No. 621,259. Patented Mar. 14, 1899.

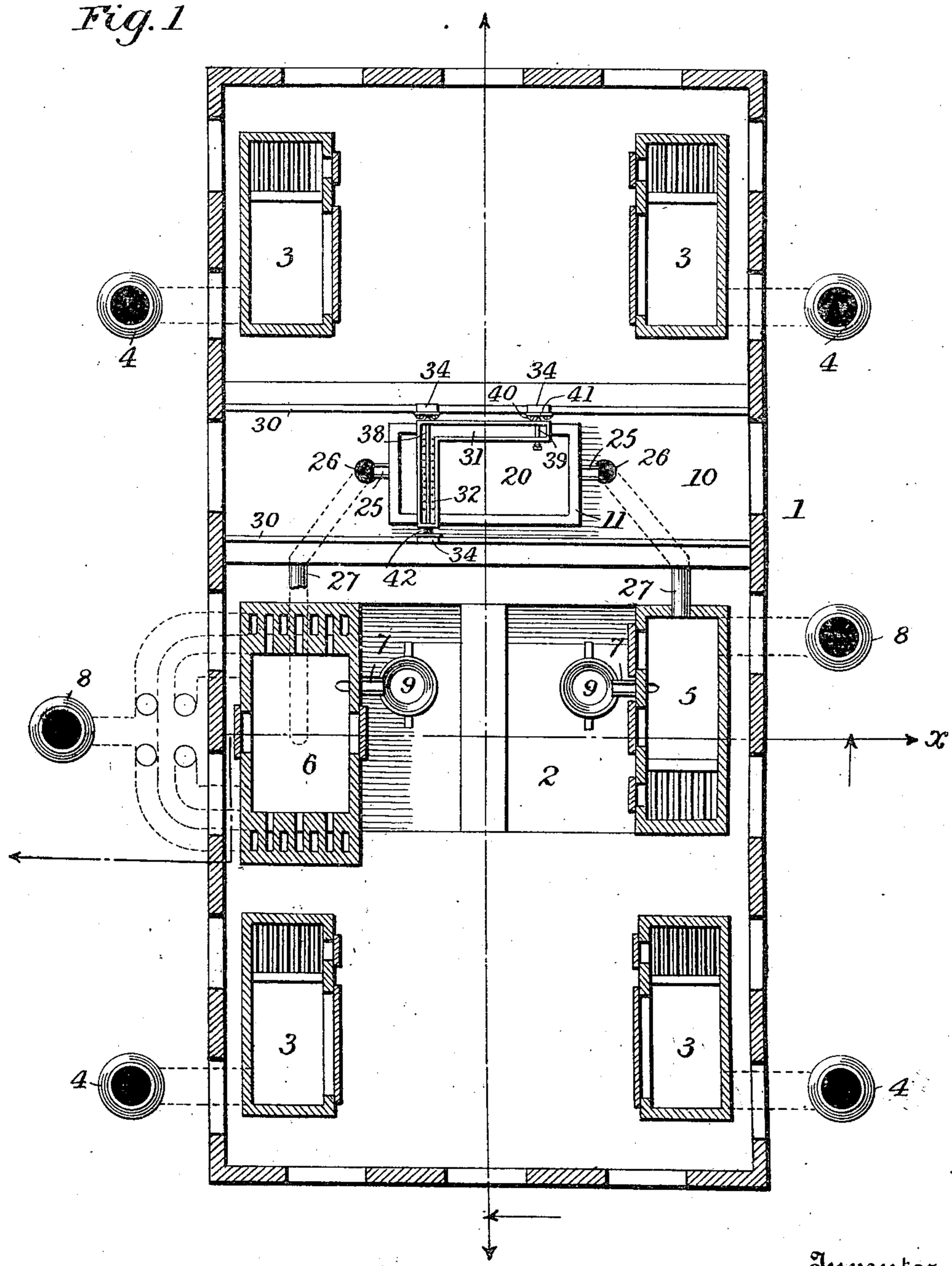
O. F. LEIBERT.

ARMOR PLATE.

(Application filed Nov. 17, 1896. Renewed Aug. 13, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1



Witnesses
Fawcett Stevens
E. Everett Ellis

Inventor
Owen F. Leibert
by Fawcett Stevens,
Attorneys

No. 621,259. Patented Mar. 14, 1899.

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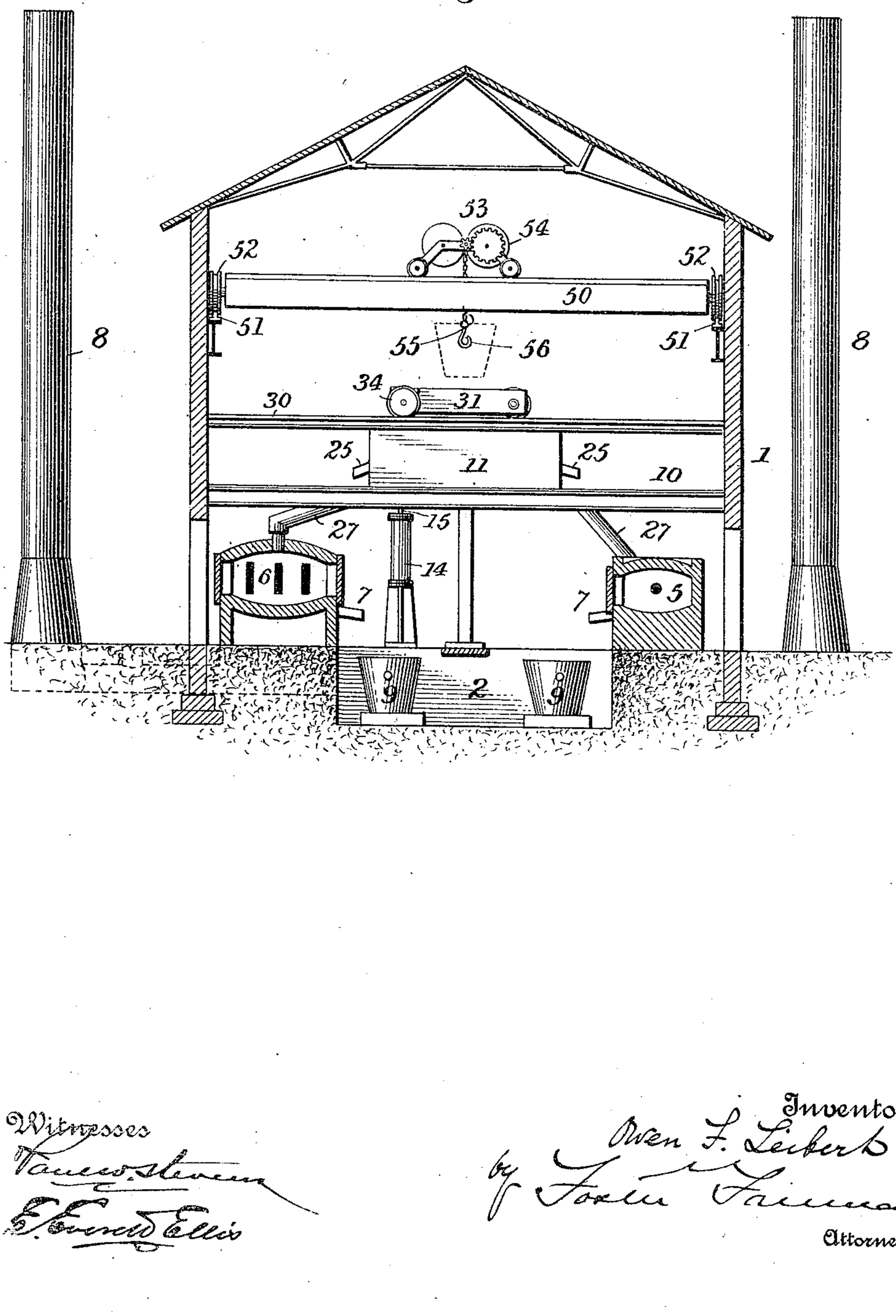
ARMOR PLATE.

(Application filed Nov. 17, 1896. Renewed Aug. 13, 1898.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



Witnesses
Thos. Steven
E. Everett Ellis

Inventor
Oren F. Leibert
by Foster Freeman
Attorneys.

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O. F. LEIBERT.

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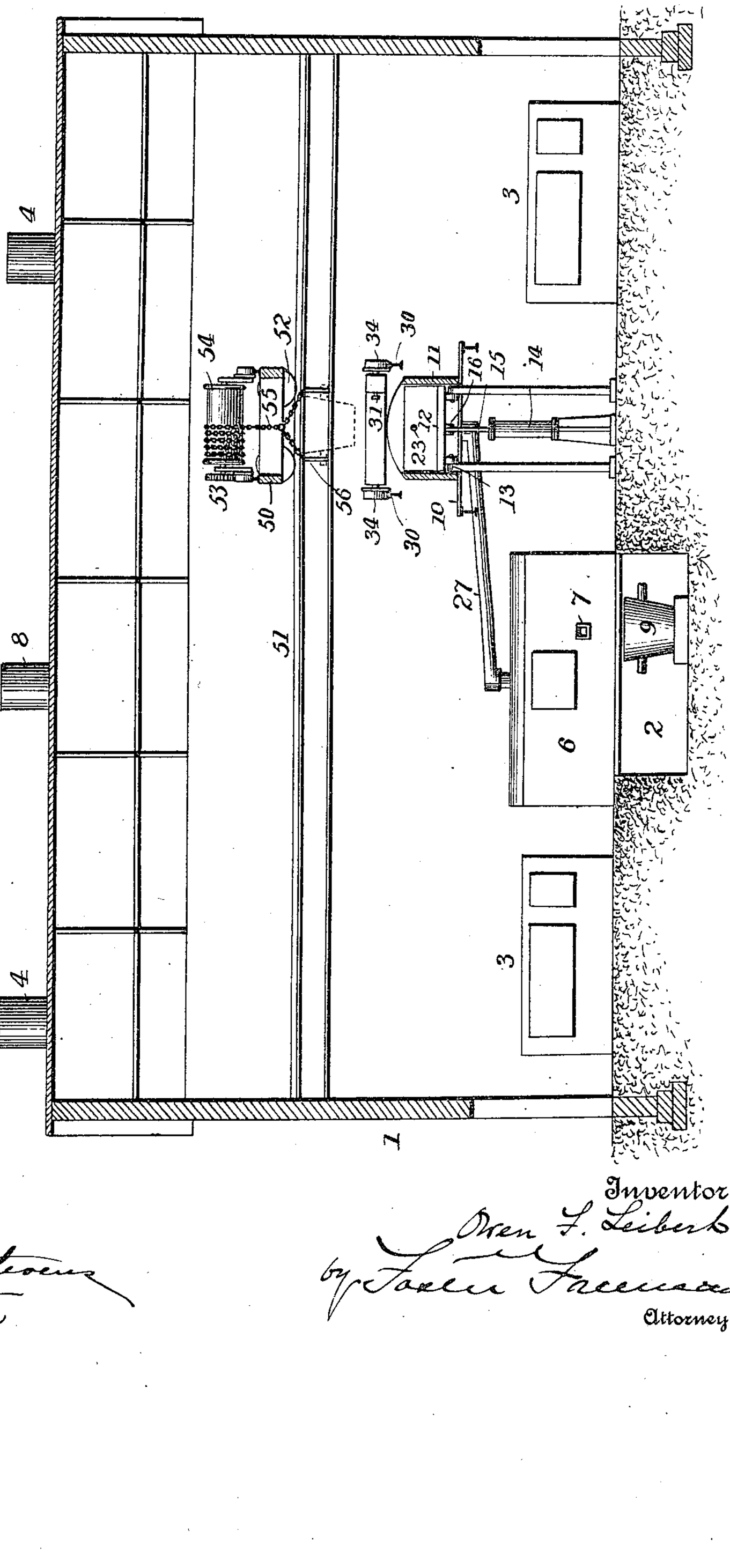
(No Model.) 4 Sheets—Sheet 3.

Fig. 3.



Witnesses
Jas. O. Stevens
J. G. Hinkel

Inventor
Oren F. Leibert
by Fowler Freeman
Attorneys

No. 621,259. Patented Mar. 14, 1899.

O. F. LEIBERT.

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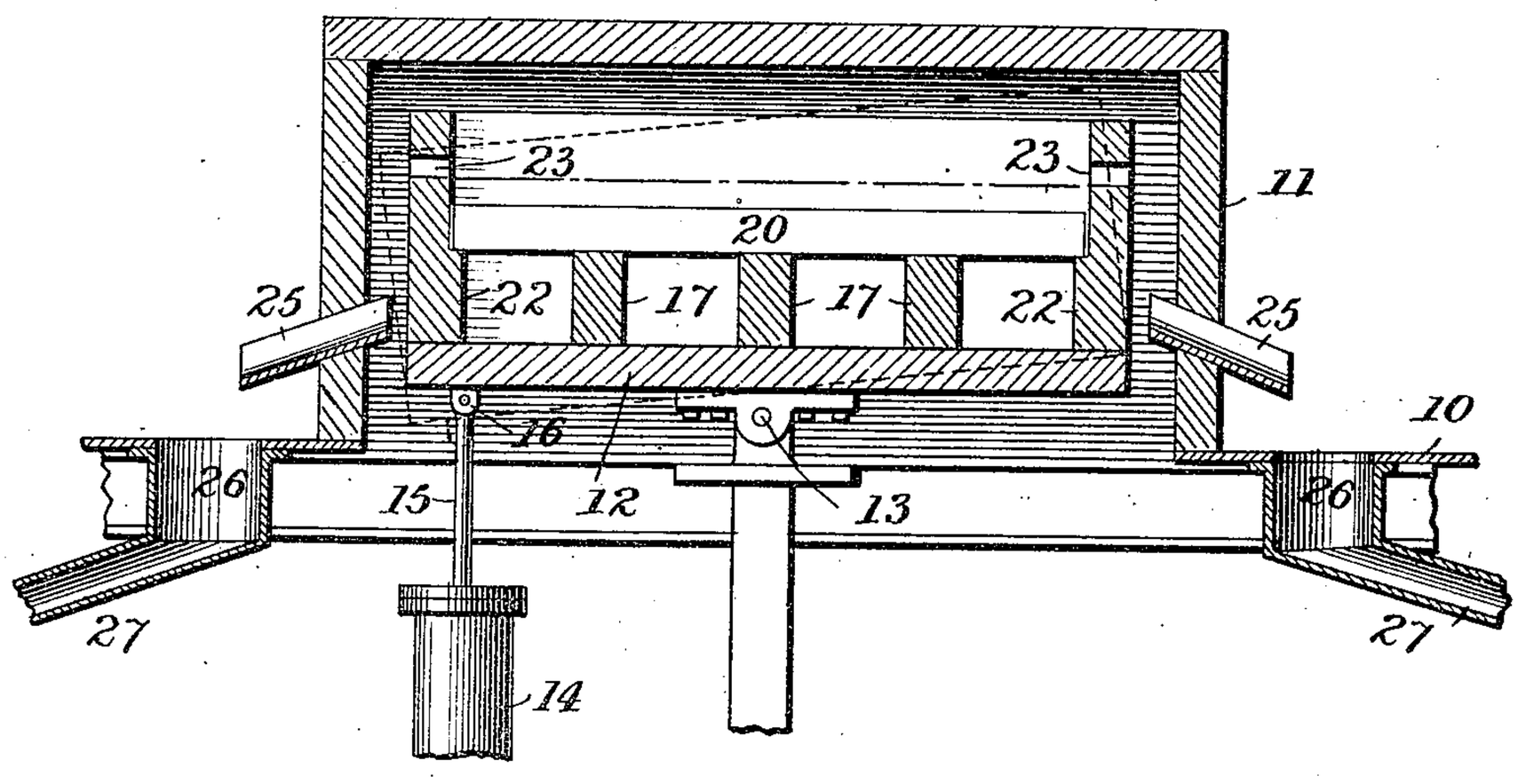
(Application filed Nov. 17, 1896. Renewed Aug. 13, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 4.



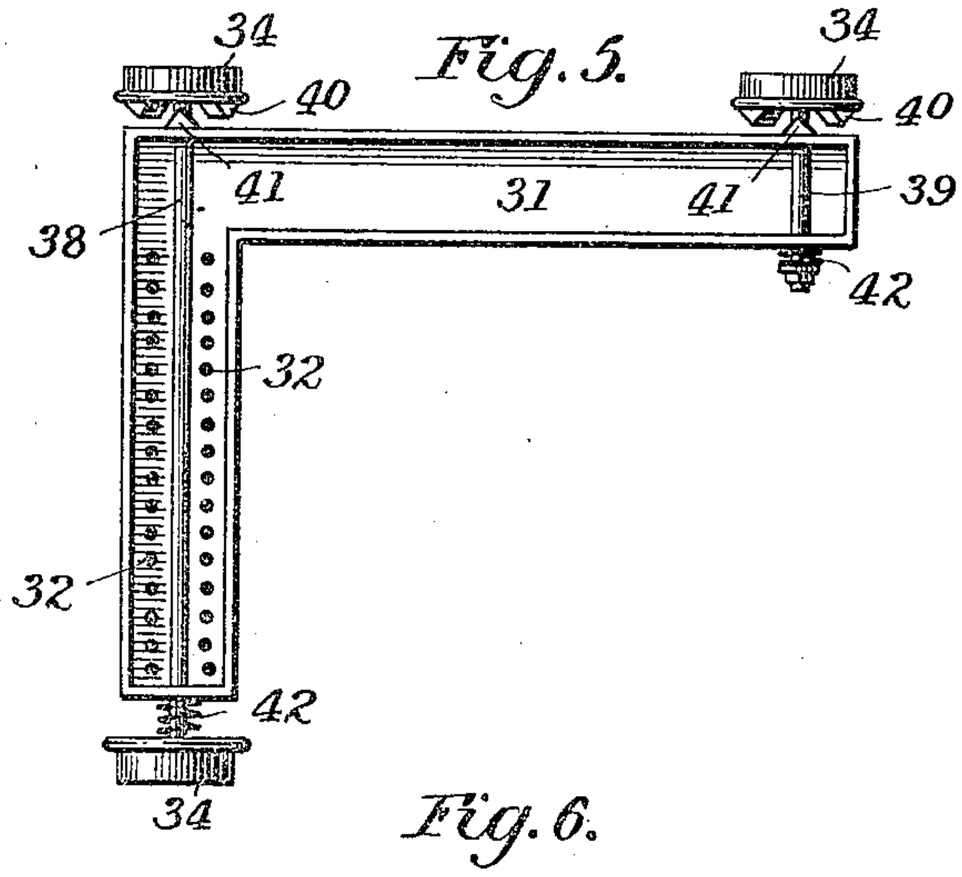
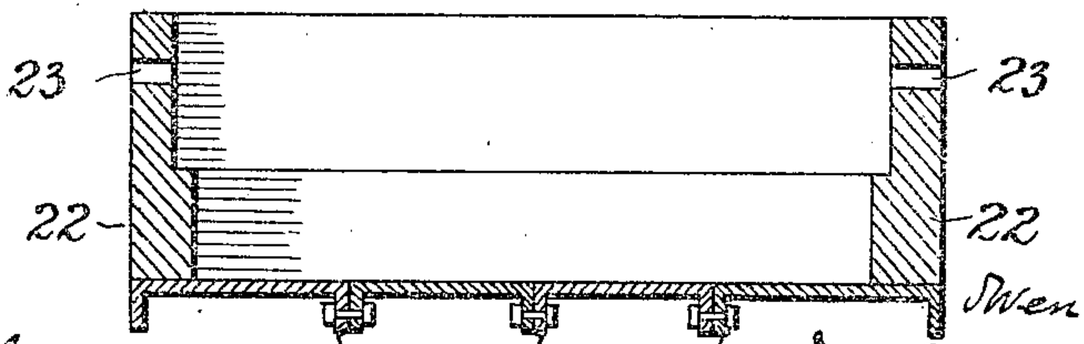


Fig. 5.

Fig. 6.



Witnesses
James A. Brown
E. Ernest Ellis

Inventor
Owen F. Leibert
by Foster Freeman
Attorneys

UNITED STATES PATENT OFFICE.

OWEN F. LEIBERT, OF BETHLEHEM, PENNSYLVANIA.

ARMOR-PLATE.

SPECIFICATION forming part of Letters Patent No. 621,259, dated March 14, 1899.

Application filed November 17, 1896. Renewed August 13, 1898. Serial No. 688,534. (No model.)

To all whom it may concern:

Be it known that I, OWEN F. LEIBERT, a citizen of the United States, residing at Bethlehem, Northampton county, State of Pennsylvania, have invented certain new and useful Improvements in Armor-Plates, of which the following is a specification.

My invention relates to the manufacture of armor-plates, and has for its object to improve and simplify such manufacture; and to these ends my invention consists in the method of and apparatus for manufacturing armor-plates.

While my process is designed more especially for manufacturing armor-plate—such as is used in ships of war, coast defenses, &c.—it is also applicable for other purposes, such as the manufacture of burglar-proof constructions and other constructions where it is desired to provide hard-faced metallic bodies, and while herein I shall describe my invention more particularly as applied to the manufacture of armor-plates it will be understood that the principles of my invention can be utilized for other and various purposes by those skilled in the art and be modified to adapt them to the particular purposes for which they are intended.

It is well known that in the manufacture of armor-plates and the like it is desirable to produce a plate the outer surface of which shall be relatively hard, while the inner portion or backing shall be relatively soft and tough, and many and various means have been suggested for accomplishing this result, which need not be recited herein. By my invention, broadly stated, I accomplish this result by burning hard steel onto the surface of the softer steel. This is accomplished, generally stated, by first cleaning the surface of the softer steel by the use of molten cast-iron and then applying the molten steel to the surface and depositing thereon a sufficient quantity to produce a hard surface.

Thus in carrying out my invention I take the soft-steel ingots, slabs, or plates to be treated and heat them in suitable furnaces or otherwise and then pour over the surface of the heated ingot, slab, or plate molten cast-iron and allow it to run over the whole surface and off, preferably into a suitable trough, so that it can be used again, and in this way I carry away all slags as fast as they are formed on the heated surface of the article being treated. When the article is clean enough, molten steel is applied to the surface in the same manner and allowed to run thereover, further cleaning the surface of the steel, if necessary, and then by the use of suitable dams or otherwise a deposit of the molten steel is made upon the face of the article and allowed to cool. The reason for using the molten cast-iron for cleansing the surface is that it is cheaper than the steel used for making the plate and does not chill as rapidly, and it is for this reason advantageous to use molten cast-iron as a cleanser before the molten steel is applied to the surface of the heated ingot or plate; but when the molten steel is applied to the heated plate in the first instance it requires more steel to do the cleansing, washing, and burning than when the molten cast-iron is used. In this process some of the molten cast or pig iron will be absorbed by the article being treated, as well as the slags removed therefrom, and the article being treated will be kept at the proper temperature and the oxidation of its surface will practically be prevented, and then when the molten hard steel is run on the excess of the cast or pig iron will be washed off, making a clean surface, so that it will be in a condition to receive the desired quantity of hard steel and burn or unite it with the surface of the article, forming a practical and substantial union between the two.

The ingots, slabs, or plates may be either of forged, rolled, or cast steel, according to the purposes for which they are to be used, and the layer or face of hard steel burned thereon may be of the thickness desired, and I have found that in this way a most effective armor-plate may be made, having exceedingly high ballistic qualities, and at the same time the plates can be cheaply and quickly produced, with relatively little labor and expense compared with the usual processes of producing such articles. The article itself proves to be an improved plate, practically homogeneous and having the desired resistance qualities to penetration by shells and the like to a high degree, combining the advantages of the hard surface plate with the toughness of the softer steel backing.

My improved process or method may be carried out in many and various ways and by many and various means, and I will now proceed to describe what I have found to be a convenient and practical means, it being understood that my invention is not limited to the details of construction or arrangement of parts hereinafter set forth, they being typical and sufficient to indicate to those skilled in the art how the invention may be practically worked.

In the accompanying drawings, Figure 1 is a sectional plan view of a building, together with a general plant preferably employed in the practice of my invention, said plant comprising melting and heating furnaces properly disposed within the building, as well as casting-pits, an operating-platform, an operating-chamber, and other accessories. Fig. 2 is a transverse sectional elevation taken on the line *x x*, Fig. 1, and showing more clearly the general disposition and arrangement of the operating-platform, the several furnaces, and the lifting or elevating devices for the molten metals. Fig. 3 is a longitudinal sectional elevation taken about centrally. Fig. 4 is an enlarged sectional view in detail of the operating-chamber and some of the accessories thereto. Fig. 5 is an enlarged detail view in plan of the preferred form of movable trough for supplying or delivering the molten metals to the faces or surfaces of the metal plates or slabs being treated; and Fig. 6 is a detail view, in vertical section, of a modification in the construction of the tilting platform by which to enable plates or slabs of different sizes or dimensions to be more conveniently handled or treated.

In the manufacture of hard-faced armor-plates the plates may be first shaped into the desired form, whether by forging, rolling, or casting, and are brought to a proper temperature for the subsequent operations by heating them in a furnace, and I have shown a number of heating-furnaces arranged in a convenient relation to an operating-platform and melting-furnaces, with apparatus so arranged that the process may be practically continuous and the molten cast or pig iron, as well as the molten hard steel, be used over and over, except so much of the latter as is applied or burned onto the surface of the plate.

In the drawings, 1 represents a building of any suitable size or dimensions, and 2 designates casting-pits, such as are usually employed in plants of this kind. At suitable parts of the building I locate heating-furnaces 3, of which any suitable number may be employed and which furnaces may be of any suitable or preferred construction, each being shown as provided with a stack 4, located on the outside of and extending above the top of the building. The metal plates or slabs are placed in these heating-furnaces and brought to the required temperature by which to better adapt them to the reception of the hardening material, which is subsequently applied.

5 represents any suitable melting-furnace in which the pig or cast iron is brought to a molten condition, and 6 represents also a melting-furnace which in the present instance is employed for the molten hard steel, each of the said furnaces having a spout 7, and each of them also communicating with a stack 8 on the outer side of the building. These said furnaces are preferably located at the edge of the casting-pits 2, and the ladles 9, which receive the molten metals, are arranged in the pit beneath said spouts, so as to receive the metals flowing therefrom. Above the said melting-furnaces 5 and 6 is arranged an operating-platform 10, centrally of which is arranged the operating-chamber, in which the plate to be treated is placed and operated upon. This operating-chamber 11 comprises any general form of chamber in which is located a tilting platform 12, centrally pivoted at 13 and capable of being tilted to one side or the other by any suitable means, but preferably by a hydraulic ram 14, having a rod 15, connecting at 16 with the under side of the said tilting platform. Mounted upon this platform 12 are a number of suitable pillars or posts 17, preferably of brick or masonry, and upon which the plate 20 is laid, substantially as shown in Fig. 4. At each side of the said tilting platform the supports 22 are preferably constructed to receive the edges of the plate, and they are provided with an opening 23 at a suitable height, and it is through these openings that the molten metal flows (when the platform is tilted to one side or the other) into the trough 25, whence the metal is delivered to the open ends 26 of passages or conduits 27, leading from the floor of the operating-platform to the upper part of the melting-furnaces 5 and 6, respectively. As shown in Fig. 4, the upper part of the said operating-chamber 11 is removable, and the same is taken off at such time as the metal is being poured over the surface of the plate being treated, and, as shown in Fig. 2, suitable rails are extended across the said chamber in such manner as to enable the delivery-truck for the molten metals to be moved back and forth longitudinally, so as to properly distribute such metals upon the surface of the plate. The rails are designated as 30 and the delivery-trough as 31, the said trough being preferably of an L shape and of proper depth, one leg thereof being formed or provided at its bottom with a series of openings 32 for the passage of the molten metals, while the other leg thereof is for the reception of the molten metals from the ladle employed for conveying the same from the melting-furnaces. This said delivery-trough 31 is provided with suitable wheels 34, which travel on the rails 30, and in addition to the trough being movable lengthwise of the rails the same is also ca-

pable of a limited sidewise reciprocating motion, which is desirable for the purposes of deriving an equal distribution of the molten metals upon the surface of the plate. To obtain this sidewise reciprocating motion, I preferably extend the shafts or axles 38 and 39 of the trough, and on the inner faces of the wheels at one side of the trough I provide suitable cams 40, which abut or come in contact with cams 41 on the adjacent side of the trough, and at the opposite ends of the said shafts or axles I interpose or arrange suitable springs 42, and in this way it will be seen that the trough will be moved in one direction by the cams and in the other direction by the springs. I am not limited to this particular form of delivery trough or to any particular means for applying the molten metals to the surface of the plate being treated; but as I have found the construction explained to be very convenient I prefer to use the same, as a rule.

Some means are required for elevating the ladles 9 to a proper height to enable their contents to be emptied into the movable trough, and while any means could be employed for this purpose I prefer the use of the movable crane 50, shown in Fig. 2 as mounted at the ends upon rails 51 through the medium of suitable wheels 52, the said crane carrying any suitable form of elevating device, such as is indicated at 53. A winding-drum 54 carries an elevating chain or rope 55, the end of which is provided with suitable hooks 56 for engaging the trunnions on the sides of the ladles, and it is evident that all that is required to be done is to simply attach the ladle to the end of the rope or chain and then rotate the drum, whereupon the ladle will be elevated to the proper height. The operator then empties the molten metal into the movable trough, and by moving the trough back and forth the metal will be evenly distributed upon the surface of the plate upon the tilting platform within the operating-chamber. As shown in Fig. 6, the tilting platform 12 is composed of a number of different plates, each having depending flanges 12', by which they are united together in any suitable way—as, for instance, by bolts and nuts, as shown. This construction enables the said tilting platform to be made of larger or smaller dimensions, by which to conform to plates or slabs of different sizes, since to reduce the size of the platform it is simply necessary to remove one or more of the flanged plates, while to increase the size thereof additional plates are put in.

The operation is as follows: The plate or slab to be treated is placed into one or the other of the heating-furnaces 3, and then when it has been brought to the desired temperature the plate is placed upon the tilting platform in the operating-chamber and this platform is tilted so that its lower end will be carried in the direction of the melting-furnace for the cast or pig iron. The molten cast or pig iron is allowed to run off at the spout of the furnace into the ladle 9 below, and the elevating rope or chain is attached to the ladle and the latter is brought high enough to enable the contents thereof to be emptied into the delivery-trough 31. As soon as this is done the said trough is moved back and forth upon its supporting-rails 30 in such a way that the molten metal flows out through the openings 32 in the transverse leg of the trough onto the upper surface of the plate, and from this latter the metal flows through the opening 23 into the trough 25 beneath, whence by means of the conduit 27 the said molten metal is carried back to the melting-furnace from which it was first taken, and in this way the same cast or pig iron can be used over and over again repeatedly, and each time it is used the scales or slag washed from the surface of the plate are carried into the melting-furnace also, and which may be removed from the furnace from time to time in the ordinary way. After thus subjecting the surface of the plate to molten cast or pig iron the platform 12 is tilted to the other side, so as to bring the opposite edge thereof in the direction of the melting-furnace for the molten steel, and then the ladle containing the molten steel is elevated and the contents thereof are in like manner emptied into the movable trough and this molten steel is distributed over the surface of the plate, and it is allowed to flow off and back to the melting-furnace therefor in the manner and by the means substantially as I have already described. The molten steel is thus brought back to the furnace from which it was originally taken, and this steel is thus kept hot and permitted to be used over and over again, excepting, however, that percentage thereof which is deposited on the plate or slab. When the surface of the plate is clean enough, the tilting platform 12 is laid horizontally and as much of the steel is deposited on the surface thereof as is desired, and for this latter purpose the side supports 22 on the tilting platform, together with additional end supports or other materials, are utilized as a dam by which to hold the molten steel upon the plate until it is of the required thickness. The molten hard steel will then burn onto or unite with the softer steel, forming a homogeneous plate of the desired quality, and I have found it most satisfactory for the purpose intended. The process is simple and relatively inexpensive both in time and labor and with apparatus arranged substantially as described may be practically continuous.

While I have herein set forth a process of burning hard steel onto the surface of softer steel, it is obvious that by substantially the same steps of operation I can in like manner apply a soft backing onto the surface of a hard plate or slab. Thus I would take, say, a comparatively thin rolled, forged, or cast plate of hard steel and manipulate the same in practically a like manner, as already ex-

plained with reference to the softer plate, with the slight difference that in finishing the work a larger percentage of molten steel would be used than in the case of the hard facing of softer metals.

In describing my invention above I have referred to heating-furnaces in which the metal plates or slabs are placed and brought to the required temperature by which to better adapt them for the reception of the hardening material which is subsequently applied. These heating-furnaces, it will be understood, are only employed in those instances in which the slab or ingot has been previously cast, and it will be understood that my invention comprehends the casting of the slab or ingot, say, for instance, in the operating-chamber referred to and then immediately subjecting the slab or ingot to the process of hard-facing such as has already been described. By this means it will be at once understood that I utilize the initial heat for hard-facing purposes instead of being obliged to heat the ingot or slab, as is necessary in the instance first above described with reference to the heating-furnaces.

It will be seen that in carrying out the process of burning the two metals together the surface of the heated foundation-plate or slab is cleansed while exposed to the action of the atmosphere by pouring or running over the surface of the same the molten metal either in the form of cast-iron or the steel which is subsequently to be united therewith to form the armor-plate. Of course the foundation-plate, while heated, is not heated to a degree sufficient to render it molten; but the metal to be applied or united thereto, whether the harder or the softer steel, is molten and is poured or run over the face or surface of the foundation-plate, and this surface is heated to a temperature sufficient to insure the burning or intimate union of the molten metal with the foundation-plate, so that the resulting article is an integral armor-plate made up of two metals of different degrees of hardness united or burned together while exposed to the action of the atmosphere.

What I claim is—

1. The method of producing a compound armor-plate having a face of hard metal and a back of soft metal, which consists in providing a foundation-plate of one of said metals, heating and cleaning the surface of said foundation-plate by passing over it a molten metal, and then applying to the surface thus heated and cleansed a layer of the other metal, suitable for the face or back of the compound plate, and allowing it to unite with said foundation-plate, substantially as described.

2. The method of producing a compound armor-plate having a face of hard metal and a back of soft metal, which consists in providing a foundation-plate of relatively soft metal, heating and cleansing the surface of said foundation-plate by passing over it a molten metal, and then applying to the surface thus heated and cleansed a layer of hard metal and allowing it to unite with said foundation-plate, substantially as described.

3. The method of producing a compound armor-plate having a face of hard metal, and a back of soft metal, which consists in providing a foundation-plate of relatively soft metal, heating and cleansing the surface of said foundation-plate by passing over it molten cast-iron, and then applying to the surface thus heated and cleansed a layer of steel and allowing it to unite with said foundation-plate, substantially as described.

4. The method of producing a compound armor-plate having a face of hard metal and a back of soft metal, which consists in providing a foundation-plate of relatively soft metal, heating and cleaning the surface of said foundation-plate by passing over it a molten mefal, then passing over the surface thus heated and cleansed molten hard steel, and finally depositing said steel upon the surface to the required thickness and allowing it to unite with said foundation-plate, substantially as described.

5. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, an operating-chamber for effecting the burning of the plate, and means for conveying the molten metals from the operating-chamber to the said melting-furnaces respectively, substantially as described.

6. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, an operating or burning chamber for the plate comprising a tilting platform and means for tilting the same in either direction, and a movable trough for distributing the molten metals over the surface of the plate, substantially as described.

7. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, an operating or burning chamber for the plate comprising a tilting platform and means for tilting the same to one side or the other, a movable trough for distributing the molten metals over the surface of the plate, and means for elevating the molten metals to said trough, substantially as described.

8. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, an operating-chamber, means for distributing the molten metals over the surface of the plate in the operating-chamber, and spouts and conduits for conveying the molten metals back to the melting-furnaces, substantially as described.

9. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, and an operating or burning chamber for the plate

comprising a tilting platform and supporting-pillars for the plate, substantially as described.

10. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, a melting-furnace for pig-iron, a melting-furnace for steel, an operating or burning chamber for the plate comprising a tilting platform and supporting-pillars for the plate, a distributing device for the molten metals, an elevating device for the metals, and conduits for conveying the metals from the operating-chamber back to the melting-furnaces, substantially as described.

11. In apparatus for the manufacture of armor-plates, the combination of a heating-furnace for the plate, melting-furnaces for pig-iron and steel, an operating or burning chamber for the plate, a distributing-trough for the metals, and a supporting-rail therefor, and means for imparting a sidewise movement to said trough as it is moved along its rail, substantially as described.

12. In apparatus for the manufacture of armor-plates, the combination of one or more heating-furnaces, melting-furnaces for pig-iron and steel, an operating or burning chamber for the plate, a movable trough for distributing the molten metals over the surface of the plate, and ladles and a traveling or movable crane for elevating the molten metals from said melting-furnaces to the said trough, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OWEN F. LEIBERT.

Witnesses:
HENRY A. KRAUSE,
R. W. LEIBERT.