

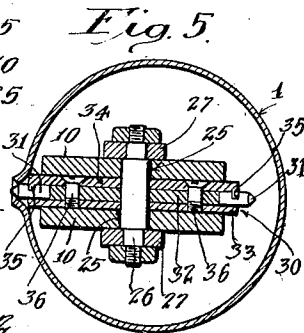
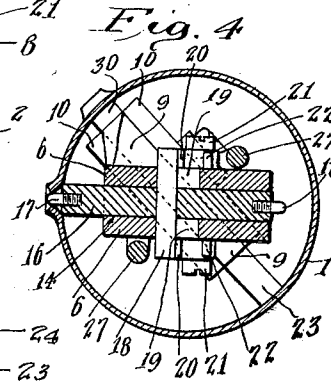
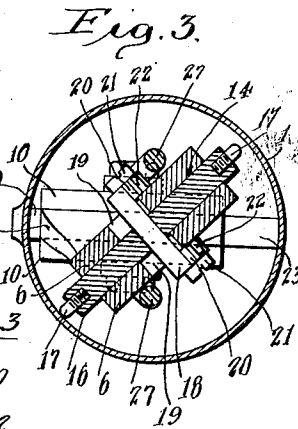
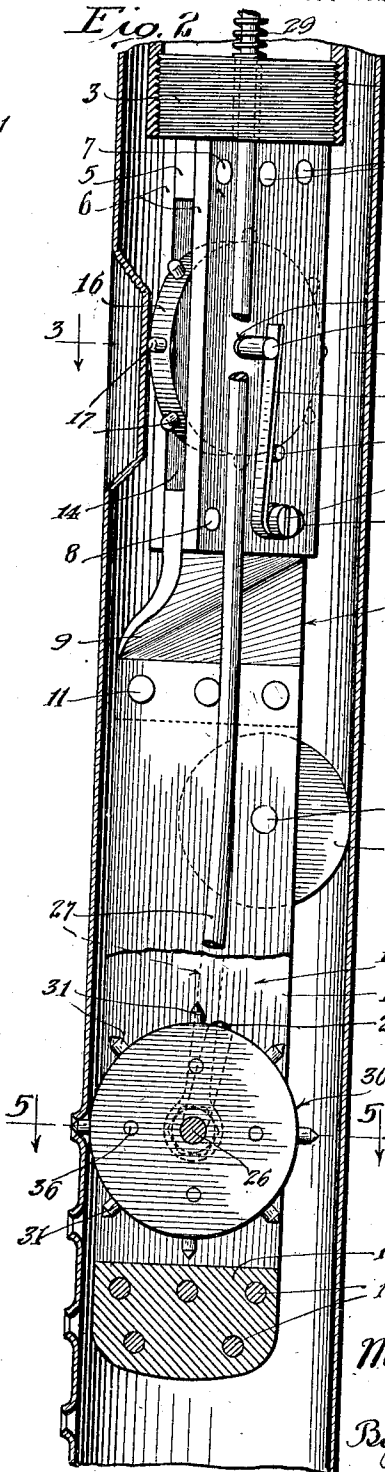
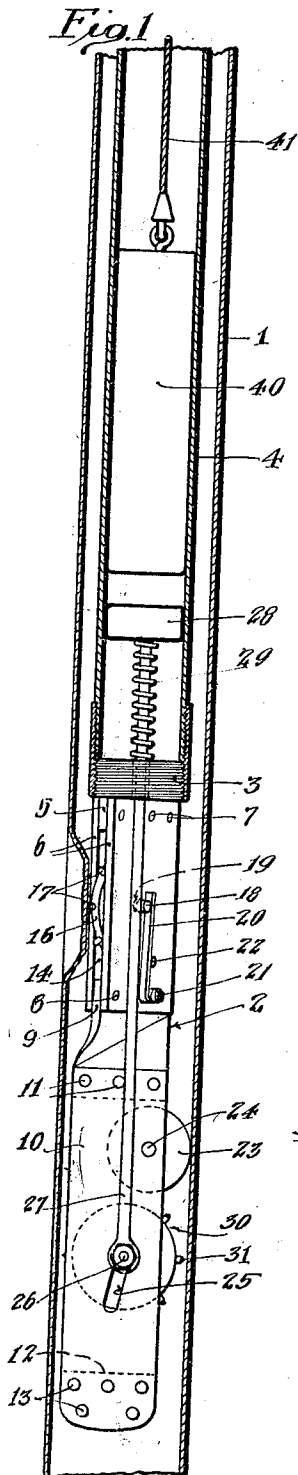
June 17, 1924.

M. E. LAYNE

1,497,919

PERFORATING TOOL

Filed July 20, 1922



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Patented June 17, 1924.

1,497,919

UNITED STATES PATENT OFFICE.

MAHLON E. LAYNE, OF HOUSTON, TEXAS.

PERFORATING TOOL.

Application filed July 20, 1922. Serial No. 576,222.

To all whom it may concern:

Be it known that I, MAHLON E. LAYNE, a citizen of the United States, residing at Houston, in the county of Harris and State of Texas, have invented a new and useful Perforating Tool, of which the following is a specification.

This invention relates to a perforating tool and is particularly directed to a tool adapted for use in the perforating of well-casings.

An object of the invention is to provide a well-casing perforator especially adapted for use in perforating a well-casing after it is installed in a well.

Another object is to provide a tool capable of forming a single vertical row of holes in the casing during each perforating stroke of the tool and provided with means for insuring a circular spacing of adjacent rows of such holes.

Another object is to provide a tool having a perforating element which is held in an inoperative position during the lowering of the tool into a well casing, and to provide cooperating means operable to condition said element so that a subsequent longitudinal translation or movement of the tool will effect the perforation of the casing, and also capable of later increasing the width of said perforation, breaking up the lining, cementing or clogging of same.

Various other objects and advantages will be more fully apparent from the following description of the accompanying drawings which form a part of this disclosure, and which illustrate a preferred form or embodiment of the invention.

Of the drawings:

Figure 1 is a vertical section showing the perforating tool lowered into a well casing.

Fig. 2 is a similar enlarged section showing the tool in a perforating operation.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a section similar to Fig. 3 showing the tool as perforating a second row of holes.

Fig. 5 is a section on line 5—5 of Fig. 2.

The tool of the present invention is particularly adapted for insertion into the casing of a well and to be manipulated from the well surface or ground level for perforating a selected portion of the well-casing to form a well-screen, the tool functioning to successively perforate relatively spaced rows of holes in the casing wall.

In a tool of this character it is necessary to provide a perforating means which is normally maintained in an inoperative position during the lowering of the tool into the casing to the selected portion to be perforated and to provide a means operated from the well surface to condition or set said perforating means for a perforating operation only during a perforating stroke of the tool. Further it is necessary to provide a means insuring the perforating of each row of holes in spaced relation to the preceding row to equally distribute the several rows around the casing, such means, in the present instance, consisting of a pilot or locating element which may engage in a row of perforations and guide the tool so that the next row of perforations will be located in spaced relation to the preceding row, whereby the several rows will not overlap or be so close together as to cause a tearing out of the casing or a weakening thereof such as would cause the casing to collapse. Such construction is of further utility in the use of the tool for the purpose of correcting a clogged condition of the screen, especially where the well is located in territories where water containing lime or other elements such as will encrust the perforations, and also for the purpose of widening previously punched holes. In such use it is necessary that the perforating means register with the previously punched holes of the screen, and this can only be accomplished with a tool having a locating means for engaging the rows of previously formed holes as a guide for the tool during the relieving of such clogged condition of the perforations.

In the drawings, 1 designates a well-casing to be perforated and 2 designates the body of the perforating tool which is provided with a screw-threaded head 3 joined to a tubular tool shank 4 extending to the surface of the well and by which the tool is operated. The body of the tool may be formed of a single piece of material or it may be constructed of several pieces joined together to form a unitary structure. As shown in the drawings, the head 3 has a medial depending web 5 joined to opposed relatively spaced upper side plates 6 by rivets 7 and the lower ends of said side plates 6 are joined by rivets 8 to a central web 9. In turn, the lower end of the central web 9 extends between the upper ends

of opposed relatively spaced lower side plates 10 and is joined thereto by rivets 11, the lower ends of the plates 10 being maintained in spaced relation by a spacing block 12, with the plates 10 and block 12 secured together by rivets 13.

This provides a body having an upper transverse slot 14 and a lower transverse slot 15, and the central web 9 is bent or twisted spirally so that the diametric plane of the upper slot 14 is inclined or askew relative to that of the lower slot 15 to the amount of 45° or one-eighth of a circle.

Positioned in the upper slot 14 is a rotary pilot or locating wheel 16 having a plurality of relatively spaced locating studs 17 projecting from its periphery, and provided with a shaft 18 projecting through transversely elongated slots 19 in the opposite side plates 6. Each end of said shaft is engaged by the free end of a spring member 20, the opposite end of said spring being secured to the respective plate 6 by a stud 21 with its medial portion engaging an abutment pin 22. This provides a toothed rotary locating member which is yieldingly urged towards the casing wall.

In the upper portion of the lower slot 15 is an abutment roller 23 which is journaled on a shaft 24 carried by the side plates 10, and which extends beyond the body of the tool to engage the wall of the casing.

Below the roller 23, the opposite side plates have relatively aligned angled, that is, inclined cam slots 25 and positioned within the slot 15 is a rotary perforator element 30 having its shaft 26 extended through the cam slots 25 and supported upon the lower ends of depending rods 27. The rods 27 extend upwardly on opposite sides of the body and through apertures in the head 3, their upper ends being joined to a plunger 28.

Surrounding each rod 27 between said plunger and the head 3, is a spring 29, these springs exercising their tension to normally maintain the perforating element in elevated position, as shown in Fig. 1, with its shaft 26 in the upper ends of the cam slots 25 and the perforator withdrawn from operative position.

The perforator element 30 is provided with a plurality of relatively spaced punch members 31, in the present instance there being eight of such punch members, and while it is desirable that the diameter of the perforator element and the number of its punch members 31 be equal to the diameter of the member 16 and the number of its locating studs 17, it is at least necessary that the studs 17 be spaced apart the same distance as are the punch members 31.

Preferably the perforator element is of sectional construction permitting a quick and easy removal and replacement of the

punch members 31, and as illustrated in Fig. 5, the element 30 consists of an inner abutment disc 32 against which the inner ends of the several punch members abut, a side disc 33 against which one side of the punch members seat, and a disc 34 having an in-turned peripheral flange 35 engaging into notches cut in the several punches, the three discs being clamped together by bolts 36. By this construction those punch members which become worn or broken may be easily and quickly replaced by new punch members, or in case it is desired to substitute a complete set of longer or shorter punch members such substitution may likewise be easily and quickly accomplished.

For the purpose of rendering the perforator element operative I provide means independent of the body and located within the casing above the tool. This means is controlled from above, and may be in the form of a weight 40 which is attached to a cable 41 or other means leading to the surface of the well, and which when lowered to rest upon the plunger 28 overcomes the tension of the springs 29, forcing the rods 27 downwardly. This forces the shaft 26 of the perforator element downwardly in the cam slots 25 thereby causing the perforator element to be forced transversely away from the abutment roller 23 so that the punch members 31 will penetrate the well-casing successively during a rotation of the perforator element by a longitudinal translation of the tool.

In the operation of the tool in perforating a well-casing the tool is lowered into the well as shown in Fig. 1. During such initial lowering of the tool, the springs 29 are effective to maintain the perforator element 30 in inoperative elevated position with its shaft 26 in the upper ends of the cam-slots 25. When the tool has reached a position where it is desired to perforate the casing, the weight 40 will be lowered into the tubular shank 4 to engage and force the plunger 28 and connected parts downwardly, this causing the perforator element 30 to be forced to an operative position, as previously explained. The tool is then moved longitudinally in the well-casing, by suitable means at the surface, the rolling action of the perforator element 30 causing its punch members 31 to successively penetrate the casing and form a vertical row of holes. Upon completing the first row of holes, the weight 40 is elevated from engagement with the plunger 28, the springs 29 again becoming effective to elevate the perforator element 30 to normal inoperative position. The tool is then rotated on the axis of the casing through an angle of 45° and otherwise manipulated until the studs 17 of the locator wheel register with the row of holes previously punched, this engagement of the

studs 17 into said holes being automatic by reason of the locator wheel 16 being constantly urged outwardly by the springs 20. With the locator studs 17 meshing into the holes previously punched, the perforator element 30 will be positioned to engage the casing at a point one-eighth of a turn spaced from said previously punched row of holes, and with the tool so positioned, the weight 40 is again lowered to render the perforator element effective and the tool then longitudinally translated in a perforating operation, as before explained.

This sequence of operation is continued until the casing is perforated at circularly spaced intervals throughout its circumference, after which the tool may be removed from the well.

From the above it will be understood that I have provided a perforating tool operable from the well surface to perforate vertical rows of holes in the well-casing to form a well screen, to clean or increase the size of previously punched perforations, and that I have incorporated in said tool means by which the several rows of holes will be located in definite circularly spaced relation with each row of holes serving as a guide means for the tool during the perforating of the next adjacent row.

The device as shown and described is of a preferred form of embodiment and is well adapted to fulfill the objects primarily stated, but it is to be understood that I do not desire to limit the invention in this regard for it is susceptible of embodiment in various other forms all coming within the scope of the following claims.

I claim:

1. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, a perforator element carried by the body and diametrically disposed within the casing to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, means normally maintaining the perforator element in an inoperative position, a weight within the casing above the tool and means co-operating with the weight to force said element transversely to cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal movement of the tool in the casing.

2. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, said body having relatively spaced longitudinal side walls provided with relatively aligned angled cam slots, a rotary perforator element having a plurality of relatively spaced punch members projecting from its periphery, and positioned between said side

walls with its shaft slidable in the cam slots, and means normally maintaining said shaft at one end of said slots and the perforator in inoperative position, and a weight within the casing above the tool and cooperating with said last named means to move said shaft towards the opposite ends of said slots and force the perforator element transversely to cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal movement of the tool in the casing.

3. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, said body having relatively spaced longitudinal side walls provided with relatively aligned angled cam slots, a rotary perforator element having a plurality of relatively spaced punch members projecting from its periphery, positioned between said side walls and mounted on a shaft slidable in the cam slots, tension means yieldingly maintaining said shaft in one end of the slots and the perforator element in inoperative position, and means within the casing controlled from above to co-operate with said tension means to move said shaft towards the opposite ends of said slots and force the perforator element transversely to cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal movement of the tool in the casing.

4. A well-casing perforating tool comprising a body adapted to be translated in a casing in a perforating operation, said body having relatively spaced longitudinal walls provided with relatively aligned angled cam slots, a rotary perforator element having a plurality of relatively spaced punch members projecting from its periphery, positioned between said side walls, and having a shaft slidable in the cam slots, suspension means carrying the perforator element and engaging its shaft, spring means normally maintaining the suspension means elevated, and the perforator element in inoperative position with its shaft in the upper portions of the cam slots, and means located within the casing above the tools adapted to lower the suspension means to translate the perforator element transversely and cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal translation of the tool in the casing.

5. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, a perforator element carried by the body and diametrically disposed to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, means forcing the

perforator element transversely to cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal movement of the tool in the casing, and a rotary locating element carried by the body having means for engaging perforations already made and yieldingly urged towards the casing wall, said locating element operating to facilitate the positioning of the tool for a second perforating operation.

6. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, a perforator element carried by the body and diametrically disposed to rotate in a vertical plane, said element having a plurality of relatively spaced punch members projecting from its periphery, means forcing the perforator element transversely to cause the punch members to penetrate the casing successively as the perforator element is rotated by a longitudinal translation of the tool in the casing, and a rotary locating element carried by the body and yieldingly urged towards the casing wall, said locating element being diametrically disposed within the casing to rotate in a vertical plane forming an angle with the vertical plane of the perforator element, and having means for engaging the perforations already made and thereby facilitate positioning the tool for another perforating movement.

7. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation, perforator means carried by the body and having a rolling cooperation with the casing during a longitudinal translation of the tool to punch a row of holes in the casing, and locating means having means for engaging with a previously formed row of holes in the casing to facilitate positioning the tool for another perforating operation and prevent a turning of the tool about the axis of the casing during a perforating operation.

8. A well-casing perforating tool comprising a body adapted to be moved within a casing in a perforating operation and having a shank extending to the surface of the

well and by which the tool is manipulated, a perforator element carried by the body and normally maintained in inoperative position, a member adapted for manipulation from the well surface for rendering the perforating means operative, and means cooperating with the casing to guide the tool during a perforating operation.

9. A well casing perforating tool comprising a body constructed to be moved within a casing in a perforating operation, an abutment roller carried by the body to engage the casing wall, a perforator element also carried by the body and diametrically disposed within the casing to rotate in a vertical plane and engage the casing at a point opposite to the said roller, said element having a plurality of equidistant punch members projecting from its periphery, means for normally maintaining the perforator in inoperative position, a rotary locating element carried by the body to rotate in a vertical plane and engage the casing wall at another point out of line with the points of engagement of the said roller and the perforator element, and means operating to force said perforator element transversely away from the abutment roller to cause the punch members to penetrate the casing successively as the perforating element is rotated by a longitudinal movement of the tool within the casing.

10. A well-casing perforating tool comprising a body, having an angled cam slot, a rotary perforator element mounted in the slot and adapted to be translated in the slot from an operative to an inoperative position, spring means normally maintaining said perforator element in the inoperative position, means for forcing the perforator element into the engaging position, and means for manipulating said last named means from the top of the well casing.

Signed at Memphis, Tenn., this 20th day of June, 1922.

MAHLON E. LAYNE.

Witnesses:

ADA A. LONG,

C. D. WOODBURN.