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PROCESS FOR MANUFACTURING ARMOR PLATES FOR PROTECTING SHIPS AND OTHER STEEL OBJECT OR OBJECTS MADE FROM AN ALLOY OF STEEL.

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947,486. Patented Jan. 25, 1910.

Fig. 1.

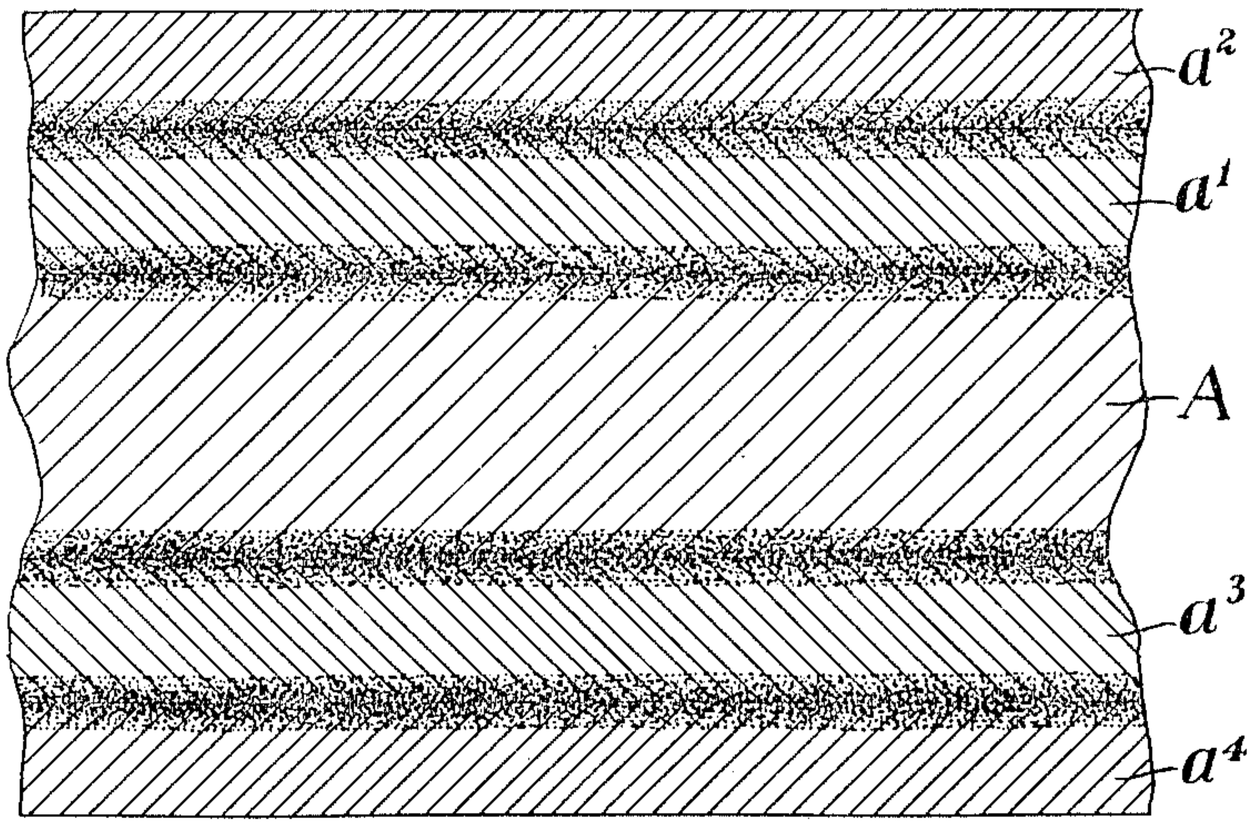
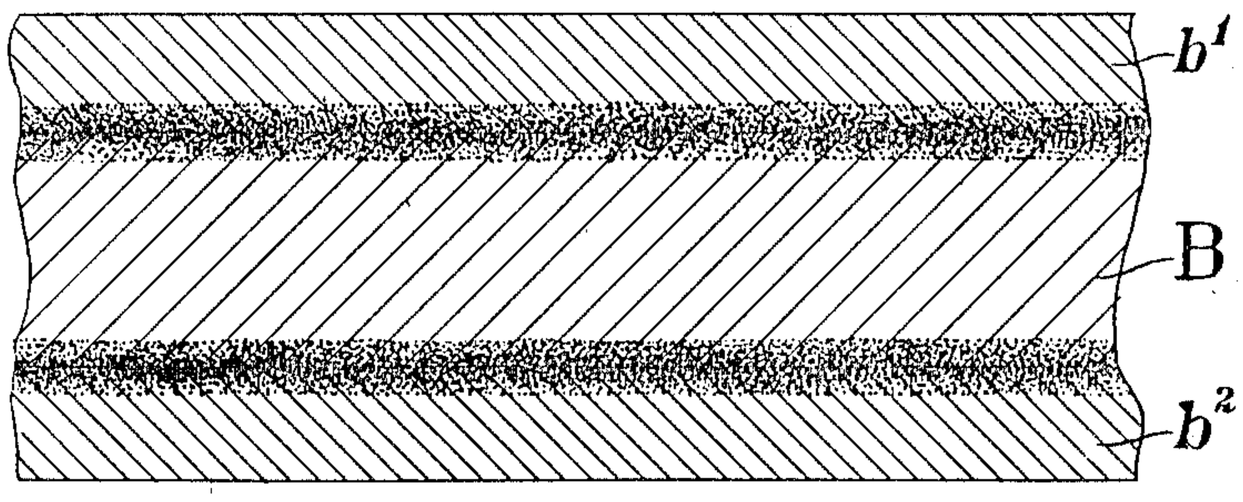


Fig. 2.



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UNITED STATES PATENT OFFICE.

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PROCESS FOR MANUFACTURING ARMOR-PLATES FOR PROTECTING SHIPS AND OTHER STEEL OBJECT OR OBJECTS MADE FROM AN ALLOY OF STEEL.

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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 processes for manufacturing armor plates for protecting ships and other steel object or objects made from an alloy of steel, of which the following is a specification.

The present invention relates to the manufacture of armor plate for ships which owing to a particular homogeneous tempering possesses various degrees of hardness and tenacity in its various layers; these layers having a determined thickness and position varying in each particular case according to the special use for which the armor plate is intended.

It is clear that owing to the special structure of the plate having layers of different kinds of steel, which on being subjected to the same treatment, receive very different degrees of hardness, according to their different composition, the plate under the action of homegeneous temper will not get uniformly hardened everywhere, but each of its layers, on the contrary, will assume different mechanical properties depending upon its peculiar composition. This is the characteristic feature which distinguishes this peculiar plate from a homogeneous plate, when hardening is carried out in a homogeneous way.

In the accompanying drawing illustrating diagrammatically the invention, Figure 1 shows a plate having two zones on each side; and Fig. 2 shows a plate having one zone on each side.

It is easy to understand that once the heterogeneous plate formed of successive layers of various compositions has been thus obtained, a simple homogeneous hardening in water, oil and the like, according to the special composition of the plate, effected at a suitable temperature varying according to the composition of the plate and the effects it is desired to obtain from the hardening in the various cases, will produce the mechanical properties more particularly desired to be obtained.

The result is attained by making the plate so that it is formed by two or more successive layers of steel of different composition, either as regards the proportion of carbon contained in the different layers, or by the presence of one or more metals forming alloys with the steel. These layers are arranged so that the layers formed by the various ternary or quaternary steels (suitably chosen as regards their composition and the order of their succession) preferably alternate with intermediary layers of ordinary carbon steel. The ternary steels which are most suitable for this purpose are the chrome, the nickel, the tungsten, or molybdenum steels, and for limited zones the uranium steels; the most desirable among the quaternary steels being the nickel-chrome and chrome-tungsten of different proportions.

The process does not consists merely in forming a compound plate by uniting (either by casting or by welding) separate plates as such process was known long ere this, but in producing, by means of the treatments described, the diffusion of one or several of the elements of each layer toward the adjacent portions of the other layers.

Where the continuity of the interior heterogeneous structure of the plate is necessary it may be effected by means of suitable mechanical and thermic manipulations by reason of the diffusion (greater or less as desired) of the elements of each layer with contiguous layers. When passing from one surface to the other of the plate, sudden variations in the composition and consequently in the mechanical and chemical properties, especially, as regards the property of hardening are not encountered; on the contrary, these variations take place gradually, one zone merging into the other. Furthermore this diffusion can give new layers having consequently new properties either mechanical or as regards the temper. If for example the reciprocal diffusion is effected between two layers of ternary steels differing from each other as regards the metal characterizing them, there will be formed an intermediary zone consisting of a quaternary steel containing the two metals characterizing the two ternary steels between which it is formed.

The mechanical manipulations to which

the heterogeneous plate formed in this manner, as referred to above, should be submitted is of great importance for the successful manufacture of the plate. These manipulations are the ordinary manipulations of the hammer, the press and the rolls, the said manipulations being chosen, and suitably alternated among themselves and the thermic processes, according to the characteristic properties of each of the steels forming the different layers. These manipulations may be effected either directly on an ingot of the same heterogeneous structure which the finished plate is to possess, or on separate sheets or plates destined to form the armor plate, by obtaining or not, according to circumstances, the reciprocal penetration by means of mechanical and thermic manipulations to which the armor plate is then to be submitted.

Press, rolls and hammer are employed as in all metallurgical processes in order to impart to the pieces a determined form and render their structure more compact. Their action has also the effect of rendering the diffusion of the elements at the respective adjacent portions much more complete than that which could be obtained by heating alone.

In the first instance the heterogeneous ingot in question will be obtained by casting at distinct periods as regards the temperature and the composition. The variations of the composition may be attained, according to circumstances, either by suitable additions during the different phases of the same manipulations, or by distinct preparations. Obviously the whole manipulation should be effected in a reducing atmosphere, furthermore it may often be necessary to use a suitable reducing agent and a suitable oxidizing agent.

The temperature cannot be indicated beforehand for all cases, because the conditions on which they depend vary with the composition of the steel; but they can be exactly calculated for each particular case by well known methods, because the conditions in question are known or can be easily determined for each steel of a given composition. The most important point of the manipulation is to determine the suitable temperature because the exact penetration of the various component elements of the structure of the plate depends precisely on the temperature.

As an example may be mentioned a casting effected in two periods of the manner indicated, of an ingot consisting of ordinary steel having 0.5 to 0.6% of carbon, and a chrome steel having 3 to 7% of chromium and a proportion of carbon greater by 0.3 to 0.5% than that which, for the proportion of chrome given, corresponds to the maximum proportion in the case of a "pearlitic" steel. In this particular instance the first phase of the casting will be effected at the ordinary temperature of fusion of the carbon steel mentioned above, whereas the second phase will be maintained very hot.

A prolonged reheating after cooling of the casting at a temperature above that of the first critical point of the chrome steel chosen, will serve to effect by diffusion, the homogeneousness of the ingot.

As has just been stated, the same structure of the mass of steel may also be obtained by separate castings and the successive reunion of the pieces obtained as well as by the ordinary manipulations by the hammer, the press and the rolls, alternating with thermic manipulations capable of enhancing the diffusion of the carbon and of the various metals forming the alloys of steel. These thermic manipulations should be effected at a temperature below the last critical point of the steels employed.

In certain cases and for certain special steels (as for example the tungsten steels) a part of the casting may be effected at a high temperature; which can be obtained by using a suitable electric furnace.

Similar considerations serve to determine the temperature in the series of the reheating operations constituting the thermic manipulation of the finished heterogeneous plate, mentioned above, and designed to produce by reciprocal diffusion of the carbon and the various metals—or even independently of the said diffusion—the intimate union of the various parts of the plate necessary for effecting its compactness.

Some of the layers may be formed by ordinary carbon steel and consequently be capable of being hardened, although at a less degree, according to the proportion of carbon they contain. Other layers on the contrary may be formed by ternary or quaternary steels and be consequently capable of tempering, in the most varied manners from steel with negative temper, which are softened by the temper, to those which attain the maximum hardness and tenacity, passing through all the intermediary graduations including those of the steels which are unaffected by the hardening.

For the purpose of giving a special example of this, one may mention a plate containing a quaternary zone of chrome tungsten having 12 to 13% of tungsten, 0.5 to 0.7% of carbon and about 2 to 4% of chromium and small quantities of manganese; this piece strongly hardened may be softened and rendered tenacious in its mass by a reheating below 600 degrees C. whereas it will preserve the temper in the zone of the proceeding composition.

Very often the preliminary hardening may be followed by a suitable reheating and by a second hardening at a different tempera-

ture, but always simply homogeneous and if necessary also by a third or fourth series of similar operations sometimes accompanied by various mechanical manipulations and serve to improve the mechanical or chemical property of the metal.

The properties of the plates thus obtained can be made to still further vary among themselves if, besides the hardening properly so called, a reheating at very high temperatures is employed varying according to circumstances, then following this by a more or less rapid cooling down, but less sudden than that which can effect the hardening properly so called. This ulterior manipulation is precisely that which is best adapted to the first special example referred to above. The principle of the invention can be applied also to the production of any other steel casting in which it may be advantageous to obtain various mechanical and chemical properties in the various parts of the piece by means of one or several simple homogeneous hardenings.

In the structure indicated in Fig. 1 the plate A has two zones a' and a^2 at one side that merge into each other and into the central portion. On the other face are two zones a^3 and a^4 that also merge into each other and into the central portion. Fig. 2 represents a plate having a central portion B with two zones b' and b^2, that merge into the central portion.

Having thus described my invention, I claim:

1. The process of forming compound plates or other articles of steel consisting in taking an article formed by molecularly uniting at their contiguous faces several plates of ternary and quaternary steel, and subjecting them to a heat treatment at a temperature below fusion for a period of time to cause diffusion of the characteristic metallic steel component, whereby a zone or zones are formed at the junction of the said plates possessing properties different from either of the plates themselves.

2. The process of forming compound plates or other articles of steel consisting in taking an article formed by molecularly uniting at their contiguous faces several plates of ternary and quaternary steel arranged in alternating strata, and subjecting them to a heat treatment at a temperature below fusion for a period of time to cause diffusion of the characteristic metallic steel component, whereby a zone or zones are formed at the junction of the said plates possessing properties different from either of the plates themselves.

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

FEDERICO GIOLITTI. [L. S.]

Witnesses:

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