No. 632,020. Patented Aug. 29, 1899.

C. H. MORGAN.

FURNACE FOR HEATING INGOTS.

(Application filed Aug. 3, 1896.)

(No Model.) 3 Sheets—Sheet 1.

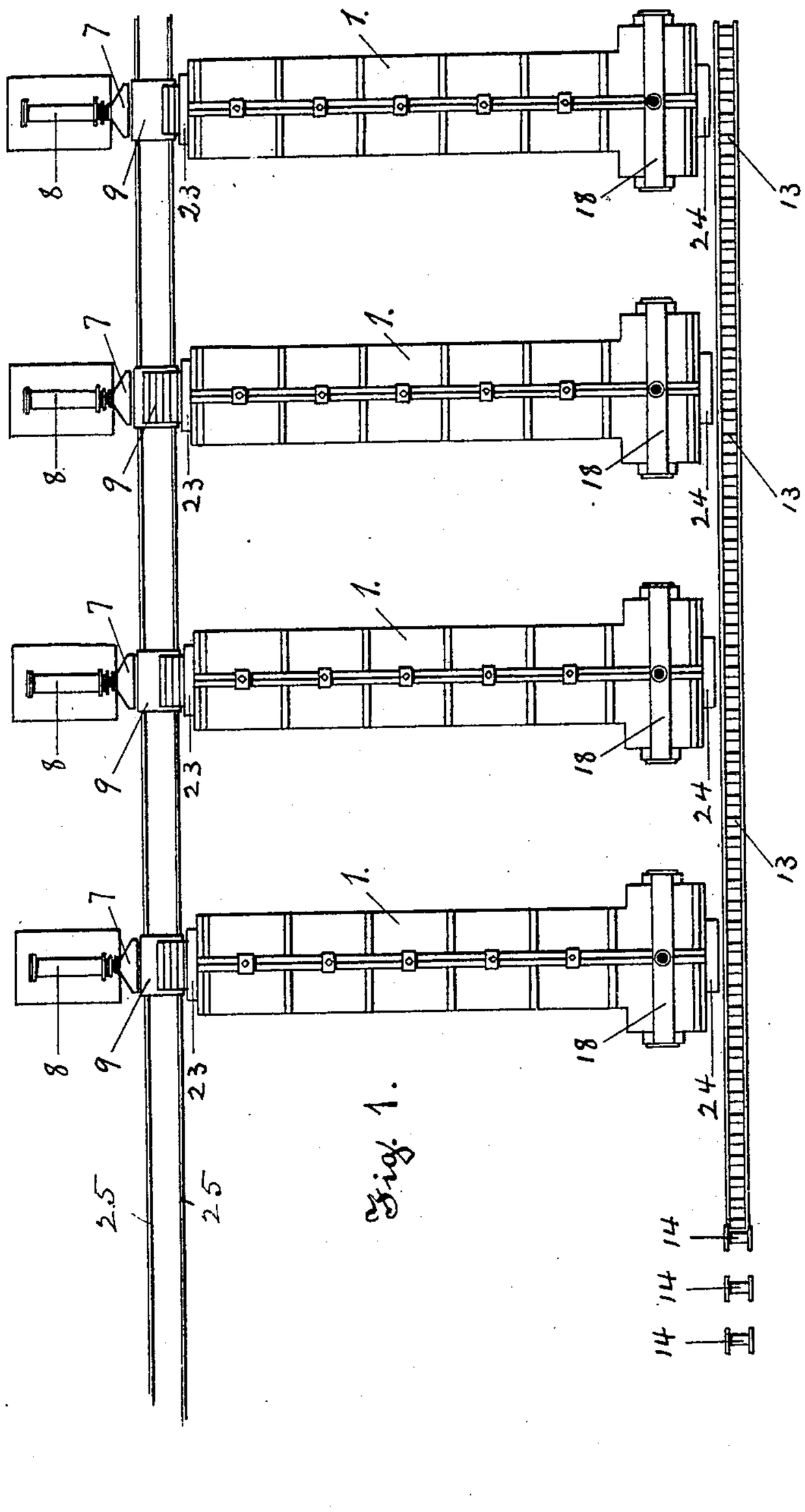

Fig. 1.

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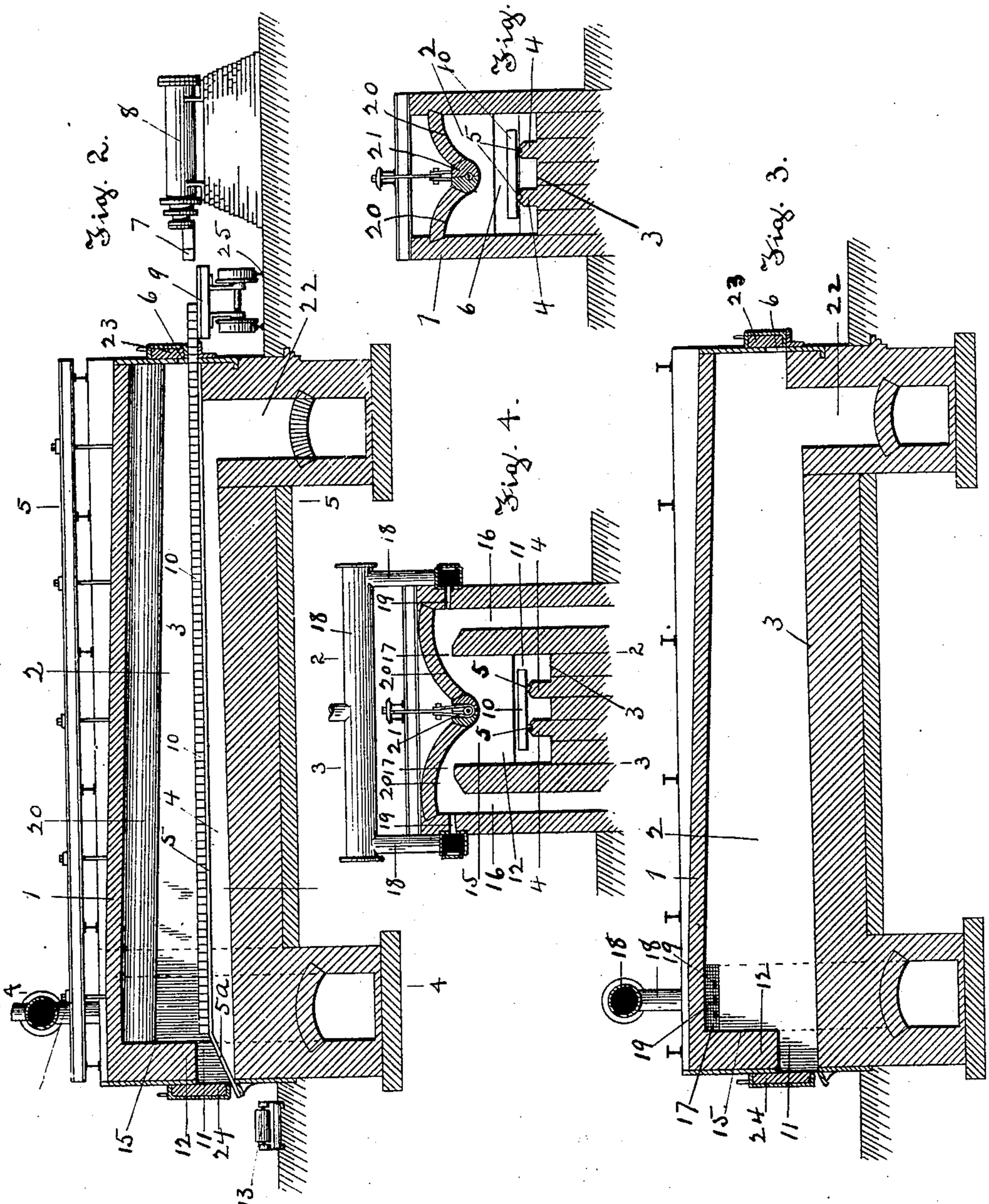

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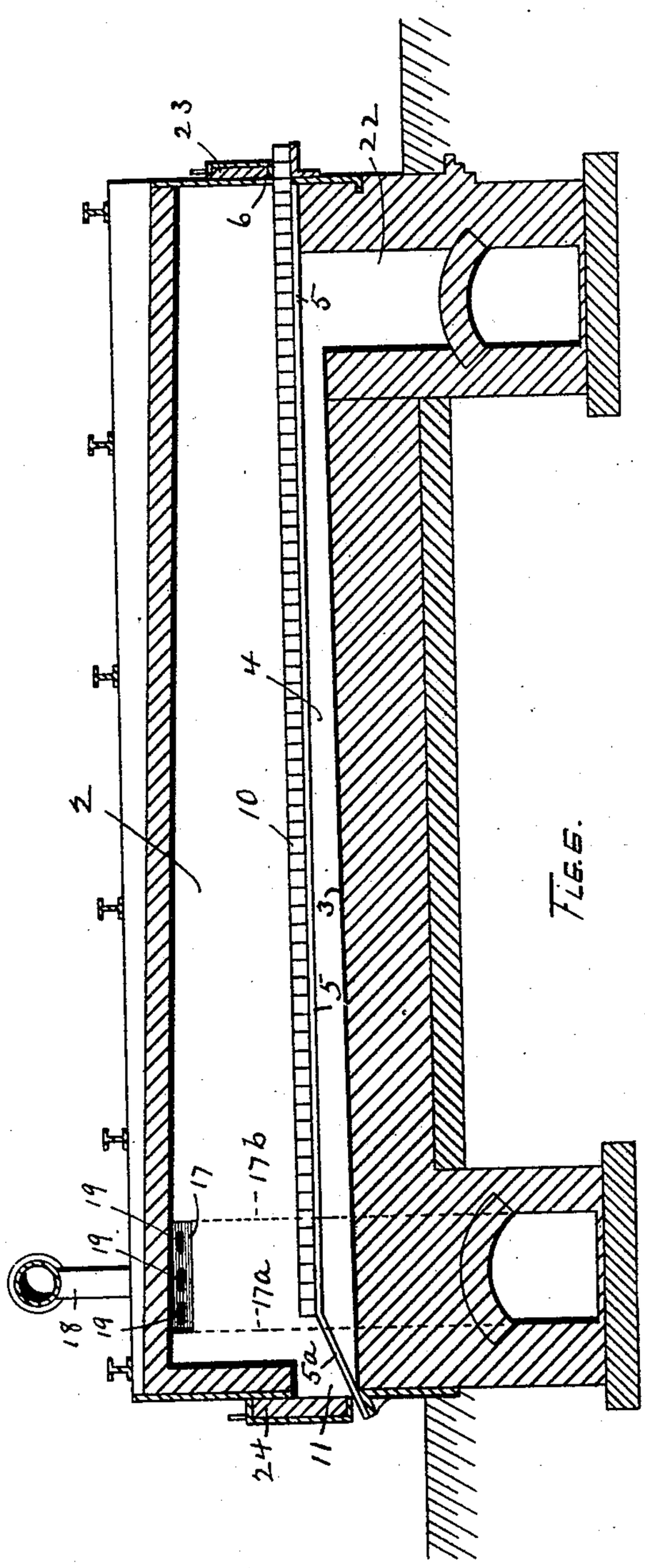

FIG. 6.

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UNITED STATES PATENT OFFICE.

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FURNACE FOR HEATING INGOTS.

SPECIFICATION forming part of Letters Patent No. 632,020, dated August 29, 1899.

Application filed August 3, 1896. Serial No. 601,528. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. MORGAN, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Improvement in Furnaces for Heating Ingots or Billets for Rolling-Mills, of which the following is a specification, accompanied by drawings forming a part of the same, in which—

Figure 1 represents in plan view a series of furnaces arranged side by side in position to deliver the heated ingots from each of said furnaces upon a common conveyer. Fig. 2 is a longitudinal sectional view of a furnace embodying my invention, the section being shown on line 2 2, Fig. 4. Fig. 3 is a longitudinal sectional view of the furnace on line 3 3, Fig. 4. Fig. 4 is a transverse sectional view on line 4 4, Fig. 2. Fig. 5 is a transverse sectional view of the furnace on line 5 5, Fig. 2; and Fig. 6 represents a longigitudinal sectional view of a furnace embodying my invention, that portion above the upper surface of the row of ingots being shown on line 3 3, Fig. 4, and the part below the upper surface of the row of ingots being shown on line 2 2, Fig. 4.

Similar numerals refer to similar parts in the different figures.

My present invention relates to a furnace for heating ingots or billets for rolling-mills; and it has for its objects to increase the capacity of the furnace, to secure a more thorough diffusion of heat through the mass of metal, to lessen the manual labor required, to reduce the formation of cinder or scale, to facilitate the delivery of the heated billet to the rolls of the mill with a minimum reduction of its heat, to render the operation of the furnace automatic, and to allow two or more furnaces to be operated jointly with a single reducing-mill; and I accomplish these results by means of my present invention, which consists of novel combinations of instrumentalities with the heating-chamber of a furnace, as hereinafter described, and pointed out in the annexed claims.

In the accompanying drawings I have represented a furnace for heating ingots or billets and embodying my invention, in which 1 denotes a furnace inclosing a heating-chamber 2, having a floor 3, preferably provided with longitudinal piers 4 4, supporting a track, along which the ingots or billets are moved, and preferably consisting of water-pipes 5 5, through which a circulation of water is maintained in any known manner in order to protect them from the intense heat of the furnace. One of the end walls of the furnace is provided with an opening 6, through which the ingots or billets are pushed into the heating-chamber by a broadside movement by means of a pushing-plate 7, reciprocated by any well-known means—such, for example, as a hydraulic cylinder 8. The water-pipes 5 5 are arranged lengthwise the heating-chamber and in alinement with the entrance-opening 6, so that as each successive ingot or billet is pushed by the reciprocating pushing-plate 7 from a supporting-table, such as the platform of a car 9, into the heating-chamber it will push those which are in advance until a row of ingots or billets 10 is established along the pipes 5. In the opposite end wall of the heating-chamber is an opening 11 in alinement with the pipes 5 for the delivery of ingots by a broadside movement from the heating-chamber, and the end wall 11 is preferably thickened to provide a projecting lintel 12, but which may be omitted and the end wall of the furnace constructed the usual thickness, as shown in Fig. 6.

Immediately outside the end wall of the furnace and just below the plane of the delivery-opening 11 is a conveyer arranged transversely to the longitudinal axis of the furnace and preferably consisting of a series of parallel rolls 13, upon which the heated ingot or billet is received as it passes through the delivery-opening 11 and is conveyed to the rolls 14 of the rolling-mill.

Heat is supplied to the heating-chamber 2 at its delivery end and next the inner vertical side 15 of the end wall by means of gaseous fuel, which is conducted through the vertical conduits 16 16 and admitted through openings 17 in the side walls of the furnace with a proper admixture of air, which is supplied to the conduit 16 through the pipes 18 and openings 19. The gaseous fuel is admitted in two opposing currents, which enter from

each side of the furnace transversely to the heating-chamber and are deflected upon the ingots or billets by the downwardly-inclined surfaces 20 20, which in the present instance are formed by constructing the roof of the furnace in a double arch, supported in the center by skewbacks 21. A flue 22 is provided at the opposite or entrance end of the heating-chamber for the escape of the products of combustion, which pass in a longitudinal current from the delivery to the entrance end of the heating-chamber. A zone of maximum heat is thereby maintained at the delivery end of the heating-chamber and contiguous to the end wall of the chamber with a gradually-decreasing temperature toward the entrance end of the chamber. The openings 6 and 11 are closed by doors 23 and 24. The ingots or billets between the entrance end of the heating-chamber and the zone of maximum heat are supported upon a track which is raised by the piers 4 4 above the floor 3, and as the currents of ignited fuel are deflected downwardly into the plane of the row of ingots or billets at the zone of maximum heat the longitudinal current induced by the draft of the escape-flue 22 passes both above and below the row of ingots or billets, thereby applying heat to their upper and under surfaces without requiring the ingots or billets to be turned, as is the case when they rest upon the floor of the heating-chamber. The billets admitted at the charging end of the furnace are gradually moved along the track through successive zones of increasing temperature, causing the ingots to be gradually heated and the heat uniformly diffused throughout the mass of metal without unduly heating the outside of the billet until the billet reaches the zone of maximum heat, which is either within or approximate to the plane of the fuel-opening, depending upon the strength and direction of the current of incoming fuel and also upon the strength of the longitudinal current induced by the escape-flue at the opposite or charging end of the furnace. In the furnace shown the gaseous fuel is admitted through the opening 17 and in a plane between the broken lines 17^a 17^b, Fig. 6, in a current transversely to the heating-chamber. As soon as the current is admitted to the heating-chamber through the openings 17 17 it is drawn in a longitudinal direction toward the charging end of the furnace, and the zone of maximum heat will be found somewhere between the broken lines 17^a, Fig. 6, and the charging end of the furnace, but approximate to the plane of the fuel-opening. The space between the zone of maximum heat and the delivery-opening forms a zone of greatly-reduced heat, tending to cool the heated billet as it is withdrawn from the furnace and waste the metal by oxidation. The billets are pushed along their supporting-track until they pass through the zone of maximum heat, where the track is bent downwardly, forming an inclined section 5^a between the zone of maximum heat and the delivery-opening of sufficient inclination to cause a billet upon passing upon the inclined section to descend with an accelerated movement through the delivery-opening and in the present instance be received on the rolls 13, by which it is conveyed to the rolls of the reducing-mill.

The inclined track 5^a differs from the inclined tracks heretofore used in heating-furnaces in that it is placed between the delivery-opening 11, through which the heated ingots or billets are delivered from the heating-chamber and the zone of maximum heat, so that gravity is made to act upon the heated billet at the time when the ingot or billet has become sufficiently heated by its passage through the zone of maximum heat in order to accelerate its motion through the space intervening between the zone of maximum heat and the delivery-opening 11 and secure the automatic delivery of the ingot or billet, whereas the inclined section of track in prior furnaces was either placed in front of the zone of maximum heat and served to carry the ingot or billet into the zone of maximum heat and deliver it upon a hearth, from which it was withdrawn by an endwise movement by hand, or else it was placed entirely outside the heating-chamber and served as an inclined conduit to convey the heated metal from the delivery-opening of the heating-chamber to a receptacle or a conveyer placed at a considerably lower level than the delivery-opening of the heating-chamber and leaving a considerable space between the inclined track and the zone of maximum heat through which the heated ingot or billet was moved by the attendant.

I do not confine myself to the construction and arrangement of the fuel-openings as shown, as any known method of admitting gaseous fuel to the heating-chamber of a furnace may be employed, whereby the admission of fuel is so controlled as to maintain a zone of maximum heat contiguous to the delivery-opening of the furnace, and the beginning of the inclined section of the track is determined by the location of the zone of maximum heat, as it is desirable to accelerate the billets as soon as they pass the zone of maximum heat. In the construction shown in the drawings I have found it desirable to carry the inclined section 5^a within the plane of the fuel-opening or past the broken line 17^a.

The projecting lintel 12 serves to protect the delivery-door 24 from being destroyed by the intense heat, and while I consider the use of a projecting lintel advisable, it is not necessary, as it may be omitted, or the space may be increased between the zone of maximum heat and the delivery-door 24. In the practical operation of the furnace the space between the delivery-door 24 and the zone of maximum heat is at a lower temperature than the zone of maximum heat, and in order to accelerate the movement of the heated ingot or billet through this space of lower tempera-

ture I utilize an inclined track 5^a, upon which gravity is employed to remove the heated ingots or billets.

The ingots or billets are presented to the entrance-opening 6 of the furnace upon a platform-car 9, moved over a track 25, arranged transversely to the furnace. The track 25 and the series of conveyer-rolls 13 serve in common a series of furnaces arranged side by side, as represented in Fig. 1, each furnace being independent in itself and with an independent pushing mechanism, thereby enabling heated ingots or billets to be supplied to the rolls of the reducing-mill successively from each of the furnaces, so as to practically secure a continuous operation of the reducing-mill or to permit repairs to be made in one of the furnaces without stopping the mill.

The operation of my improved mill is as follows: Currents of gaseous fuel delivered through openings 17 17 transversely to the heating-chamber are deflected downwardly by the inclined surfaces 20 20 and diverted into a current passing lengthwise through the heating-chamber to the escape-flue 22, thereby maintaining a zone of maximum heat contiguous to the vertical end wall at the delivery end of the heating-chamber with a gradually-decreasing temperature toward the entrance end of the chamber. The ingots or billets to be heated are presented to the entrance-opening 6 in position to be acted upon by a pushing-plate 7, having a limited reciprocating motion by which the ingots or billets are successively pushed through the entrance-opening 6 upon the pipes 5. As each successive ingot or billet is pushed into the heating-chamber it moves the entire row of billets 10 along the pipes 5 until the ingot or billet at the advancing end of the row passes through the zone of maximum heat and has become sufficiently heated throughout its entire mass, when the next succeeding ingot or billet entered through the opening 6 pushes the heated ingot or billet at the forward end of the row upon the inclined section 5^a, where it is moved by gravity through the intervening space between the zone of maximum heat and the opening 11 and is delivered as soon as it leaves the heating-chamber upon the conveyer-rolls 13 and by them conveyed to the rolls of the reducing-mill 14. Each ingot or billet is moved through the heating-chamber by a broadside movement and with a step-by-step motion through successive zones of increasing heat until it passes the zone of maximum heat. The heat of the furnace and the rapidity of the feeding operation are so regulated that when the ingot or billet has passed through the zone of maximum heat its entire mass will have become sufficiently and uniformly heated to be acted upon by the rolling-mill, and when this has been accomplished the heated ingot or billet is automatically transferred with an accelerated movement through the space of reduced temperature intervening between the zone of maximum heat and the delivery-opening, preventing an undue loss of heat and waste of metal by oxidation. The ingots or billets require no manipulation whatever from the time they are presented to the entrance-opening 6 to their delivery upon the conveyer-rolls 13, and the proper heating of each ingot is determined by two factors—viz., the temperature of the heating-chamber and the rapidity of the feeding operation—both of which are capable of being controlled by the attendant, rendering the operation of the furnace regular and automatic.

In the operation of an ingot or billet heating furnace the conditions are materially different from those of other classes or types, such as annealing-furnaces or furnaces for heating molten metal. The mass of the ingot or billet is of considerable size and requires an intense heat to render it sufficiently ductile throughout to be operated upon by the rolls of a reducing-mill. It is necessary to subject the ingot or billet to a heat for a sufficient length of time to allow the heat to become equally diffused throughout the entire mass of metal, and this requires that the ingot or billet be subjected at its initial heating to a lower temperature than the maximum heat of the heating-chamber in order to prevent the overheating of the outside of the ingot or billet. When the ingot or billet has become sufficiently heated, it is desirable to rapidly withdraw it from the heating-chamber and convey it to the rolls of the reducing-mill to prevent the reduction of heat and the waste of metal due to the oxidation of its surface. By the combination of instrumentalities embodied in the furnace herein described I am able by properly charging the furnace and regulating the rapidity of the feeding operation to produce by the regular and automatic operation of the furnace ingots or billets properly heated throughout their entire mass with a minimum loss from oxidation without manipulation by the attendant during their passage through the heating-chamber and with a great saving in fuel, labor, and waste of metal.

I am aware that the individual instrumentalities embodied in my improved furnace have been used before my invention, and I do not claim such broadly; but such use was in combinations substantially different from those devised by me.

I have described what I consider the most desirable means for maintaining a zone of maximum heat contiguous to the wall of the furnace at the delivery end of the heating-chamber, comprising opposing side openings for transverse currents of gaseous fuel and inclined roof-surfaces; but I do not wish to confine myself to the specific means described, as the same may be modified and still come within the scope of my claims.

I am aware that it is not new to construct a furnace with openings at the opposite ends of the heating-chamber for the admission and delivery of ingots or billets and with an in-

clined track leading from the delivery-opening of the heating-chamber to a conveyer and inclosed within a separate chamber from the heating-chamber. Such a furnace is shown in the German patent to Daelen, No. 74,484, dated April 11, 1894, and I do not claim such; but

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

1. The combination, in a furnace for heating ingots or billets, of a heating-chamber, conduits for gaseous fuel opening into said heating-chamber and at opposite sides thereof, whereby two opposing currents of gaseous fuel are directed transversely into said heating-chamber, and means for imparting a downward direction to each of said currents as it approaches the center of the heating-chamber, substantially as described.

2. The combination, in a furnace for heating ingots or billets, of a heating-chamber, conduits for gaseous fuel opening into said heating-chamber at one end and at opposite sides thereof, whereby two opposing currents of gaseous fuel are directed transversely into said heating-chamber, means for imparting a downward direction to said currents as they approach the center of the heating-chamber, and an escape-flue at the opposite end of the heating-chamber, whereby said transverse currents are diverted into a longitudinal current, substantially as described.

3. In a furnace for heating ingots or billets, the combination with a heating-chamber having openings at opposite ends for the admission and delivery of heated ingots or billets and an opening for the admission of gaseous fuel to said chamber, between its ends, whereby a zone of maximum heat is maintained, of an inclined track extending from said delivery-opening to a point between the charging end of the furnace and a vertical plane passing transversely through said chamber and said fuel-opening, by which a heated ingot or billet is moved by gravity from the zone of maximum heat through said delivery-opening, substantially as described.

4. In a furnace for heating ingots or billets, the combination with a heating-chamber having openings at opposite ends for the admission and delivery of heated ingots or billets, and an opening for the admission of gaseous fuel to said chamber, between its ends, of an inclined track extending from said delivery-opening to a point between the charging end of the furnace and a vertical plane passing transversely through said chamber and said fuel-opening, and a pushing mechanism by which the ingots or billets are pushed upon said inclined track, substantially as described.

5. In a furnace for heating ingots or billets, the combination with a heating-chamber having an opening at one end for the admission of ingots or billets, an opening for the delivery of heated ingots or billets, and an opening for the admission of gaseous fuel to said chamber between the charging end of the furnace and said delivery-opening, of an inclined track extending from said delivery-opening to a vertical plane passing transversely through said chamber and through said fuel-opening, whereby the ingots or billets as they become heated, are carried by gravity through said delivery-opening, substantially as described.

6. In a furnace for heating ingots, or billets, the combination with a heating-chamber provided with an opening at one end for the admission of ingots, an opening at its opposite end for the delivery of heated ingots and an opening near the delivery end of the chamber for the delivery of gaseous fuel, of a track extending longitudinally through said chamber, and having an inclined section inclosed within said chamber and extending from said delivery-opening to a vertical plane passing transversely through said chamber and said fuel-opening, whereby an ingot in passing over said track is acted upon by gravity at a point opposite said fuel-opening and moved out of the heating-chamber, substantially as described.

7. In a furnace for heating ingots, or billets, the combination with a heating-chamber having an opening at one end for the admission of ingots, an opening at its opposite end for the delivery of heated ingots and an opening near the delivery end of the chamber for the admission of gaseous fuel, of a track extending longitudinally through said chamber, said track having an inclined section on which the ingots are moved by gravity, extending from said delivery-opening to a vertical plane passing transversely through said chamber and said fuel-opening, thereby bringing the inner end of said inclined section opposite the fuel-opening, and a pushing mechanism by which the ingots are pushed along the track and upon said inclined section, substantially as described.

8. In a furnace for heating ingots, or billets, the combination of a heating-chamber, having an opening at one end for the admission of ingots, an opening, near its opposite end for the delivery of heated ingots, an opening between said delivery-opening and the charging end of the chamber for the admission of gaseous fuel, a track extending from the charging end of the chamber to a vertical plane passing transversely through said chamber and said fuel-opening, and an inclined track whereon the ingots are moved by gravity, said inclined track extending from the end of said ingot-supporting track to said delivery-opening, substantially as described.

9. In a furnace for heating ingots, or billets, the combination of the following instrumentalities, namely, a heating-chamber, means for admitting ingots near one end of the chamber, a delivery-opening near the opposite end of the chamber for the delivery of heated ingots, an escape-flue near the charging end of the chamber for the products of combustion, a fuel-opening near the delivery end of the chamber, whereby a zone of maximum heat

is maintained in said chamber in a transverse plane near said fuel-opening, a track extending from the charging end of the chamber to a vertical plane transverse to said chamber and passing through said fuel-opening, an inclined track inclosed within the heating-chamber, whereon the ingots are moved by gravity, said inclined track extending from the said ingot-supporting track, to said delivery-opening and in alinement with said delivery-opening and a pushing mechanism by which the ingots are moved along said ingot-supporting track and upon said inclined section, whereby each ingot as it passes the zone of maximum heat is carried by gravity out of said heating-chamber, substantially as described.

10. In a furnace for heating ingots, or billets, the combination with a heating-chamber of the following instrumentalities, namely, an opening near one end of the chamber for the admission of ingots, an opening near the opposite end of the chamber for the delivery of ingots, a flue for the escape of the product of combustion, near the charging end of the chamber, an opening for the admission of gaseous fuel near the delivery end of the chamber, a track for the ingots extending through the chamber and in alinement with the delivery-opening, means for pushing the ingots along said track, said track having an inclined section, whereon the ingots are moved by gravity, inclosed within the heating-chamber and extending from said delivery-opening to a point opposite said fuel-opening and a conveyer outside the heating-chamber, arranged to receive the ingots from said inclined section, substantially as described.

Dated this 27th day of July, 1896.

CHAS. H. MORGAN.

Witnesses:

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LENA KESTER.