

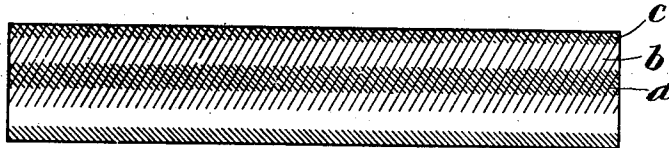
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MANUFACTURE OF ARMOR PLATES FOR THE PROTECTION OF SHIPS AND OTHER STEEL OBJECTS.

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1,061,998.

Patented May 20, 1913.



Witnesses:

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FEDERICO GIOLITTI, doctor of chemistry, a subject of the King of Italy, and a resident of Rome, Italy, have invented certain new and useful Improvements in the Manufacture of Armor-Plates for the Protection of Ships and other Steel Objects, of which the following is a specification.

10 This invention refers to a process for manufacturing armor plates or any other objects of ordinary carbon steel as well as of any other special ternary, quaternary and like steel, formed of successive layers alternately more or less hard, tenacious and elastic.

15 This process consists in submitting the plates or other objects of homogeneous steel possessing a slight or great proportion of carbon to a series of successive carbonizations or de-carbonizations suitably regulated as regards their duration, or as regards the temperature at which they are effected, so as to obtain at the interior and on one of the surfaces, or if necessary on the two larger surfaces of the steel mass, two or more layers strongly carbonized, tenacious, having a clearly crystalline structure and capable of being strongly tempered, the said layers being alternated with two or more layers having a slight proportion of carbon which consequently even after the tempering are less hard and more plastic.

20 The figure of the drawing indicates a steel plate made according to the present invention in which there is a zone *b* containing less carbon than the inner portion *a* of the article, and an outer zone *c* containing a greater proportion of carbon than the adjacent inner zone *b*.

25 In order to obtain this object advantage may be taken of the laws which regulate the velocity of diffusion of the carbon in iron and in steel at the various temperatures at the time of the carbonization or at the time of the de-carbonization, as well as of the laws which fix the limit of saturation of the iron as regards the carbon which varies also in an unequivocal manner with the variations of temperature.

30 The operation is effected in the following manner:—The ordinary ternary, quaternary or like steel ingot, before or after it has been submitted to the ordinary me-

chanical manipulations (pressing, rolling, hammering and the like) capable of transforming it into the plate of the desired shape or form, is submitted to a first treatment which varies according to the proportion of carbon contained by the ingot and then to ulterior treatments, described in what follows, and which alone of themselves constitute the essential part of the present invention, and impart to the plate in question special resisting qualities.

35 In the case where the plate has only a small proportion of carbon the preliminary operation consists in strongly carbonizing it on one of these surfaces by proceeding with the carbonization to the depth necessary so as to obtain, by means of the tempering, the hard deeper layer in the desired position and presenting the desired degree of carbonization. This carbonization can easily be obtained by the ordinary method used by maintaining the plate for a sufficiently long period and at a suitable temperature in contact with granular carbonaceous substances compressed against one of its surfaces or in an atmosphere of carburated gas, limiting also in this case the contact of these latter to only one surface of the plate. In the case where it refers on the contrary to an ingot and consequently a plate having a high proportion of carbon, the first operation to which the plate has to be submitted is inverse as regards that of the preceding case. In this second case the plate is submitted to a de-carbonization on the one or both of its surfaces. This de-carbonization is effected by heating the said plate for a given time and at a given temperature with suitable mixtures of metallic oxids reduced to a suitable degree of sub-division and firmly compressed against the surface or surfaces from which it is desired that the de-carbonization may extend to the interior of the plate.

40 The de-carbonization will be carried to a different degree and to a different depth on the two surfaces by suitably regulating the temperature and the duration of the operation for each of them. This latter can at a certain moment be interrupted on one of the surfaces by substituting for the mixture of oxids, a granular compact inert substance. In any case it would always be possible by carefully studying the laws of diffusion of

the carbonization and the de-carbonization as regards the temperatures and the times to carry the operation so far that a layer of given carbonization and given thickness and situated at a determined position at the interior of the plate is obtained.

The same effect may be obtained in the first case for example when starting with a plate having a slight proportion of carbon and which has subsequently been carbonized on one of its surfaces to a suitable depth as has been described above. In this case the same result as indicated above is obtained by submitting the plate to a suitable de-carbonization by the ordinary method on the surface which has previously been carbonized. By suitably regulating this de-carbonization one can easily conduct it and stop it so that there exists at the interior of the plate, a more or less strongly carbonized layer of the desired thickness and situated at the depth considered most suitable. This depth is only regulated by the position of the limit of the first carbonization and by that of the extreme limit of the subsequent de-carbonization. Naturally the said successive and alternative operations of carbonization and de-carbonization can be repeated several times. One will thus obtain in the mass of steel a series of layers more or less strongly carbonized alternating with layers poor in carbon, so that the proportion of carbon varies gradually and without discontinuity when passing from one layer to the contiguous layer. The said operations can ordinarily be effected simultaneously on both surfaces of the plate.

If it is desired to give to one or to both surfaces a high proportion of carbon in order for example to be able to subsequently harden them to a high degree by the tempering, the steel mass should always be submitted to a final superficial more intense or rapid carbonization on one of the surfaces or on both.

On subsequently utilizing the various methods used for the simple or multiple homogeneous tempering of ordinary steels and special steels a mass of steel will be obtained varying gradually from one layer to the other as regards hardness, tenacity and elasticity. This permits by varying the relative position, the thickness and the composition of the various layers (that is to say their quality as regards the tempering) the employment of the mass of steel for a great number of applications in which the heterogeneity of the mass may be very advantageous.

This process of manufacture could be largely employed for example in the manufacture of armor plates for ships. In these plates the plastic and tenacious mass which forms the base and the support of the layer, strongly hardened by the carbonization and

by the tempering under given conditions, will be substituted by the mass itself supported by one or several very hard and tenacious layers. These layers will considerably assist, owing to the great hardness and tenacity of the mass with which they form a homogeneous whole, in stopping the projectile which has already lost much of its kinetic energy in perforating the very hard and very tenacious exterior surface. This will permit considerable decrease in the thickness of the plates for equal resistance, and for equal thickness of considerably increasing the resistance. This principle can be advantageously applied to the manufacture of a great number of steel articles for various purposes.

Supposing to have to do with a piece of mild steel showing the following composition: carbon 0.2%, manganese 0.45%, silicon 0.12%, sulfur 0.01%, phosphorus 0.03%, and that it be intended to obtain two carburized zones separated from each other by a decarburized zone, thus for instance that on proceeding inwardly from the outer face of the piece the percentage of carbon decreases from 0.9% at the surface to 0.2 at 3 mm. depth, then remains unchanged up to 6 mm. depth and at last increases again up to 0.8% at 9 mm. depth and again lowers down to 0.2% at 12 mm. depth. In order to obtain this result the following course should be adopted: 1st step, heating the steel piece up to 1100 C. during 36 hours in contact with a granular mixture consisting of two parts of charcoal and one part of barium carbonate. 2nd step, heating the steel piece up to 1000 degrees C. during 20 hours in contact with a mixture consisting of three parts of silicious sand and one part of ferric oxide (F_2O_3). 3rd step, heating up to 1160 degrees C. during 6 hours in contact with the same mixture of charcoal and barium carbonate used during the first step of the treatment.

In making the above statements as to the duration of the heating, it has been assumed that the time begins to run since the full heat has been laid on the steel pieces; the additional time necessary for reaching the aforesaid temperatures, as well as for cooling after each treatment, of course depends upon the size of the pieces and the arrangement of the heating furnaces.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The process of forming a unitary steel plate or other article consisting in subjecting the steel article to a surface treatment in contact with a carbonizing substance at a temperature sufficient to cause diffusion, whereby a zone is formed in the article in which the percentage of carbon united with

the iron to form steel is increased, next subjecting the article to a surface treatment in contact with an oxidizing material, whereby the proportion of carbon in the said zone is decreased at the outer part of the said zone to form a sub-zone, and thereupon subjecting the article to a surface treatment in contact with a carbonizing substance to increase the carbon in the outer part of the said sub-zone to form another zone at the outer part of the article in which the proportion of carbon is greater than that of the next inner zone.

2. The process of forming a unitary steel plate or other article consisting in subjecting the steel article to a surface treatment in contact with a carbonizing substance at a temperature sufficient to cause diffusion, whereby a zone is formed in the article in which the percentage of carbon united with the iron to form steel is increased, next subjecting the article to a surface treatment in contact with an oxidizing material, whereby the proportion of carbon in the said zone is decreased at the outer part of the said zone to form a sub-zone, and thereupon subjecting the article to a surface treatment in contact with a carbonizing substance to increase the carbon in the outer part of the said sub-zone to form another zone at the outer part of the article in which the proportion of carbon is greater than that of the next inner

zone, and in which the proportion of carbon differs from the other two zones.

3. The process of forming a unitary steel plate or other article consisting in subjecting the steel article to a surface treatment in contact with a carbonizing substance at a temperature sufficient to cause diffusion, whereby a zone is formed in the article in which the percentage of carbon united with the iron to form steel is increased, next subjecting the article to a surface treatment in contact with an oxidizing material, whereby the proportion of carbon in the said zone is decreased at the outer part of the said zone to form a sub-zone, and thereupon subjecting the article to a surface treatment in contact with a carbonizing substance to increase the carbon in the outer part of the said sub-zone to form another zone at the outer part of the article in which the proportion of carbon is greater than that of the next inner zone, and in which the proportion of carbon differs from the other two zones, and also differs from the article beyond the said zones.

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

FEDERICO GIOLITTI. [L. S.]

Witnesses:

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