(No Model.) 4 Sheets—Sheet 1.

J. A. MILLER.

FORTIFICATION.

No. 603,451. Patented May 3, 1898.

Fig. 1

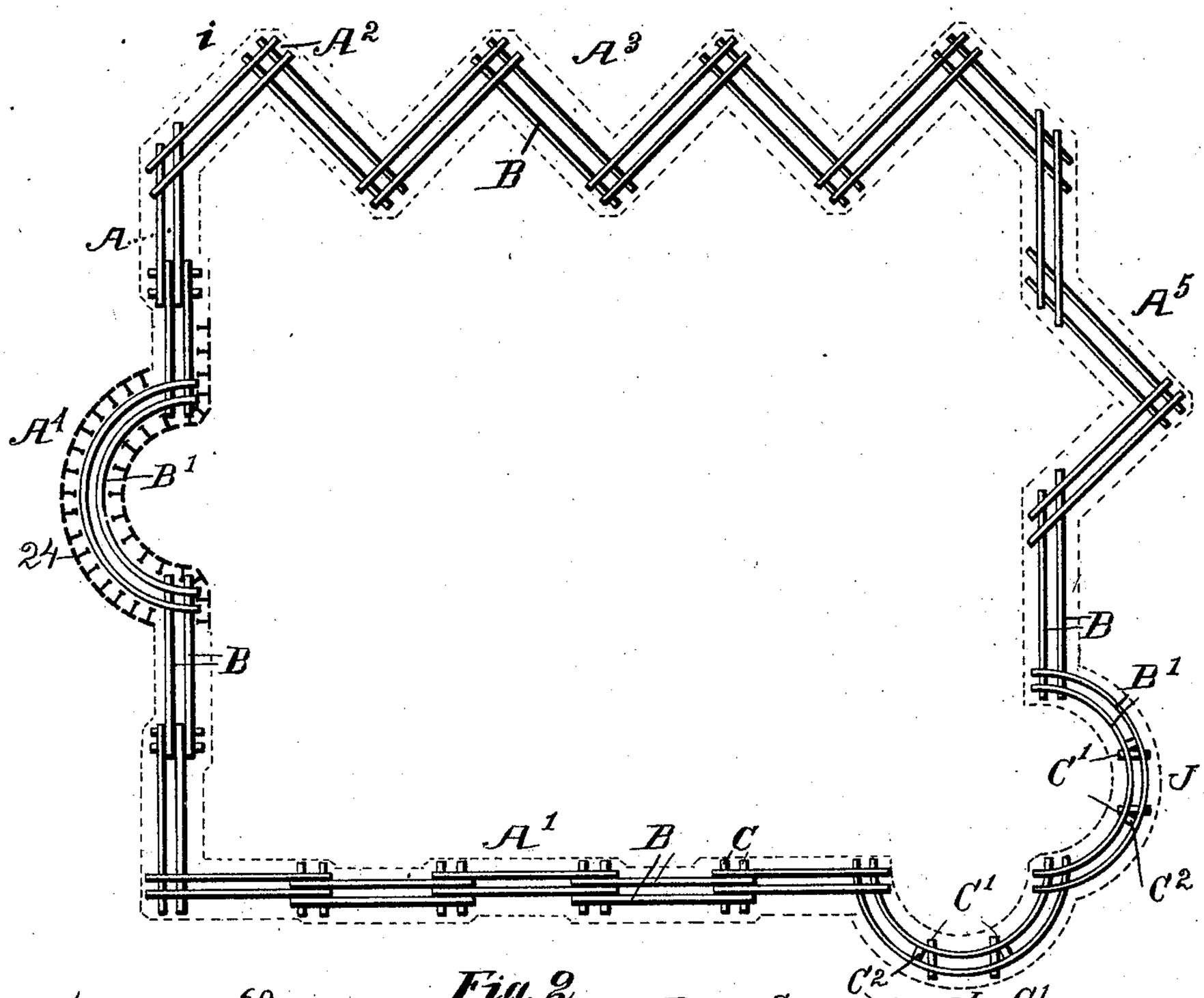

Fig. 2

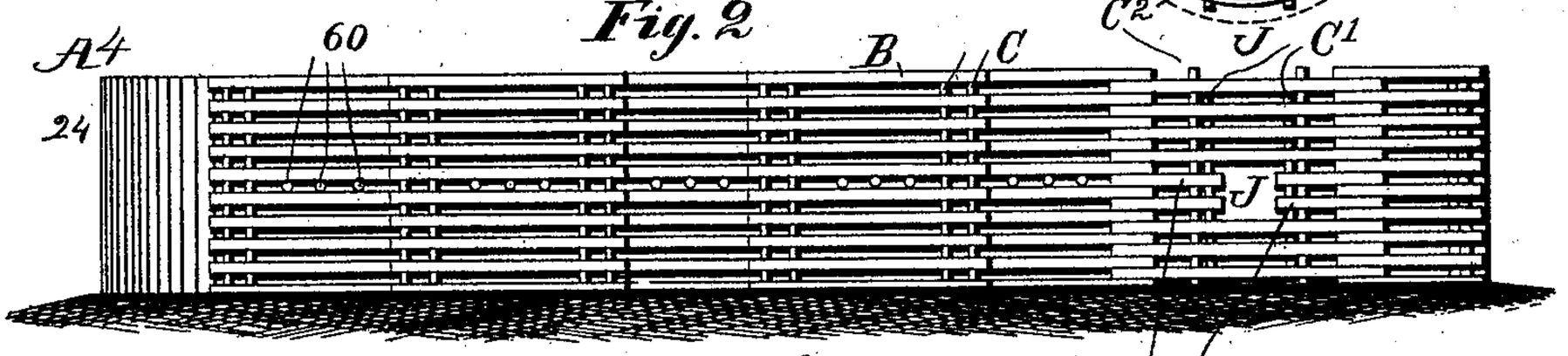

Fig. 3

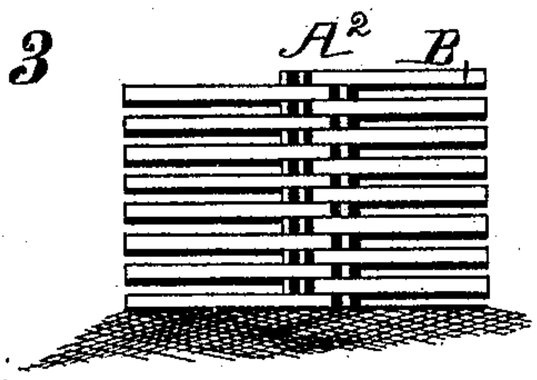

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Fig. 4

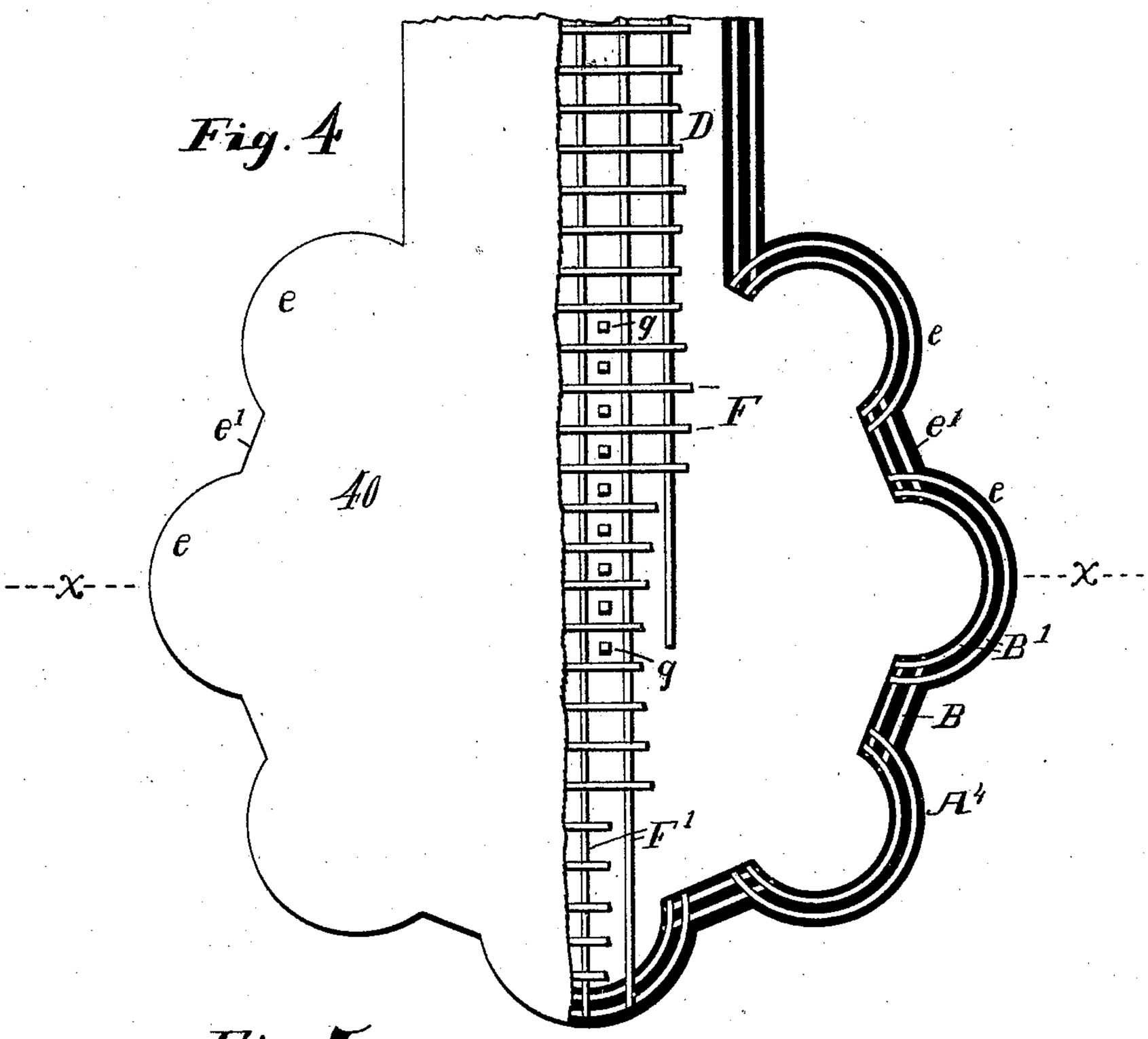

Fig. 5

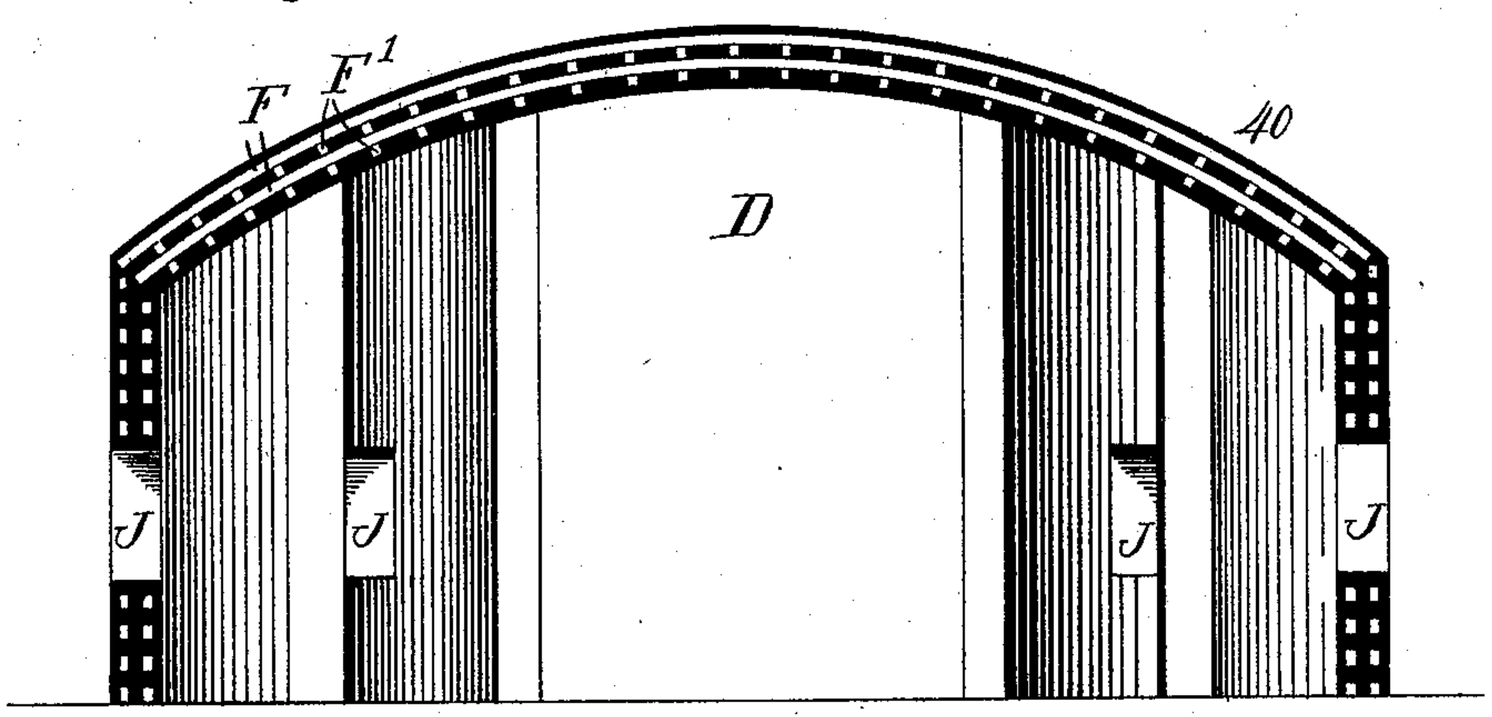

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Fig. 6

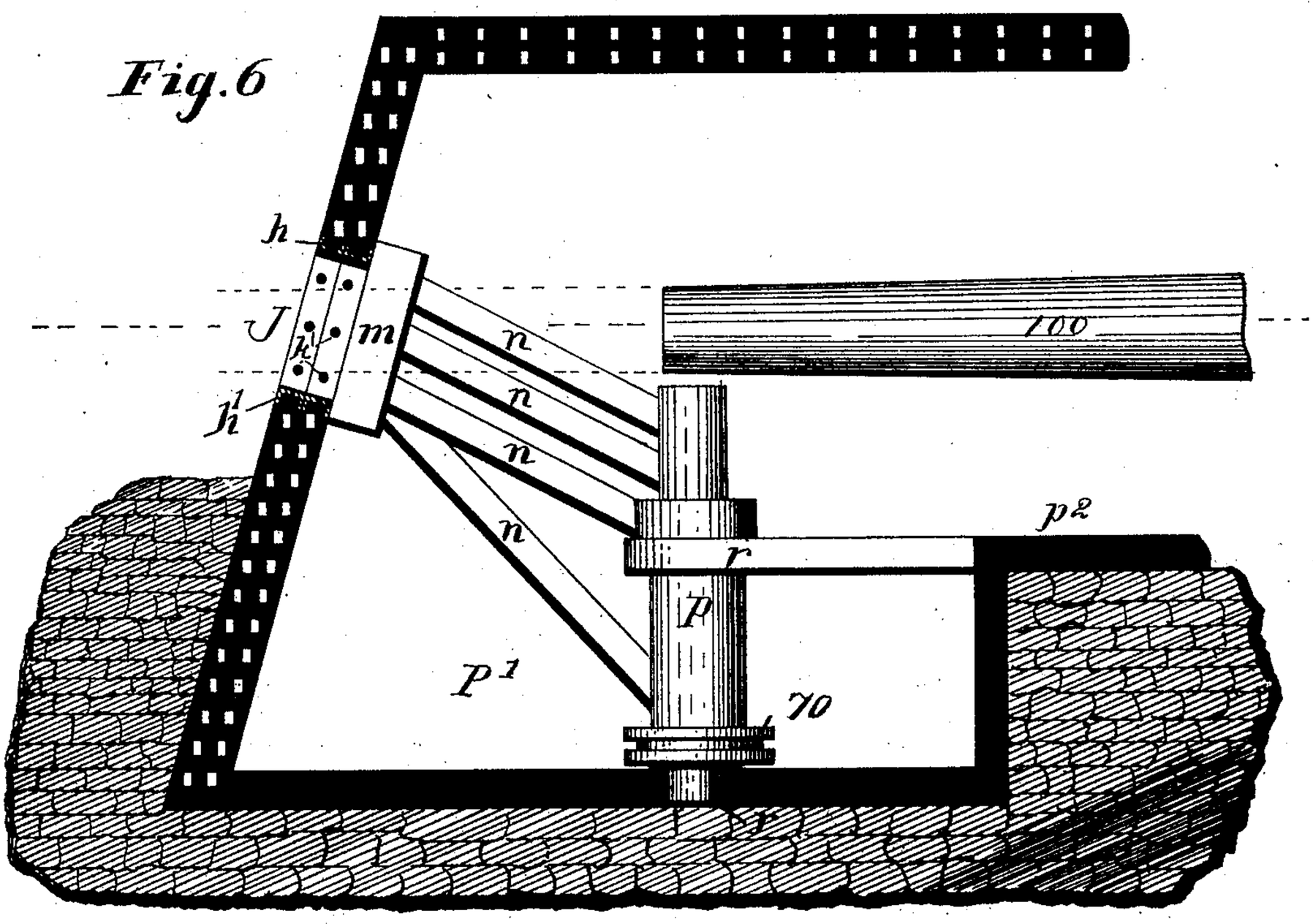
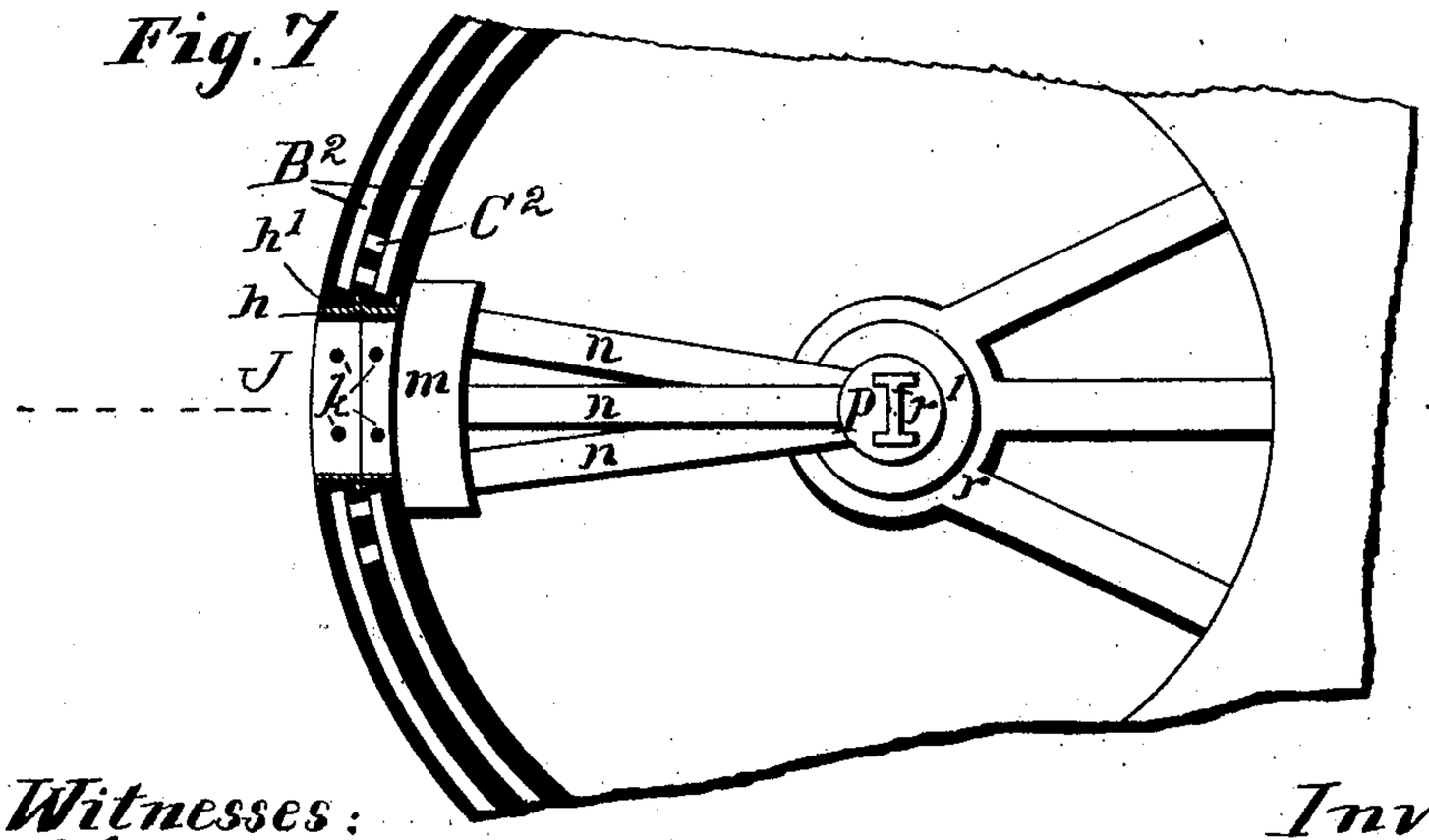


Fig. 7



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(No Model.) 4 Sheets—Sheet 4.

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Fig. 8

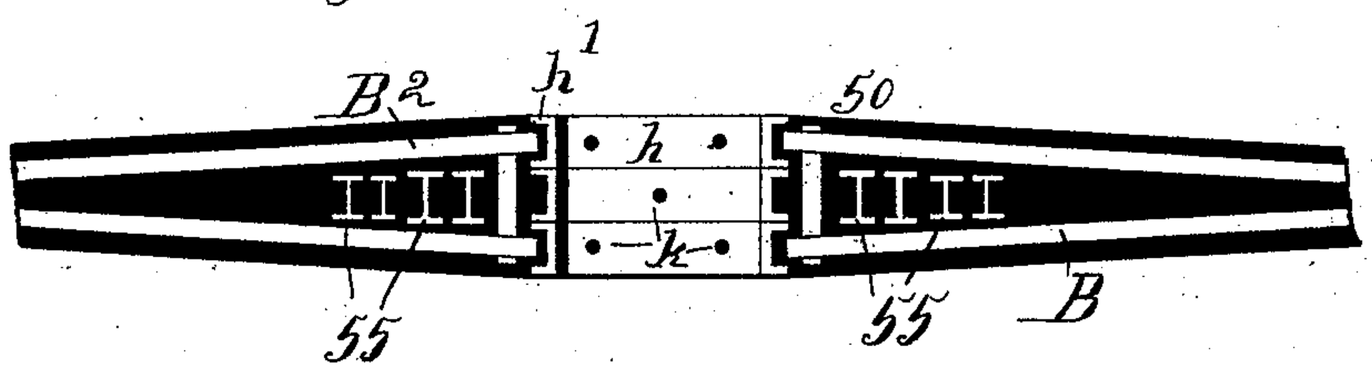


Fig. 9

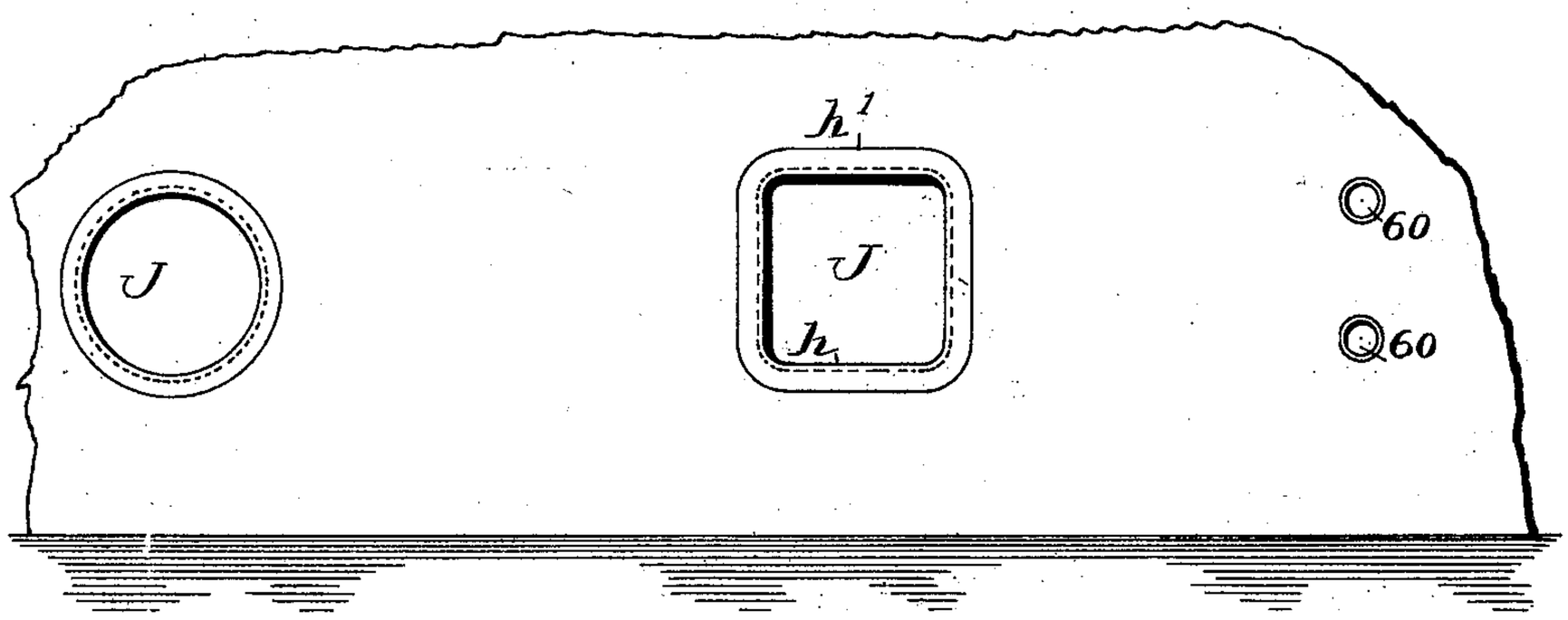


Fig. 10

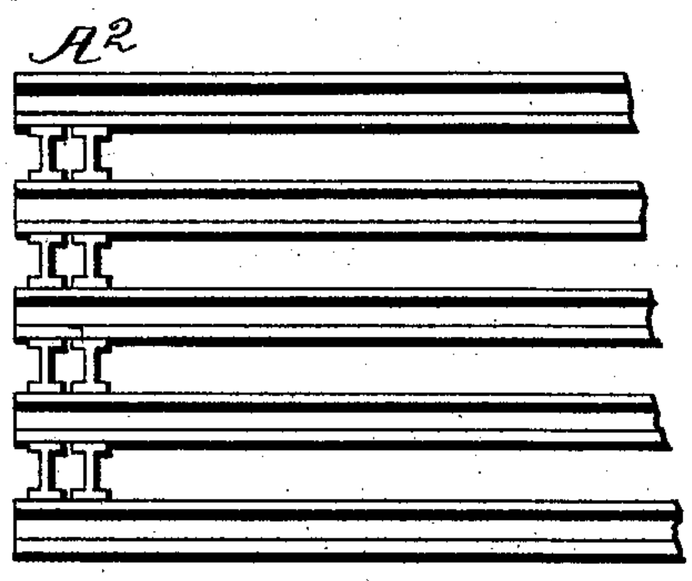
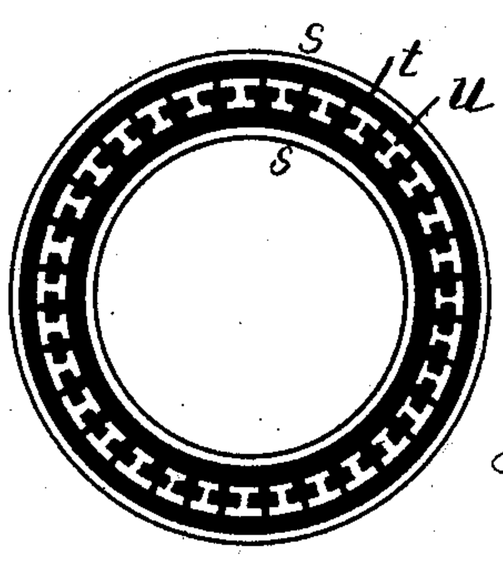


Fig. 12

Fig. 11



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UNITED STATES PATENT OFFICE.

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FORTIFICATION.

SPECIFICATION forming part of Letters Patent No. 603,451, dated May 3, 1898.

Application filed August 3, 1896. Serial No. 601,455. (No model.)

To all whom it may concern:

Be it known that I, JAMES ACTON MILLER, a citizen of the United States, residing at New Haven, in the town and county of Hew Haven and State of Connecticut, have invented certain new and useful Improvements in Fortifications, of which the following is a specification.

My invention relates to composite armor or walls for fortifications or military defenses.

It has for its object to provide plating or armor of great resisting strength and comparative cheapness and which is practicable for defensive structures of various classes and designs.

The invention consists in a composite armor comprising a framework or interlacery of wrought-iron, steel, or other malleable metal embedded in a body or wall of cast-iron or other suitable cast metal or alloy cast around the framework in a molten state and in the position in which it is intended to be used, thereby combining the tensile and crushing resistances of the respective materials and correspondingly increasing the strength of the structure to withstand penetration or punching strains. The aforesaid casting of a fortification in a single part without joints is by itself an important and novel feature of my improvement and may be employed independently of the wrought-iron work, though with less advantage in point of strength.

The invention further consists in the novel construction of the framework with the cast metal cast around it and between its parts in such manner as to interlock therewith and rigidly bind or tie the parts together, and, finally, my invention consists in the fortification or protective defense and the parts thereof constructed, arranged, and combined as hereinafter specified, and more particularly recited in the claims.

In the accompanying drawings, forming a part of this specification, Figure 1 is a plan view of the framework or wrought-iron interlacery of a fort embodying the principles of my improved armor, and Fig. 2 is an elevation of the side A′ of the same. Fig. 3 is a front elevation of one of the angles or redans *i* of Fig. 1. Fig. 4 is a plan of one form of turret or inclosed fortification represented with part of the roof removed or broken away to show the construction of the wrought-iron framework of the sides and covering. Fig. 5 is a vertical cross-section on line *x x* of Fig. 4 through an embrasure, showing its construction and the closing mechanism thereof. Fig. 6 is a vertical section of an elevation made in accordance with my invention and showing means for closing it. Fig. 7 is a plan section of Fig. 6, each of said views being taken on the dotted line of the other or central plane of the embrasure. Fig. 8 is a section through an embrasure, showing a modification. Fig. 9 is an elevation of a portion of the wall of a fortification, showing different forms of embrasure. Fig. 10 is an enlarged side view of one of the corners of the framework, showing the arrangement of the wrought-iron railwork. Fig. 11 is a horizontal section of a circular turret adapted to be used either as a stationary or revolving structure. Fig. 12 is a view of a tube for forming a loophole.

Referring to the drawings, A A′ A^2 A^3 A^4 A^5 designate the wrought-iron or steel framework or interlacery of my improved fortification, and which is designed for being embedded in a corresponding-shaped wall of cast-iron, cast-steel, or other suitable cast metal or alloy poured around it and between its parts in molten state and held in place through the process of cooling by a mold or retaining-banks of any suitable material, such as masonry. It will be understood that such framework may embody various methods of construction comprising every known arrangement or system of combining and securing wrought-iron parts; but I have here shown a simple plan of frame which contemplates the use of plain steel or wrought-iron bars, rails, or beams of any desired form of cross-section, preference being given to the common and well-known I-beams commonly used in architectural work or ordinary railroad-rails, the parts being built up without the use of bolts or rivets or machine-work of any description when desired to avoid expense; but I do not limit the invention to this particular construction.

Where the walls of the fortification extend in a straight line, as at A′, Fig. 1, the beams or rails B are arranged in horizontal parallel tiers, preferably comprising two rails in each

tier, laid parallel, as shown; but the tiers may consist of single rails or as many as desired to produce any required thickness of wall. The rails are laid with the ends of each length or section lapping the ends of the rails of the adjacent lengths, at the sides thereof, as shown. Under the ends of the rails so lapped or joints of the lengths or sections are short bars C, placed transversely to the line of the wall and between and separating the different tiers. Two or more of said transverse bars are preferably placed at each joint; but a single bar may be used, if desired. In this manner the rails are laid up to any required height vertically over each other or overhung to give any desired inclination of the wall from the perpendicular. The rails may be laid either edgewise, as shown, or flatwise, if preferred, the latter method presenting the greatest depth of section in the direction of the strains from projectiles.

At the corners or salient angles of the fortification the bars C may be dispensed with, the tiers of one side or wing of the angle resting upon the tiers of the other wing or intersecting like the tenons of the familiar construction known as "dovetailing," as shown at A^2, Figs. 1 and 3. Thus the entire fort or any side thereof may be made of zigzag outline with angles at the joints of the lengths or sections, as shown at A^3, Fig. 1, comprising a series of redans *i*. In such case the rails are laid with the ends of each length or section simply overlapping upon the ends of the next section, thus separating the respective tiers without the use of special short bars. Redans may be made in like manner, projecting from the straight side of the fortification, as shown at A^5, Fig. 1, the inner ends of the rails of the redans overlapping upon the straight side of the fortification. A semicircular bastion may also be made, as shown at A^4, Fig. 1, and also in Fig. 4, by the use of bent rails B′, the ends of the bent rails being laid upon the straight rails B, as shown. Whenever embrasures are made in the walls of the fortification, as at J in Figs. 1 and 2, it is necessary to place short transverse bars C′ between the ends of the tiers of broken rails B^2, terminating at the sides of the embrasures. In the semicircular bastions it is necessary to place one or more such transverse bars intermediate of the ends of the rails or at least midway of the lengths thereof, where there are no embrasures, to prevent the sagging of the central part or bow of the rails and maintain them in horizontal position. On each side of the embrasure vertical bars C^2 are preferably placed, standing between the double row of rails to further strengthen the structure around the embrasure. Wire and waste iron may be utilized in the structure, particularly in the form shown in Fig. 11.

All the parts hereinbefore described should preferably be covered with a coating of pure tin previous to being laid in position. The purpose of such tinning is to make the contact and union of the wrought and cast metals more perfect. It is also well known that tin will harden and toughen cast-iron and is therefore preferably intended to be used in the construction of this armor. When desired, tin may be mixed with the cast metal for a like purpose, and other well-known methods of hardening the same may be employed.

With the framework erected and a suitable retaining wall or mold built around it on both sides thereof molten cast-iron is then allowed to flow into the said mold around the wrought-iron frame, preferably direct from the cupola. A sufficient number of cupolas should be used to run a constant stream or streams of metal into the mold at one or more points during the filling process, which process should be completed in such period as to prevent the chilling of a portion of the structure and consequent breaking of the continuity of the metal. In this connection it may be stated that large masses of cast-iron cool very slowly, retaining a red heat for a long interval after being cast, thus insuring ample time for forming the fortification in a single piece.

The structure may be cast piecemeal by inclosing a portion of the framework in a mold and pouring such section alone, then adding another section thereto in the same manner until the whole is complete. Should the several portions so cast independently integrally unite, the fortification would then consist of a single piece, the same as if poured at one operation; but if such sections do not unite they will nevertheless remain firmly tied and fastened together by the inclosed wrought-metal framework extending continuously throughout the entire structure, provided such breaks and the rail-joints are not brought into the same position, whereby each of the two classes of metal supplies a complete tie for the joints of the other.

Wholly inclosed or roofed fortifications may be made in the manner described, the interior being first filled with earth to form a mold for the roof 40 and afterward excavated when the cast metal has become cooled. Figs. 4 and 5 represent such a roofed structure or turret, the sides being formed of a series of semicircular bastions *e* and short intermediate straight sections *e′*, built as hereinbefore described. A passage D, having straight sides and covered over, is provided upon one side of the structure connecting the turret with some other part of the fortress or with a suitable place of safety or retreat, or with the power plant whence the motive force is derived for performing the various mechanical movements and operations. In the construction of the roof of the turret two or more layers of rails F′ are laid at right angles to the rails F, alternating therewith—that is, a layer F being first laid transversely over the turret, the next layer F′ is laid longitudinally or at right angles with the first layer, and so

on to the uppermost layer, forming a lattice-like framework or interlacery of rails, as shown. If desired, vertical bars *g* may be placed in the opening of the lattice-work to further strengthen the frame, as shown in Fig. 4. This framework of the roof and sides is afterward wholly embedded in an envelop of cast-iron, as hereinbefore described. The black or heavily-shaded portions of the drawings in the sectional parts of the several views represent the said cast-iron envelop, which thoroughly incloses the rail-work interlacery designated by the white or unshaded portion thereof and interlocks therewith.

The detailed construction of the embrasure J is shown in Figs. 6 to 9, inclusive. A casing or lining *h* is provided, preferably of channel-iron bent into the form required, which is usually either rectangular or circular, the flanges or ribs *h'* of the channel-beams being placed outward, bringing the flat side of the beam adjacent the embrasure. As many such channel-iron sections may be employed side by side as desired, several narrow sections having the advantage over a single broad section, both in convenience of bending and strength when placed in the structure. In Figs. 6 and 7 the number of sections equal the number of rails in a tier of the framework, and the ends of the rails B^2 may terminate close to or enter between the ribs *h'* of the channel-iron. Holes *k* may be punched through the flat web of the channel-iron for the cast-iron to engage and thoroughly secure the sections in place. Any of the wrought-iron work throughout the structure may, if desired, be perforated in similar manner and for the same purpose.

In Figs. 8 and 9 the thickness of the wall around the embrasure is increased by forming a swell of sufficient proportions to counteract the weakening effect due the embrasure. Additional vertical **I**-beams 55 are placed between the longitudinal rails adjacent the embrasure to strengthen the structure at that point. Fig. 9 shows the external appearance of the embrasure, and the loop-holes 60, also shown in Fig. 2, and used for sighting, sharp-shooting, or use of small-arms. They are preferably formed of a tube or pipe 62, around which the cast-iron is run, being first filled with sand cores. The tubes are preferably perforated, as shown, and when engaged with the cast-iron are held firmly against being driven out of the wall lengthwise.

The mechanism for closing the embrasure is shown in Figs. 6 and 7, comprising a heavy plate *m*, of cast-iron, in which the ends of wrought-iron beams *n* are embedded, and any suitable interlacery, in accordance with the principles hereinbefore set forth. The inner ends of the beams *n* are embedded in a cast-iron post *p*, which is adapted to turn in suitable bearings arranged in the structure, the post being wholly below the horizontal plane of the embrasure, for which purpose the pit B' is provided below the floor p^2 of the fortification. In the post is a wheel or sprocket 70, by which the post may be turned by means of suitable cables and machinery, here requiring neither to be shown nor described. The post has a central beam *r'*, of wrought-iron, embedded within it or any suitable interlacery or frame to give to this mechanism the strength due to the combination of materials in the armor-plate, as set forth. In operation the plate *m* may be swung to one side to uncover the embrasure, and the gun 100 then run out through the embrasure and fired, after which the gun may be withdrawn and the plate *m* swung to place to close the port-hole.

Fig. 10 shows an elevation of part of one of the angles A^2 enlarged to properly illustrate the arrangement of the **I**-beams. It is to be understood that all the beams used in the construction shown in the figures are preferably **I**-beams, but in some of the figures are drawn rectangular, owing to the difficulty of representing **I**-beams on a scale so small.

Fig. 11 shows a form of turret in horizontal cross-section which may be readily applied to war vessels. Exterior and interior wrought-iron shells *s* of cylindrical form are arranged concentric to each other, and in the intervening circular space *t* vertical **I**-beams *u* are set up, or any other wrought-iron framework desired may be substituted, after which the said space is filled with cast-iron, suitable masonry being erected to prevent the collapse of the wrought-iron shells when heated, and thus retain the form of the structure until cooled. Vertical **T**-beams 24 may be erected upon the exterior or interior surface of the walls of any of the designs of fortifications shown, as shown at A^4 in Fig. 1, the cast-iron being cast around the inner flange of the beams, which will hold them in place securely and leave a smooth surface on the outside.

When it is desired to construct a light structure of great strength, like that of the turret of a monitor or naval work generally, a steel casting may be used in place of cast-iron, and this material may be substituted for cast-iron at any point in or portion of the armor—as, for instance, at points where it is preferable to reduce the thickness of the walls beyond that which would result were the metal of lesser strength employed. It will also be understood that the walls of the structure will require to be materially increased when made of cast-iron alone without the wrought-iron framework, which construction, however, should be employed only on the less-exposed portions of the fortress, where it is less liable to be struck by projectiles.

It will readily be perceived that while the use of wrought-iron and steel rails for the framework and cast-iron or cast-steel for the cementing or inclosing material will be very desirable all other metals or alloys may be included in the spirit of the invention and

disposed either in a regular or irregular manner. The framework may be formed of old "scrap" or "waste" metals, so called, embedded in the cast metal in an irregularly-disposed mass which is incapable of distinct description or delineation. Old wrought-iron materials—such as old wire, old iron rods, bolts, tubes, rails, bars, plates, and pieces of every form—may be cast indiscriminately into the mold and cemented, bound, tied, and interlocked together by the cast metal poured around them, forming a very tenacious and projectile-proof armor for protective defense.

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

1. A composite structure having a framework consisting of several series of bars with overlapping and interlocking ends and arranged with openings or spaces between the bars, and a body of cast metal, cast around such framework, so as to surround and penetrate between the bars, substantially as described.

2. A composite structure having a framework consisting of several series of wrought-iron bars, with the ends of one series overlapping and interlocking with the ends of an adjoining series, the bars of each series being arranged so as to have spaces or openings extending through between them and a body of cast-iron, cast so as to surround the bars and fill the spaces between them, substantially as described.

3. A composite structure having a framework consisting of a series of bars, another series of bars between the bars of the other series, and arranged transversely thereto, the bars of the different series being arranged so that there are spaces extending through between them and a body of cast material, cast around such framework, so as to surround the bars thereof and fill the spaces between them, substantially as described.

4. A composite structure having a framework consisting of several series of bars arranged with the ends of one series overlapping the ends of an adjoining series, bars transverse to and between the other bars, and a cast body, cast around such framework, so as to surround the bars thereof and fill the spaces between such bars, substantially as described.

5. A composite structure having a frame consisting of a series of bars, a series of bars at right angles to the other bars, and a body of cast metal surrounding the bars of the first series and portions of the bars of the other series, substantially as described.

6. A composite structure having a series of substantially horizontal bars and two series of upright bars, on the opposite sides of the horizontal bars, a body of cast metal surrounding the horizontal bars and a portion of each of the vertical bars, so as to tie such latter bars to the horizontal ones, substantially as described.

7. A composite structure having a framework consisting of a series of parallel bars, I-shaped in cross-section, and a body of cast metal covering such bars and filling the spaces between them and between their flanges, substantially as described.

8. A composite protective structure having a protective covering formed of a series of layers of parallel bars, in which the bars of one layer run transverse to those of an adjoining layer, bars extending between the bars of the several layers, in a direction at right angles to such layers, and a body of cast-iron cast upon and around the bars, substantially as described.

9. A composite protective structure having an opening surrounded by one or more channel-bars, bent to make the opening, and having their flanges on their outer sides and a body of cast material, cast around such bar or bars, so as to enter the space between the bar-flanges, substantially as described.

10. A composite protective structure having an opening with a frame encircling it made of one or more bars of wrought-iron bent to inclose the opening and having flanges on their outer sides, a body of cast-iron, cast around the opening-casing, composed of such bar or bars, so as to make the same project between the bar-flanges, substantially as described.

11. A composite structure having an opening surrounded by a frame made of one or more bars bent to inclose the opening, each having flanges in its outer side and openings in its web, and a body of cast metal, cast around such frame, so as to inclose it and enter between the flanges on the bar or bars, substantially as described.

12. A composite protective structure having a series of bars to form a framework, and an opening inclosed by one or more channel-bars, bent to inclose the opening, and having their flanges turned outward, and arranged so that the ends of the framework-bars project in between them, and a body of cast metal, cast upon and around the framework-bars, and into the spaces between the flanges on the bar or bars inclosing the opening in the structure, substantially as described.

13. A composite structure having an opening inclosed by one or more channel-bars bent to surround the opening and having their flanges turned outward, series of framework-bars having their ends projecting into the spaces between the flanges of the respective channel-bars, and a body of cast metal, cast upon and around the series of bars, and around the outside of the channel bar or bars, so as to surround the outer side of the opening-frame formed of the latter bar or bars and enter the spaces between the flanges thereof, substantially as described.

14. A composite protective structure having an opening with a frame inclosing it, made of one or more channel-bars with their flanges turned outward, series of bars having their ends projecting in between the flanges

of the bar or bars, series of bars arranged between and at right angles to the bars of the other series and a body of cast metal, cast upon and around the two series of bars and around the frame of the opening so as to extend into the space between the flanges of each channel-bar forming such frame, substantially as described.

15. Composite armor for defensive structures consisting of a framework of longitudinal tiers or rails or beams of wrought metal arranged one above the other and resting upon and separated by transverse bars in the straight or non-angular portions of the wall, and at the sides of the ports, having their ends intermeshing at the angles thereof, and vertical bars placed adjacent the port, in combination with a body of metal cast around and integrally inclosing the said framework substantially in the manner and for the purpose specified.

16. In a fort or turret the combination of a framework or interlacery of wrought-metal bars, beams or rails, a body of cast-iron or other suitable metal cast around and integrally inclosing the framework, and a surface plating of wrought-metal sheets or bars having engaging parts or projections inserted and embedded within the cast metal of the structure, substantially in the manner and for the purpose specified.

17. In a defensive structure of wrought-metal interlacery embedded in a cast-metal body, the combination therewith of the port, combining one or more frames of channel-iron bent to the form of the cross-section of the port, and having the cast metal cast around the frames and engaging the flanges thereof, substantially as and for the purpose specified.

18. In a fortification or defensive structure of wrought-metal interlacery embedded in cast metal cast around and between the parts thereof, the construction of the embrasure, combining one or more frames of channel-iron bent to the form of the cross-section of the embrasure, and having the cast metal cast around the frames and engaging the flanges thereof, the horizontal rails of the wrought-metal interlacery projecting into the spaces between the flanges of the channel-iron frames, and being reinforced by auxiliary vertical rails adjacent the sides of the embrasure, substantially as and for the purpose specified.

19. In a defensive structure of wrought-metal interlacery or framework embedded in a cast-metal body, the construction of the embrasure consisting of the combination of the channel-iron frames lining the port, with flanges projecting outwardly, the horizontal rails having their ends terminating at or near the channel-iron frames, and a series of vertical beams or bars, arranged at the sides of the port and between the horizontal rails, the cast metal being cast around and between the wrought-metal parts, and interlocking therewith, substantially in the manner and for the purpose specified.

20. In fortifications or structures for military defense, the herein-described mechanism for closing the embrasures comprising in combination a shield or stopper supported on the ends of carrying braces or beams, a vertical composite post or pivotal structure mounted and journaled in the fortification and having the supporting-beams of the stopper secured thereto, the post being adapted to be turned by suitable mechanism to swing the stopper into position to open or close the embrasure, substantially in the manner and for the purpose specified.

21. In a protective structure having an embrasure in combination with a shield to cover the inside of the embrasure, an upright post pivoted in suitable bearings so as to be rotatable and having one or more arms attached to the embrasure-closing shield so as to support the same, substantially as described.

22. In a protective structure having an embrasure in combination with a shield for closing the embrasure, an upright rotatable post journaled in suitable bearings and a series of inclined arms carried by the post and supporting the shield, and means for rotating the post, substantially as described.

23. In fortifications the herein-described mechanism for closing the port comprising in combination a composite shield or stopper having supporting braces or beams embedded in it, a vertical composite post or pivotal structure of wrought and cast metal mounted and journaled in the fortification and having the supporting-beams of the stopper embedded in it, the post being adapted to turn by suitable mechanism to swing the stopper into position to open or close the port, substantially in the manner and for the purpose specified.

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