(No Model.)

W. T. SAMPSON & A. A. ACKERMAN.

MANUFACTURE OF HARD FACED ARMOR.

No. 539,010. Patented May 7, 1895.

Fig. 1.

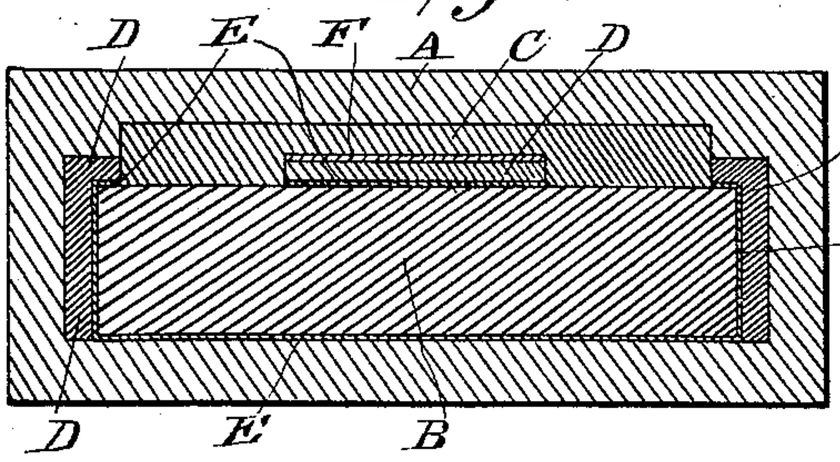


Fig. 3.

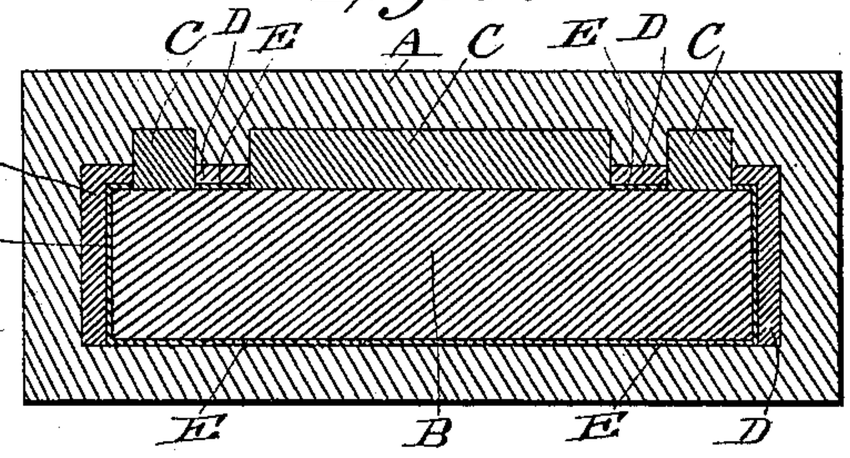


Fig. 2.

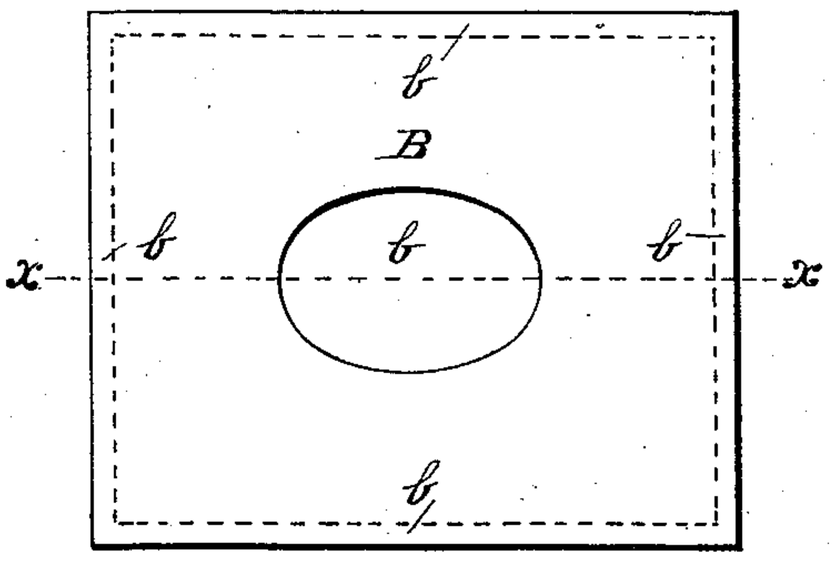


Fig. 4.

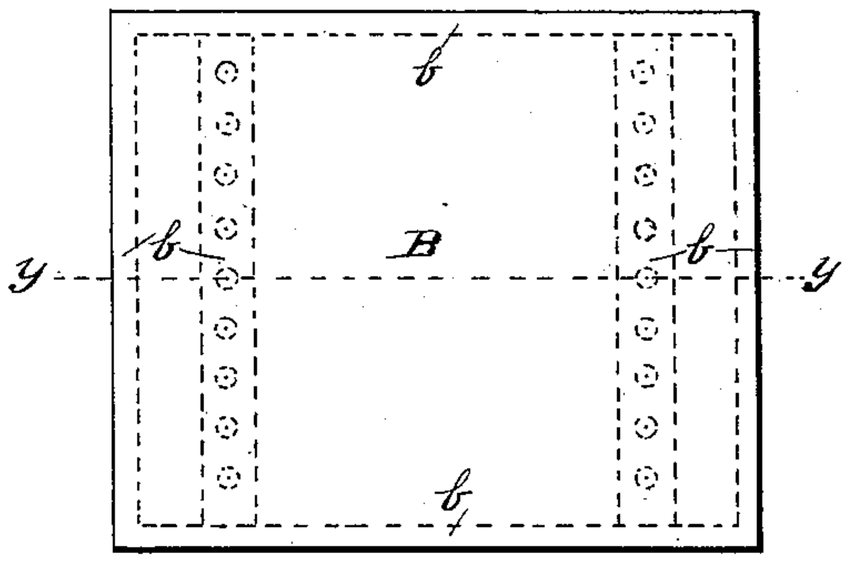


Fig. 5.

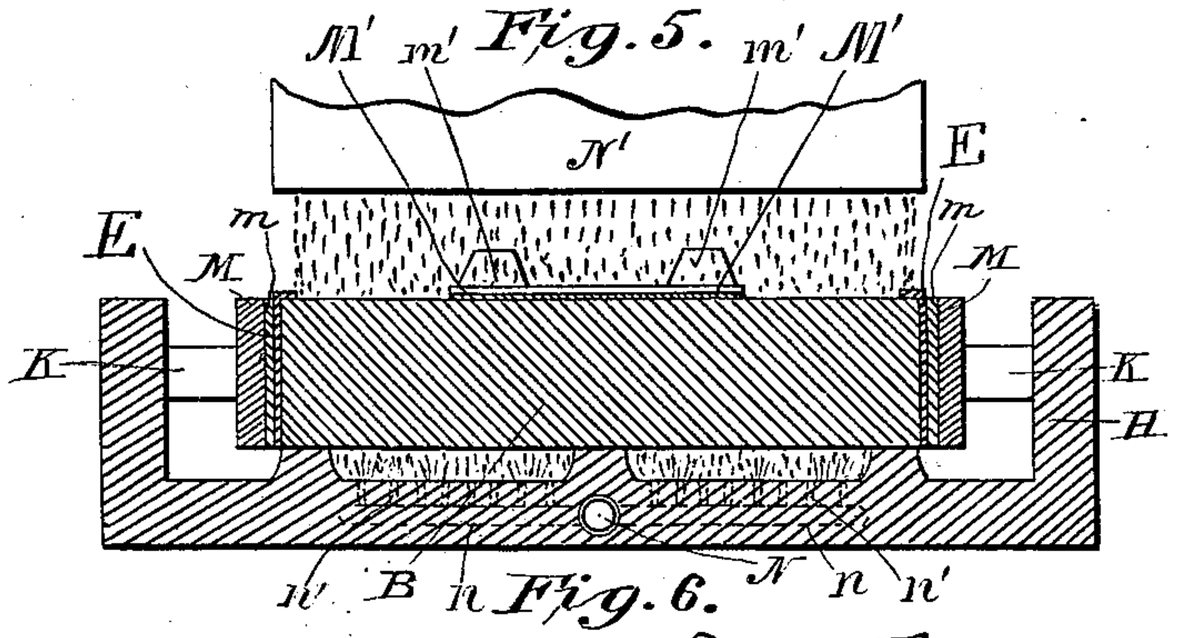
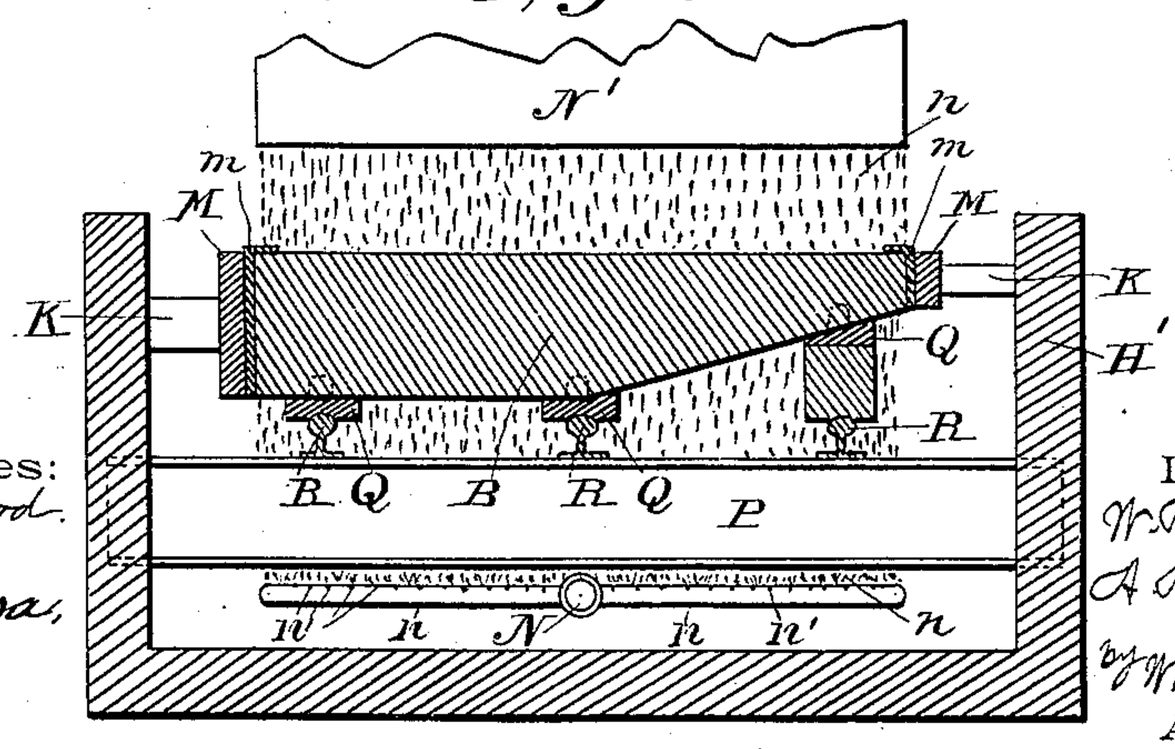


Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM T. SAMPSON AND ALBERT A. ACKERMAN, OF THE UNITED STATES NAVY; SAID SAMPSON ASSIGNOR TO SAID ACKERMAN.

MANUFACTURE OF HARD-FACED ARMOR.

SPECIFICATION forming part of Letters Patent No. 539,010, dated May 7, 1895.

Application filed November 28, 1894. Serial No. 530,240. (No specimens.)

To all whom it may concern:

Be it known that we, WILLIAM T. SAMPSON, captain United States Navy, and ALBERT A. ACKERMAN, lieutenant United States Navy, citizens of the United States, stationed at Washington, in the District of Columbia, have invented certain new and useful Improvements in the Manufacture of Hard-Faced Armor; and we 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.

Our invention relates to improvements in the manufacture of face hardened armor, and it consists of certain novel means for controlling and limiting the hardening of such portions of the plate as it is desired to keep soft enough for machining.

It has been the custom for some years in cementing armor plates and other castings and forgings, to protect from carburization the edges which may require fitting after hardening, as well as certain areas in the face of the plate, intended for port-holes, sight-holes, bolt and rivet-holes where it may be necessary to drill holes after the plate is hardened and in position on the ship or elsewhere. The object of so doing is to keep the carbon at so low a point in these localities that the metal will not harden when chilled after cementation, and thus will not become impossible to machine. This protection has hitherto been secured by, first, superimposing metallic frames or shapes either in cementing or hardening, or both; but these are expensive and inefficient, since the shapes fit irregularly and expansion permits the carbon gases, whether supplied from a reservoir or generated by heat from carbonaceous matter in contact with the plate to leak beneath them in cementing, as well as the chilling medium in hardening; second, by superimposing inert material in cementing, such as sand, clay and silicious compounds. The second method is also unsatisfactory, as this inert material permits the carbon gases to seep through; or by baking and rising, or cracking away, exposes the surface to the carburizing agents. Materials of this supposed inert nature are also dangerous on account of unnoticed impurities which may flux with the highly carburized steel at the border of the protection, causing deep holes to be scored and fused in the surface of the plate. The result is that after the application of either of these methods there is no certainty that the metal will not have taken up sufficient carbon in these localities to render it quite impossible to machine after the hardening process has been completed. The methods of preventing the hardening of these spaces by delaying the abstraction of heat in the subsequent operation of chilling the heated plate through the application of red hot bars or guards of metal to those localities it is intended shall remain soft for fitting and drilling holes, are also uncertain and disadvantageous on account of their requiring that much additional heat to be abstracted through the remaining unprotected surface, and thereby delaying and moderating, if not altogether preventing its hardening. The method by which we accomplish the desired result is by providing over the portions of the plate to be protected from the carburization a coating of material which will oxidize or decarbonize the carbon gases which may seep through it before they reach the face of the plate. In addition to this these parts so protected may also be covered with a non-conducting or partially non-conducting substance during the operation of hardening. The preferred method of so doing is before the spray or cooling medium is brought to play upon the heated plate, asbestos boards of appropriate shape to the port-holes, lines of rivet-holes, fitting ends of the plate, &c., are firmly pressed upon the plate, preventing the contact of the cooling medium and preventing heat radiation over these areas which it is not desired to chill. These asbestos boards are not intended to act as a dam preventing the flow of the cooling medium over certain areas which are cooled by radiation as in certain processes of saw tempering, where the hardness and toughness of metal is shaded from the teeth to the back, but is for the purpose of retaining the heat as long as possible over certain areas in contact with them and permitting the freest abstraction of heat elsewhere.

The metal with which we propose to deal in

the surface of armor plates is capable of hardening by air cooling. Moreover it is desired to harden one part right out and to retain the other part as soft as possible. This it would be found impossible to do by means of dams and edge and corner guards which may act as dams and prevent the rapid flowing off of the cooling medium after it has absorbed sufficient heat to reduce its chilling properties.

We have found that to a certain degree the desired result may be accomplished in cementation by leaving on the scale, which forms on the plate in its various heatings, over the parts to be protected from the action of the carbon gases, and by removing the scale from all of the parts of the plate as above mentioned to be subsequently hardened. This scale, being an oxide of iron is reduced to metallic iron by the carbonic oxide gas, which gas is converted into carbon dioxide, which has little or no effect in carburizing the plate. This scale is also left in position over these localities while hardening the plate subsequent to cementation, when through its being a poor heat conductor the abstraction of heat is delayed on those parts, especially, if further prevented by covering them with artificial non-conducting material such as the asbestos boards mentioned above. Since this scale forms unevenly, varies largely with different conditions, and is occasionally cracked away we would prefer in cementation to grade the coating of the decarburizing agent mentioned above to the conditions required, in addition employing when needed in the hardening operation the asbestos boards. To accomplish this we propose to coat heavily the surfaces not to be carburized with a decarburizing agent, such as iron, or other metallic oxide paint, said paint being mixed and stiffened with asbestos, clay, or other refractory material. Over the scale or the decarburizing paint, and protecting it from the surrounding carbonaceous compound, charred boards may be placed, if necessary. This is not essential, however, as any inert material to fill up the space will do. Thus the only carbon gases having access to the coating will be simple, scanty, and less penetrating than that from the other material. In this manner, a decarburizing material will be brought closely into contact with the surface of the metal, baking to it when heated. This material will not only require to be reduced before the gases can reach the plate, but on account of its large percentage of oxygen, and its compact nature, the gases will be much attenuated, nearly inert, and long delayed before reaching the true surface. In addition, where through lack of knowledge of the exact location of the desired soft strips, before cementation, it has been impossible to wholly exclude the carbon from a space required to be machined after hardening, and also as an additional precaution to prevent hardening, when the carburized spaces have been correctly located, it is proposed to protect these areas in hardening from contact with the chilling medium by means of non-conducting material such as boards lined with asbestos firmly pressed to the plate. The latter alone it is found will prevent the hardening of even a fully carburized surface. Where the decarburizing paint is used, the asbestos or clay serves merely to dilute and give body to the decarburizing material.

The advantage of this process over that employed at present is obvious, especially where the original plate is of a material subject in itself to a degree of hardening, such for instance, as chrome steel, or other steel containing a high percentage of nickel which is capable of hardening when cooled in the air.

We are aware that a certain decarburization takes place on the back of cemented plates where they happen to be bedded in sand, presumably inert, but containing some oxide, and where the metal is inaccessible to the carbon.

The intention of this invention is not to grade the carbon throughout the thickness of the plate, as in the case above mentioned, but is to prevent the access of the carbon to certain localities or to render it inert before it reaches them.

From the foregoing it will be seen that this invention consists not only in retarding, in diluting with inert carbon dioxide, and in diminishing in quantity the carbonic oxide gases that may eventually reach the plate through the protecting material; but the said invention also consists in actually decarburizing the metal itself, thereby rendering it certain that in the time required for cementation the said localities of the plate will not be carburized to such an extent as to render its hardening possible in the subsequent operation of chilling. The scale in the one case, and the asbestos or clay mixed in with the metallic oxides in the other case, will also form a non-conducting medium which should not be removed prior to the process of chilling; and thus those parts of the plate are shielded from the direct action of the chilling medium, keeping the said parts softer than the contiguous parts which are chilled. In addition to the above scale and protective material employed in cementation being left in hardening on these spaces they are further covered with non-heat conducting material which prevents access of the chilling medium.

The accompanying drawings illustrate diagrammatically the operation of the herein described invention.

Figure 1 represents a section through a plate and the adjacent media, the plate being shown in section along the line $x\,x$ of Fig. 2, and the purpose being to keep the center and edges of the plate soft. Fig. 2 represents a plan view of a plate intended for use in the wake of a post-hole. Fig. 3 represents a similar section to that shown in Fig. 1, except that the edges and two strips for drilling rivet-holes are to be kept soft, the section being

along the line *y y* of Fig. 4. Fig. 4 represents a plan view of the plate shown in Fig. 3. Fig. 5 is a sectional view showing diagrammatically the means of chilling the plate shown in Figs. 1 and 2. Fig. 6 is a sectional view showing diagrammatically a tapered plate for side armor with means for chilling the same on both sides.

The same parts are indicated by the same letters throughout the several views.

A represents a mass of inert material which is applied in the ordinary way.

B represents the plate under treatment, and *b* the softer portions of the surface thereof.

C represents the carburizing material.

D represents the decarburizing material.

E represents the scale which may or may not be left on over the portions to be kept soft.

F represents the board divisions, which may be employed as shown in Fig. 1, or may be omitted as shown in Fig. 3.

In the chilling apparatus shown in Fig. 5 the plate B rests on the frame H and is wedged in place with the wedges K, which wedges bear against the boards M faced with asbestos *m* for keeping the ends of the plate from becoming chilled. The part of the plate to be cut away for the port-hole is covered with an asbestos faced board M′, weighted down by weights *m′*.

N and N′ represent sources of water supply for the sprays *n*.

In the form of chilling apparatus shown in Fig. 6 the plate B is wedged in the frame H′ as described with reference to Fig. 6, but is supported upon asbestos pads Q on tracks R transverse to the iron beams P set across the frame H′. The plate is sprayed on from top and bottom as before. In this case the locations of the bolt-holes on the back as well as the edges of the plate are kept soft.

We are aware that in Boynton's patent, No. 66,785, granted July 16, 1867, portions of the metal not desired to be converted into steel were described as covered with a wash of silicate of alumina or silicic acid, or both combined, mingled with lime or other alkaline substances; but it will be noted that such a combination will form a fusible slag incapable of absorbing or oxidizing the carbon gases.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists, in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating of material adapted to oxidize the carbon in the carbon gases of cementation; and in exposing to the action of the said gases the remaining portions of the plate, substantially as described.

2. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists, in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating of material adapted to oxidize the carbon in the carbon gases of cementation; in exposing to the action of the said gases the remaining portions of the plate; and, in the subsequent operation of hardening by chilling the heated plate, covering the said locations which it is desired to retain in a soft condition with a layer of non-conducting material, substantially as described.

3. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating composed of a mixture of inert material and material adapted to oxidize the carbon in the carbon gases of cementation, and in exposing to the action of the said gases the remaining portions of the plate, substantially as described.

4. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating composed of a mixture of inert material and material adapted to oxidize the carbon in the carbon gases of cementation; in exposing to the action of the said gases the remaining portions of the plate; and, in the subsequent operation of hardening by chilling the heated plate, covering the said locations which it is desired to retain in a soft condition with a layer of non-conducting material, substantially as described.

5. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face, or faces of the plate, which consists, in the operation of supercarburization, of providing or leaving on the surface of those portions which it is desired to retain soft, a coating of metallic oxide capable of oxidizing the carbon in the carbon gases of cementation, in removing the scale from the part to be hardened and in exposing to the action of the said gases the remaining portions of the plate, substantially as described.

6. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists, in the operation of supercarburization, of providing or leaving on the surface of those portions which it is desired to retain soft, a coating of metallic oxide capable of oxidizing the carbon in the carbon gases of cementation in removing the scale from the part to be hardened; in exposing to the action of the said gases the remaining portions of the plate; and, in the subsequent operation of hardening by chilling the heated plate, covering the said locations which it is desired

to retain in a soft condition with a layer of non-conducting material, substantially as described.

7. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face, or faces of the plate, which consists, in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating consisting of a mixture of inert material and metallic oxide capable of oxidizing the carbon in the carbon gases of cementation, and in exposing to the action of the said gases the remaining portions of the plate, substantially as described.

8. In the manufacture of armor plates, the method of controlling and limiting the hardness of the face or faces of the plate, which consists, in the operation of supercarburization, of providing on the surface of those portions which it is desired to retain soft, a coating composed of a mixture of inert material and metallic oxide capable of oxidizing the carbon in the carbon gases of cementation; in exposing to the action of the said gases the remaining portions of the plate; and, in the subsequent operation of hardening by chilling the heated plate covering the said locations which it is desired to retain in a soft condition with a layer of non-conducting material, substantially as described.

9. The method of controlling and limiting the hardening of armor plates of any description by retaining the scale in position over parts it is desired to retain in their soft condition and in cleaning it off of the other parts and covering these surfaces to be kept soft with a comparatively non-heat conducting material in the operation of hardening by chilling the heated plate, substantially as and for the purposes described.

In testimony whereof we affix our signatures in presence of two witnesses.

W. T. SAMPSON.
A. A. ACKERMAN.

Witnesses:
C. S. SPERRY,
HENRY MCCREA.