Sept. 7, 1943. P. T. BYNUM 2,328,782

FLUID WELL PERFORATOR

Filed May 23, 1941

Fig. 1.

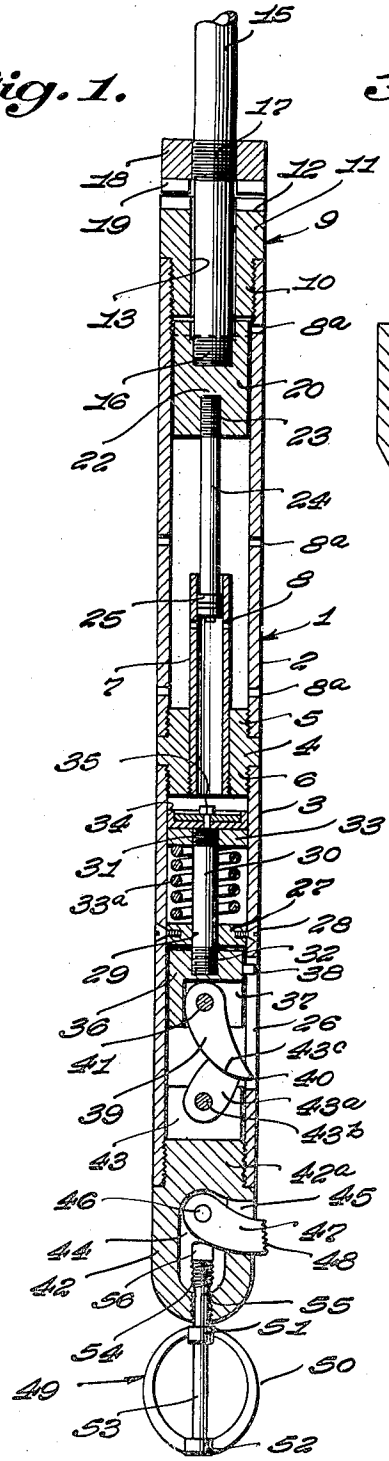


Fig. 3.

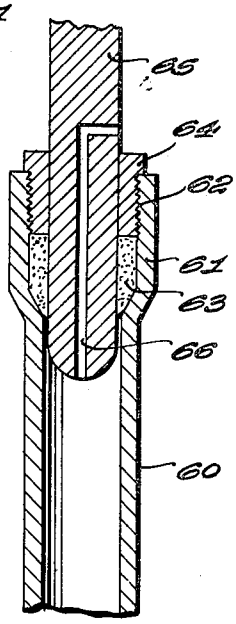


Fig. 4.

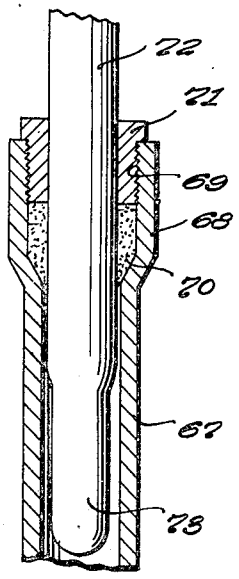


Fig. 2.

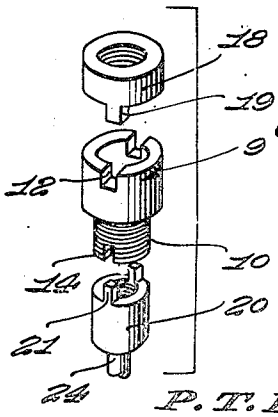
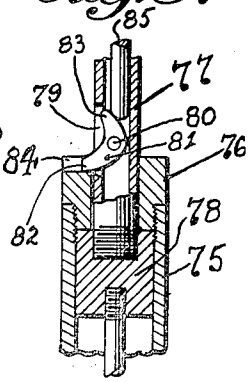


Fig. 5.



Inventor

P. T. Bynum

By Lacey & Lacey.

Attorneys

& PUNCHING
EETS & BARS,

Patented Sept. 7, 1943

2,328,782

UNITED STATES PATENT OFFICE

2,328,782

FLUID WELL PERFORATOR

Pink T. Bynum, Beeville, Tex.

Application May 23, 1941, Serial No. 394,949

24 Claims. (Cl. 164—0.4)

This invention relates to cutting tools and more particularly to an improved fluid well-perforator.

One object of the invention is to provide a fluid well-perforator which may be lowered within a well casing to any desired depth, and wherein fluid operated means is employed for perforating the casing at said desired depth.

Another object of the invention is to provide a device of this character having perforating mechanism of such durable construction that it will be possible to perforate a well casing repeatedly without withdrawing the device from the casing with the result that maximum economy and efficiency will be had from the use of the device.

A further object of the invention is to provide a fluid well-perforator wherein the perforating mechanism is so constructed that but a relatively small amount of fluid pressure will be required for causing the perforator knife employed to perforate an elongated slot in casings of the heaviest weights.

Still another object of the invention is to provide a fluid well-perforator having safety means for positively preventing premature actuation of the perforator knife.

A further object of the invention is to provide a tool of the character described employing venting means for permitting reciprocating movement of fluid between the well bore or casing and the cylinder.

Another object of the invention is to provide a fluid well-perforator wherein means is employed for controlling the amount of penetration.

And a still further object of the invention is to provide a fluid well-perforator which employs improved means for directing the perforator knife outwardly against the wall casing.

Still further objects of the invention will be apparent as the description proceeds.

In the drawing:

Figure 1 is a vertical sectional view of my improved fluid well-perforator,

Figure 2 is a detail perspective view showing the locking collar, the cylinder head and the plunger head,

Figure 3 is an enlarged detail sectional view showing a modified plunger construction,

Figure 4 is an enlarged detail sectional view, partly in elevation, showing another modified plunger construction, and

Figure 5 is a detail vertical sectional view showing safety means of modified construction.

In the drawing similar reference numerals are used to designate similar parts in Figures 1 and 2.

My improved fluid well-perforator includes a cylinder which is indicated generally by the numeral 1. The cylinder 1 includes upper and lower sections 2 and 3 having their meeting ends connected by a coupling element 4. The coupling element includes an upper threaded portion 5, which is screwed into the lower end of the cylinder section 2, and a lower threaded portion screwed into the upper end of the cylinder section 3. Mounted axially within the coupling element and extending upwardly into the section 2 of the cylinder 1 is an operating cylinder 7. The operating cylinder has an externally threaded end portion which is screwed into the coupling element. The upper end of the cylinder 7 is formed with vents 8. Further reference to the operating cylinder will be made hereinafter.

Formed in the section 2 of the cylinder 1 are vents 8ª, the purpose for which will be set forth later on in the description of this invention.

In order to close the upper end of the section 2, I provide a cylinder head 9 which includes a reduced threaded shank 10 and a body 11 which is formed at its upper end with slots 12. Extending throughout the length of the cylinder head 9 axially thereof is a bore or opening 13. As best seen in Figure 2, the threaded portion 10 of the cylinder head is formed with slots 14. It is desired to point out that the slots 12 and 14 are diametrically opposed.

Normally slidably mounted within the upper section 2 of the cylinder 1 is an operating stem 15. The operating stem is slidable through the opening 13 in the cylinder head and is provided with a threaded lower end portion 16. Also, the stem is provided with a slightly enlarged threaded portion 17 on which is normally screwed a locking collar 18. Formed on the lower surface of the locking collar are tongues 19 which are engageable in the slots 12 for a purpose to be described in more detail hereinafter. Screwed on the threaded lower end portion 16 of the operating stem 15 is a plunger head 20, said plunger head, as best seen in Figure 2, including upwardly projecting diametrically opposed tongues 21 which are engageable in the slots 14 for a purpose to be set forth in more detail hereinafter. The plunger head 20 is formed with an axially disposed internally threaded bore 22 which extends from its lower face upwardly, and screwed into the bore 22 is the threaded upper end portion 23 of a plunger 24, said plunger having its lower end portion extending into the cylinder 7 and having

packing rings 25 on its lower end within said cylinder 7.

Formed in the section 3 of the cylinder 1 substantially medially of its ends is a longitudinally extending slot 26 and mounted in the said section 3 between the upper end of the slot 26 and the upper end of said section is a bushing 27, said bushing being held rigidly in the cylinder by screws 28. Formed in the bushing is an axial opening 29 and slidable in the opening is a stem 30, said stem having threaded upper and lower end portions 31 and 32 respectively. Operatively connected with the upper end portion of the stem is a piston 33, said piston having the usual packings 34 which are held in place by means of an axially extending bolt 35. Confined between the piston 33 and the bushing 27, and surrounding the stem 30, is a compression spring 33a. Screwed on the lower end of the stem 30 is a mounting element 36 which is formed with a recess 37 which opens at one side of the element and confronts the slot 26. A pin 38 is carried in the element 36 and is slidably mounted in the slot 26 for retaining the element 36 against horizontal displacement with respect to the slot.

Pivotally mounted in the recess 37 of the mounting element 36 is a perforator knife 39. As will be seen, the perforator knife is of arcuate configuration and terminates at its free end in a point 40. A pivot pin 41, which extends transversely through the element 36 and through the recess 37, pivotally mounts the knife on said element. As will be seen clearly in Figure 1, the point 40 of the knife extends slightly into the slot 26. It should be understood that the position of the knife with respect to the slot is dependent upon the position of the piston 33. However, the knife is always mounted with its point disposed toward the slot.

In order to close the lower end of the cylinder 1, I provide a plug 42 which is formed with a reduced externally threaded portion 42a which is screwed into the lower end of the section 3. Formed on the portion 42a is a yoke 43 and pivotally mounted in the yoke is a cam 43a. The cam 43a is pivotally mounted in the yoke 43 by means of a pivot pin 43b and said cam is formed with an arcuate end face 43c which is normally engaged with the lower arcuate surface of the knife 39. The pivoting of the cam 43a not only tends to reduce wear on the upper crest of said cam but also insures accuracy of cut of the perforator knife and said cam acts as a guide for the knife. The plug 42 is formed with a recess 44 and communicating between the upper end of the recess and the exterior of the plug is a slot 45. Pivotally mounted within the recess 44 by means of a pin 46 is an anchoring element 47, said anchoring element being of arcuate shape and having a serrated free end face 48. As will be seen, the anchoring element is formed with an arcuate lower surface, the purpose for which will be set forth presently.

My improved fluid well-perforator includes a retainer assembly which is indicated generally at 49. The retainer assembly includes arcuate arms 50, which are resilient and of bowed shape and which have their mid-portions engageable with the wall of a well casing for releasably retaining the entire device at a desired level within said well casing. The retainer assembly also includes collars 51 and 52 which engage the corresponding free ends of the arms 50. Rigidly mounted in the collar 52 and extending slidably through the collar 51 is a plunger 53, said plunger having a threaded portion 54 near its upper end, which threaded portion is normally screwed into an internally threaded opening 55 in the lower end of the plug 42. The plunger 53 terminates at its upper end in a hardened head 56 which is engageable, under certain conditions, with the arcuate surface of the anchoring element 47 for shifting said anchoring element outwardly whereby the serrated surface 48 thereof will engage the wall of the well casing and anchor the device in place at a desired level within said well casing.

The operation of my improved fluid well-perforator will now be set forth. The device is first placed in a well casing to be perforated and is moved downwardly by means of the operating stem 15. The locking collar 18 will engage the upper surface of the cylinder head 9, during movement of the device downwardly within the well casing toward operative position, for preventing premature actuation of the perforator knife. The arms 50 of the retainer assembly 49 will frictionally engage the wall of the well casing so that, as soon as downward movement of the stem 15 is stopped, the device will be held against further downward movement. After the device has been moved to a level at which a perforation is to be made, and it is desired to anchor the device at said level, the stem is rotated. If necessary, said stem is raised slightly for assuring that the tongues 21 will engage in the slots 14. Inasmuch as said tongues are engaged in the slots when the stem is rotated, the entire cylinder will be rotated. However, the retainer assembly will be held against rotation by frictional engagement of the arms 50 with the wall of the well casing as the cylinder is rotated. Therefore, the threaded portion 54 is unscrewed from the threads 55 for releasing the plunger 53. The stem 15 is then released for permitting the cylinder to shift downwardly slightly against the retainer assembly. The weight of the downward shifting cylinder will urge the plunger or stem 53 upwardly for engaging the hardened head 56 with the curved surface of the anchoring element. When this takes place, the anchoring element will be shifted outwardly so that its serrated face will be engaged with the wall of the well casing. Thus, the device will be anchored against further downward movement and is in position for a perforating operation.

In order to effect the perforating operation, it is first necessary to disengage the locking collar 18 from the stem 15. To accomplish this, the stem 15 is lowered until the tongues 19 engage in the slots 12. The collar 18 will thus be locked on the cylinder head. The stem is then rotated for disengaging the threaded portion 17 thereof from the collar, when said stem will be released and will be allowed to move downwardly within the upper section 2 of the cylinder. Downward movement of the stem will, of course, impart like movement to the plunger head 20 and to the plunger 24. It should be understood that a suitable amount of liquid will always be retained within the operating cylinder so that, when the plunger is shifted downwardly, the column of liquid within the operating cylinder will be shifted downwardly and against the piston 33. The piston 33 will be forced downwardly within the section 3 of the cylinder 1 and against the tension of the spring 33a. Downward movement of the piston will shift the stem and the mounting element downwardly with the result that the perforator knife 39 will be shifted downwardly

and outwardly, by means of the cam 43a, to engage the point 40 with the wall of the well casing with the result that an elongated slot will be punched in said wall.

After the plunger 24 has been raised, the spring 33a will urge the piston 33 upwardly for withdrawing the knife to retracted position. In view of the fact that I have provided the vents 8and 8a, circulation of fluid between the cylinder and the wall of the well casing, and within the cylinders 1 and 7, will take place and upward movement of the piston will not be retarded. Moreover, said vents permit unretarded movement of the plunger 24 and the plunger head 20. However, it is desired to call attention to the fact that the vents 8 are arranged near the upper end of the cylinder 7 so that there will be no interference with the proper operation of the plunger 24 when moving downwardly in said cylinder 7.

When it is desired to remove the device from a well casing after a perforating operation, it is only necessary to raise the cylinder 1 upwardly, when the threaded portion 54 will again be engaged with the threaded opening 56. The cylinder is then rotated, by means of the stem 15, the plunger head 20 and the cylinder head 9, for locking the plunger 53 in its lowermost position and releasing the anchoring element 47 from the wall of the well casing.

In Figure 3 I have shown a slightly modified operating cylinder construction. In this view the numeral 60 indicates an operating cylinder which functions for the same purpose as the cylinder 7 in the preferred embodiment of the invention. The cylinder 60 is provided with an enlarged upper end 61 which is formed with an internally threaded portion 62. Placed in the enlarged upper end portion 61 is packing 63 and retaining said packing in place is a packing gland 64. Slidable though the packing gland and into the cylinder 60 is a plunger 65 which serves the same purpose as the plunger 24. In order to vent the plunger 65, when it approaches the upper limit of its travel, I provide a bore 66 which extends axially of the plunger and which communicates between the lower end of the plunger and a point along the wall of said plunger in spaced relation to the lower end of said plunger. This bore will serve the same purpose as the vents 8 and the plunger and cylinder will, as stated, operate in a manner identical with that of the preferred embodiment of the invention.

In Figure 4 I have shown still another embodiment of the invention. In this embodiment the numeral 67 indicates an operating cylinder which serves the same purpose as the cylinder 7. The cylinder 67 is formed with an enlarged upper end 68 which is formed with an internally threaded portion 69. Carried in the portion 68 is packing 70 and retaining said packing in place is a gland 71. Slidable through the gland is a plunger 72 which serves the same purpose as the plunger 24. However, in order to vent the cylinder 67, I provide a reduced lower end portion 73 for the plunger 72. In operation, when the plunger 72 approaches the upper limit of its travel, the reduced portion will be disposed within the gland 71. Liquid will be permitted to pass between the reduced portion and the gland and thus escape into the cylinder 1. The cylinder 67 is thus vented.

It is desired to call attention to the fact that the spring 33a will maintain the liquid at proper level within the cylinder 7 so that the device will be ready to operate immediately upon release of the operating stem 15 from the collar 18.

It is also desired to direct attention to the fact that the amount of penetration of the knife may be controlled by movement of the plunger 24. In other words, the farther downwardly the plunger is moved within the cylinder 7 the greater the amount of penetration of the knife 39 in the wall of the well casing. As has been pointed out hereinbefore, the cam 43a, with the arcuate surface 43c thereon will operate to direct the knife 39 outwardly at all times.

Attention is also directed to the fact that, as that the cylinder 7 is relatively small, but a small column of liquid will be needed to shift the piston 33. The advantage for this construction is twofold, i. e., practically no weight is caused to bear against the knife 39 when said plunger is in inoperative position. Therefore, the knife will be retained in proper position at all times. In addition, in view of the small column of liquid, but a relatively small amount of pressure will be required to actuate the piston 33.

Figure 5 discloses modified safety means for preventing premature actuation of the perforator knife and for placing the device in operative condition. The numeral 75 indicates the upper end of a cylinder identical with the cylinder 1. Closing the cylinder 75 at its upper end is a cylinder head 76 and extending into the cylinder head is a hollow operating stem 77. The operating stem is connected with a plunger head 78 similar to the plunger head 20. Formed in the side of the operating stem 77 near its lower end is a slot 79 and pivotally mounted in the slot, by means of a pin 80, is a latch 81, said latch having arms 82 and 83. The arm 82 is engageable in a notch 84 which is formed in the head 76, for holding the operating stem in inoperative position. The arm 83 of the latch 81 is formed with a curved outer surface which is, when the latch is in latched position, disposed obliquely with respect to the length of the stem. Movably mounted in the stem is a go-devil 85. When it is desired to release the arm 82 of the latch 81 from the notch 84, the go-devil is allowed to plunge downwardly through the operating stem 77. The go-devil will strike the curved surface of the leg 83 of the latch with the result that said latch will be swung about the pivot 80 for disengaging the end of the leg 82 from the notch. The stem 77 will thus be permitted to slide through the head 76. The go-devil will continually bear against the latch and prevent said latch from accidentally engaging in the notch 84 when the device is in use. Of course, when it is desired again to return the device to inoperative condition, the go-devil is withdrawn upwardly through the stem. After this has been done and the stem has been raised so that the plunger head is in its uppermost position, the arm 82 of the latch will tilt outwardly into engagement with the notch 84, for retaining the device in inoperative position.

It is believed that further description of my invention is unnecessary.

Having thus described the invention, what is claimed as new is:

1. A fluid well-perforator including a cylinder, a cylinder head closing the cylinder at its upper end, a stem slidable through the cylinder head, a plunger head on the stem within the cylinder, a perforator knife in the cylinder, and fluid operated means between the perforator knife and the plunger head and operable upon downward move-

ment of the stem for projecting the perforator knife to perforate a casing wall, said fluid operated means including an enclosed operating cylinder fixed to the first mentioned cylinder and a plunger in the operating cylinder, said plunger being connected with the stem.

2. A fluid well-perforator including a cylinder, a cylinder head closing the cylinder at its upper end, a stem slidable through the cylinder head, a plunger head on the stem within the cylinder, a perforator knife in the cylinder, fluid operated means between the perforator knife and the plunger head and operable upon downward movement of the stem for projecting the perforator knife to perforate a casing wall, and means displaceably mounted on the stem for positively locking the stem against premature downward shifting movement of said stem and plunger head.

3. A fluid well-perforator including a relatively large cylinder, a cylinder head closing the cylinder at its upper end, an operating stem having its lower end extending through the cylinder head, a plunger head within the cylinder and connected with the lower end of the operating stem, a relatively small enclosed operating cylinder fixed to the first mentioned cylinder, a plunger slidable in said operating cylinder and having its upper end connected with the plunger head, a perforator knife, a piston slidable in the first-mentioned cylinder beneath the operating cylinder, and means operatively connecting the piston with the perforator knife, said plunger being slidable within the operating cylinder upon downward movement of the operating stem and plunger head for shifting fluid against the piston whereby said piston will be shifted downwardly for projecting the perforator knife to engage a wall of a well casing for perforating the same.

4. A fluid well-perforator including a cylinder, a cylinder head closing the cylinder at its upper end, said cylinder head having an upper end portion formed with a slot and a lower end portion also formed with a slot, an operating stem having a threaded portion at its lower end and another threaded portion near its lower end, a locking collar screwed on said second-mentioned threaded portion and having a tongue, a plunger head within the cylinder and screw on the first-mentioned threaded portion, said plunger head having a tongue, and means pivotally mounted within the cylinder and operable upon downward movement of the operating stem for perforating the wall of a well casing, said locking collar being engageable with the cylinder head for preventing premature operation of said last-mentioned means and the tongue of said plunger head engaging the slot in the lower end of said cylinder head for rigidly connecting the operating stem and cylinder to turn as a unit, said tongue on the locking collar engaging in the slot in the upper end of the cylinder head for locking the slot against rotation with the stem whereby, when said stem is rotated, said stem will be freed from the locking collar for downward movement within the cylinder for displacing the tongue on the plunger head from the slot in the lower end of the cylinder head and permitting operation of said last-mentioned means.

5. A fluid well-perforator including a cylinder, a perforator knife pivotally mounted in the cylinder for projection therefrom, an operating stem having its lower end slidable in the cylinder, an enclosed operating cylinder fixed to the first-mentioned cylinder above the perforator knife, a plunger in the operating cylinder and connected with the operating stem, and fluid operated means within the first-mentioned cylinder and operable upon movement of the operating stem for projecting the perforator knife to perforate the wall of a well casing.

6. In a fluid well-perforator, a pivotally mounted perforator knife having a fixed center movement, fluid operated means for shifting the knife about its pivot, and a pivotally mounted cam disposed beneath the knife and slidably engageable therewith for directing the point of said knife outwardly to engage the wall of a well casing.

7. In a fluid well-perforator as recited in claim 6 wherein the free end of said cam has an arcuate face for slidable engagement with an arcuate surface of the perforator knife.

8. In a fluid well-perforator as recited in claim 6 wherein said cam has an arcuate face for engagement with an arcuate surface of the perforator knife, and means mounting the cam beneath said perforator knife for pivotal movement about a fixed center.

9. A fluid well-perforator including a cylinder, a cylinder head closing the cylinder at one end, an operating stem having its lower end slidable through the cylinder head, a plunger head on the stem, a perforator knife within the cylinder and pivotally mounted for projection from the cylinder, fluid operated means connected between the plunger head and the perforator knife and being operable upon downward movement of the plunger head and stem for shifting the plunger knife, said fluid operated means including an enclosed operating cylinder fixed in the first mentioned cylinder, and a plunger connected with the plunger head, and means in the first-mentioned cylinder and engageable with the knife for directing said knife outwardly to perforate the wall of a well casing.

10. A hydraulic perforator including a cylinder, a cylinder head closing the cylinder at its upper end, a perforator knife pivotally mounted in the cylinder for projection therefrom, an operating stem having a portion thereof slidable through the cylinder head, a plunger head on the operating stem within the cylinder, fluid operated means connected between the plunger head and the perforator knife and operable upon downward movement of the stem for projecting the perforator knife to engage and perforate the wall of a well casing, means locking the stem, plunger head and cylinder to turn as a unit, and means on the operating stem for preventing premature shifting movement of the operating stem and consequent actuation of the perforator knife, said means being displaceable by rotation of the stem for freeing the shaft and said penultimate mentioned means for permitting displacement of the stem and plunger head from the cylinder.

11. A fluid well-perforator including a cylinder, a stem supporting the cylinder within a well casing, means carried by the cylinder and frictionally engaging the wall of the well casing for retaining the cylinder at a desired level within the well casing, and anchoring means carried by the cylinder and operated by said friction means for anchoring the cylinder in the casing at said desired level, said cylinder being movable with respect to the friction means to permit resetting thereof at another desired level in the well casing.

12. A fluid well-perforator including a cylinder, perforating means carried by the cylinder, a plug closing the cylinder at its lower end, means

operatively connected with the plug and frictionally engageable with the wall of a well casing for releasably retaining the cylinder in a set position in the well casing, anchoring means carried within the plug and shiftable by said friction means upon rotation of the cylinder for engagement with the wall of the well casing for anchoring the device in set position in the well casing.

13. A fluid well-perforator including a cylinder, perforating means carried by the cylinder, a plug closing the cylinder at its lower end, an anchoring element pivotally mounted within the plug and projecting from one side thereof, and a retainer assembly carried by the plug and having arms frictionally engageable with the wall of a well casing for releasably retaining the device at a desired level within the well casing, said retainer assembly having a stem screwed into the lower end of the plug and being releasable upon rotation of the cylinder and movable upwardly for engagement with the anchoring element for urging said anchoring element into engagement with the wall of the well casing for anchoring the device against displacement at the desired level within the well casing.

14. A fluid well-perforator including a cylinder having sections, a cylinder head closing the cylinder at its upper end, a coupling element connecting the sections of the cylinder, an operating cylinder carried by the coupling element, a stem having a portion slidable through the cylinder head, a plunger head connected with the stem within the cylinder and above the operating cylinder, a plunger carried by the plunger head and slidable in the operating cylinder, means formed in the first-mentioned cylinder for permitting, circulation of liquid therethrough, said cylinder having a slot formed therein beneath the coupling element, a perforator knife, means pivotally mounting the perforator knife for projection through the slot for engagement with the wall of a well casing, a piston slidable in the cylinder beneath the operating cylinder, fluid in the operating cylinder above the piston, and means connecting said piston with said last-mentioned means, said piston being movable within the cylinder by pressure of the fluid in the operating cylinder and above the piston for shifting said mentioned means and knife upon downward movement of the plunger within the operating cylinder, said plunger being shiftable downwardly by downward movement of the stem and plunger head.

15. A fluid well-perforator including a cylinder comprising upper and lower sections, a coupling element connecting the sections, an operating cylinder carried by the coupling element and projecting into the upper section, a plunger slidable in the operating cylinder, a piston slidable in the lower section, a perforator knife pivotally and slidably mounted within the lower section, means operatively connecting the knife with the piston, said piston being movable downwardly by pressure of fluid in the operating cylinder upon downward movement of the plunger, and means in the lower section for directing the perforator knife outwardly to perforate the wall of a well casing upon downward movement of the piston.

16. A fluid well-perforator including a cylinder comprising upper and lower sections, a coupling element connecting the sections, an operating cylinder carried by the coupling element, a plunger slidably mounted in the operating cylinder, a piston slidably mounted in the lower section beneath the operating cylinder, a stem connected with the piston, a mounting element connected with the stem, a perforator knife pivotally connected with the mounting element, and means pivotally mounted in the lower section and engageable with the knife for guiding said knife to project outwardly to perforate a well casing wall upon downward movement of the piston, stem and mounting element, said piston being shifted downwardly by pressure of fluid within the operating cylinder upon downward movement of the plunger in said operating cylinder.

17. In a fluid well-perforator as recited in claim 16 wherein means is employed for shifting the piston upwardly upon retraction of the plunger for returning the perforator knife to inoperative position within the lower section of the first-mentioned cylinder, said means including a bushing, means anchoring the bushing to the lower section of the first-mentioned cylinder, and a spring surrounding the stem and extending between the piston and said bushing.

18. A fluid well-perforator including a cylinder, a relatively small operating cylinder, means mounting the operating cylinder within the first-mentioned cylinder, a plunger in the operating cylinder, a piston in the first-mentioned cylinder below the operating cylinder, fluid in the operating cylinder and above the piston, a mounting element, a stem connecting the mounting element with the piston, said first-mentioned cylinder having a slot, a guide pin on the mounting element and slidable in the slot for permitting rotation of the mounting element within the first-mentioned cylinder, a plug closing the first-mentioned cylinder at its lower end, a perforator knife pivotally mounted on the mounting element, a cam pivotally mounted on the plug and having a surface engageable with a surface of the knife for guiding the knife outwardly through the slot for perforating a wall of a well casing upon downward movement of the piston in response to fluid pressure created by downward movement of the plunger in the operating cylinder.

19. A fluid well-perforator including a cylinder, a relatively small operating cylinder, means mounting the operating cylinder within the first-mentioned cylinder, a plunger in the operating cylinder, a piston in the first-mentioned cylinder below the operating cylinder, fluid in the operating cylinder and above the piston, a mounting element, a stem connecting the mounting element with the piston, said first-mentioned cylinder having a slot, a guide pin on the mounting element and slidable in the slot for preventing rotation of the mounting element within the first-mentioned cylinder, a plug closing the first-mentioned cylinder at its lower end, a perforator knife pivotally mounted on the mounting element, a cam pivotally mounted on the plug and having a surface engageable with a surface of the knife for guiding the knife outwardly through the slot for perforating a wall of a well casing upon downward movement of the piston in response to fluid pressure created by downward movement of the plunger in the operating cylinder, and means for imparting movement to the plunger.

20. A fluid well-perforator including a cylinder, a relatively small operating cylinder, means mounting the operating cylinder within the first-mentioned cylinder, a plunger in the operating cylinder, a piston in the first-mentioned cylinder below the operating cylinder, fluid in the operating cylinder and above the piston, a mounting element, a stem connecting the mounting element with the piston, said first-mentioned cylinder

having a slot, a guide pin on the mounting element and slidable in the slot for permitting rotation of the mounting element within the first-mentioned cylinder, a plug closing the first-mentioned cylinder at its lower end, a perforator knife pivotally mounted on the mounting element, a cam pivotally mounted on the plug and having a surface engageable with a surface of the knife for guiding the knife outwardly through the slot for perforating a wall of a well casing upon downward movement of the piston in response to fluid pressure created by downward movement of the plunger in the operating cylinder, means slidable through the first-mentioned cylinder for imparting movement to the plunger, and means for releasably retaining the device at a desired level in a well casing.

21. A fluid well-perforator including a cylinder, a relatively small operating cylinder, means mounting the operating cylinder within the first-mentioned cylinder, a plunger in the operating cylinder, a piston in the first-mentioned cylinder below the operating cylinder, fluid in the operating cylinder and above the piston, a mounting element, a stem connecting the mounting element with the piston, said first-mentioned cylinder having a slot, a guide pin on the mounting element and slidable in the slot for permitting rotation of the mounting element within the first-mentioned cylinder, a plug closing the first-mentioned cylinder at its lower end, a perforator knife pivotally mounted on the mounting element, a cam pivotally mounted on the plug and having a surface engageable with a surface of the knife for guiding the knife outwardly through the slot for perforating a wall of a well casing upon downward movement of the piston in response to fluid pressure created by downward movement of the plunger in the operating cylinder, means slidable through the first-mentioned cylinder and engageable with the plunger for imparting downward movement to the plunger, displaceable means on said last-mentioned means for preventing premature actuation of the plunger, means frictionally engageable with the wall of the well casing for anchoring the device at a desired level in the well casing, and means carried by the first-mentioned cylinder and operated by said last-mentioned means for anchoring the device at the desired level within the well casing.

22. In a device of the class described, an operating cylinder, and a plunger slidably mounted in the operating cylinder, said plunger having a reduced lower end portion defining a vent upon movement of the plunger to raised position.

23. In a device of the class described, a cylinder, a plunger in the cylinder, an operating stem for the plunger, and displaceable means carried by the operating stem for retaining the plunger against premature shifting movement, said means comprising a latch pivotally mounted in the stem and having an arm engageable with the cylinder, an arm disposed within the stem, and a go-devil movable into engagement with the second-mentioned arm for tilting the latch out of engagement with the cylinder and thus permitting movement of the stem and plunger in the cylinder.

24. In a fluid well-perforator, an operating cylinder, and a plunger slidable in the operating cylinder, said plunger having a vent formed therein and communicating between the lower end thereof at a point along the wall of said plunger.

PINK T. BYNUM.