C. DAVIS.

MANUFACTURE OF HARDENED STEEL PROJECTILES.

APPLICATION FILED APR. 23, 1902.

970,428. Patented Sept. 13, 1910.

Fig. 1.

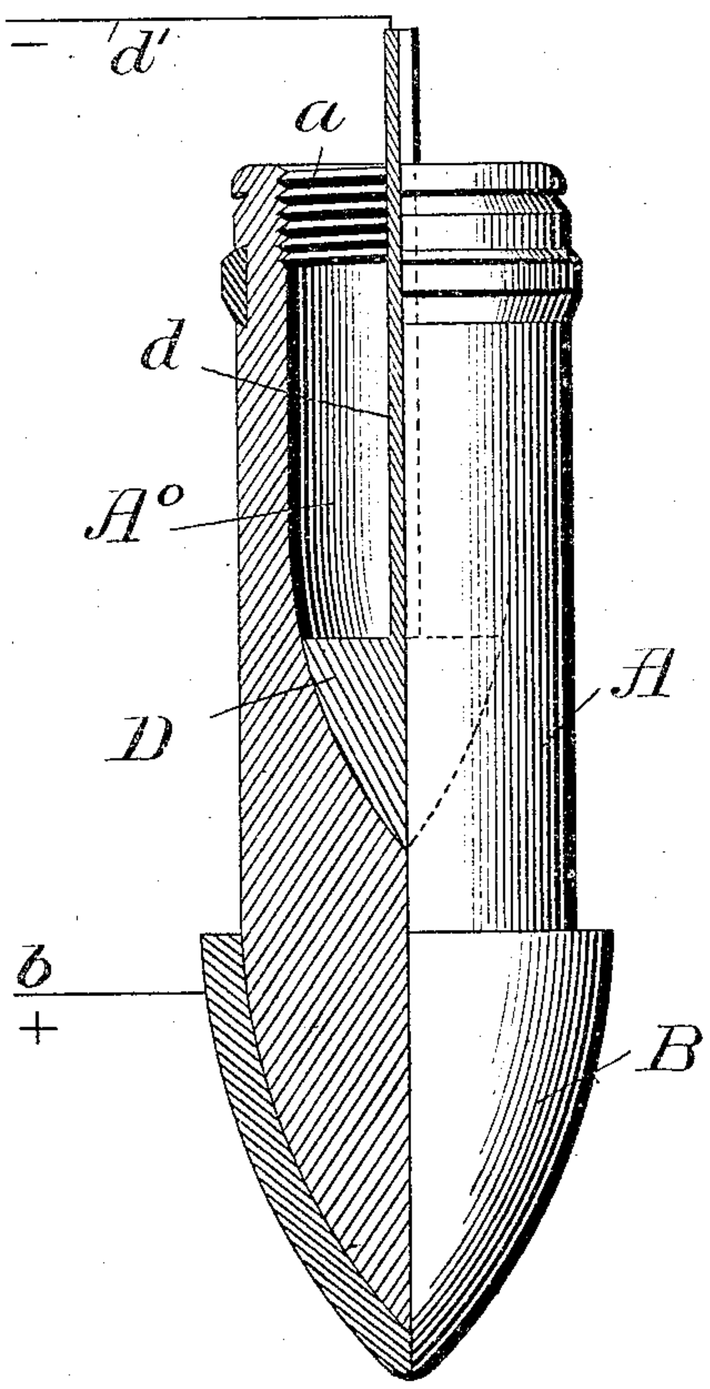
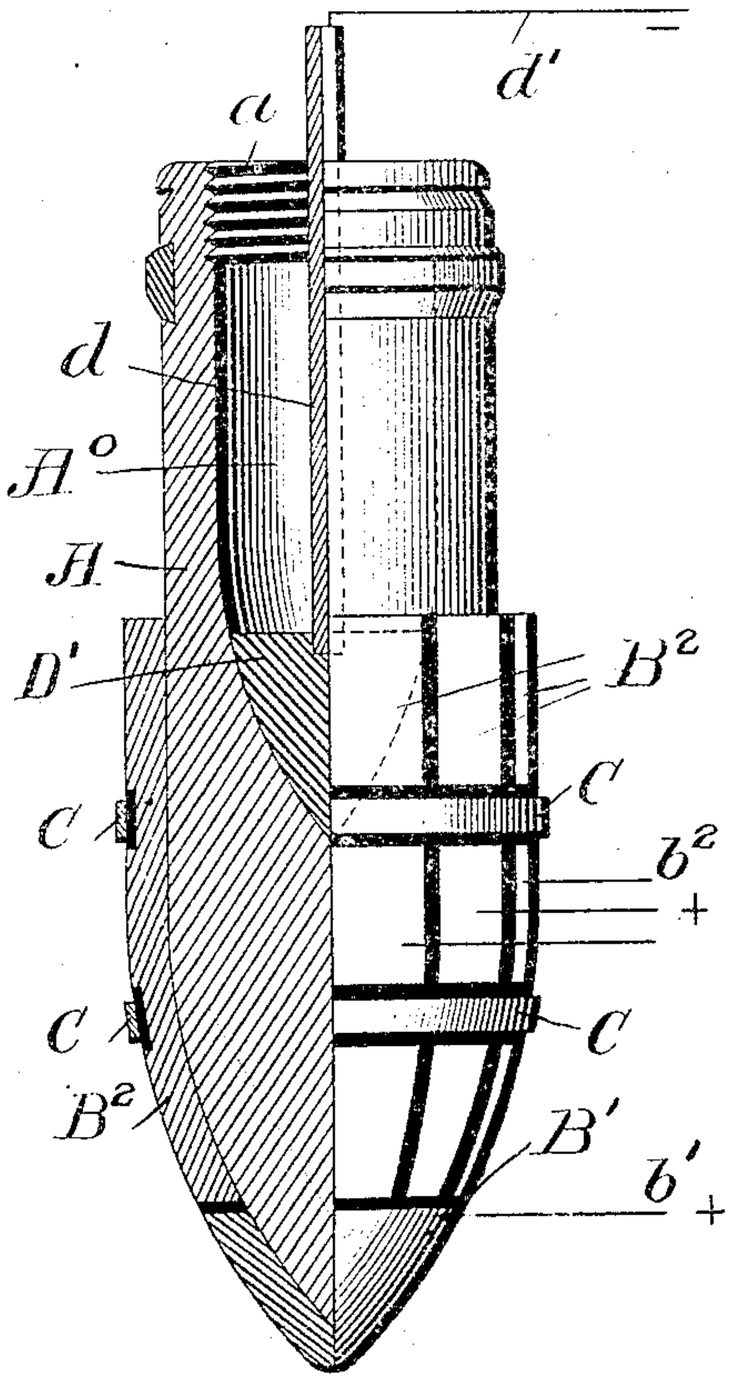


Fig. 2.



Witnesses
Geo. A. Bepple
Fredw. Engler

Inventor
Cleland Davis.
By Wilkinson & Fisher,
Attorneys.

UNITED STATES PATENT OFFICE.

CLELAND DAVIS, OF THE UNITED STATES NAVY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CARNEGIE STEEL COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

MANUFACTURE OF HARDENED-STEEL PROJECTILES.

970,428. Specification of Letters Patent. **Patented Sept. 13, 1910.**

Application filed April 23, 1902. Serial No. 104,381.

To all whom it may concern:

Be it known that I, CLELAND DAVIS, lieutenant U. S. Navy, a citizen of the United States, stationed at Washington, in the District of Columbia, have invented certain new and useful Improvements in the Manufacture of Hardened-Steel Projectiles, (Case F;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in processes of hardening steel and while applicable to plates or other masses of steel of any shape whatever, it is especially adapted for use in manufacture of hollow steel projectiles.

The drawings show one embodiment of the invention in the treatment of hollow projectiles.

Figure 1 represents an elevation partly in section of a shell being treated according to my invention, the electrical connections being indicated diagrammatically. Fig. 2 is a similar view showing modified forms of electrodes.

A represents the shell having the usual cavity A^0 and provided with screw threads *a* for the bushing not shown.

B represents an electrode, preferably of carbon, which incloses the head of the shell and to which current is applied by the conductor *b*. D represents the other electrode, preferably of copper, which is of shape to make suitable contact with the inner wall of the cavity A^0 at its forward end. The electrode D may be inserted or removed by the stem *d* which is connected by a conductor *d'* to the opposite pole of the source of electricity, not shown.

The current which may be either direct or alternating passes from one electrode to the other, heating the forward portion of the shell in such a manner as to produce a hardening effect when the shell is cooled.

Where the electrodes are applied to the portions to be hardened the necessary heat is obtained by varying the contact and consequent resistance between the electrode and the body under treatment. Where high temperatures are used, I preferably screen the heated portions from the air while under treatment, as described in my patent No. 687612 granted Nov. 26, 1901.

Since with large shells it might not always be practicable to secure a heavy enough current to heat so large a portion of the shell at the same time, an arrangement similar to that in Fig. 2 may be adopted, in which the outer electrode is composed of a number of conducting strips B^2 insulated from each other and from the holding bands C. At the ends of these strips I provide the conducting piece B' inclosing the tip of the shell. This piece B' and the strips B^2 are connected to the source of electricity, not shown, by the conductors *b'* and b^2 respectively. These pieces B' and B^2 may be of metal or carbon or any other suitable conductor. The inner electrode D' may be of carbon secured to the copper stem *d* and connected to the conductor *d'*. The current may be applied either from the positive pole of the source of electricity through the conductor *b'* and b^2 passing out through the conductor *d'*; or it may be caused to flow in the opposite direction; or an alternating current may be used. By cutting in the pieces B' B^2 singly or in groups, the front end of the shell may be hardened progressively, that is one part at a time until it is all hardened.

While I have described electrodes of carbon and copper, any suitable material may be used for the electrodes, and the carbon electrode may be applied to the outer wall or to the inner wall or to both walls of the shell by having one or the other or both electrodes of carbon; moreover the current may be caused to flow in either direction, or an alternating current may be used.

A heavy electric current will quickly bring the part of the shell being treated to the requisite degree of temperature, and the shell may be then chilled either by simply turning off the current, or by actually removing the electrodes and immersing it in a bath, or by spraying water or blowing air on the shell.

I have shown the shell in an advanced state of manufacture, but it may be treated at any time after the front of the shell has been suitably shaped.

While I have described the invention more especially as applied to the manufacture of hollow projectiles, it will be obvious that any

other form or configuration of steel may be treated in precisely the same way by varying the position and arrangement of the electrodes. The electrodes should preferably be placed far enough apart to prevent the softening or annealing of the mass which might occur about midway between the electrodes, if the electrodes were too close together.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is:

1. In the method of hardening hollow projectiles of steel, that step which consists in placing an electrode exterior of the nose of the projectile and another electrode in the cavity in said projectile and passing a heavy current between said electrodes, substantially as described.

2. In the method of hardening hollow projectiles, the steps of applying a carbon electrode to the nose of the projectile, another carbon electrode to the inner wall of the projectile, and passing a heavy current between the said electrodes, substantially as described.

3. The method of hardening hollow steel projectiles of high carbon steel which consists in placing an electrode exterior to the nose of the projectile, placing another electrode in the forward part of the cavity of the projectile, passing a heavy electric current between said electrodes, and subsequently chilling the nose of the projectile, substantially as described.

4. In the method of hardening hollow projectiles, the steps of applying a carbon electrode to the exterior nose of the projectile, applying another electrode in the cavity against the other face of the nose, passing a heavy electric current between said electrodes, and driving carbon from the exterior electrode into the steel point of the projectile, substantially as described.

5. The method of hardening hollow projectiles consisting in applying a carbon electrode to the exterior nose of the projectile, applying a second carbon electrode in the cavity against the other surface of the nose, passing a heavy electric current between said electrodes and driving carbon from one of the electrodes into the steel point, then removing the electrodes and cooling the point of the projectile, substantially as described.

6. In the method of hardening hollow projectiles, the steps of applying a carbon electrode to a portion of the nose of the projectile, another electrode in the cavity of the projectile, passing a heavy electric current between said electrodes and shifting the point of application of the carbon electrode, substantially as described.

7. The herein described method of hardening hollow projectiles, which consists in applying an electrode within the nose portion of the projectile, and another electrode upon the exterior of the nose in imperfect contact therewith, and covering that portion of the nose which is to be hardened, passing a heavy current of electricity through the electrodes and the nose portion of the projectile, shutting off the current, and then chilling the heated portion of the projectile, substantially as described.

In testimony whereof, I affix my signature, in presence of two witnesses.

CLELAND DAVIS.

Witnesses:
CLARENCE O. BATEMAN,
FRED W. ENGLERT.