

March 8, 1938.

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2,110,322

PROTECTIVE STRUCTURE AGAINST ARTILLERY SHELLS

Filed April 20, 1935

2 Sheets-Sheet 1

Fig. 1.

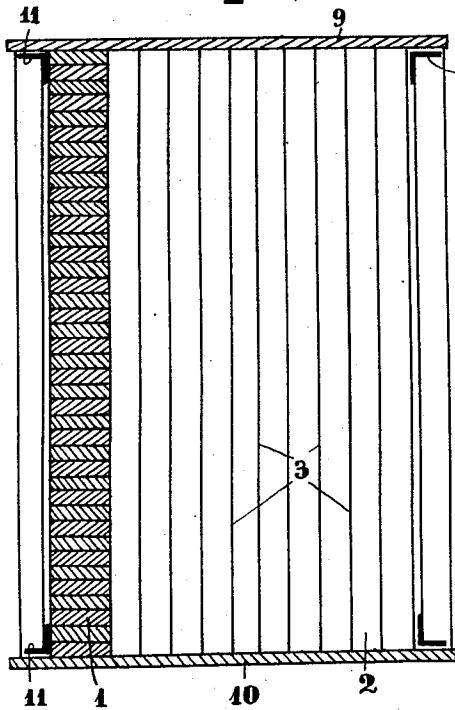


Fig. 2.

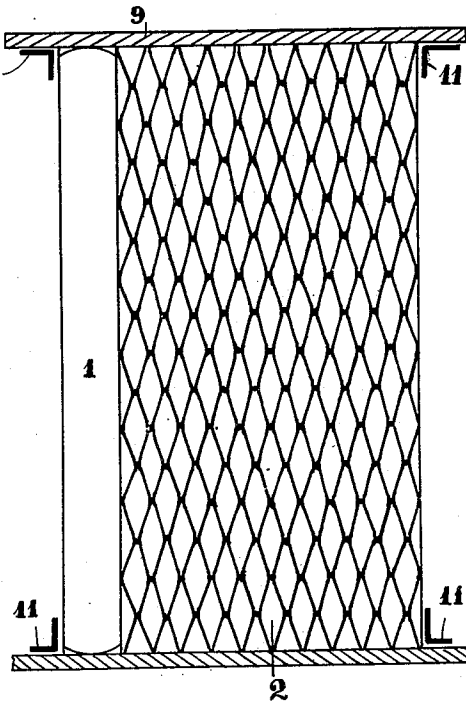
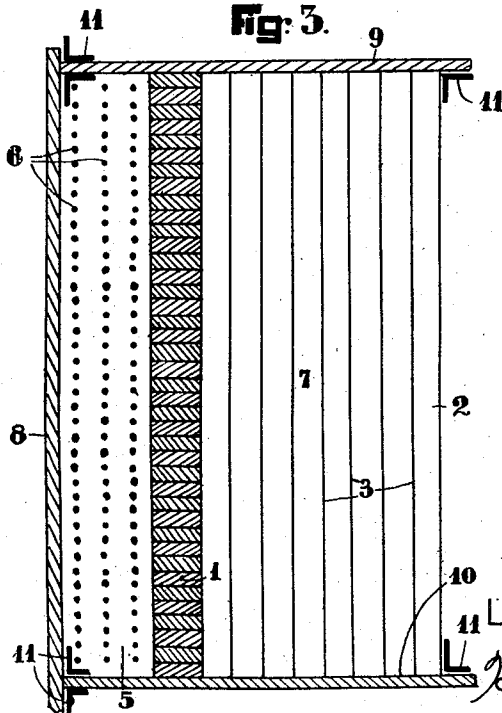


Fig. 3.



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Fig. 4.

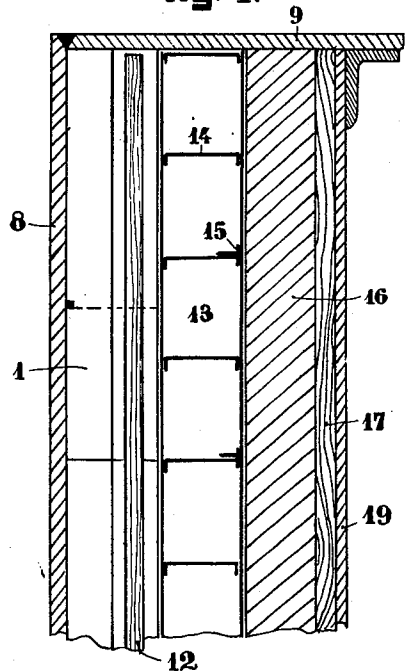


Fig. 5.

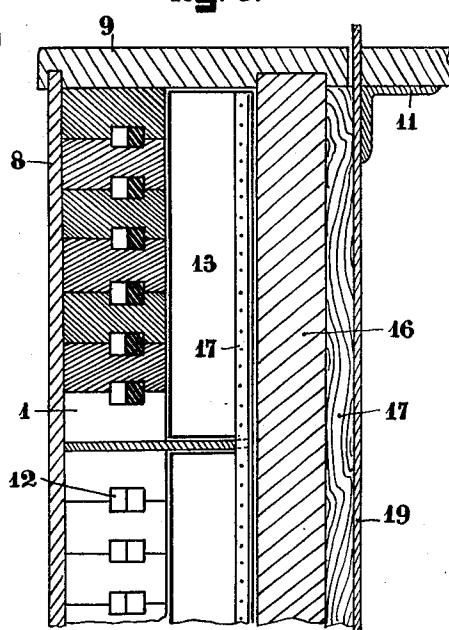


Fig. 6.

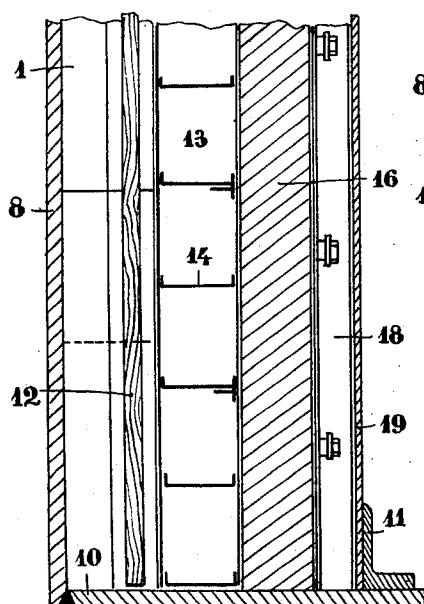
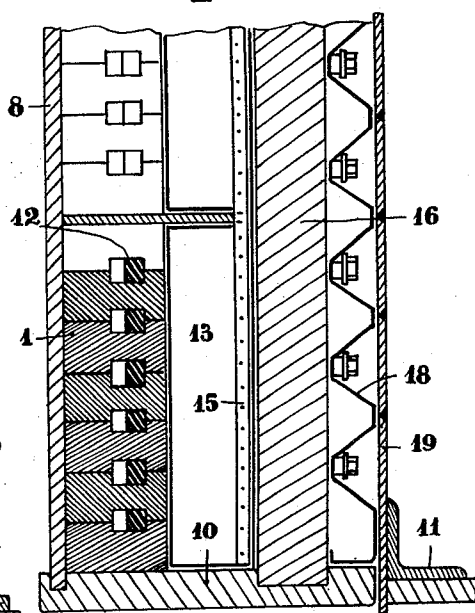


Fig. 7.



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PROTECTIVE STRUCTURE AGAINST
ARTILLERY SHELLS

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Application April 20, 1935, Serial No. 17,404
In Italy April 26, 1934

1 Claim. (Cl. 89—36)

It is known that the ordinary systems of protection against artillery projectiles or shells are usually formed of steel armour plates having a considerable thickness, which are heavy and very costly, and which moreover do not afford a complete protection, owing to the fact that the shock of impact of the projectile is taken up by a very limited area of the armour, both in surface and in depth. As the inertia of the mass of the armour plate is relatively great, during the very short time in which the perforation occurs, the armour plate is not caused to move inwardly any effective distance by the sudden impact of the shell so as to consume the momentum of the latter and prolong contact with the shell during such movement of the plate. Hence, the momentum of the shell is rather consumed in demolishing a part of the armor plate in a very limited area, and it is thus ordinarily necessary to employ highly resisting and costly materials for the construction of armour plates.

The invention concerns a mixed protective structure against artillery shells, whose object is to damp and annul the momentum of the shell by greatly increasing the effective resistance opposed to the impact of the shell by the protective structure by locating as great a mass as possible of material around the zone of impact, both in respect of surface area and in depth. This object is obtained by forming the structure with an external layer consisting of rectangular or flat steel bars arranged side by side either vertically or horizontally so as to form a continuous layer, these bars being also suitably connected to one another so as to allow a limited relative movement between each two consecutive bars; the continuous layer of bars being followed by a filling and damping layer including cement concrete, pumice stone, cork and the like, which may be reinforced by means of iron rods formed into grids, cages and the like, or by reinforcing the concrete by means of corrugated steel sheets spaced apart by suitable distance pieces. The section of the bars forming the external layer of the structure is such that the large shells thrown against the structure, will hit directly and simultaneously two or more contiguous bars, which, owing to their relatively small mass, will give way under the action of the impact, by bending, deforming, and transmitting the effect of the impact, both to two or more contiguous bars, as well as to the mass of material in the rear which corresponds to the whole area of the larger surface deformed.

vention may be used both as the sole protection of the ships' sides or other surfaces to be protected, as well as for the protection of the armour plates proper, so as to impart to these latter a much greater resistance or protecting power than that obtained by the single armour plates now being used.

The invention will be better understood with reference to the annexed drawings which show by way of example two embodiments of the new protective structure which may be used as a self contained protection for a given surface, the second embodiment being specially adapted for the protection of an ordinary armour plate of a warship. In the drawings:

Figs. 1 and 2 show respectively in horizontal and vertical sections the first form of embodiment of the invention.

Fig. 3 shows in horizontal section a second form of embodiment.

Figs. 4 and 5 show respectively in horizontal and vertical sections a form of embodiment specially suitable for the protection of armour plates; and

Figs. 6 and 7 show also in horizontal and vertical sections another form of embodiment of the protective structure, suitable for the protection of armour plates.

Throughout the views, the same reference numerals indicate the same or like parts.

In all the forms of embodiments shown on the drawings, the protective structure according to the invention comprises a continuous layer of metallic elements or bars disposed side by side, vertically or horizontally, which form the main feature of the invention.

In the forms of embodiment shown in Figures 1, 2, and 3, these steel bars have a flat shape and are contiguous to each other, and although in these figures only one layer of these bars is shown, it is to be understood that the layers formed by these bars may be two or more, each of them being inserted between concrete blocks which may be made of cement concrete, pumice stone, cork and the like, and reinforced by means of iron rods formed into grids, cages and the like, or reinforced by means of corrugated steel sheets spaced apart by suitable distance pieces, said concrete forming a filling and damping layer. In any case however, these bars, formed preferably of alloy steel having a high tensile strength and hardness, are so disposed as to cover completely without discontinuity the surface that has to be protected.

In the form of protective structure shown in

The protective structure according to the in-

Figures 1 and 2, the back packing comprises, for example, a conglomerate 2 having the composition aforesaid, into which a number of corrugated iron or steel plates are inserted, suitably interconnected by welding along the lines of contact of the corrugations as shown in Figure 1, the points of welding being shown in Figure 2.

In Figure 3 is shown an embodiment of the structure, comprising a layer 1 of metallic bars as above described, placed between a front outer packing 5 of concrete conglomerate, reinforced with horizontal steel rods 6, the back packing 7 being formed as shown in Figures 1 and 2 as described above. A front plate 8, (Figure 3) formed of carbon or alloy steel serves to cover the outer packing 5.

In all the embodiments the protective structure is provided with connecting steel end plates 9 and 10, disposed respectively at the top and at the bottom of the structure if the bars 1 are placed vertically, or at the lateral vertical sides of the structure if the said steel bars 1 are placed horizontally. Moreover, the structure is held firmly by gusset plates 11 which also serve to maintain the bars in their position.

It is clear that it is possible if desired to provide two or more structures, each formed as above described, disposed so as to be contiguous to each other.

In the two forms of embodiment shown in Figures 4, 5, 6 and 7, the cross section of bars 1, has an H shape, and in the hollow spaces comprised between two contiguous bars, smaller metallic bars or keys 12 are inserted, these keys having a square or rectangular cross section, and more particularly one side of this section is equal to the distance between the stem of two adjoining bars 1, while the other side of the cross section of the key 12 is about one half of the height of the said stem.

The layer of the structure which follows the one formed by the H shaped bars 11 above described, is formed by a box shaped construction 13 formed by steel plates, which is divided and reinforced by suitable diaphragms 14 and gussets 15.

The subsequent steel plate layer of the protective structure supports the armor plate 16, which is made of a special highly resistant steel, is formed of a corrugated plate 18, said corrugated plate being secured to the armor plate 16 by means of bolts, screws, or in any other suitable way. While not forming any necessary part of my invention, a layer of hardwood 17 might be introduced within plate 19 as shown in Figures 4 and 5, but the corrugated plate 18 of Figures 6 and 7 is preferred and superior. The last or rearmost layer of the structure is formed by a closing and supporting plate 19, rigidly connected to the ship's bridges and side walls, and fixed thereon by means of the corner gussets 11 to the end plates 9 and 10, in the same way as previously described.

The protective efficiency of the structure above described, is due to the various reactions which are produced at the moment of the impact of the projectile on the external plate 8, inasmuch as when the shock produced by the said impact is transmitted from said plate 8 to the movable bars 1, these latter become deformed and are simultaneously carried rearward on to the armor plate 16 after mutilating a comparatively large zone of the layer 13.

Moreover, owing to the partial connections above described between the adjoining H bars,

not only the bars actually hit by the projectile will be deformed and driven on to the surface of the armor plate or on the interposed layer (which occurs when the flat bars are used as shown in Figures 1 to 3) but the zone of resistance of the material will be extended to the H bars adjoining the zone of impact on both sides thereof, owing to the mentioned connections between the bars.

The bars which are directly struck and those trailed by the impact as described, owing to their relatively small mass, acquire a considerable momentum at the expense of the momentum of the projectile, and this, together with the momentum expended in deforming and mutilating a considerable zone of the structure in front of the armor plate 16, causes the projectile to strike the surface of this latter after a considerable amount of its original momentum has already been expended. In other words, while in the protections now formed with single continuous armor plates, the energy of the projectile is almost completely absorbed by the section of armor actually hit and carried away or displaced by the projectile, in the composite protective structure embodying the present invention, the energy of the projectile is absorbed in two ways, viz; owing to the effect of the kinetic energy in the form of momentum acquired by the bars under the impact, which is damped by the back layers, and by mutilation of the zones of materials of the fore layers, hit either directly or indirectly by the projectile. The kinetic energy acquired by movable steel bars does not produce any undesirable effect on the armor plate placed behind them, in view of the fact that the impact of these bars with the armor plate extends across a large surface and thus produces a minimum amount of mutilation on the said armor plate. Thus the composite protective structure according to the invention, affords a more efficient protection in comparison with the single cemented steel armor plates now used.

Another important advantage of the composite structure above described accrues from the fact that because the front end of the bars are hardened, and also because of the unevenness of the stricken surface produced by the impact, the head of the projectile or shell is broken by the impact.

Moreover, it is pointed out that the construction of the composite protective structure according to the invention, requires less time and entails an expenditure far below that required for making a single ordinary cemented steel armor plate, as the bars described, forming the principal part of the protection may easily be obtained in rolling mills from homogeneous materials.

Although the preceding description, made with reference to the annexed drawings shows some preferred forms of embodiment of the invention, it must be understood that this latter comprises other possible forms of construction, comprising variations in the treatment of the materials used, the shape of the movable bars and their mutual connections, the construction and the arrangement of the subsequent layers, the structure, the disposition and the shape of the innermost base layer etc., without departing from the fundamental principle of the invention.

Having now fully described my invention, I claim:

Protective structure intended to withstand artillery shells and projectiles, said structure, commencing with the exterior surface of the same,

comprising in combination, a front metallic covering plate, a layer of contiguous displaceable metallic elements of relatively reduced dimensions with respect to said covering plate, said
5 elements having an H-shaped cross section and small metallic keys intercalated between said elements so as to individually extend from the web in one element to the web in the next adjacent
10 element, said keys being shorter than the webs of said H-shaped elements; a rear closing principal armor plate, and a light metallic yielding frame for said H-shaped elements, interposed between
the latter and the principal armor plate, said
15 yielding frame being adapted normally to support the layer of displaceable metallic elements, keeping them at a convenient distance from the

armor plate, so that, when the covering plate is struck by a projectile, the key connections of the H-shaped elements permit the successive rearward movement of the elements contiguous to the point of impact of the projectile, while the light
5 yielding frame allows the free movement of the whole mass of the H elements thus displaced by the projectile in a direction approximately perpendicular to the plane of the protective structure, so as to cause the mass of said H elements
10 thus displaced, to absorb a greater amount of the kinetic energy of the projectile on being driven into the space intervening between the layer of said displaceable elements and the principal armor
15 plate.

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