Jan. 6, 1925. 1,522,153

H. A. STILLWELL

METHOD OF FORMING CAVITIES IN EXPLOSIVES

Filed April 22, 1918

Fig: 1

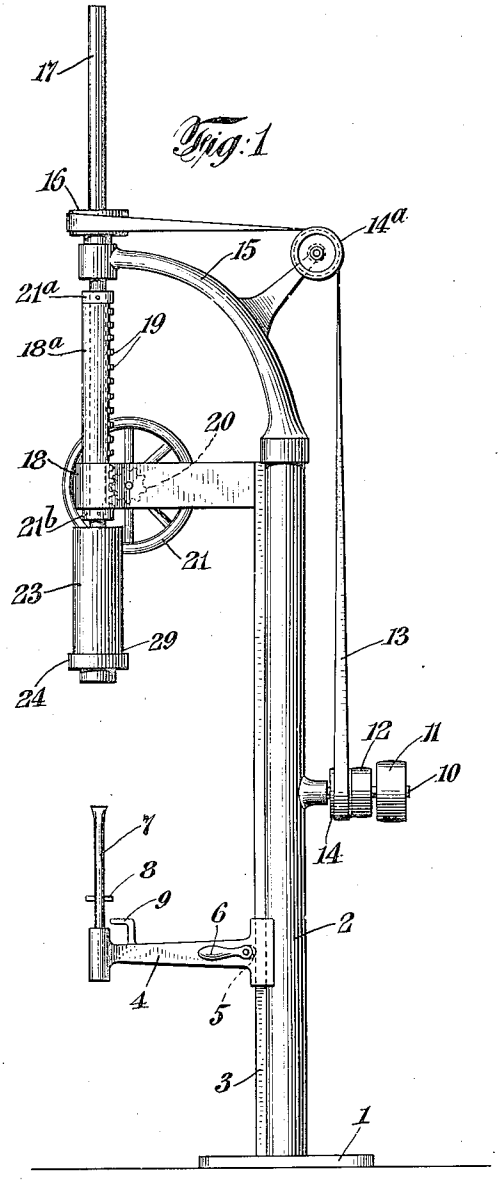
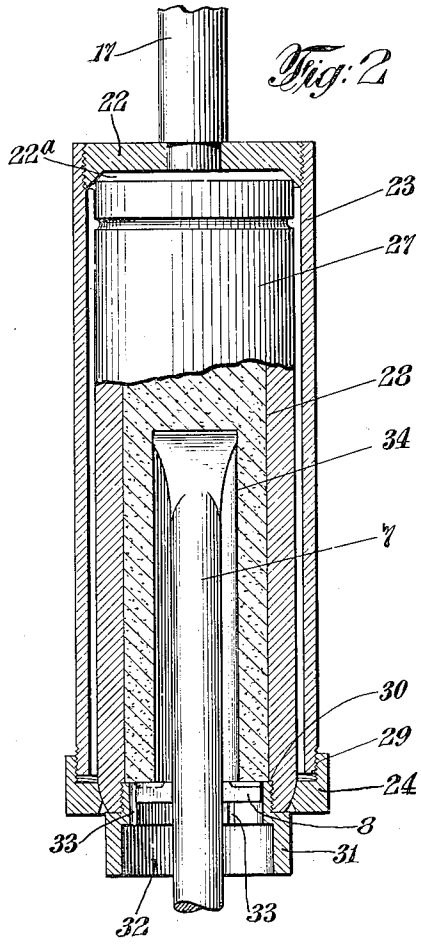


Fig: 2



Howard A. Stillwell Inventor

By his Attorneys

Prindle, Wright & Small

Patented Jan. 6, 1925. 1,522,153

UNITED STATES PATENT OFFICE.

HOWARD A. STILLWELL, OF WOODBURY, NEW JERSEY, ASSIGNOR TO E. I. DU PONT DE NEMOURS & COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

METHOD OF FORMING CAVITIES IN EXPLOSIVES.

Application filed April 22, 1918. Serial No. 230,070.

To all whom it may concern:

Be it known that I, HOWARD A. STILLWELL, of Woodbury, in the county of Gloucester and in the State of New Jersey, have invented a certain new and useful Improvement in Methods of Forming Cavities in Explosives, and do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to a method of boring out cavities or recesses in high explosive material such as the drilling out of explosive charges contained in shells so that primers or detonators may be inserted therein.

In producing high explosive shells it is customary to employ a steel shell having a cylindrical bore of a given diameter throughout almost its entire length and having a cylindrical bore of somewhat greater diameter for a short distance from its open end or mouth, thus affording an annular shoulder in the plane between the bores of the two diameters against which shoulder the detonator head rests when the shell is completely assembled. The shell is first filled with high explosive material in molten form, the explosive being cast in to fill the space completely so as to prevent the occurrence of pipes or blowholes. An axial hole of relatively small diameter is then drilled in the portion of the shell of smaller diameter and a hole of larger diameter is drilled in the portion of the explosive which is beyond or in front of the smaller shell recess, the latter hole thus forming, in combination with the smaller hole, a shoulder against which the detonator head rests.

The removal of the explosive material from the shell involves certain vital requirements among which may be mentioned the following. In the first place, great accuracy must be employed not only so that the detonator will be in intimate contact with the remaining explosive material, thereby properly to detonate the mass, but also so that the detonator will not jam when inserted before firing. Secondly, in removing the explosive material occupying the larger portion of the shell adjacent to its mouth, the material must be cut accurately to the plane defined by the shoulder between the two portions of the shell of large and small bore, respectively, for the reasons that if the material is removed to a plane rearwardly of the shoulder, the remaining material will not be held in place but will break loose from the walls of the shell, thereby making the detonation ineffective or causing the shell to explode in the gun, and if the material is only removed to a plane forwardly of the shoulder the remaining material which extends forwardly of the shoulder is likely to be broken down when the detonator and other parts of the head are placed in position, thereby causing the explosive to fall into the detonator recess and jam the exploder. And thirdly, in boring a recess of accurately predetermined depth, it is necessary to gauge the depth of the recess with respect to some accurately machined part of the stock which bears a known relation to the point or plane to which it is desired to bore. In the case of shells of the character described, for example, the over-all length of the shells may vary considerably due to allowed tolerances, and it is therefore advantageous to gauge the depth of penetration of the drill with reference to a point at a fixed distance from the internal shoulder, in order to make sure that the recess will be of the desired depth in each shell.

The principal objects of my invention, therefore, are to provide for the above and other cardinal requirements, thereby accurately and rapidly to bore recesses in explosive or similar material; to remove all of the explosive material from the forward larger portion of a shell of the type referred to without rubbing the borings between metals which might cause an explosion, and so that the forward end of the remaining material lies precisely in the plane defined by the aforesaid internal shoulder of the shell, and to bore an axial recess in the explosive material occupying the rearward portion of the shell of smaller bore; and to provide for properly positioning the shell or other stock with respect to a boring tool arranged to reciprocate (relatively) with regard to the stock to be bored.

Other objects and conditions of the invention will be in part obvious and in part specifically referred to in the description contained hereinafter in which I have disclosed one embodiment of my invention together with a certain apparatus adapted to carry

out the same; such embodiment however is to be considered merely as illustrative of the principle thereof. In the drawings—

Fig. 1 is a side elevation of an apparatus adapted to carry out my invention.

Fig. 2 is a longitudinal section of the shell holding means, the shell being shown in partly drilled out condition and the drill being shown in operative relation thereto.

As is shown in Fig. 2, the shell 27 has a recess 28 of relatively small diameter for the major portion of its length, but is provided with a larger recess 29 adjacent its mouth, thus forming a shoulder 30 between the two recesses. The drill is designed to bore out the explosive contained within the recess 28, while a cutter produces the larger recess adjacent the shell mouth. An adapter 31 is secured into the recess 29 prior to the operation of casting the explosive into the shell, such adapter having a recess 32 therein of slightly smaller bore than that of the recess 28 in the shell. The shell is then entirely filled with explosive up to the shoulder in the adapter 31, thus producing a solid body of explosive unlikely to contain blow holes or pipes. The drilling operation may then be carried out by means of the apparatus now to be described.

I have shown a drill comprising a base 1 having thereon an upright 2 provided with a flange 3 extending to either side of such upright. Sliding on said upright 2 there is a bracket 4 adapted to be held in place by a cam clamp 5 adjustable by a handle 6. Said bracket 4 carries in its ends a stationary drill 7 having projecting from the side thereof a cutter 8 for producing the cylindrical bore of larger diameter adjacent the mouth of the shell. A gauge 9 attached to bracket 4 determines the depth of the hole to be bored in the shell since it forms a stop which is engaged by the adapter 31 after the drill has penetrated to the desired depth. As the adapter is of standard dimensions and as its forward end is therefore at a fixed distance from the end of the shell and from the shoulder 30, the drill 7 and cutter 8 will penetrate exactly to the desired depth in each shell. At the rear of the upright 2, there is a shaft 10, having a driving pulley 11 thereon driven from any suitable source of power, said driving pulley being connected to a pulley 12 for driving a belt 13 adapted to be moved over the same. A loose pulley 14 is also located on the shaft 10 to receive the belt 13 when the apparatus is thrown out of operation. Said belt 13 passes over two idler pulleys 14^a carried on a bracket 15 at the top of the upright 2, and thence around a pulley 16, which is splined to a slide 17 passing through the upper end of the bracket 15. Said slide 17 also passes through a lower bracket 18 extending laterally from the upright 2. The slide 17 is provided with a sleeve 18^a carrying a rack 19 which engages with a pinion 20 carried by a hand-wheel 21 journaled in the lower bracket 18. Collars 21^a and 21^b retain the sleeve 18^a in place on the slide 17. On the lower end of the slide 17 there is fixed a collar 22, to which there is screw-threaded a cylinder 23. The collar 22 has a tapered recess 22^a in the base thereof to engage the base of the shell 27, and position it so that the drill 7 will work concentrically therein. On the lower end of the cylinder 23 there is screw-threaded a cap 24 having a tapered opening 25 which engages with the lower tapered end of shell 26 thus holding the same firmly in position.

In carrying out my method of drilling shells in connection with the above described apparatus, the shell is first centered properly in the cylinder 23 after which the rotation of the cylinder is begun and the shell permitted to move downwardly by gravity onto the drill 7 and lastly onto the cutter 8. The smaller recess 34 is thus cut in the body of explosive within the shell recess 28, and toward the end of the cutting operation, the cutter 8 advances within adapter 31 and bores out the part of the explosive which is located within the larger shell recess 29. Owing to the fact that the cutter 8 is of slightly smaller diameter than the smaller recess 28 of the shell, it does not come into contact with shoulder 30, and thereby a common cause of premature explosion during the boring process is eliminated, and the cutting edge of the cutter 8 is not impaired. Any explosive which remains in the notches 33 of the adapter 31 will be easily broken off from the main body of explosive, so that the recess 29 for the detonator head, is completely formed to the desired depth, by the method of operation above described. Owing to the fact that the shell is supported by means of the tapered cap 24 around its forward end, instead of by means of a stop engaging its forward end, the space beneath the mouth of the shell is left comparatively open so that the material cut away from the boring tube can freely fall from the recess.

It is to be understood that it is not essential to the method and that the apparatus herein disclosed need not be operated in precisely the position shown in the drawings, that is, in precisely a vertical position, but is of utility when employed in any position wherein the opening in the shell is directed somewhat downwardly, that is, in any position other than a horizontal position and other than a position in which the base of the shell is lower than the mouth of the shell. In order broadly to recite a position other than the two last mentioned positions, I have employed the expression "a fixed path having a vertical component," meaning by

this a path other than one disposed horizontally.

This specification contains certain subject matter disclosed in my prior applications #110,886, filed July 24th, 1916, entitled Drilling apparatus for shells, and #108,794, filed July 12th, 1916, entitled Drilling apparatus.

While in accordance with the patent statutes, the improved method has been illustrated by reciting in detail steps by which it may be carried out and in connection with apparatus by which it may be performed, it is to be understood that the details may be varied and that it may be carried out by other apparatus than that illustrated without departing from its spirit; it is not therefore, limited to the precise details recited nor to practice with the apparatus shown in the drawings, the invention being pointed out in the appended claims as required by the patent statutes.

What I claim is—

1. The method of forming a cavity in explosive material contained in a shell having directly communicating bores of different diameters, which consists in boring out the explosive contained in the bore of larger diameter, on a diameter not greater than the diameter of the lesser bore.

2. The method of forming a cavity in explosive material contained in a shell having directly communicating bores of different diameters, which consists in boring out the explosive contained in the bore of larger diameter, on a diameter not greater than the diameter of the lesser bore and removing from the larger bore the remaining explosive.

3. The method of forming a cavity in explosive contained in a shell having bores of different diameters, which consists in boring out on different diameters the explosive contained in the different bores respectively, the boring of larger diameter being carried out simultaneously with a portion of the boring of smaller diameter.

4. The method of forming a cavity in explosive contained in a shell having bores of different diameters, which consists in boring out on different diameters the explosive contained in the different shell bores respectively, the boring of larger diameter being carried out simultaneously with a portion of the boring of smaller diameter, the diameter of the boring in the explosive of the smaller shell bore being less than the diameter of the boring in the explosive of the larger shell bore and the latter boring being not greater in diameter than the smaller shell bore.

5. The method of forming a cavity in explosive cast in a shell having bores of different diameters, which consists in advancing boring cutters or drills in fixed longitudinal relationship into the said explosive, the said cutters or drills being of different diameters to form holes of different diameters in the different bores respectively, the hole of larger diameter in the larger shell bore being not greater than the lesser bore.

6. The method of forming a cavity in explosive cast in a shell having bores of different diameters, which consists in supporting the shell with its axis having a vertical component whereby borings released tend to drop away from the shell and having its lower end open, removing explosive material to form the desired cavity by advancing drills or cutters in longitudinally fixed relationship into the explosive from the lower end of the shell along a path having a vertical component, the said cutters or drills forming holes of different diameters and the hole in the larger bore being of a diameter not greater than the diameter of the smaller bore, and gaging the penetration of the drills or cutters into the explosive by reference to a part attached to the forward end of the shell.

7. The method of forming a cavity in explosive contained in a shell which consists in supporting the shell with its axis having a vertical component, whereby explosive released tends to drop away from the shell, and having its lower end open, and removing explosive material to form the desired cavity by relatively moving the shell and drills or cutters of different diameters and in longitudinally fixed relationship, whereby the said drills or cutters enter into the explosive from the lower, open end of the shell along a path having a vertical component and the boring of large diameter is carried out simultaneously with a portion of the boring of smaller diameter.

8. The method of forming a cavity in explosive contained in a shell, which consists in relatively moving the shell and a drill whereby the drill is entered into the explosive and limiting the penetration of the drill by a part at the forward end of the shell.

In testimony that I claim the foregoing I have hereunto set my hand.

HOWARD A. STILLWELL.