C. E. FREDERICKSON.

PIPE PERFORATOR.

APPLICATION FILED OCT. 8, 1910.

1,015,432.

Patented Jan. 23, 1912.

4 SHEETS—SHEET 1.

Fig. 1.

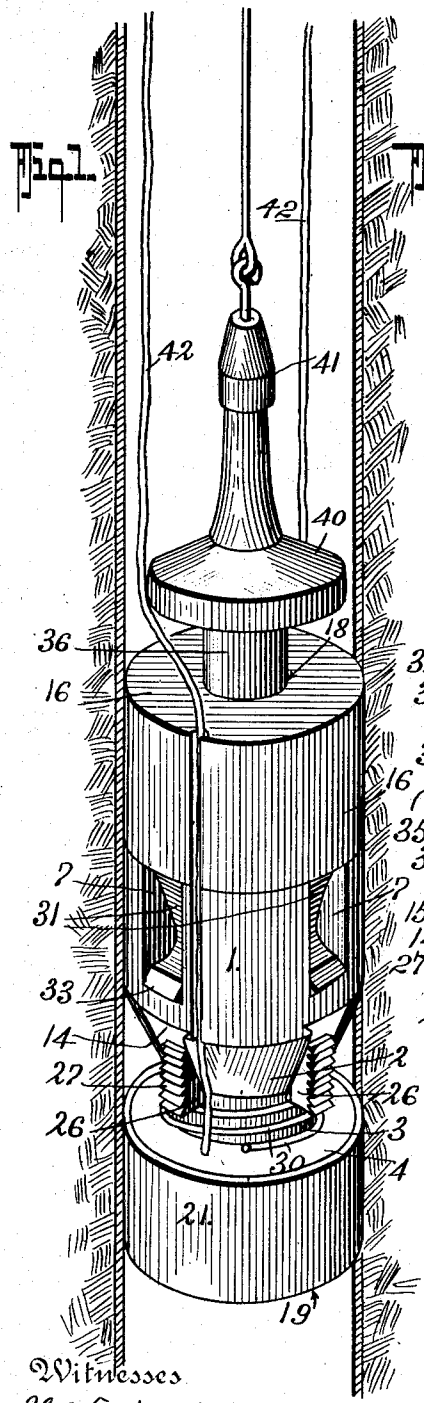
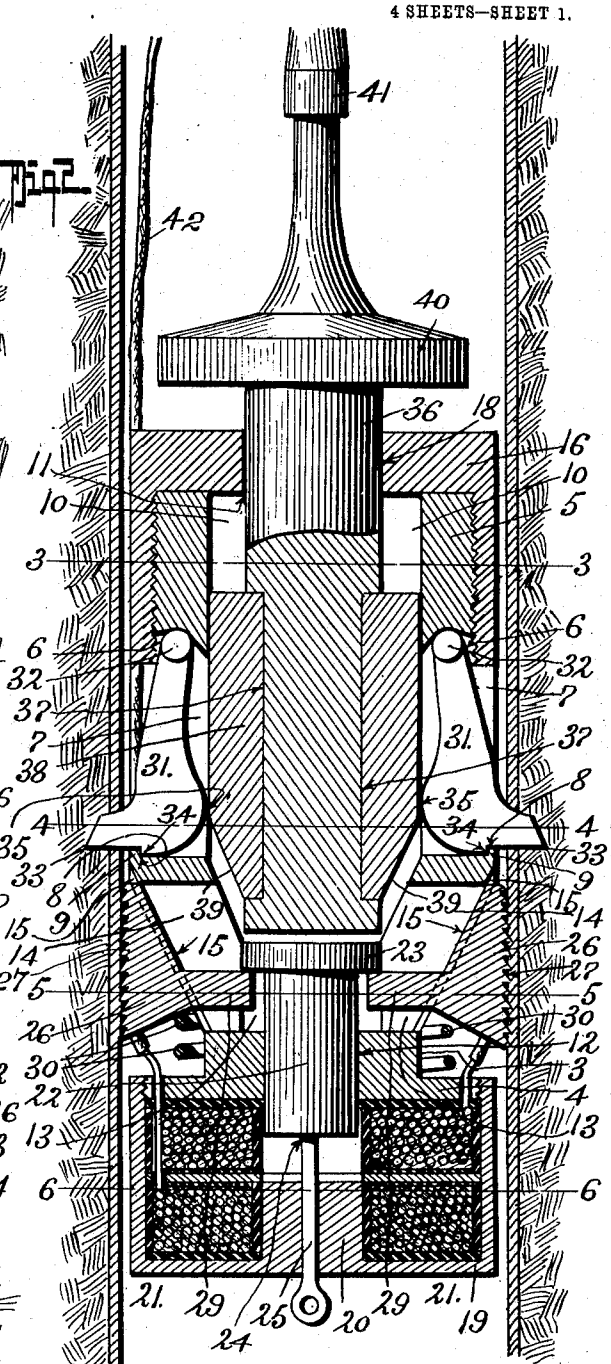


Fig. 2.



Witnesses

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4 SHEETS—SHEET 2.

Fig. 3.

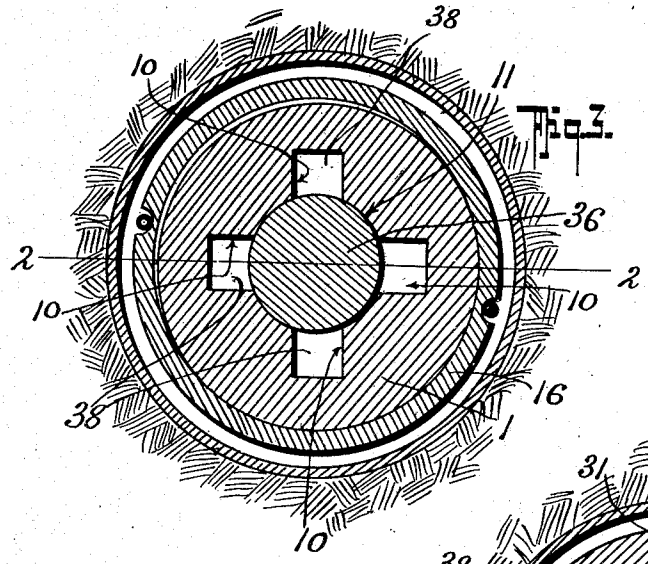


Fig. 4.

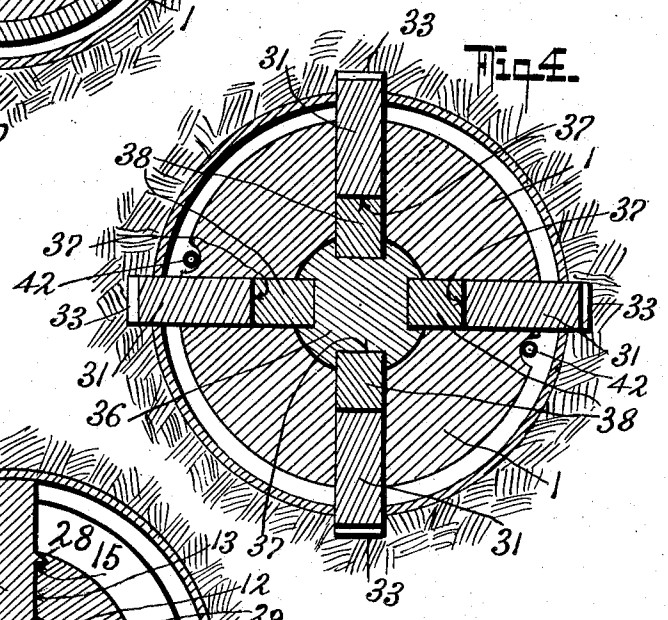
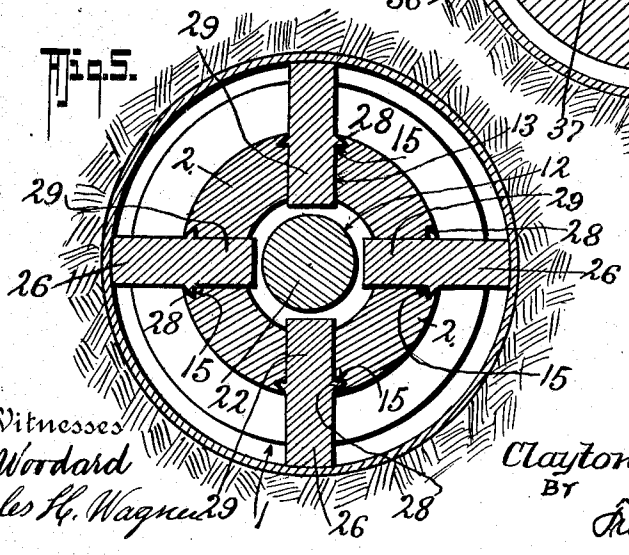


Fig. 5.



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4 SHEETS—SHEET 3.

Fig. 11.

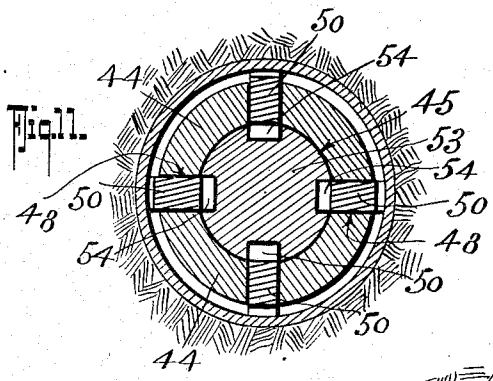


Fig. 12.

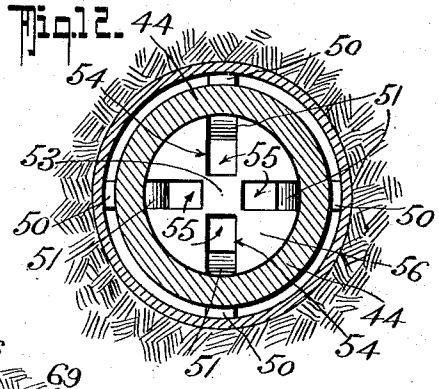


Fig. 13.

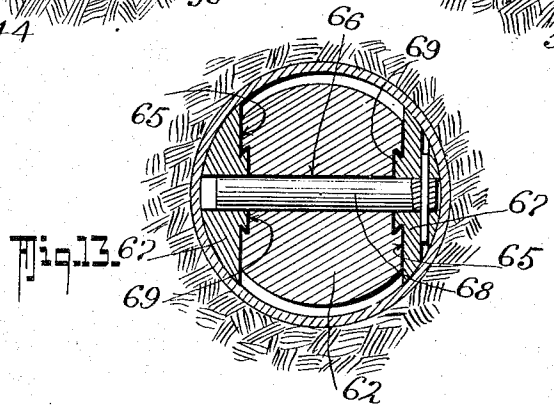


Fig. 7.

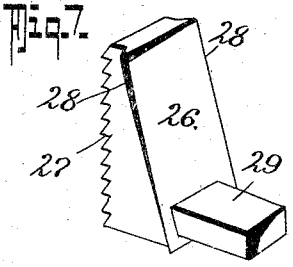


Fig. 6.

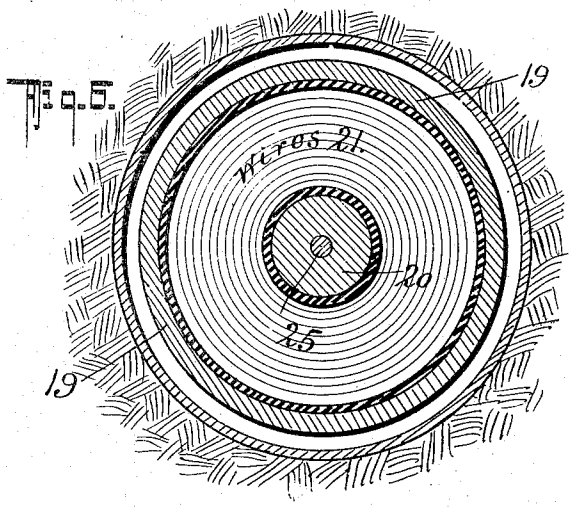
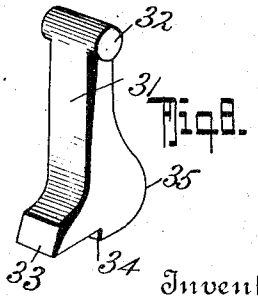


Fig. 8.



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1,015,432.

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4 SHEETS—SHEET 4.

Fig. 9.

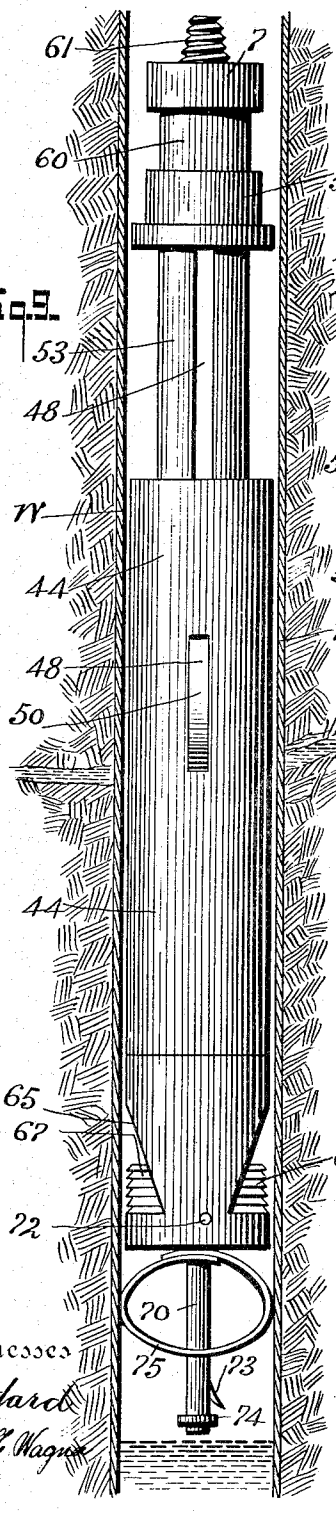
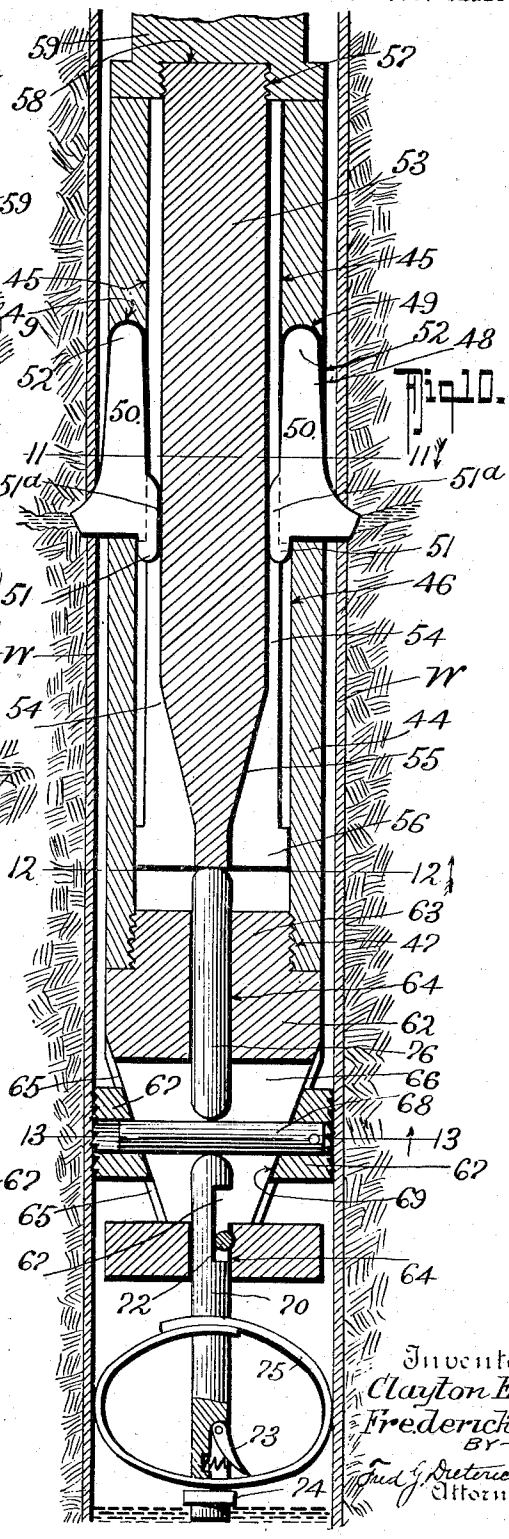


Fig. 10.



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UNITED STATES PATENT OFFICE.

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PIPE-PERFORATOR.

1,015,432. Specification of Letters Patent. Patented Jan. 23, 1912.

Application filed October 8, 1910. Serial No. 586,107.

To all whom it may concern:

Be it known that I, CLAYTON E. FREDERICKSON, residing at Coalinga, in the county of Fresno and State of California, have invented a new and Improved Pipe-Perforator, of which the following is a specification.

My invention relates to the art of pipe perforators and cutters and it particularly has for its object to provide a device for cutting holes or slots in oil well tubing and the like.

Generically, the invention includes a support having grippers to engage the inner wall of the tubing, and devices for holding the grippers inactive; the casing having cutter devices mounted on the same, while a cam carrying plunger operates within the casing to force the cutters outwardly and cause them to penetrate the tubing walls at the desired places. The plunger also includes means whereby the device may be struck a succession of blows when the cutters have penetrated the tube to cause them to cut the slots in the tubing.

In its more detailed nature the invention also resides in those novel details of construction, combination and arrangement of parts, all of which will be hereinafter fully described, specifically pointed out in the appended claims and illustrated in the accompanying drawings, in which:—

Figure 1, is a perspective view of my invention in use, the well tubing and well being shown in section. Fig. 2, is a central vertical longitudinal section on the line 2—2 of Fig. 3. Fig. 3, is a cross section on the line 3—3 of Fig. 2. Fig. 4, is a cross section on the line 4—4 of Fig. 2. Fig. 5, is a cross section on the line 5—5 of Fig. 2. Fig. 6, is a cross section on the line 6—6 of Fig. 2. Fig. 7, is a detail perspective view of one of the grippers. Fig. 8, is a detail perspective view of one of the cutters. Fig. 9, is a side elevation of another form of my invention, the well tubing and well being shown in section, and the device being lowered into the well ready for setting. Fig. 10, is an enlarged central vertical longitudinal section and part elevation of the device showing the device set and the holes punched into the well tubing. Figs. 11, 12 and 13 are cross sections on the lines 11—11, 12—12 and 13—13 respectively, on Fig. 10.

Referring now to the accompanying drawings in which like numerals and letters of reference indicate like parts in all the figures, 1 designates the casing of my apparatus whose lower portion is reduced by a coni-formed section 2 and further reduced by a cylindrical section 3 which terminates in a threaded flange 4.

The main body of the casing 1 has an upward extension 5 which is threaded to receive a cap 16, hereinafter again referred to. The casing 1 is provided with a series of longitudinal slots 7 which merge with transverse slots 6 to form, as it were, T-slots. The slots 6 and 7 communicate radially with the internal bore of the casing and at their lower ends the slots 7 are undercut as at 8 to form shoulders 9 for a purpose hereinafter to appear.

The bore 11 of the casing 1 has guideways 10 which aline with the slots 7 in and into which the radial splines 38 of the plunger 36 hereinafter again referred to, operate.

At its lower end the casing 1 has its central bore reduced as at 12 to receive a movable armature member 22 whose flange 23 works in the main bore 11 of the casing 1, as clearly indicated in Fig. 2 of the drawings.

Alining with the slots 7 but not in communication with the same are additional slots 14 in the coni-formed section 2 of the casing, which slots 14 have undercut edges 15 to form, as it were, a dove-tail in cross section, the slots 14 merging with openings 13 at the lower end of the coni-form section 2 through which openings the lugs 29 of the grippers 26 project.

The cap 16 is internally threaded to screw onto the threaded end 5 of the casing 1 and has a bore 18 to register with the bore 11 of the casing 1.

19 designates a housing for the electromagnet 21, the housing 19 being such as to form with the magnet 21 an iron clad magnet and the housing 19 is internally threaded to receive the threaded flange 4 of the casing 1 which acts as a closure for the housing 19. The housing 19 is provided with a cross section 20 for the magnet 21 that coöperates

with the movable armature 22 in a manner hereinafter more fully explained.

25 is an adjusting bolt that is passed through the core 20 and is threaded into a tap 24 of the armature 22 and by means of which the movement of the armature 22 is limited.

26 are the grippers which have the external serrated faces 27 and are provided with the dove-tailed portions 28 to enter dove-tailed slots 15.

The grippers 26 have lugs 29 which are adapted to be engaged by the flange 23 of the armature 22 and move the grippers 26 inwardly when the magnet 21 is energized, the grippers 26 being moved upwardly under the influence of the spring 30 that is carried on the section 3 of the casing.

31 designates the cutters whose trunnions 32 lie in the cross slots 6 of the casing 1 and are held therein by the cap 16 when screwed home. The cutters 31 lie in the slots 7 and they are provided with the penetrating edges 33, the shoulders 34 that engage the shoulders 9 when the cutters are in their outermost position, and the cutters are further provided with the cam surfaces 35 that cooperate with the splines 38 of the plunger 36.

The splines 38 have their forward ends beveled as at 39 to coöperatively engage the cam surfaces 35 of the cutters 31 and move such cutters outwardly when the plunger 36 is lowered. The plunger 36 is of cylindrical form and has radial recesses 37 to receive the splines 38 which snugly fit in such recesses and operate in the grooves 10 of the casing 1. The plunger 36 is also formed with a head 40 that is adapted at times to rest against the upper end of the cap 16 and the plunger 36 is continued above the head 40 and terminates in a threaded union 41 to which the well rod is connected in the usual manner.

So far as described, the manner in which the present form of my invention operates is best explained as follows: Assume that it is desired to cut holes in a well tubing for any purpose whatever, the operator causes electric energy to pass into the magnet 21 to energize the same, the energy entering into leading wires 42 from any suitable source of supply. The energization of the magnet 21 causes the armature 22 to draw in, thereby moving the grippers 26 downwardly and inwardly toward the central longitudinal axis of the device. The apparatus is then lowered into the well as indicated in Fig. 1 of the drawings. Inasmuch as the casing 1 and its attached parts are suspended from the plunger 36, the plunger 36 will move with its head 40 away from the cap 16 and consequently permit the cutters to lie within the bounds of the casing 1. As soon as the device has been lowered to the proper place the energy of the magnet 21 is cut off, thereby releasing the armature 22 and permitting the grippers 26 to be forced upwardly and outwardly by the spring 30. This causes the grippers 26 to engage the walls of the well and the weight of the apparatus will then assist the spring 30 in holding the grippers 26 in engagement with the well walls. The plunger 36 is next lowered until the head 40 engages the cap 16. This movement causes the splines 38 to travel downwardly until the cutters 31 are forced outwardly into engagement with the well tubing and penetrating the wall thereof. Should it be desired to slot the well walls after the cutters 31 have been forced through the well walls the magnet is again energized, thus releasing the grippers 26 from engagement with the well wall and by reciprocating the plunger 36 and causing its head 40 to impact the cap 16, the apparatus can be forced downwardly while the cutters 31 are extended and thereby slit the well tubing through as long a distance as may be required. To remove the apparatus from the well, it is only necessary to pull up on the plunger 36 when the device will readily disengage itself from the well walls and can then be easily withdrawn.

In Figs. 9 *et seq.*, I have disclosed another form of my invention in which the electromagnetic setting mechanism is done away with and mechanical devices substituted in lieu thereof.

By referring now more particularly to Figs. 9, *et seq.* it will be seen that the casing 44 of this form of my invention is centrally bored from its upper end as at 45 which bore is enlarged or counter-bored at 46 and tapped at 47 at its lower end. The casing 44 is slotted at 48 to receive the cutters 50, the upper end of the slots 48 being concaved as at 49 to receive the convexed ends 52 of the cutters 50, the cutters 50 having shoulders 51 to limit their outward movement and having portions 51^a to enter the longitudinal slots 54 of the plunger 53 which works in the bore 45 with its head 56 operating in the counter-bore 46 of the casing 44. At its lower end the plunger 53 has its slots 54 deepened to form inclines 55 so that the cutters 50 may close into the casing 44 when the plunger 53 is drawn upwardly with respect to the casing. The plunger 53 is threaded at 57 at its upper end to fit into a threaded opening 58 of the collar 59 of the cap 60, to which cap at 61 a swivel joint for the suspending cable may be attached. 62 designates a gripper head or spear which has a threaded projection 63 to thread into the threaded end 47 of the casing 44 and form a closure therefor, the gripper carrying head 62 having a central bore 64 in which a releasing pin 76 and a setting pin 70 operate. The head 62 is cut away as at 65 on an incline

and slotted through as at 66 to receive a connecting pin 68 of the grippers 67 which have a tongue and groove sliding connection 69 with the head 62, as indicated, it being understood that the pin 68 may be fastened to one of the grippers 67 and slide loosely in a hole in the other gripper so that the grippers 67 may separate or draw together as they are moved in one direction or the other by the pins 70 or 76 as the case may be. The pin 70 projects into the slot 64 from its lower end and is cut away as at 67 to pass the dowel 72 that limits the movement of the pin 70 in the bore 64. 75 is a coil leaf spring which is pierced at its ends and middle by the pins 70 and is loosely slidable thereon, the movement of the spring 75 being limited in one direction by a collar 74 of the pin 70 and adapted to be retained in a definite position by the latch device 73 at times, it being understood that the transverse or spreading dimension of the spring 75 is greater than that of the head 62 or casing 44 so as to frictionally engage the wall of the well tubing when the tool is being lowered into the well tube. In operating this form of my invention the spring 75 is released from engagement with the pawl 73 and moved above such pawl, the pin 70 being drawn down to its lowest position permitting the pins 76 to be moved down with the grippers inwardly away from the wall of the well tubing. At this time also the casing 44 will be suspended on the plunger 53 whose head 56 will at this time be at the uppermost limit of the counter-bore 46 so that the cutters 50 will locate in the depressions 55 of the plunger and come within the external boundaries of the casing 44. The device is lowered into the well. The spring 75 frictionally engages the walls of the well tube but inasmuch as it has free movement on the pin 70 and being above the latch 73 as shown in Fig. 9 it will not disturb the position of the pin 70. The tool having been lowered to the desired position, the operator starts to raise up on the tool. As the tool is raised, the spring 75 being in frictional engagement with the well tube, will slide down on the pin 70 until it passes the latch 73 by which it will be retained. As soon as the spring 75 has passed latch 73, the operator relieves the suspending cable to lower the device, whereupon the pin 70 being held stationary by the spring 75 will move the pin 68 upwardly thereby forcing the grippers 67 upwardly and outwardly to engage the wall of the well. As soon as the grippers 67 engage the well wall the weight of the device will be sufficient to hold the grippers against the well wall owing to their serrated faces. Lowering of the suspending cable after the grippers 67 have caught, causes the plunger 55 to travel downwardly in the casing 44, thereby forcing the cutters 50 outwardly, thereby causing them to penetrate the walls of the well tubing W and make the required cut. A further lowering of the plunger 55 causes the head 56 to engage the pin 76 and release the grippers 67, thus allowing an impacting action to be imparted to the casing 44 and force the cutters 50 downwardly to slit the well tube W, as will be clearly understood by reference to the drawings.

To remove the device from the well it is only necessary to draw up on the suspending cable when the plunger 55 will extend out of the casing 44 and permit the cutters moving into the casing as the casing 44 is pulled upwardly and at the same time the grippers 67 will be released.

From the foregoing description, taken in connection with the accompanying drawings, it is thought the complete construction, operation and advantages of my invention will be readily apparent.

What I claim is:

1. In a device of the class described, a casing, a cutter mounted in said casing, said casing having an opening through which said cutter may be projected, and reciprocable means operating within said casing for forcing said cutter out of said casing, means at the bottom of said casing for sustaining said casing in a well tube and means forming a part of said reciprocable means for impacting said casing when said reciprocable means is reciprocated after said cutter has been forced out of the casing, to cause said cutter to cut a slit.

2. In a device of the class described, a casing, a cutter mounted in said casing, said casing having an opening through which said cutter may be projected, and reciprocable means operating within said casing for forcing said cutter out of said casing, and means for impacting said casing to cause said cutter to cut a slit.

3. In a device of the class described, a casing, a cutter mounted in said casing, said casing having an opening through which said cutter may be projected, and reciprocable means operating within said casing for forcing said cutter out of said casing, means at the bottom of said casing for sustaining said casing in a well tube, and means governed by said reciprocating means for releasing said sustaining means, and an impacting member carried by said reciprocable means for impacting the casing and thereby forcing said casing downwardly to cause said cutter to slit the well tube.

4. In a well perforating apparatus, a casing, a plunger reciprocable in said casing and projecting through one end of said casing, means for limiting the movement of said plunger out of said casing, a cutter

mounted in said casing, said plunger having a groove into which said cutter projects, said plunger having a pocket merging with said groove, in which said cutter may lie when said plunger and casing are extended, said plunger serving to force said cutter out of said casing to perforate the well wall when said plunger is telescoped into said casing, and means for holding said casing in position in the well tube while said cutter is being forced outwardly to penetrate the well tube.

5. In a well perforating apparatus, a casing, a plunger reciprocable in said casing and projecting through one end of said casing, means for limiting the movement of said plunger out of said casing, a cutter mounted in said casing, said plunger having a groove into which said cutter projects, said plunger having a pocket merging with said groove in which said cutter may lie when said plunger and casing are extended, said plunger serving to force said cutter out of said casing to perforate the well wall when said plunger is telescoped into said casing, and gripper devices carried by said casing for engaging the well wall to sustain said casing in position.

6. In a well perforating apparatus, a casing, a plunger reciprocable in said casing and projecting through one end of said casing, means for limiting the movement of said plunger out of said casing, a cutter mounted in said casing, said plunger having a groove into which said cutter projects, said plunger having a pocket merging with said groove, in which said cutter may lie when said plunger and casing are extended, said plunger serving to force said cutter out of said casing to perforate the well wall when said plunger is telescoped into said casing, and means for holding said casing in position in the well tube while said cutter is being forced outwardly to penetrate the well tube and means controlled by said plunger for releasing said sustaining means to permit said casing to be moved downwardly while said cutter is extended to slit the well tube.

7. In a well perforating apparatus, a casing, a plunger reciprocable in said casing and projecting through one end of said casing, means for limiting the movement of said plunger out of said casing, a cutter mounted in said casing, said plunger having a groove into which said cutter projects, said plunger having a pocket merging with said groove in which said cutter may lie when said plunger and casing are extended, said plunger serving to force said cutter out of said casing to perforate the well wall when said plunger is telescoped into said casing, and gripper devices carried by said casing for engaging the well wall to sustain said casing in position, and means controlled by said plunger for releasing the said grippers at times to permit said casing to be driven downwardly to cause said cutter to slit the well tube.

8. In a well tube perforating device, a casing, a plunger telescopically mounted in said casing, and adapted to be extended out of said casing, means for limiting the outward movement of said plunger, a cutter mounted within said casing, said casing having an opening through which said cutter is adapted to project, means carried by said plunger for forcing said cutter through said opening when said plunger is telescoped into said casing, gripping devices carried by said casing for engaging the well tube wall to retain said casing in position, and means controlled by said plunger for releasing said gripping devices after said cutter has penetrated the well wall.

9. In a well tube perforating device, a casing, a plunger telescopically mounted in said casing, and adapted to be extended out of said casing, means for limiting the outward movement of said plunger, a cutter mounted within said casing, said casing having an opening through which said cutter is adapted to project, means carried by said plunger for forcing said cutter through said opening when said plunger is telescoped into said casing, gripping devices carried by said casing for engaging the well tube wall to retain said casing in position, and means controlled by said plunger for releasing said gripping devices after said cutter has penetrated the well wall, and other means for holding said gripping devices inactive while said casing is being lowered into the well tube.

10. In a well tube perforating device, a casing, a plunger telescopically mounted in said casing, and adapted to be extended out of said casing, means for limiting the outward movement of said plunger, a cutter mounted within said casing, said casing having an opening through which said cutter is adapted to project, means carried by said plunger for forcing said cutter through said opening when said plunger is telescoped into said casing, gripping devices carried by said casing for engaging the well tube wall to retain said casing in position, and other means for holding said gripping devices inactive while said casing is being lowered into the well tube.

11. In a well tube perforating device, a casing, a plunger telescopically mounted in said casing, and adapted to be extended out of said casing, means for limiting the outward movement of said plunger, a cutter mounted within said casing, said casing having an opening through which said cutter is adapted to project, means carried by said plunger for forcing said cutter through said opening when said plunger is tele-

scoped into said casing, gripping devices carried by said casing for engaging the well tube wall to retain said casing in position, and other means for holding said gripping devices inactive while said casing is being lowered into the well tube, said last named means comprising electromagnetically actuated mechanism for engaging said gripping devices to hold them in their inoperative position.

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