No. 876,862. PATENTED JAN. 14, 1908.

C. DAVIS.

METHOD FOR THE CEMENTATION OF STEEL.

APPLICATION FILED APR. 10, 1901.

Fig. 1.

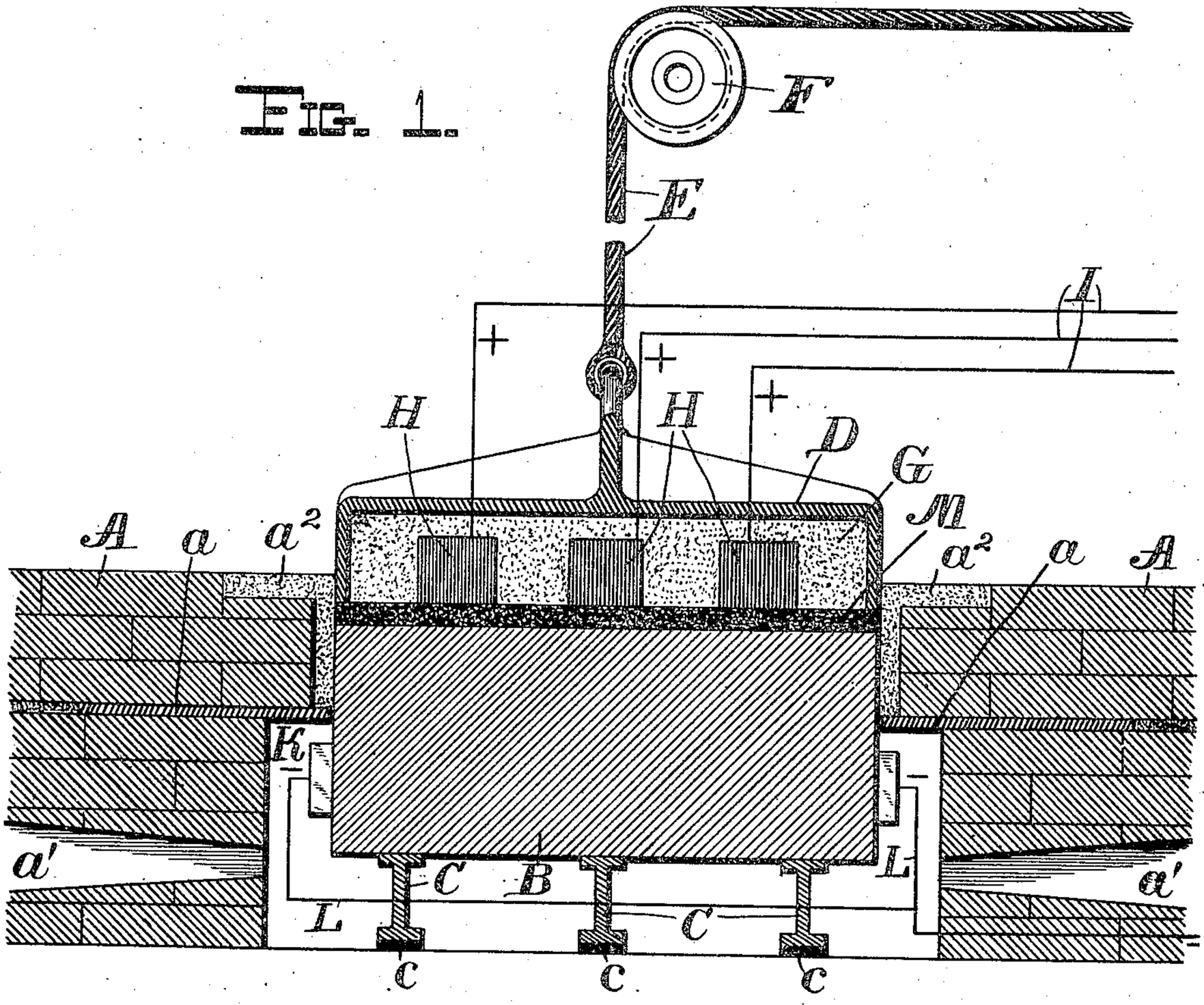
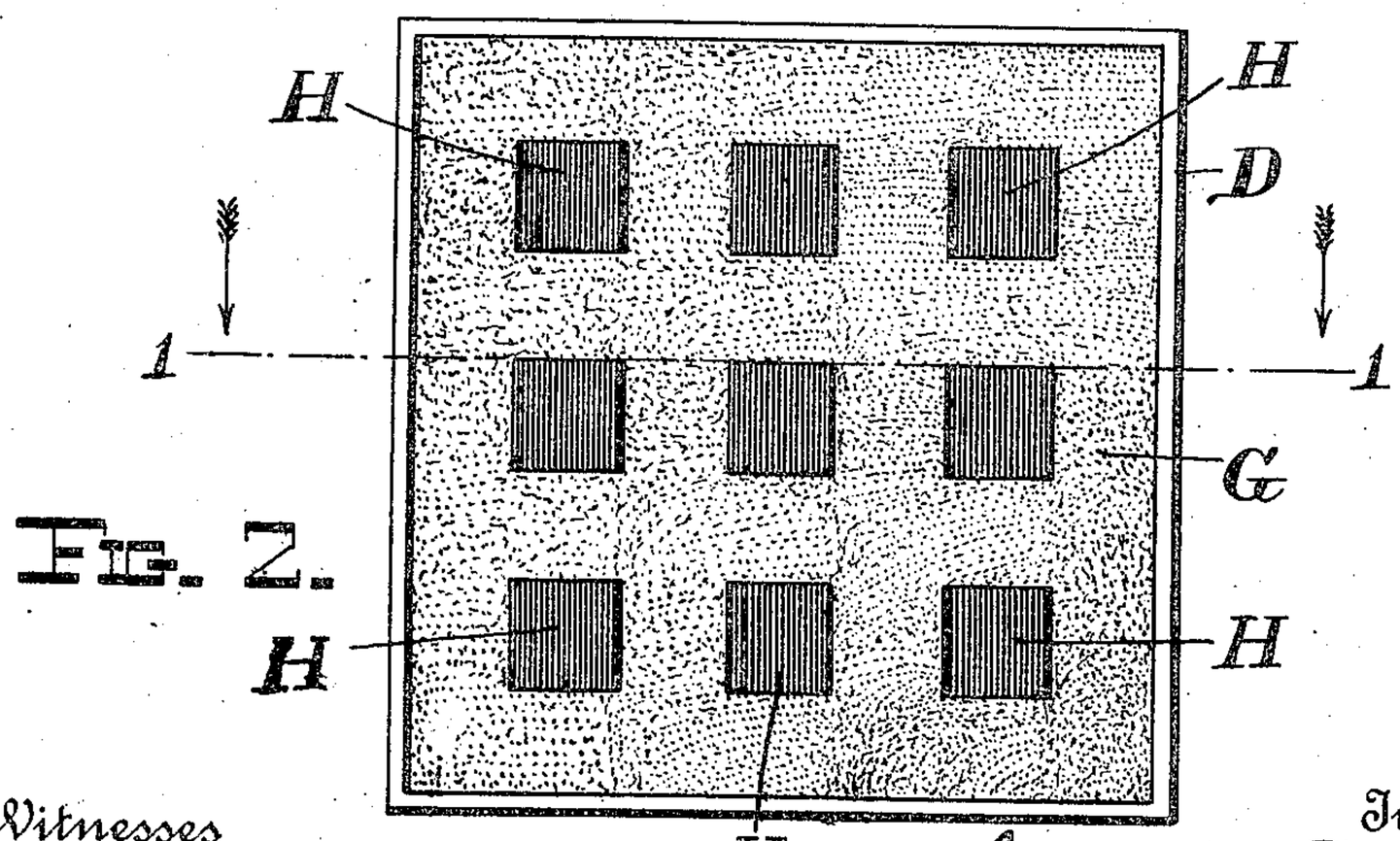


Fig. 2.



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UNITED STATES PATENT OFFICE.

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

METHOD FOR THE CEMENTATION OF STEEL.

No. 876,862. Specification of Letters Patent. Patented Jan. 14, 1908.

Application filed April 10, 1901. Serial No. 55,124.

To all whom it may concern:

Be it known that I, CLELAND DAVIS, lieutenant U. S. N., a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Methods for the Cementation of Steel; 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 an improved method for the cementation of steel, and it consists of certain novel features that will be hereinafter described and claimed. In processes of this character the main objects to be attained are, first, to be able to regulate the depth of carbonization and of chill, so as to preserve the most effective proportion between the hard face and the tough back; and second, at the same time preserve the integral character of the metal throughout.

If a plate be heated by an electric furnace to any desired depth to a molten point, or to one approaching fluidity, the back being kept comparatively cool, carbon can be introduced in the desired quantity and will be absorbed instantly or in a very short time, uniformly throughout the molten portion and shade away into the body of the plate.

In all the processes of cementation hitherto employed, the shading off of carbon begins from the surface or immediately below it.

The accompanying drawings show an electric furnace adapted to carry out the foregoing process, and in which,

Figure 1 represents a section through a furnace constructed for carbonizing armor plate, the section of the cover being shown along the line 1—1 of Fig. 2, and Fig. 2 represents an inverted plan view of the detachable air tight cover to go over the side of the plate that is to be heated.

A represents the masonry, preferably firebrick, having the plate *a*, twyers *a'* and asbestos and fire clay backing *a"* let inside the same.

B represents the armor plate supported on eye-beams C, which are insulated as at *c*. The entire plate should be insulated in this or any other convenient way.

D represents a removable cover which may be removed as by means of the cable E passing over the pulley F, or in any other convenient way. This cover makes an air tight joint over the side of the plate to be treated. The said cover is packed with asbestos, or fire clay, or similar material G, in which a plurality of electrodes H are held, and these electrodes are connected with the source of electricity by suitable conductors indicated diagrammatically at I. The circuit to the source of electricity is completed by means of the contacts K and the conductors L. The contacts K may be placed at suitable points on the sides or bottom of the plate. A layer of powdered carbon M is interposed between the cover D and the face of the plate to be heated. Air, either hot or cold, may be blown through the twyers *a'* from any suitable air blast, not shown, and thus lower the temperature of the under side of the plate, while the upper side of the plate is being heated, or other means may be employed to keep the back of the plate cool, if preferred.

In practice, the plate is put in position, a measured quantity of powdered or granular carbon M is spread over the surface to be treated, the cover D is lowered in place and the joints made tight, and the necessary electric current is turned on. This speedily raises the temperature of the carbon M and the upper part of the plate, until the latter reaches almost, if not quite, the fusing point, and the layers of carbon will be absorbed into the plate. In the meantime the lower part of the plate may be kept comparatively cool, by means of an air blast through the twyers *a'*. If the electric current be kept on until all the carbon M has disappeared, then it will be known that this has been carried into the body of the plate, and in this way a measured degree of carburization may be obtained. Moreover, by varying the current and the time of its application, the carbon may be carried through into the plate, causing the cementation to be deeper than with the processes now in use.

A direct current would, I believe, be preferable to an alternating current, as the tendency of the carbon would be to follow the current. If desired, a single electrode might cover the entire mass of carbon M, or a single carbon electrode might be used, covering the entire face of the plate to be treated, or the electrodes H might be differently grouped,

and the currents passed through them *seriatim*, or in groups, or the pulverized carbon M might be done away with, and the carbon supplied direct from the carbon electrodes, all of which, and any other grouping of electrodes I intend to include within the scope of my claims.

Instead of having the circuit closed, I may establish an arc between the electrodes and the face of the plate to be treated, and I prefer this method for carbonizing; or I may so adjust the electrodes and the plate, as to give a suitable heating effect.

No hard and fast rule can be laid down as to the treatment of any particular class of plates, as the treatment would differ for different grades of steel, and for different sizes of plates, etc., but the electrical characteristics once being established, it is evident that conditions can be reproduced with great accuracy by use of the volt meter and ammeter, and by regulating the amount of carbon to be introduced into the plate.

In practice it may be found that the quality of the metal can be improved, after carbonizing, by treatment such as forging, annealing, etc., the plate being removed from the furnace for this purpose.

It will be evident that this method of treatment may be used with any plate in which it is desired to make harder or chill deeper on one side than on the other.

While I have described this invention as applied to the treatment of armor plate for the purpose of face hardening the same, it will be obvious that the same is applicable to the cementation or hardening of steel plates wherever it is desired to have one side of a plate harder than the other.

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

1. The process of treating previously formed iron or steel plates which consists in heating one face of the solid plate to an approximately molten condition by means of a heavy current of electricity, and carburizing said molten face, substantially as described.

2. The process of treating previously formed iron or steel plates which consists in heating one face of the solid plate to approximately molten condition by means of a heavy current of electricity, and carburizing said molten face and in maintaining the opposite face of said plate at a lower temperature, substantially as described.

3. The process of treating armor plate, which consists in applying carbon to one side of the plate and screening said carbon and that side of the plate from air, in passing a heavy current of electricity through said carbon and through said plate, and simultaneously blowing air on the opposite side of the plate, substantially as described.

4. The method of making hardened steel plates, consisting in applying carbon to one face of the solid plate, screening such portion of the plate from air, heating the carbon covered face to an approximately molten condition by a heavy current of electricity, and maintaining the opposite portion of said plate at a lower temperature; substantially as described.

5. The method of treating iron or steel plates, consisting in applying carbon to one face of the plate, screening such face from the air, and then applying an electric current to such face to raise it to an approximately molten condition; substantially as described.

6. The method of treating iron or steel plates, consisting in applying solid powdered carbon to one face of a solidified plate, covering and protecting such portion of the plate from the air, heating the carbon-covered face to approximately a molten condition by a heavy current of electricity, and simultaneously applying cooling means to the other portion of said plate to keep it at a lower temperature; substantially as described.

7. The herein described method which consists in impregnating a face of a metal plate with carbon to a prescribed depth while said depth of the plate is in a molten condition, the remaining portion of the plate being in a solid condition, substantially as described.

8. The herein described method which consists in remelting one face of a metal plate to a prescribed depth while maintaining the remaining portion of the plate in a comparatively solid condition and uniformly impregnating the melted portion with carbon, substantially as described.

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

CLELAND DAVIS.

Witnesses:

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