C. O. Holyoke. Sheet 1, 3 Sheets.

Armor Clad.

No. 49,407. Patented Aug. 15, 1865.

Fig. 5.

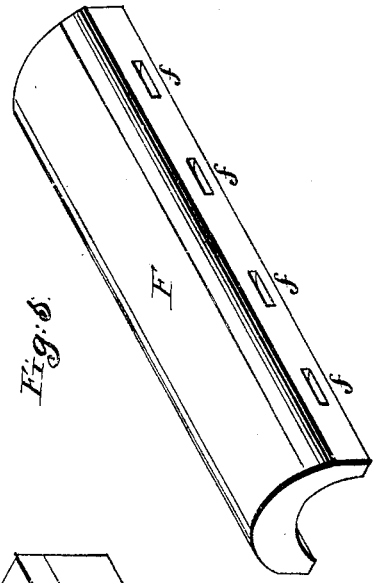


Fig. 6.

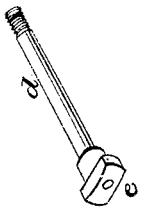
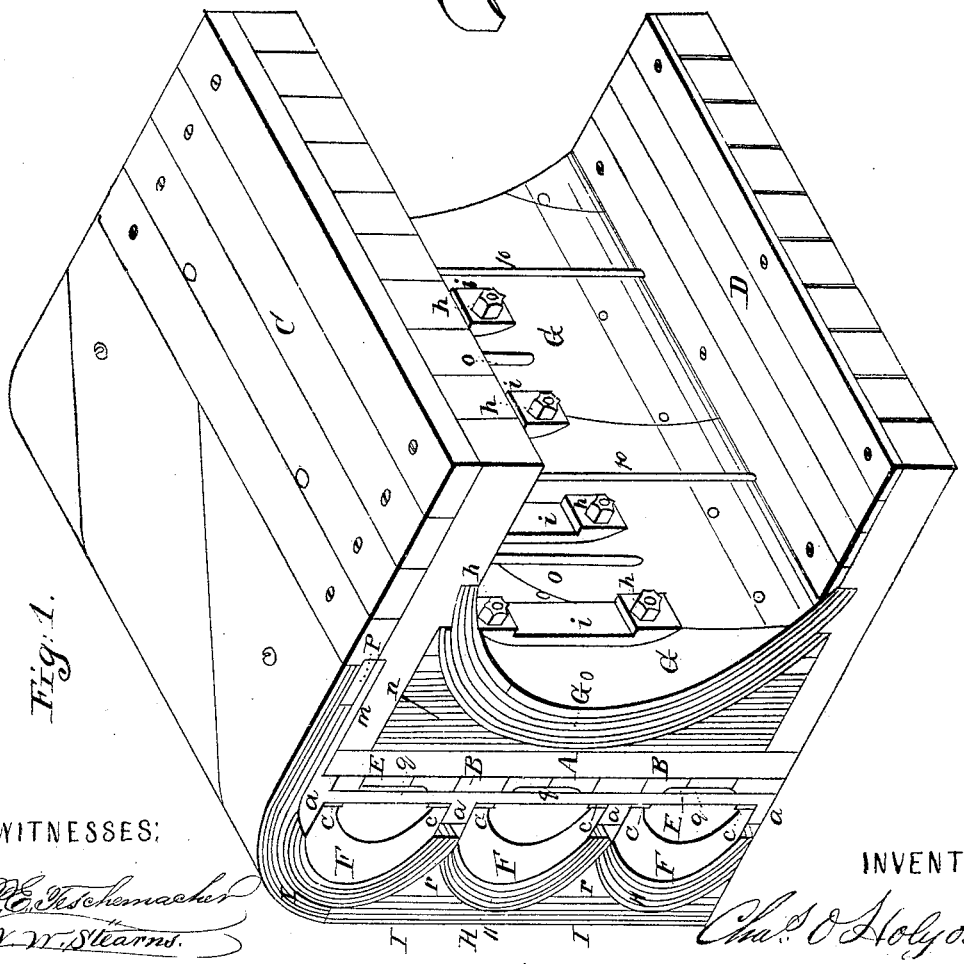


Fig. 1.



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Armor Clad.

No. 49,407. Patented Aug. 15, 1865.

Fig: 2.

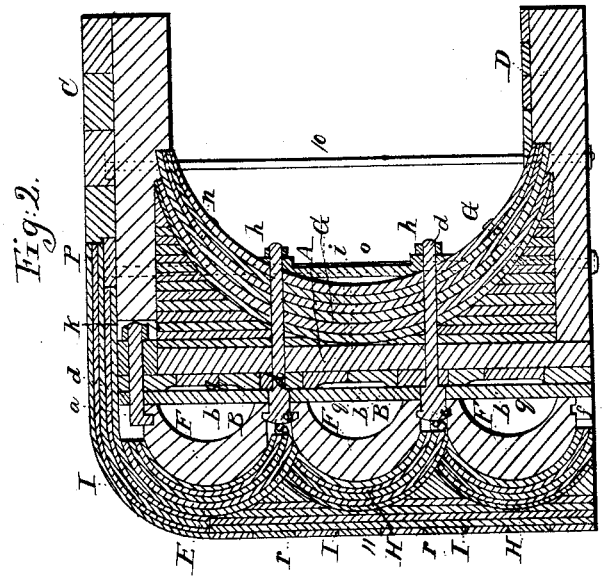
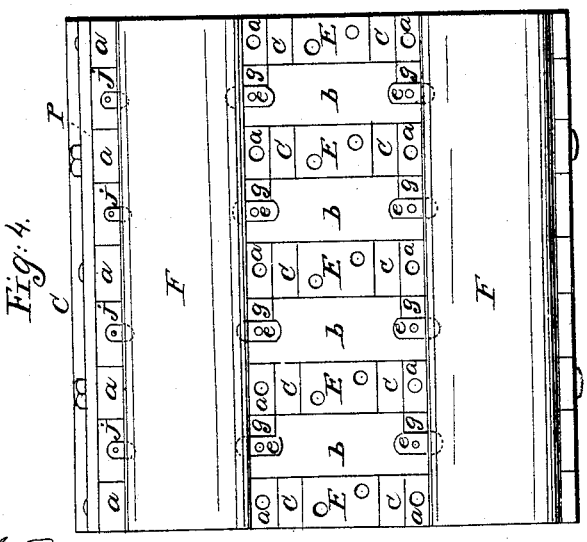


Fig: 4.



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C. O. Holyoke. Sheets, 3 Sheets.

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Fig. 7.

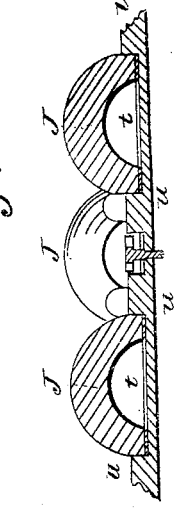


Fig. 8.

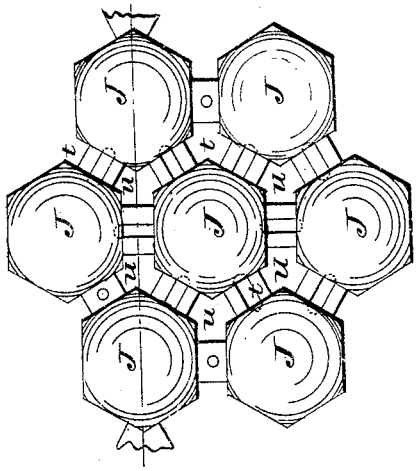
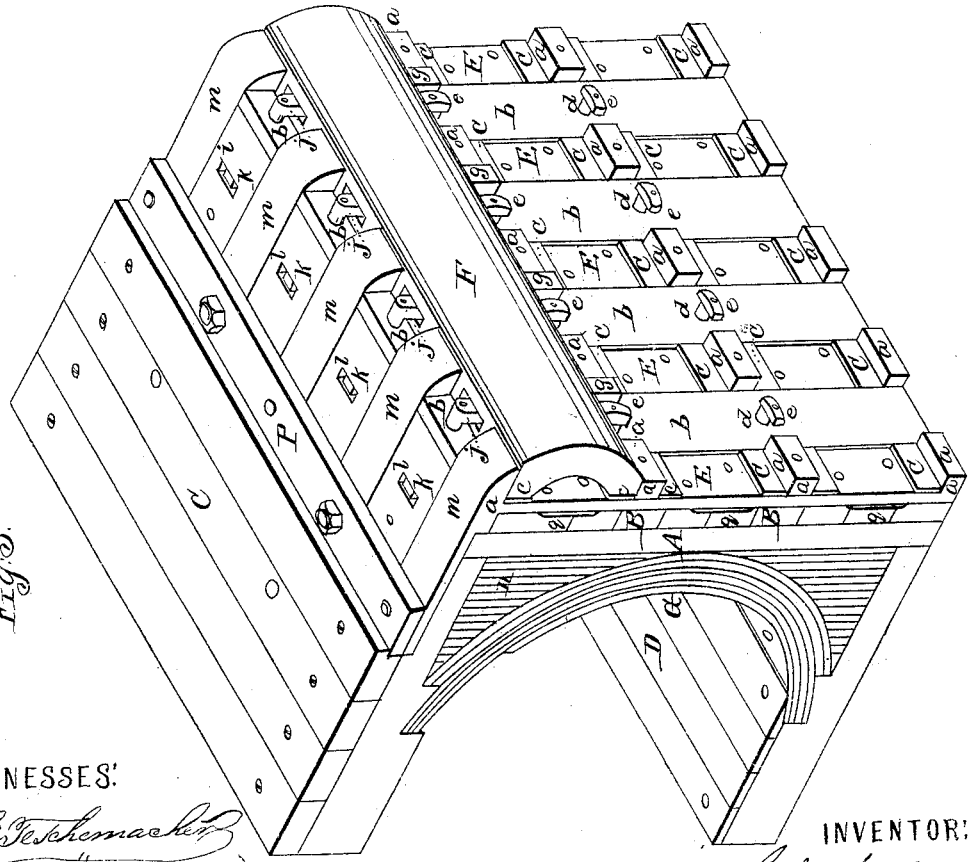


Fig. 5.



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UNITED STATES PATENT OFFICE.

CHAS. O. HOLYOKE, OF BOSTON, MASSACHUSETTS.

IMPROVED DEFENSIVE ARMOR FOR VESSELS OF WAR.

Specification forming part of Letters Patent No. **19,407**, dated August 15, 1865.

To all whom it may concern:

Be it known that I, CHARLES OTIS HOLYOKE, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improved System of Defensive Armor for Vessels, Turrets, Casements, and Fortifications, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a view of a portion of the side of a vessel, showing the construction of my improved armor. Fig. 2 is a vertical section through the same. Fig. 3 is a perspective view of the same, the facing and two of the arched metallic beams or bars being removed to show the construction. Fig. 4 is a front elevation of the same, the facing and one of the arched metallic beams or bars being removed. Fig. 5 is a view of one of the arched metallic beams or bars detached. Fig. 6 is a view of one of the bolts by which the metallic beams are secured in place. Figs. 7 and 8 represent a modification of my invention.

The system of defensive armor in most general use consists of flat plates—that is, such as simply conform to the contour of the surface of the structure on which they are laid—on flat backing, and with flat facing, if any. A projectile striking such armor delivers its full force on a very small point of the surface, and is diffused over and resisted by a proportionally small portion of the backing; but, notwithstanding so small an amount of material is opposed to the blow, even that is placed at the worst possible mechanical disadvantage for the service to be done, being exposed to "cross strain," so that in opposing a blow the back part of the material bears a tensile strain and the outside is compressed and pushed against the back part, thus serving as a fulcrum over which to break the backing. Various forms of corrugated or thin curved plating have also been tried or suggested, but seem to offer little if any advantage over the ordinary system above described.

My invention consists of metallic beams or bars of arched form in cross-section, firmly bolted or otherwise secured to the face of the structure and securely connected with one another, to guard against their lateral displacement, and placed so near to each other as to oppose the entrance of a projectile in the space between them. I thus avoid the ordinary mistake of placing material of equal thickness over the whole structure, and mass my material in such a way that a much larger portion of it is opposed to a blow than in the ordinary system, besides which the arching of the beam serves to greatly strengthen it, putting all the material in a state of compression under a blow, besides diffusing the force of the blow over a very much larger surface than does the ordinary plating, and consequently over a correspondingly large amount of the backing. Thus the strength and weight of a much larger and better disposed mass of material is opposed to any blow than in the ordinary system of armor. Consequently a much less weight of material, in the aggregate, is required to successfully oppose a given blow than in the ordinary system—a consideration of the first importance, whether in sea-going vessels or those for the navigation of harbors, rivers, and shallow waters.

My invention also consists in constructing the backing of an arched form, whereby its strength, stiffness, and consequent resistance to the crushing effect of a blow are immensely increased, and which serves, moreover, to diffuse the weight of the blow and convey or direct it against the mass of the decks, floors, or partitions of the structure against which the backing takes its bearing, thus requiring a much less weight of backing for opposing a given blow than in the ordinary system; and my invention further consists in facing the metallic plating with wood arched in "cross-laminations"—that is, with the fibers of each layer placed at an angle with those of the adjoining layers—which is again faced and built up level with wood laid flatwise and cross-laminated, which facing serves to resist and cushion the projectile and diminish the force of the blow upon the metallic plating.

To enable others skilled in the art to understand and use my invention, I will proceed to describe the manner in which I have carried it out.

In the said drawings, A represents the side

timbers or ribs of a vessel; B, the planking or "wales;" C, the upper deck, and D the gun-deck.

To the outside of the planking B are bolted, at equal distances apart, the tie-bars E, which are placed vertically, and by means of the projections or shoulders *a*, with which they are provided, serve to bear the chief weight of the arched beams F, also hold them against displacement from their horizontal position from the wedging effect of a shot striking between two beams F. The vertical spaces between these tie-bars are filled in with planking *b*, brought up level with the plates *c*. These beams or bars F are of iron or steel, of an arched form in cross-section, and are laid parallel to each other and lengthwise of the vessel, and are made of such width as to fit snugly between the projections *a* on the tie-bars E. The plates *c*, of lead or other yielding material, through which the arched beams F take a bearing on the tie-bars E, serve to cushion the tie-bars from the concussion consequent on a blow on the arched beams. The arched beams F are secured to the vessel by the heavy bolts *d*, which pass through the side of the vessel. These bolts have elongated button-shaped heads *e*, as seen in Figs. 3, 4, and 6, which also show an increased thickness of the bolt just under its head, which it serves to strengthen. These bolts *d*, being first inserted with their heads parallel to the arched beams F, are turned quarter-way round, so as to cause the bolt-heads *e* to enter the notches or slots *f*, Fig. 5, in the arched beams F. The bolts are then tightened by the screw-nuts *h* bearing against the washer-plates *i*, and the arched beams F are thereby brought to a solid bearing on the plates *c* and the wood planking *b*. The bolts *d*, when thus fastened in place, are secured from turning by means of the blocks *g*, driven in between the bolt-heads *e* and the shoulders *a* on the tie-bars, as seen in Figs. 3 and 4, which blocks *g* also serve to give a bearing of one arched beam against the next, being fitted snugly between them, thus combining their united strength against lateral displacement. The bolts *j*, which secure the upper edge of the top arched beam, coming, as they do, opposite the deck, are let into the ends of the deck-timbers just far enough to get a strong hold, when they are secured by the screw-nuts *k* inserted in the mortises *l*. *m* are continuations of the tie-bars, which are returned onto the deck and firmly bolted thereto, in order to assist in holding the filling of the upper "spandrel," *n*, of the arched backing in place.

The backing G is constructed of an arched form, the arch being sprung between the two decks C and D, on which it takes a bearing, and is composed of cross-laminated wood-work, the spandrels between the arch, decks, and side of the vessel being made solid, with cross-laminated wood-work firmly secured in place.

The tie-rods *o*, in connection with the bar *p*, serve to hold the decks and hips of the arch G against any outward thrust they may receive from the force of a blow received on the arched iron beams F, and they also assist in holding down the ends *m* of the tie-bars where they are returned onto the deck. In a similar manner the rods 10 serve to hold together the feet of the arch against any outward thrust from the effects of a blow on the arched beams F. By thus arching the backing against the side of the vessel or structure its resistance to pressure or the crushing effect of the blow of a projectile is greatly increased, while at the same time the whole side of the vessel is materially strengthened against all other strains, and no knees will be required and by thus constructing the backing G of cross-laminated instead of straight wood-work it serves to render it more homogeneous and less liable to split, and serves further to diffuse the force of a blow along the sides of the decks in proportion to the distance apart of the ends of the pieces crossing each other at the point struck. The arched backing may, however, be constructed of wood with the fibers running parallel instead of being cross-laminated, or of wood interlaminated with iron, or may be constructed in any other suitable manner. The planking B, under the tie-bars, is grooved out longitudinally, as seen at *q*, for nearly the width of the inside span of the arched beams, in order to secure that part of the tie-bar from being pressed against the wood, and thus deflected from a straight line, in case the other parts of the bar were pressed into the wood by the force of a blow on the arched metallic beams F. The beams F are faced with arched cross-laminated wood-work H, which is held in place against them by means of the wedge-shaped bars *r*, which are laid lengthwise of the vessel opposite the space between the arched beams and fastened to the shoulders *a* of the tie-bars E by the screw-bolts *s*, Fig. 2, which screw into said shoulders. The arched cross-laminated facing is then built up to a level surface with cross-laminated wood-work or facing I, so as to present a smooth and even exterior surface, as seen in Figs. 1 and 2. By thus constructing the facing of cross-laminated instead of straight wood-work, as heretofore practiced, it is rendered more homogeneous in its substance and is less liable to be split under the blow of a projectile; furthermore, the arrangement of cross-laminated facing in an arched form serves to offer additional resistance to the penetration of a shot, as the force of the blow is diffused through and resisted by a large amount of material.

In Figs. 7 and 8 is represented a modification of my invention, in which domes J, of an arched form in cross-section, similar to the beams F, are employed. These domes may be round or polygonal on plan, or of any suitable form, and are secured against lateral displacement by the tie-plates *t*, and to the side of the vessel by heavy bolts, in a similar manner to

that described for the arched beams F, and the whole is then covered in a similar manner with cross-laminated wood facing, the tie-plates *t* being provided with shoulders *u* and bolted to the side of the vessel or structure in a manner similar to the tie-bars E. I consider this arrangement, however, the equivalent of the arched beams first described.

If preferred, the arched facing may be composed of layers of cross-laminated wood, alternating with layers of iron or any tough material, such as dry rawhide; or dry rawhide or other tough material may be substituted entirely for the cross-laminated wood. The arched beams F may also be of variously modified construction, as either simply rolled to shape directly from the bloom, or rolled or hammered from a pile made of cross-laminated iron, or built up of plates cross-laminated or not, and bolted together, or may be built in any other suitable manner The beams may be also additionally strengthened by a plate bolted or welded to the feet of the arch.

On a projectile striking the armor at the point 11, as seen in Fig. 2, the cross-laminated wooden facing serves to resist and cushion the face of the projectile, thus lessening the severity of the blow on the arched beam F, which, by means of its arched form, diffuses the force of the blow over a space corresponding to the width of the beam, when it is received by the arched backing G, and in like manner is again diffused and conveyed against the sides of the decks, which constitute the chief support of the sides of the vessel. When a projectile strikes opposite a point between the arched beam F it is first resisted and cushioned by wooden facing, and on entering which it is opposed by the wedge-shaped bar *r*, which, on being forced inward, tends to compress the arched wooden facing on which it rests against two of the arched beams F, and is resisted by their combined strength, and the force of the blow is diffused over a space corresponding to the width of both beams, and thence to the backing G, as before explained.

It will thus be seen that by disposing the material in massive arched beams, with arched backing, as above described, it offers a much greater amount of resistance with a given weight of armor to the impact of a projectile than when the material is laid flatwise, the comparative lightness and strength of my system of armor particularly adapting it to vessels for ocean navigation, or for that of harbors, rivers, and shallow waters.

I do not confine myself to the precise method herein described of connecting the beams F by means of the tie-bars E and securing them in place by the bolts *d*, as it is evident that other means may be employed to effect these ends without departing from the spirit of my invention.

I have heretofore spoken of the arched beams F as placed lengthwise of the vessel; but it is evident that they may be placed vertically, or in any desired direction or position.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The arched metallic beams F, constructed and applied substantially as set forth, for the purpose specified.

2. The arched backing G, constructed and applied substantially as described, for the purpose set forth.

3. The curved cross-laminated facing H, constructed and applied substantially as set forth, for the purpose described.

4. The flat cross-laminated facing I, constructed and applied substantially as set forth, for the purpose specified.

5. The tie-bars E, with their projections *a*, in combination with the arched beams F, substantially as described.

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Witnesses:

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