A. E. RAINE.
CASING PERFORATOR.
APPLICATION FILED NOV. 10, 1909.

984,702. Patented Feb. 21, 1911.

2 SHEETS—SHEET 1.

Fig. 1

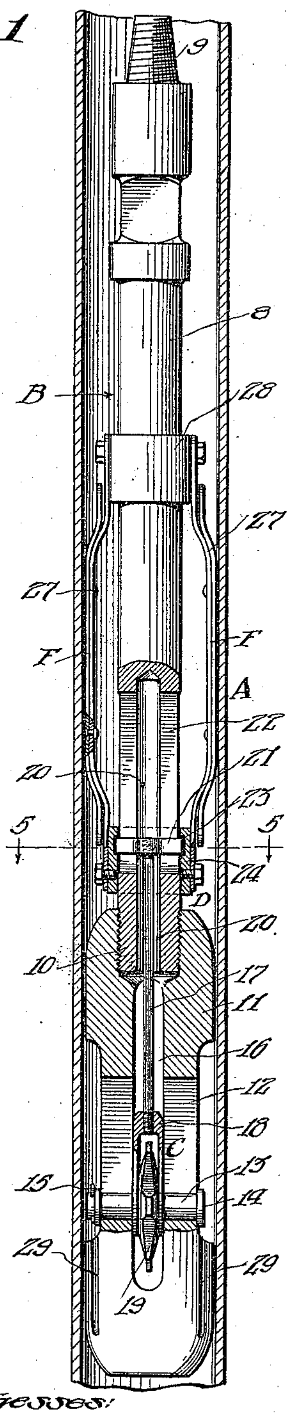


Fig. 2

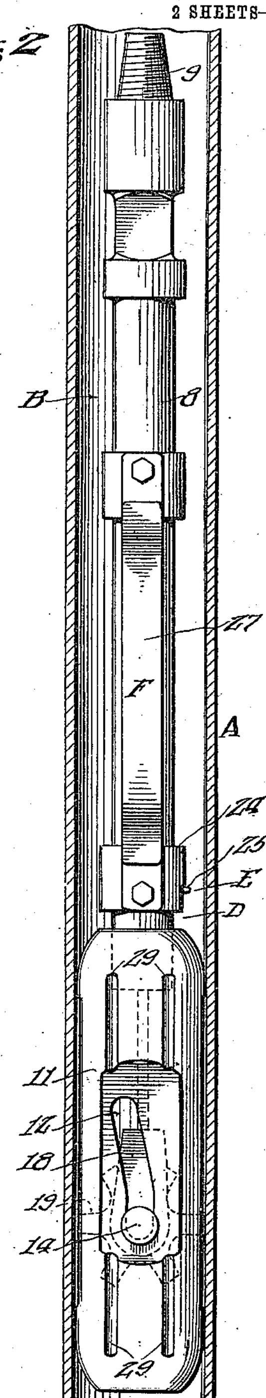
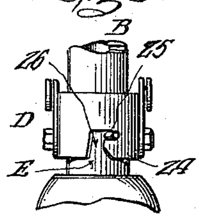


Fig. 3



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A. E. RAINE.

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2 SHEETS—SHEET 2.

Fig. 4

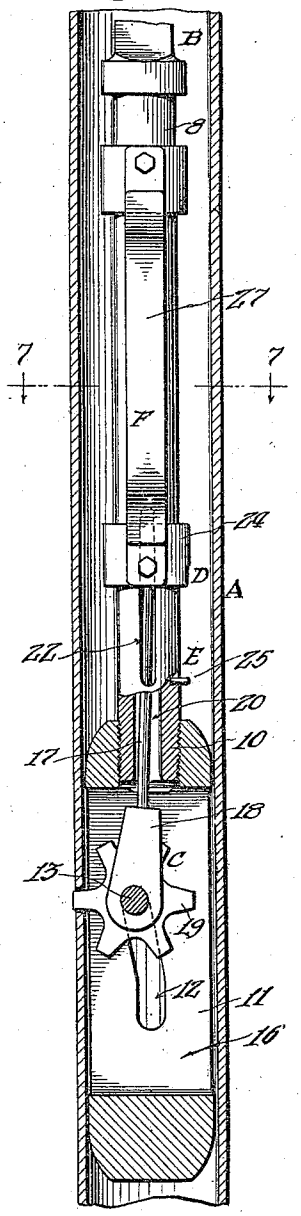


Fig. 5

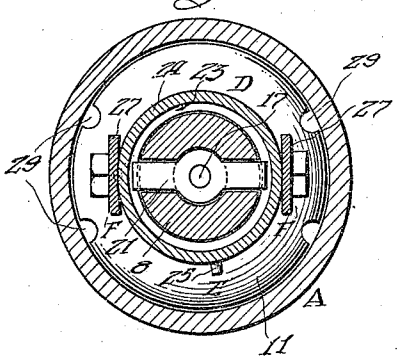


Fig. 6

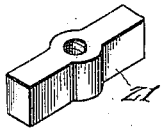
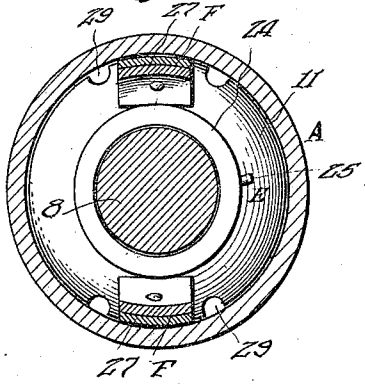


Fig. 7



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UNITED STATES PATENT OFFICE.

ARTHUR E. RAINE, OF BAKERSFIELD, CALIFORNIA.

CASING-PERFORATOR.

984,702. Specification of Letters Patent. Patented Feb. 21, 1911.

Application filed November 10, 1909. Serial No. 527,317.

To all whom it may concern:

Be it known that I, ARTHUR E. RAINE, a citizen of the United States, residing at Bakersfield, in the county of Kern and State of California, have invented new and useful Improvements in Casing-Perforators, of which the following is a specification.

This invention relates to casing perforators for puncturing the casing walls of oil and other wells in registration with the strata from which the oil or other commodity or material is to be extracted; and the invention has for its object to provide an improved perforator of the character stated which will be superior in point of relative inexpensiveness and simplicity of construction, facility of control, positiveness of operation, and durability, and which will be generally superior in point of efficiency and serviceability.

Particular objects of the invention comprise the provision of a casing perforator the operative control of which is at all times subject to regulation at the surface of the well; which will permit perforation of any portion of the walls of the casing without successive withdrawals from the casing; which may be utilized with the end in view last stated and without cutting or injuring the joints or unions whereby the casing sections are connected together; which may be readily introduced within, passed through and withdrawn from the casing without obstruction by inequalities in the formation of the inner casing walls or projections therefrom; which may be controlled and operated without the employment of any tripping or releasing means adjunctive to the main features of construction; and the actuation and control of which is performed and accomplished through the body or stem of the tool or apparatus without the employment of adjunctive means such as stated.

With the above and other objects in view the invention consists in the novel provision, formation, construction, combination, association and relative arrangement of parts, members and features, all as hereinafter described, shown in the drawings, and finally pointed out in claims:—

In the drawings: Figure 1 is a vertical sectional view, partly in full lines and partly broken away for clearness of illustration, of a casing perforator organized according to the invention; the same being shown as introduced within a section of well casing; and the perforating member being shown in contracted or inoperative position; Fig. 2 is a view similar to Fig. 1 but taken at an angle of ninety degrees to the line of vision of Fig. 1; the parts, however, being shown in full lines; Fig. 3 is a fragmentary detail view of locking means which serve to hold the perforating element in retracted or inoperative position; Fig. 4 is a view similar to Fig. 3, parts being in section and broken away for clearness of illustration, and the perforating element being shown in projected or operative position; Fig. 5 is an enlarged detailed transverse sectional view taken upon the line 5—5, Fig. 1, and looking in the direction of the appended arrows; Fig. 6 is an isometric view of a feature of the perforating element and the supporting means of the same, such part being most clearly shown in Figs. 1 and 5; and, Fig. 7 is a detail transverse sectional view taken upon the line 7—7, Fig. 4, and looking in the direction of the appended arrows. Figs. 5, 6 and 7 are each upon an enlarged scale.

Corresponding parts in all the figures are denoted by the same reference characters.

Referring with particularity to the drawings, the casing perforator organized according to the invention is shown in several of the figures as introduced within a casing A, or section of casing, such as is commonly lowered within oil wells, and the walls of which require puncturing or perforating to permit the flow of oil from the bearing strata to the interior of the casing.

The casing perforator comprises a body or stem B, of integral or built-up construction; a perforator or perforating element C; a mounting or suspension means D for the perforator, and locking means E acting to hold the body or stem B and the mounting or suspension means D for the perforator in such definite relation that the perforator is retained in inoperative or retracted position until the body or stem B is actuated or manipulated to permit relative movement of

the perforator mounting and the body or stem, to accomplish the projection of the perforator into operative position.

F designates frictional means holding the perforator C and its mounting D against movement jointly with the stem or body B, whereby said features may be relatively moved to cause the projection of the perforator into operative position, and the maintenance of such projection during a working period of the perforator. The frictional means F bear with relation to or contact with the inner walls of the casing A.

A particular form of construction and organization of a casing perforator embodying the invention, and containing and embracing the main features and parts above set forth, is, as shown in the drawings, as follows:—The stem B comprises a shank 8, the upper end of which is threaded, as at 9, for connection with the lowering and actuating rod or tube or equivalent; the lower end of the shank having threaded connection, as at 10, with an enlarged head 11 the transverse dimensions of which are approximately those of the interior of the casing A, whereby the head 11 closely fits the inner walls of the casing. The head 11 when actuated by the shank 8 may be forcibly introduced within the casing without obstruction by unevennesses or irregularities of interior casing formation. Within the head 11 is formed a transverse slot 12 extending upwardly and obliquely toward the circumference of the head. A shaft or arbor 13, headed at one end, as at 14, lies within the slot 12, being held removably therein by a key or cotter pin 15 at the other end thereof. In a plane longitudinally of the head 11 and at right angles to that of the lower end of the slot 12, is formed a transverse chamber 16; and a stem 17 projects at its lower end within the chamber 16 and carries a forked hanger or bifurcated end piece 18 through which the shaft or arbor projects; and the hanger 18 embraces a star cutter head 19 which former lies entirely within the chamber 16; the operative portions thereof being adapted to project from the chamber 16 in position to puncture the casing A when the shaft 13 lies in the upper end portion of the slot 12. The specific formation of the cutter head 19 which constitutes the perforator C, does not concern the invention. The shank 8 is provided with a central bore or chamber 20 which communicates with the chamber 16 in the head 11; and the stem 17 projects upwardly within the bore or chamber 20 and has a threaded connection at its upper end with an elongated block 21, the operative end portions of which lie within a diametrical chamber 22 formed in the shank 8 and are received in an integral annular groove 23 formed in a collar 24 which fits over the shank 8; said collar 24 and block 21 and stem 17 constituting the mounting or suspension means D for the perforator C; the perforator being thereby mounted or suspended so as to be capable of movement relative to the stem B. The locking means E may comprise a pin 25 connected with the shank 8 directly above the head 11, and a bayonet slot 26 formed in the collar 24 at the lower portion thereof. Relative axial movement of the shank 8 of the collar 24, as well as relative longitudinal movement permits and causes engagement and disengagement of the pin 25 and the bayonet slot 26, as well as movement of the shaft 13 in the slot 12 to project or retract the perforator C.

The frictional means F comprise bowed leaf springs 27, which are opposed one to the other, and are connected at their lower ends with the collar 24 and at their upper ends with a collar 28 slidably mounted upon the shank 8. The springs 27 project outwardly or are buckled outwardly so as to bear upon the inner walls of the casing A, above the cutter head at opposed portions of the same, and frictionally hold the collar 24 and the other features and parts of the mounting or suspension means D of the perforator C during relative movement of the perforator and the stem B for projection or retraction of the perforator respectively into or out of operative position.

The head 11 may be provided with longitudinal exterior channels 29 permitting liquid in the casing to rise above the head as the perforator is lowered in the casing, thus providing for dissipation of any liquid cushion which otherwise would oppose movement of the perforator within the casing.

The operation, method of use and advantages of the improved casing perforator constituting the invention will be readily understood from the foregoing description, taken in connection with the accompanying drawings and the following statement:— With the parts in the positions shown in Figs. 1, 2, 3 and 5, and the locking means E holding the stem or body B and the mounting D of the perforator against relative movement, so that the perforator C is retracted within the chamber 16 in the head 11, the shaft 13 being at the lower portion of the slot 12, the entire perforator is lowered within the casing A, by any suitable rigid rig, such as a rod or tube; and when the working region for the perforator has been reached, the shank 8 is given an axial twist which frees the pin 25 from the slot 26. The shank 8 is then depressed, causing relative movement of the head 11 and the perforator C and its mounting D, said perforator and its mounting being held stationary by the engagement of the springs 27 of the frictional means F with the inner walls of the casing. The shaft 13 is thus

caused to traverse the slot 12, in effect, bringing said shaft into the upper portion of said slot laterally of a diameter of the head 11 and causing projection of the star cutter head 19 into working position as shown in Fig. 4. The cutter head 19 thus swings upon the stem 17, as does a pendulum, the head 21 rocking in the chamber 22 and annular groove 23 in the collar 24. Continued depression of the shank 8 and head 11 will cause the cutter head 19 to perforate the wall of the casing in a line of predetermined extent, as between joints or unions of the casing sections. When the shank 8 is raised, the perforator C, and its mounting D will be held stationary by the friction springs 27 until the shaft 13 has traversed the slot 12, in effect, to the lower and inner end thereof, when the entire apparatus will be raised in common to a point from which a fresh line of perforations is to be extended; the friction of the springs 27 upon the casing being overcome by the pressure of the rigid stem 17, and the block 21 and the collar 24, under actuation of the shaft 13 which is positively borne upon by the head 11 at the lower end of the slot 12. As soon as the shank 8 is depressed again, relative movement of the perforator C and the mounting D thereof with respect to the head 11 of the shank 8 takes place, until the cutter head 19 is projected from the slot 16 in the head 11, as above set forth; and when the shaft 13 has reached the upper end of the slot 12 the continued depression of the shank 8 moves the head 11 and shank 8 downwardly in unison with the cutter head 19 and its mounting, the temporary frictional binding of the springs 27 being positively overcome through the shaft 13, the stem 17, the block 21 and the attendant features. When the new line of perforations is formed in the casing, the shank 8 is raised as before, withdrawing the perforating head 19 from operative position. When it is desired to withdraw the entire perforating mechanism or apparatus from the casing, the shank 8 is elevated until the cutter head 19 is withdrawn into the chamber 16, and the shank 8 is then given an axial twist to bring the pin 25 of the locking means E into the slot 26 when relative movement between the cutter head and the stem B, to cause inadvertent projection of the perforator into operative position, will be positively prevented.

It is manifest that all that is necessary to lock the perforator to the stem or unlock it therefrom, respectively, to maintain the perforator in retracted position or to permit the projection of the perforator into operative position, is to give the stem an axial twist, the frictional means F holding the perforator and its mounting against movement jointly with the stem; and that likewise said frictional means temporarily hold the perforator and its mounting stationary during the independent movement of the stem to cause either the retraction or projection of the perforator. There are no separate and adjunctive parts required for projecting or retracting the perforator, the stem or body B of the apparatus performing the function in combination with the frictional means F and the mounting D of the perforator. Where tripping means for projecting and retracting the cutter head are employed, they are extremely liable to get out of order; and when said tripping means, such as triggers, latches, coiled springs and separately manually operated parts and connections, are located beneath the perforating element, they are subject to frequent damage and obstruction and disarrangement, through contact with the lower end of the well and obstructions within the casing. It will be further noted that the perforator can operate with respect to any part of the walls of the casing, and within precisely predetermined working regions, or as regulated at the surface of the well. Injury to the casing joints is entirely obviated in the use of this perforator, as the perforating element may be retracted into inoperative position while passing such joint or union. The perforating element or cutter head 19 may readily be removed by withdrawing the shaft 13 from the forked hanger 18, which permits the cutter head to be slipped out of the chamber 16. Repair of the cutter head, or substitution, may thus be readily effected.

Having thus described my invention, I claim and desire to secure by Letters Patent:—

1. Apparatus of the character described, comprising a stem provided with a chamber, a cutter head movably mounted within the chamber, a collar slidably surrounding the stem, means connecting the cutter head with said collar and projecting within a second chamber in the stem, and frictional means connected with the collar and adapted to bear upon the inner wall of a well casing.

2. Improvements of the character described, comprising a stem or body provided with a chamber, a cutter head movably mounted in the chamber, a collar slidably surrounding the stem, a shaft upon which the cutter head is mounted, there being a slot in the stem extending upwardly and obliquely toward the circumference of the stem or body and within which slot the shaft is mounted, a hanger for the shaft, a block loosely mounted in the collar, and a stem between the hanger and the block.

3. Improvements of the character described, comprising a stem or body provided with a chamber, a cutter head movably mounted in the chamber, a collar slidably surrounding the stem, a shaft upon which the cutter head is mounted, there be-

ing a slot in the stem extending upwardly and obliquely toward the circumference of the stem or body and within which slot the shaft is mounted, a hanger for the shaft, a block loosely mounted in the collar, a stem between the hanger and the block, and a spring connected with the collar and adapted to bear upon the inner wall of a well casing.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

ARTHUR E. RAINE.

Witnesses:
W. W. KAYE,
T. H. MINOR.