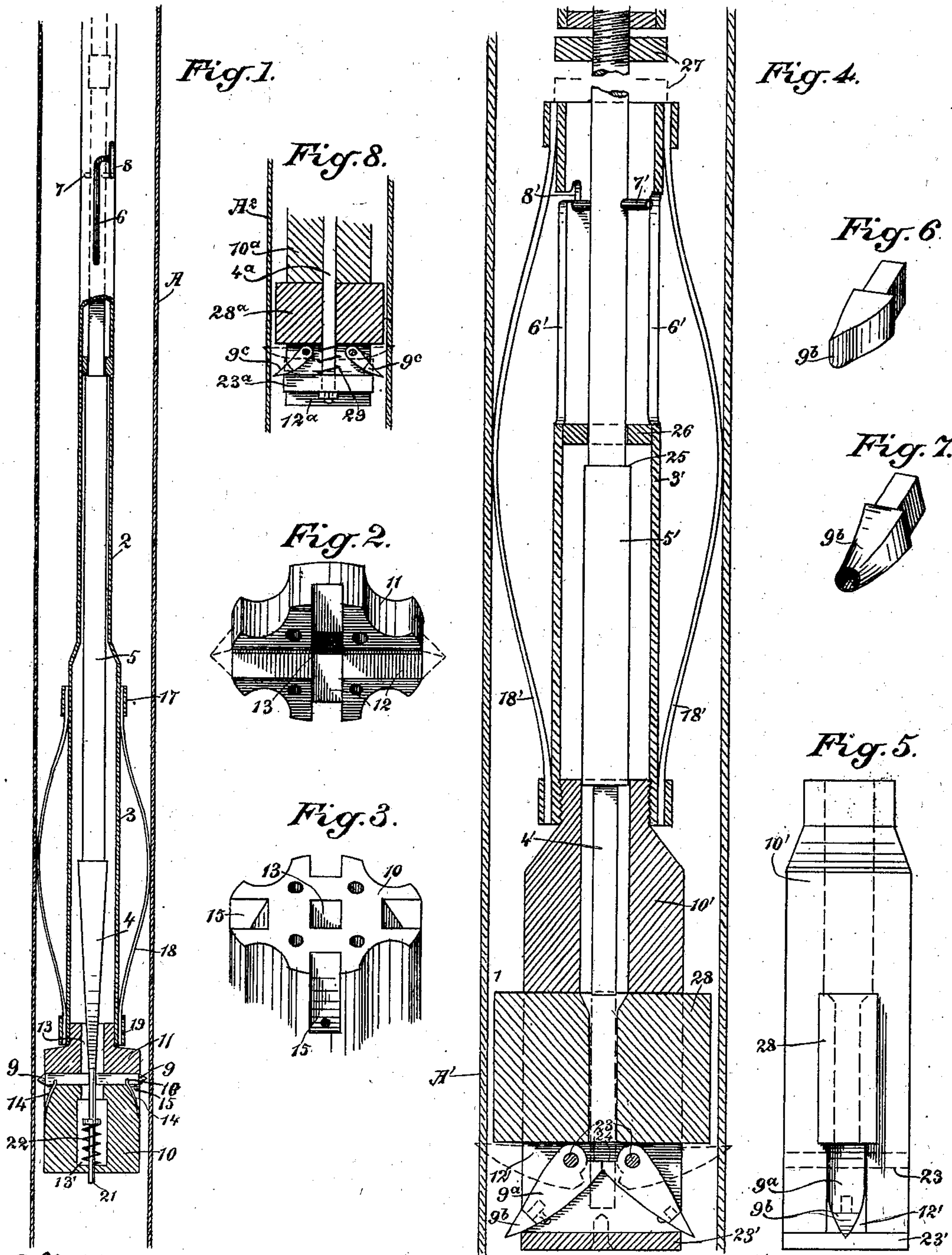


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MACHINE FOR PERFORATING PIPES.

(Application filed Jan. 7, 1902.)

(No Model.)



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UNITED STATES PATENT OFFICE.

EDWIN R. GRAHAM, OF BAKERSFIELD, CALIFORNIA.

MACHINE FOR PERFORATING PIPES.

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To all whom it may concern:

Be it known that I, EDWIN R. GRAHAM, a citizen of the United States, residing at Bakersfield, county of Kern, State of California, have invented an Improvement in Machines for Perforating Pipes; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to improvements in devices for perforating pipe, and is designed particularly for perforating the casing of oil, gas, and like wells. It is frequently desirable to perforate a casing at one or more points above the bottom of the well in order to let in the surrounding oil or water, which is afterward removed by the pumps.

My invention consists, essentially, of a series of radially-disposed punches or knives, a spreader or mandrel by which the punches are driven outwardly against and through the casing, means for suspending the parts at any desired point in the well, and means for retracting the punches and mandrel.

It comprises details which will be more fully set forth hereinafter, having reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section through the machine. Fig. 2 is a view of the upper cross-head. Fig. 3 is a similar view of the lower head. Fig. 4 is a longitudinal section showing a modification. Fig. 5 is an end view of the block which contains the punches. Figs. 6 and 7 show different styles of punches. Fig. 8 shows still another modification.

In Fig. 1, A represents the ordinary casing of a well. A pipe or tube 2, consisting of a series of conjoined sections, is let into the casing and carries and is a part of the perforating mechanism. The lower end of this tube is formed with an enlarged section 3, in which a mandrel or tapered spreader 4 is adapted to operate. This mandrel is secured to a rod 5, slidable within the pipe 2, which rod extends to the surface, where it may be engaged and turned when desired and as will be pointed out later. At a suitable place in the pipe 2 the longitudinal slots 6 are formed. A pin 7 on the rod 5 is slidable in these slots. The upper ends of the slots are formed with off-

sets, in which are the drops or notches 8. The rod is normally supported in the pipe by means of the pin 7, resting in these notches. To the lower end of section 3 is suitably secured a block or head which contains the perforators or punches 9. This head is made in two portions—a body portion 10 and a cap 11. The adjoining faces of the parts are radially channeled, as at 12. In these channels the punches 9 are movable. The cap and body are centrally bored to form a continuous passage 13, through which the mandrel 4 operates to spread the punches. In order that the punches may be normally retracted within the block or head, I provide each with a spring 14, which has one end secured to the body 10, is movable in a guide-slot 15 in the body, and has its other end extending into a slot 16 in the under side of the punch. These springs curve inwardly in such a way and the slots 15 are of such depth that the outward movement of the punches is not interfered with; but the moment the mandrel is drawn upward and out of contact with the inner ends of the punches the latter are forced backward toward the center or axis of the head by means of the springs. A ring 17 is slidable upon the section 3, and to this ring a tubular series of spring-rods 18 are secured. The other ends of these rods are fastened to the sections, as at 19. These rods are convexed intermediate their ends to such an extent as to cause them to press tightly against the interior of the casing. This frictional contact is ordinarily sufficient to sustain the weight of the tube 2 and the mechanism carried by it at a point in the well where it may be desired to operate the apparatus and yet at the same time allow the apparatus to be raised or lowered as necessity requires. Moreover, these convexed spring-rods serve as centering-guides to the apparatus, so that each of the radial punches will be the same distance from the inner periphery of the casing.

In operation the punch is lowered to the desired point in the well and held there by means of the springs 18, the rod 5 and mandrel being elevated within the tubing 2 and section 3 and held by means of the pin 7, rest-

ing in the notches 8. When it is desired to perforate the casing, the rod 5 is turned to disengage the pin 7 from the notches and bring the pin into the guide-slots 6, whereupon the rod and mandrel are dropped and by reason of their weight the punches are driven outward and through the casing. The moment the rod and mandrel are lifted the punches are automatically retracted and the apparatus may be moved to any other desired point in the well and the operation repeated. Suitable auxiliary guides (not here shown) may be provided upon the head-block to assist in centering the punches and steadying the apparatus when the blow by the mandrel is given.

In case the mandrel should break off at or near its junction with the rod 5, it is necessary that some means be provided to prevent the mandrel from falling and spreading the punches, and so render it impossible to withdraw the apparatus from the well. I have accordingly shown the mandrel with an extension 21, which projects into the socket 13' in the body portion of the head. A spring 22 of suitable strength is disposed in this socket and acts to force the mandrel upward and out of engagement with the punches, so that even in case of the accidental breaking of the connections with the mandrel the latter would free itself and release the punches independently of the operator.

In Figs. 4 and 5 is shown a modification of my device. In this case the mandrel-casing 2 previously shown in Fig. 1 is dispensed with, and the entire punching mechanism is carried by the mandrel-rod 5'. The head or block 10' is secured to the section or sleeve 3', which is carried on and slidable in relation to the mandrel 4'. The sleeve is provided with the spring members 18', which operate in the same way and for the same purpose as the springs 18 in the first instance. The sleeve 3' is longitudinally slotted, as at 6', while the mandrel is provided with the radial projections or pins 7', which are guided and slidable in these slots. The latter are provided with offsets and notches 8' similarly as in Fig. 1. When it is desired to move the cutter-block up or down in the well-casing, the mandrel is lifted and turned, so as to bring the pins 7' into the notches 8'. In order to relieve the pins, however, to a certain extent and prevent the mandrel from possibly being withdrawn from the sleeve 3', the mandrel is formed with a shoulder 25, which is adapted to engage an annular ledge 26 on the interior of the sleeve whenever the block is drawn toward the surface of the ground. The head or block 10', which may be of any suitable or convenient shape or size, is radially slotted, as at 12'. The perforators or knives operate in these slots. These knives, of which there may be two or more, are here shown as pivoted in the block at 23 and having their inner adjacent ends provided with

shoulders 24, which lie contiguous to each other when the knives are in a normally retracted position. The head is axially bored to permit of the operation of the mandrel. 70 The act of the dropping of the mandrel upon the shoulders 24 causes the knives to turn on their pivots and force their points against and through the well-casing A'. The slot 12' is closed at the bottom by means of a plate 23', on which the lower edges of the knives normally rest. This plate serves as a stop to prevent the knives dropping downwardly so far as to become inoperative on the dropping of the mandrel. I prefer to make the knives, 80 as shown in Fig. 4, in two sections—a socket portion 9^a and a cutting or punching portion 9^b, removably fitting the former. It not infrequently happens that these knives are broken, and it is a matter of considerable 85 labor, expense, and difficulty to replace them when they are formed in one solid piece. By making the knife portion separate from the socketed holder a broken knife-point may not only be quickly replaced, but different 90 forms of cutters or punches may be used in the same apparatus. For example, it may be desirable to use a punch, such as shown in Fig. 7, which will cut a round hole in the casing, or a knife, as in Fig. 6, which will slit 95 or slash the casing. In operation whenever it is desired to perforate the casing the device is lowered into the well a desired distance. The spring members 18' bearing against the casing are sufficient to hold it in 100 place at that point. The mandrel-rod and mandrel are then turned to carry the pin 7' out of the notches and into the slots 6'. The mandrel is allowed to drop or is driven down upon the shoulders 24 of the knives or 105 punches. This action of the mandrel forces the points of the knives out against and through the casing. At the same time that the knives pierce the casing the block is moved downward more or less, so that the knives are 110 made to extend approximately at right angles to the axis of the head, the length of the knives and the arc of their movement being such that they will be driven clear through the casing when so extended. The mandrel may be pro- 115 vided with a collar 27, whereby the downward movement of the mandrel through the sleeve and head may be limited. In the case of a knife-point being used of the character shown in Fig. 6 the casing may be slashed for any 120 length desired by simply forcing the apparatus downward into the well after the knives have been driven outward. The action of dropping the mandrel and the consequent operation of the knives renders it advisable 125 to interpose a steel bar or plate 28 between the upper wall of the slot 12' and the upper side of the knives. This bar is centrally perforated to permit of the proper movement of the mandrel, and its ends project slightly be- 130 yond the periphery of the head, as shown. It serves as a stop to the upward movement

of the knives and offers a broad supporting-surface for them when the block is forced downward. By withdrawing the mandrel and lifting the head toward the surface the knives released themselves from the casing and drop back again into their normal position.

In Fig. 8 is shown a further modification, which is, in fact, a combination of the design in Figs. 1 and 4. The head 10^a is secured to a tubular rod similar to the tube 2 of Fig. 1, and in this tube the mandrel 4^a operates. Knives 9^c are pivoted in the slots 12^a, but instead of being actuated from above, as in the two first instances, they are operated from below. The rod 4^a carries a plate 23^a, upon which the knives ordinarily rest. When it is desired to perforate the casing, the head is moved to the proper spot by means of the tube which surrounds the mandrel-rod and which extends to the surface. The mandrel may be sustained in the tube by means analogous to the slots and notches 6 and 8 and pin 7. It is obvious that these slots, notches, and pin may be disposed below the knives, if desired. On raising the plate 23^a by means of the mandrel 4^a the knives 9^c are lifted and forced through the casing. A downward movement of the head causes the casing to be slashed to any length desired. By dropping the mandrel and raising the head the knives release themselves from the casing and fall by their own weight back into place. The spring 29 serves to keep the plunger-plate 23^a and head normally apart.

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

1. The combination of a rod adapted to be reciprocated within the well-casing, a mandrel or spreader carried on said rod, a block having a series of radially-operating knives or punches disposed in relation to said mandrel, means by which said block may be supported at any desired point in the casing and means by which the mandrel may be supported out of contact with the knives.

2. The combination of a rod adapted to be reciprocated within the well-casing, a head or block in which are carried a series of punches or perforators, spring-guides by which said head is supported at any desired point in the well, a mandrel on said rod adapted to operate said perforators to drive them outwardly against the casing, and means by which the perforators are automatically retracted.

3. The combination of a head adapted to be moved in a well-casing, a series of radially-disposed knives or perforators on said head, a mandrel or spreader by which said knives or punches are operated to perforate the casing, a section or sleeve in which said mandrel is slidable, longitudinal slots in said sleeve, a radial projection on said mandrel slidable in said slots, and notches formed in the walls of said slots with which said projections may

engage whereby the mandrel may be held out of contact with the perforators.

4. The combination of a rod adapted to be reciprocated in a well-casing, a sleeve slidable upon the lower end of said rod, means by which said sleeve is retained on the rod and means by which the slidable movement of the two members in relation to each other is limited, a head carried by said sleeve, knives pivoted in said head, means by which said head is held at any suitable point in the casing, and a prolongation of said rod adapted to engage said knives to drive them outwardly to perforate the casing.

5. The combination of a head adapted to be moved within a well-casing, radial slots in said head, knives movable in said slots, said knives having a pivoted socket portion and a removable knife-point portion removably fitting the sockets of said pivoted portions, means for supporting said head at any desired point in the well and means by which said knives are operated to perforate the casing.

6. The combination of perforating means, a radially-slotted head, knives pivoted in said slots, said head having an axial bore, a mandrel movable in said bore and adapted to operate said knives, and means adapted to suspend the head at any point in the well-casing.

7. The combination of perforating means, a radially-slotted head, knives pivoted in said slots, projections or shoulders upon the adjacent inner ends of said knives, a mandrel adapted to engage said shoulders to force the knives outward against the casing, means by which the movement of said knives in either direction is limited, and means capable of suspending the head at any point in the well-casing.

8. The combination, of a rod adapted to extend into the casing, a mandrel or spreader carried at the end of said rod, a sleeve in which said mandrel is slidable, longitudinal slots in said sleeve, projections on said mandrel extending into said slots, a head in connection with said sleeve, radially-operating knives carried by said head, said mandrel adapted to engage said knives to force the latter outwardly against the casing, means for holding the head at any desired point in the casing, and a collar carried by the mandrel and adapted to contact with the end of the sleeve when the mandrel engages the knives, whereby the movement of the mandrel through the head and sleeve may be limited.

9. The combination of a mandrel, a sleeve in which said mandrel has a limited reciprocating movement, means by which the withdrawal of the mandrel from the sleeve is prevented, a head carried on the lower end of said sleeve, said head having an axial bore in which the mandrel is movable, transverse slots in said head, knives pivoted in said slots, the inner adjacent ends of said knives pro-

jecting into the path of the mandrel and
adapted to be engaged by the latter whereby
the knives are operated, a plate by which the
upward movement of the knives is limited,
5 and spring members secured upon said sleeve
whereby the device may be centered and held
at any desired point in the casing.

In witness whereof I have hereunto set my
hand.

EDWIN R. GRAHAM.

Witnesses:

S. H. NOURSE,
CHAS. E. TOWNSEND.