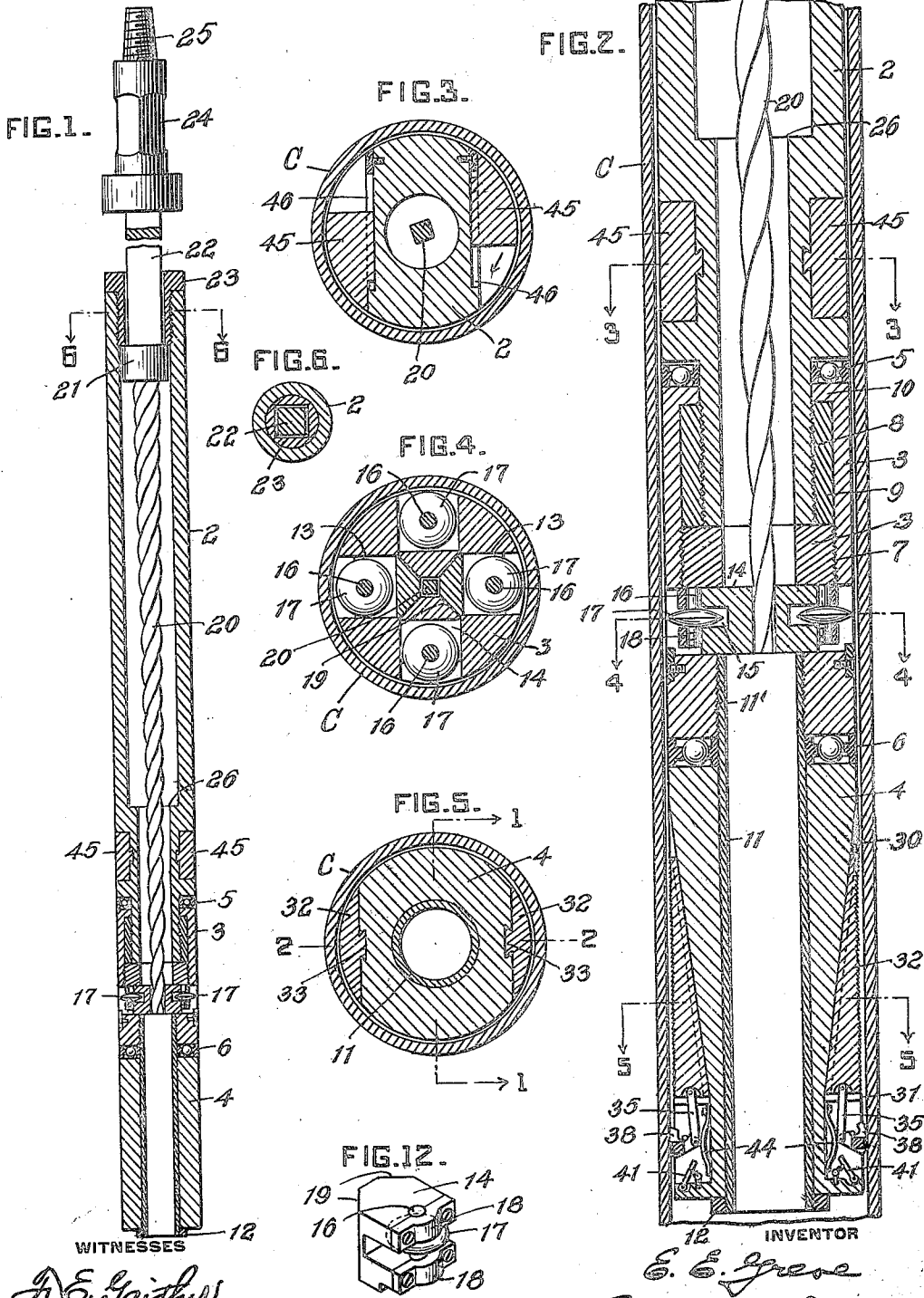


E. E. GREVE.
CASING CUTTER.
APPLICATION FILED MAR. 14, 1914.

Patented July 21, 1914.

2 SHEETS—SHEET 1.

1,104,492.



A. E. Gaithers.
Ellis M. Connell

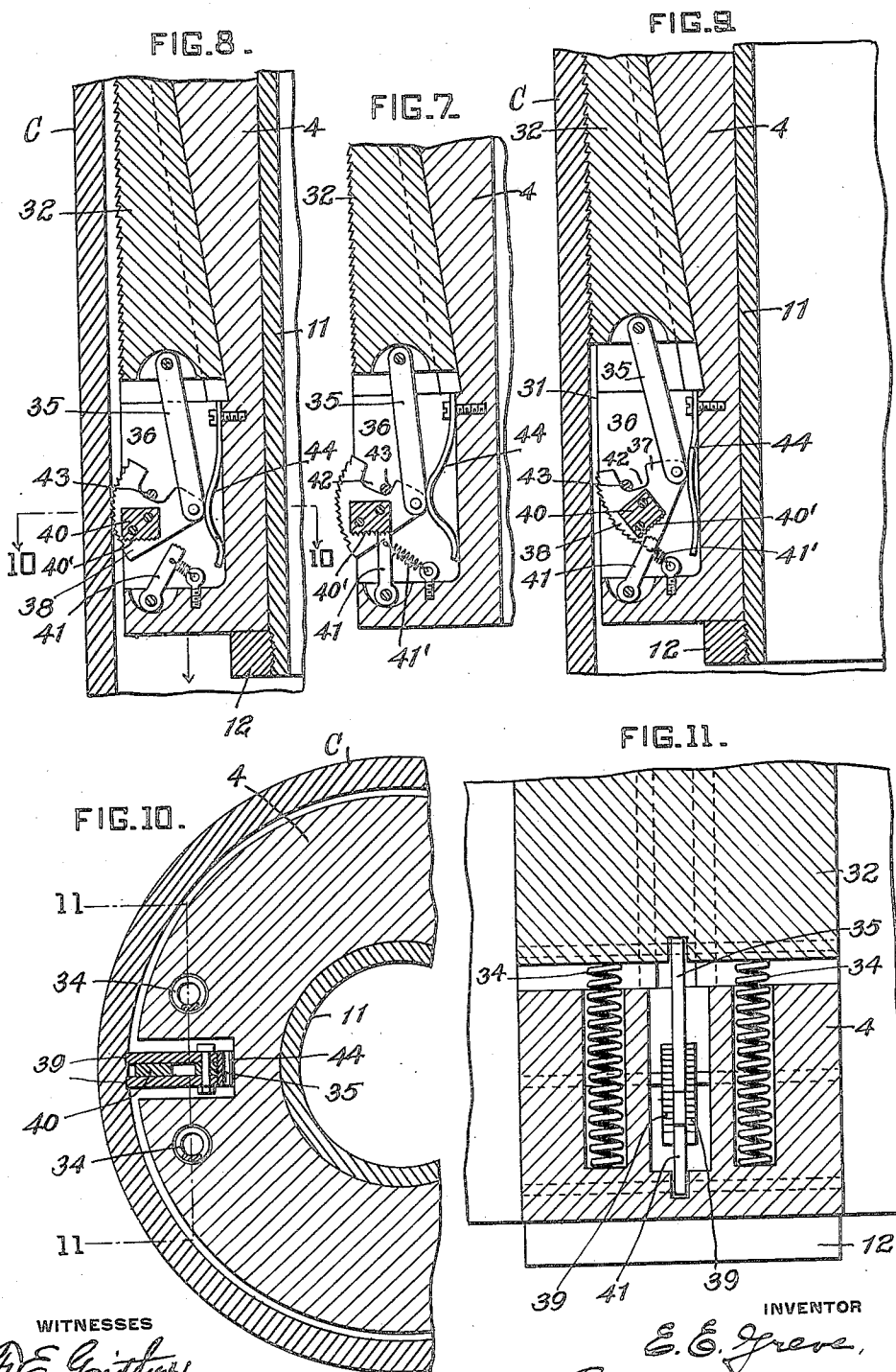
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UNITED STATES PATENT OFFICE.

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CASING-CUTTER.

1,104,492.

Specification of Letters Patent.

Patented July 21, 1914.

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To all whom it may concern:

Be it known that I, EDGAR E. GREVE, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Casing-Cutters, of which the following is a specification.

Implements for cutting casing in deep wells so that the portion above the cut may be removed are usually of complex construction, and in many instances their operation is slow, laborious, uncertain and costly, all this in addition to the considerable initial cost of a special tool of this class.

The primary objects of the present invention are to simplify the tool and render more certain its action; also to provide a tool that may be attached to a string of drilling tools and be operated by jarring blows imparted by the latter as distinguished from the heretofore necessary rotary motion applied at the upper end of the well for actuating the casing cutter.

The invention also includes improved means for supporting the cutter at any point in the well where the casing is to be cut, the supporting means being made operative by up and down movements of the tool accomplished by corresponding reciprocations of the supporting string of tubing or tools, all as hereinafter described.

Generally stated, the invention in its preferred adaptation is embodied in a tool body which is adapted to be supported by frictional engagement with the casing at any point where the casing is to be cut and provided with a rotatable carrier which supports laterally movable cutting devices, the latter being projected and the carrier rotated by the action of a spiral mandrel to which movement is imparted by jarring strokes of the drilling tools to which the casing cutter is connected.

In the accompanying drawings, Figure 1 is a vertical section of the improved casing cutter, the plane of section of the lower portion thereof being indicated by line 1—1 of Fig. 5. Fig. 2 is a vertical section on a larger scale of the lower portion of the tool with the parts in the positions they assume when being lowered in a string of casing, the plane of section of the lower portion of

the view being indicated by line 2—2 of Fig. 5. Figs. 3, 4 and 5 are sectional plan views taken on lines 3—3, 4—4, and 5—5, respectively, of Fig. 2. Fig. 6 is a sectional plan taken on line 6—6 of Fig. 1. Fig. 7 is a vertical section of one of the slip operating trip devices showing it in set position before being passed into the well casing. Fig. 8 is a vertical section of the lower portion of the tool supporting body and one of the slip operating trips, the latter being shown in the position it takes when lowering the tool in the casing, and Fig. 9 is a similar view showing the position of the trip after the tool has been lowered to the point where the casing is to be cut, the tool having been raised slightly to accomplish the slip-releasing operation of the trip devices. Fig. 10 is a sectional plan taken on line 10—10 of Fig. 8. Fig. 11 is a vertical section of the trip mechanism taken on line 11—11 of Fig. 10. Fig. 12 is a detail of one of the cutter slides.

Referring to the drawings, the tool body is of elongated tubular form and consists of the upper section or portion 2, the intermediate rotatable carrier section 3, and the anchoring or supporting section 4, ball bearing races 5 and 6, respectively, being interposed between sections 2 and 3, and 3 and 4.

Carrier section 3 is formed in two parts, one above the other and connected by the screw joint 7, and for connecting the carrier section to the upper body section 2, the lower extremity of the latter is reduced and threaded at 8 to receive sleeve 9, and the upper end of this sleeve engages internal shoulder 10 of the upper portion of carrier section 3 and holds it against the upper ball race 5.

The lowermost or anchoring body section 4 is connected to the carrier section 3 by tube 11 which is threaded at its upper end at 11' to the bore of carrier 3, the tube extending through body section 4 and rotatable therein and at its lower end carrying stop 12 which holds section 4 from longitudinal displacement and with ball race 6 confined in proper position, all as shown in Fig. 2.

The tubular carrier section 3 has the radial passages 13 which provide ways for the radially movable slides 14. The outer por-

tion of each slide is slotted horizontally at 15 and journaled therein on a vertical pin 16 is the disk cutter 17, the latter secured in position on the slide by cap plates 18.

5 The inner ends 19 of slides 14 are tapered so as to fit or nest together as shown in Fig. 4 and form a vertical angular passage, with each slide having a face exposed in and constituting a wall of the passage. With 10 the tool positioned or anchored within casing C, as hereinafter described, carrier 3 is rotated and simultaneously therewith slides 14 are projected radially and cutters 17 are caused to score and cut the casing, ordinarily 15 a complete rotation of the carrier and corresponding traverse of the cutters being sufficient to sever the casing. These simultaneous movements of the carrier and cutter-carrying slides are accomplished by means of 20 a downwardly tapering spirally twisted mandrel 20 which moves vertically in the passage formed by the inner ends 19 of slides 14. The blank or bar of which mandrel 20 is formed is of angular section, preferably square as shown in Fig. 4, to present 25 a flat face to each of the four cutter-carrying slides. With the parts constructed and co-operating as shown, it will be seen that the downward movement of spiral mandrel 20 (the latter being held from rotating as will 30 presently be described) operates to rotate carrier 3 through the medium of slides 14, and the taper of the mandrel serves to project the slides gradually but definitely and 35 positively at a rate sufficient to hold them in cutting engagement with the casing until the latter is severed, but without, however, projecting them so rapidly as to cause them to stick or bind in the score or cut formed 40 in the casing.

While the construction shown is a desirable adaptation, it will be understood that the invention is not restricted to a tool having four cutter carriers, nor to a twisted 45 mandrel which in the blank is square in cross section.

Mandrel 20 depends from a head 21 which loosely fits the bore of body 2, this head being carried by a stem 22 angular in 50 cross section which is adapted to move vertically through the angular bore in bushing 23 secured in the upper end of body portion 2, the bushing forming an abutment for head 21 so that when stem 22 is fully 55 raised as in Fig. 1 the entire tool is supported for lowering into a well or for withdrawal therefrom. The upper extremity of stem 22 is enlarged into the usual well tool coupling formation, embodying wrench hold 60 24 and the usual coupling pin 25, whereby the tool may be connected as may be most convenient to a string of drilling tools which includes jars of any description, or it may be connected to jars alone, it being only nec- 65 essary that the supporting and operating

tools, not shown, be capable of imparting the downward stroke or blow to stem 22 necessary to accomplish the above described operation of the cutters and cutter carrier. The angular formation of stem 22 and bush- 70 ing 23 prevent rotation of mandrel 20 while actuating the cutters, the downward limit of the cutter actuating stroke being defined by the internal abutment 26 which is engaged by head 21. 75

The mechanisms for anchoring the tool in cutting position and for holding body section 2 from rotating will now be described. The exterior of lower body section 4 is flattened to form the diametrically opposite up- 80 wardly diverging slipways 30, each terminating at its lower end in the shoulder or abutment 31 and movable vertically on each of these ways is an upwardly tapering slip 32 held in sliding engagement with the slip- 85 way by the dove-tail rib 33. Bearing upwardly on the lower end of each slip are the coiled springs 34 seated in sockets in abutment 31 and operating when the slip is released to raise it into casing-impinging position, as shown in Fig. 9. Each of the slips 90 is held depressed or contracted against the pressure of the springs, as in Fig. 8, by a link 35 which extends downwardly into a laterally open slot or cavity 36 in abutment 31 with the lower end of the link pivoted to 95 the rear side of the floating jaw 37, the front edge or face 38 of this jaw being serrated and projecting from slot 36 to impinge the casing, as will presently be described. Jaw 100 37 is preferably formed of two like plates 39, Fig. 10, which are spaced apart but securely united by a block 40. The lower edge 40' of this block is serrated and is adapted to be engaged by the pivoted prop 41 for 105 holding the jaw in set position, as in Fig. 7, movement of the jaw, as presently described, operating to release the prop and permit it to drop back under the pull of 110 spring 41'. The top face of jaw 38 is recessed at 42 to afford the jaw a floating movement around pin 43 bridging slot 36.

In the set position of the jaw shown in Fig. 7, its position prior to entering the tool 115 in the casing, the rear portion of depression 42 is in engagement with pin 43, the rear side of the jaw is depressed and with it link 35 and slip 32, and prop 41 is in engagement with block 40. This position of the parts is maintained by the stout leaf spring 44 in the rear of slot 36, from which position jaw 37 cannot turn in response to the upward pressure of springs 34. But as soon as the tool 120 is entered in casing C, the downward or lowering movement thereof causes the curved projecting jaw edge 38 to impinge against the casing, and the turning or rocking movement resulting from this impingement moves the jaw on pin 43 to the position 125 shown in Fig. 8, thereby releasing prop 41, 130

and this engagement of the jaw with the casing maintains the parts in the position shown in Fig. 8 throughout the lowering movement of the tool and so holds slip 32 depressed.

5 When, however, the tool has been lowered to the point at which it is desired to cut the casing, it is given a slight upward movement, sufficient to reverse the impinging rocking motion of jaw 37, and with prop 41
10 out of the way this upward movement causes the impinging face 38 of the jaw to move downwardly and the jaw as a whole to move backwardly and upwardly around pin 43 until the latter engages the front of depression 42, as shown in Fig. 9, and the resulting
15 upward movement of the rear portion of the jaw permits link 37 to move sufficiently to permit slip 32 to rise under the influence of springs 34 and securely impinge against the casing, as in Fig. 9. The slight upward
20 movement of the tool is now discontinued and it is permitted to settle between the wedging slips 32, the latter securely holding the lower body portion 4 and thus forming
25 an unyielding support or anchorage for the tool.

The tool having been anchored, the cutting operation may proceed as above described by so manipulating the string of tools as to
30 cause the jars embodied therein to impart a downward blow to stem 24, and the resulting depression of mandrel 20 causes the latter to at once rotate carrier portion 3 of the body and project the cutters. Any tendency of the
35 mandrel and of stem 22 to rotate due to the resistance of the cutters is prevented by the segmental slips 45 movable horizontally in ways 46 on the exterior of body portion 2, so that if body 2 starts to rotate these slips
40 grip or clutch the casing, as in Fig. 3, and lock the tool body against such movement. And as stem 22 and the bore of bushing 23 are angular in cross section, the stem is prevented from turning independently of the
45 body.

The pitch and taper of the spiral mandrel are preferably such as to cause the cutting elements to revolve and expand in a definite manner. The cutting elements obviously
50 make a complete rotation with each complete pitch convolution, and the degree of taper is such that ordinarily the traverse of a complete convolution of the spiral through or between the cutting elements is sufficient to
55 so project the latter as to completely sever the casing. And ordinarily this may be accomplished by a single blow of the jars, although it will be understood that if necessary the entire length of the mandrel may be
60 utilized in order to obtain rotation and projection of the cutters sufficient to sever the casing; likewise any necessary number of blows may be imparted to the tool.

I claim:

65 1. In a casing cutter, the combination of a

rotatable carrier, cutters movable laterally in the carrier, a downwardly tapered spirally twisted mandrel movable vertically between the cutters and operating to rotate and laterally move the same, and mandrel operating means. 70

2. In a casing cutter, the combination of a rotatable carrier, cutters, cutter supports slidable laterally in the carrier, a downwardly tapered spirally twisted mandrel
75 movable vertically between and engaging the inner ends of the cutter supports for moving them laterally and for rotating the carrier, and mandrel operating means.

3. In a casing cutter, the combination of casing cutting means rotatable about a vertical axis and also movable laterally, and means made operative by vertical blows for rotating and moving laterally the cutting means. 80

4. In a casing cutter, the combination of cutting means rotatable about a vertical axis, a support for the rotatable cutting means, and a device movable vertically relatively to the cutting means and operatively engaging
85 the latter for rotating the same.

5. In a casing cutter, the combination of cutting means rotatable about a vertical axis, a support for the rotatable cutting means, and a vertically movable non-rotatable spiral
95 device operatively engaging the cutting means with its spiral formation operating to rotate the latter.

6. In a casing cutter, the combination of a carrier rotatable about a vertical axis, a support for the carrier, cutters rotatable with and movable laterally relatively to the carrier, and a tapered vertically movable spiral device cooperating with the cutters to move them laterally and to rotate the carrier. 100

7. In a casing cutter, the combination of a tubular carrier rotatable about a vertical axis, a support for the carrier, cutters, cutter-carrying slides rotatable with and movable laterally of the carrier, and a tapered
105 vertically movable non-rotatable spiral mandrel adapted to move vertically between and engage the cutter-carrying slides and move them laterally and at the same time rotate the carrier. 110

8. In a casing cutter, the combination of a vertically hollow carrier rotatable about a vertical axis and formed with radially disposed slideways, a support for the carrier, cutters, cutter-carrying slides movable in the
120 slideways, the inner ends of the slides shaped to fit together and form a mandrel passage with each slide having a face exposed in said passage, and a downwardly tapered non-rotatable spiral mandrel movable vertically in said slide-formed passage with the faces of the mandrel engaging the slides for moving them radially and at the same time rotate the carrier. 125

9. In a casing cutter, the combination of 130

a vertically hollow body, means for supporting the body within a well casing and for holding it from rotating therein, a hollow carrier mounted on the body and rotatable about a vertical axis, cutting devices rotatable with and movable laterally relatively to the carrier, and means movable vertically in the body and carrier and operating to rotate the carrier and to move the cutter devices laterally.

10. In a casing cutter, the combination of a vertically hollow body, means for supporting the body within a well casing and for holding it from rotating therein, a vertically hollow carrier supported by the body and rotatable about a vertical axis, the carrier formed with slideways, cutters, cutter-carrying slides movable in the slideways, a vertically movable non-rotating stem fitting in the hollow body, and a downwardly tapering mandrel of spiral form depending from the stem and operatively engaging the slides for moving them laterally and for rotating the carrier.

25 11. In a casing cutter, the combination of a carrier formed with a vertical passage and rotatable about a vertical axis, a support for the carrier, cutters, cutter-projecting devices supported by and movable radially of the carrier with the inner ends of said devices shaped to combine in forming a passageway with each device having a face exposed in the passageway, and a mandrel movable vertically in said passageway and consisting of a longitudinally tapered bar angular in cross section and twisted spirally with the spiral faces adapted to engage the cutter-sustaining devices and move them radially and at the same time rotate the carrier.

40 12. In a casing cutter, the combination of a vertically hollow body, means for supporting the body within well casing and for holding it against rotation, a vertically hollow carrier supported by the body and rotatable about a vertical axis, cutter devices rotatable with the carrier and movable laterally thereon, the hollow body having a passage above the carrier angular in cross-section, a stem angular in cross-section and fitting and movable vertically in said passage, and means carried by the stem and co-operating with the cutter devices to move them laterally and also to rotate the carrier as the stem moves vertically.

55 13. In a casing cutter, the combination of an elongated tubular body consisting of a lower or anchoring section, an intermediate rotatable carrier section and an upper non-rotatable section, means for anchoring the lowermost section within well casing, cutter devices movable laterally and rotatable with the carrier, means for holding the uppermost body section from rotating in the casing, and a non-rotating device movable vertically in the uppermost body section and

coöperating with the cutter devices to move them laterally and to rotate the carrier.

14. In a casing cutter, the combination of an elongated tubular body consisting of an upper section, an intermediate rotatable carrier section constituting a downward continuation of the upper section, an anchoring section forming a downward continuation of the carrier section and connected to the latter with the carrier section rotatable relatively thereto and to the upper section, means for securing the anchoring section within a well casing, laterally movable cutter devices rotatable with the carrier section, means for holding the upper body section from rotating in the casing, and a non-rotatable mandrel movable vertically in the tubular body and coöperating with the cutter devices to move them laterally and to rotate the carrier section of the body.

15. In a casing cutter, the combination of a tubular body having an abutment adjacent to its upper end, a carrier movable vertically with the body and rotatable about a vertical axis, means for supporting the body within a well casing, cutters movable laterally relatively to the carrier and rotatable therewith, a stem movable vertically in the body and provided with a shoulder adapted to engage said internal abutment for supporting the body when the latter is unsecured to the casing, and a device depending from the stem and coöperating with the cutter devices to move them laterally and to rotate the carrier when the stem moves vertically within the body.

16. In a casing cutter, the combination of an elongated tubular body consisting of a non-rotating upper portion, an intermediate rotatable carrier portion, and a lower anchoring or supporting portion, casing-engaging slips movable vertically on said lower body portion, means actuated by the vertical movement of the body for operating the slips, cutter devices rotatable with the carrier and movable relatively thereto, and cutter-actuating and carrier-rotating means movable vertically in the body.

17. In a casing cutter, the combination of an elongated tubular body consisting of a non-rotating upper portion, an intermediate rotatable carrier portion, and a lower anchoring or supporting portion, means for securing the lower portion within a well casing, casing cutting means rotatable with and movable relatively to the carrier-forming portion, slips movable on the upper body portion and adapted to engage the casing and hold said portion from rotating, and cutter-actuating and carrier-rotating means movable vertically in the body.

18. The combination with a well tool, of an anchoring device carried by the tool and adapted to provide a support therefor, the anchoring device having vertical slipways,

slips movable on said ways and adapted when released to engage the casing, devices carried by the anchoring device and adapted when set to hold the slips retracted, said devices adapted to frictionally engage the casing and operated by said frictional engagement to release the slips.

19. The combination with a vertically movable well tool, of an anchor carried by the tool and adapted to provide a support therefor within a well casing, the anchor provided with vertical slipways, wedging slips movable on said ways, springs for projecting the slips into wedging position, trip devices operating to hold the slips out of wedging position, the trip devices adapted to frictionally engage the well casing, devices for holding the trip devices in set position with the slips retracted, the frictional engagement of the trip devices with the casing during the downward movement of the tool operating to release the trip-holding devices from set position, and the frictional engagement of the trip devices with the casing when the tool is moved upwardly operating to so move the released trip devices as to re-

lease the slips to the action of the slip-actuating springs.

20. The combination with a vertically movable well tool, of an anchoring device movable vertically with the tool and adapted to provide a support therefor, the anchoring device having vertical slipways, slips movable on said ways and adapted when released to engage the casing, a trip device for each slip operatively connected thereto and having a floating movement on the anchoring device, the trip device adapted to frictionally engage the casing with the frictional engagement operating to so move the trip device during the lowering of the tool as to hold the slip retracted, the floating movement of the trip device when the tool is elevated operating to release the slip for wedging engagement with the casing.

In testimony whereof, I affix my signature in presence of two witnesses.

EDGAR E. GREVE.

Witnesses:

J. M. NESBIT,
F. E. GAITHER.