

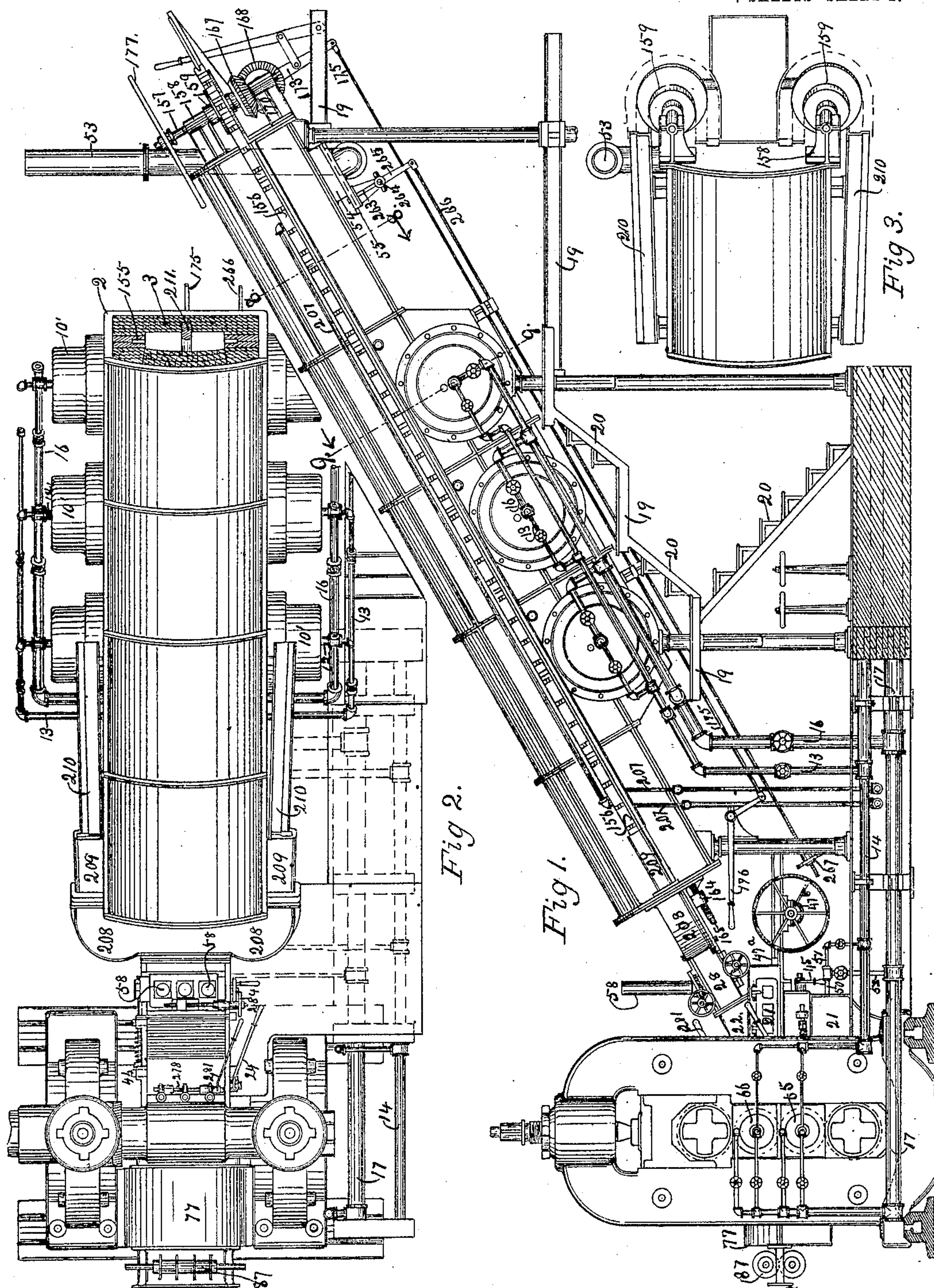
No. 803,076.

PATENTED OCT. 31, 1905.

D. M. SOMERS.
FURNACE.

APPLICATION FILED OCT. 19, 1904.

7 SHEETS—SHEET 1.



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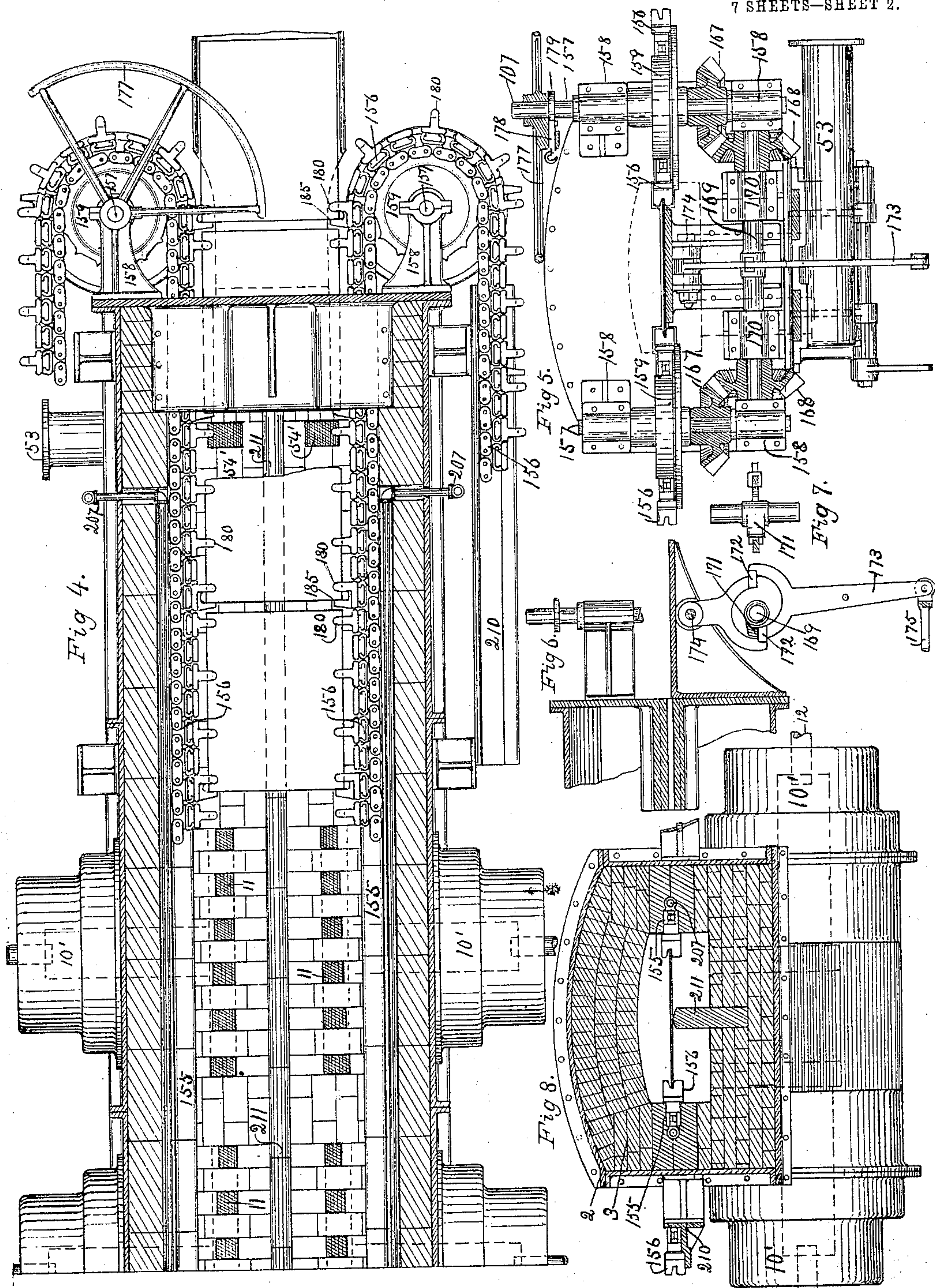
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7 SHEETS—SHEET 2.



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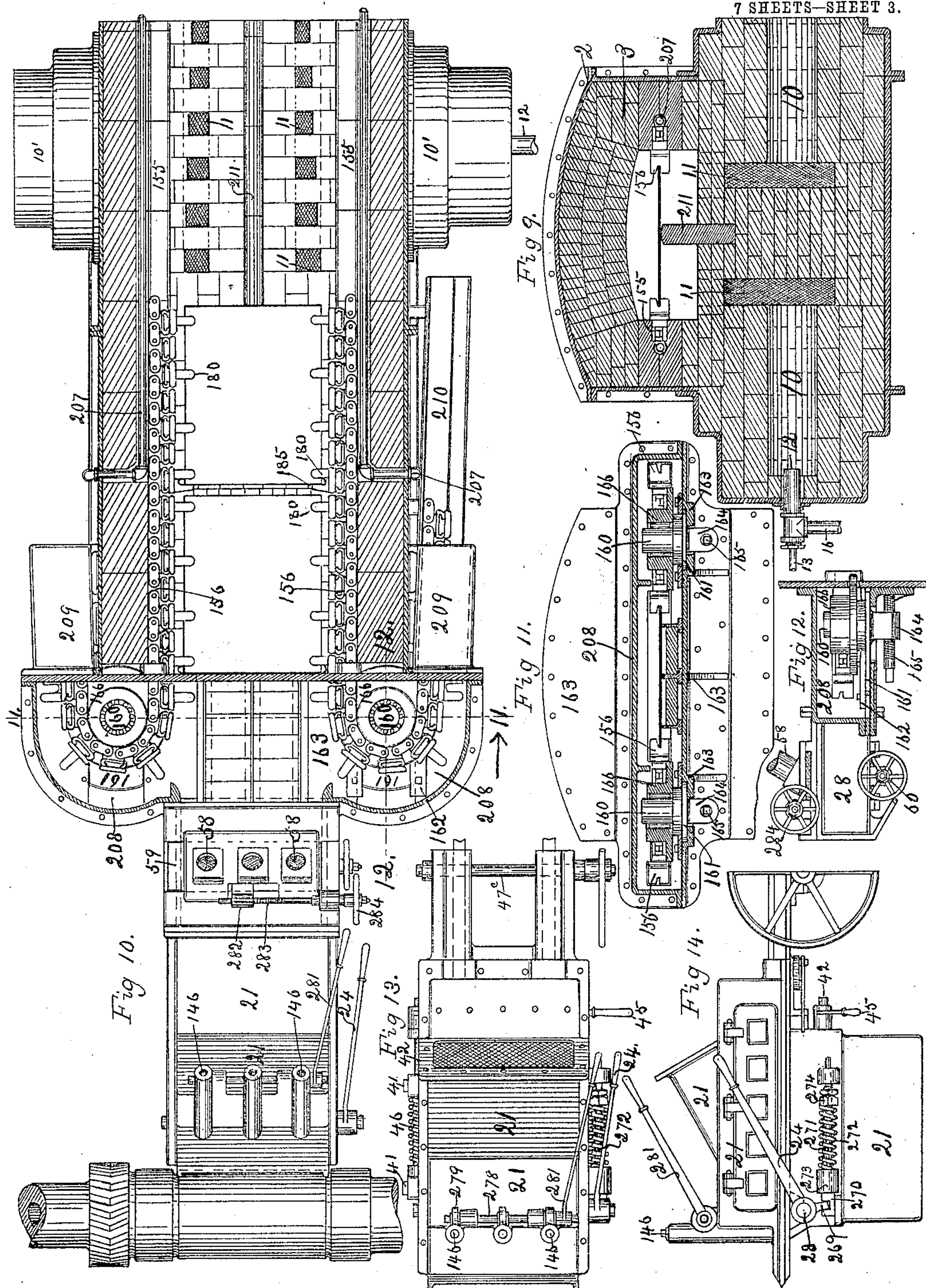
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7 SHEETS—SHEET 3.



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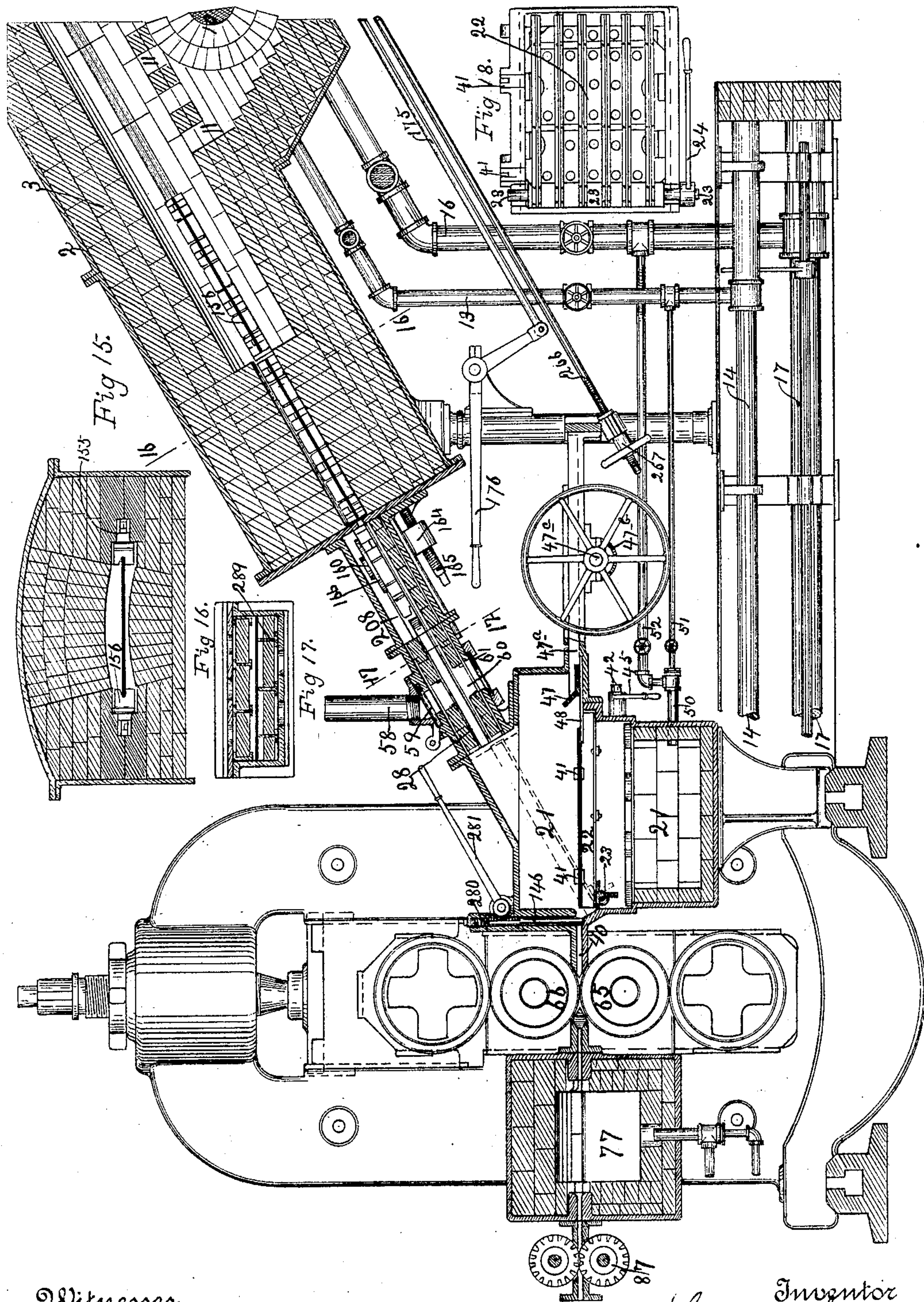
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7 SHEETS—SHEET 4.



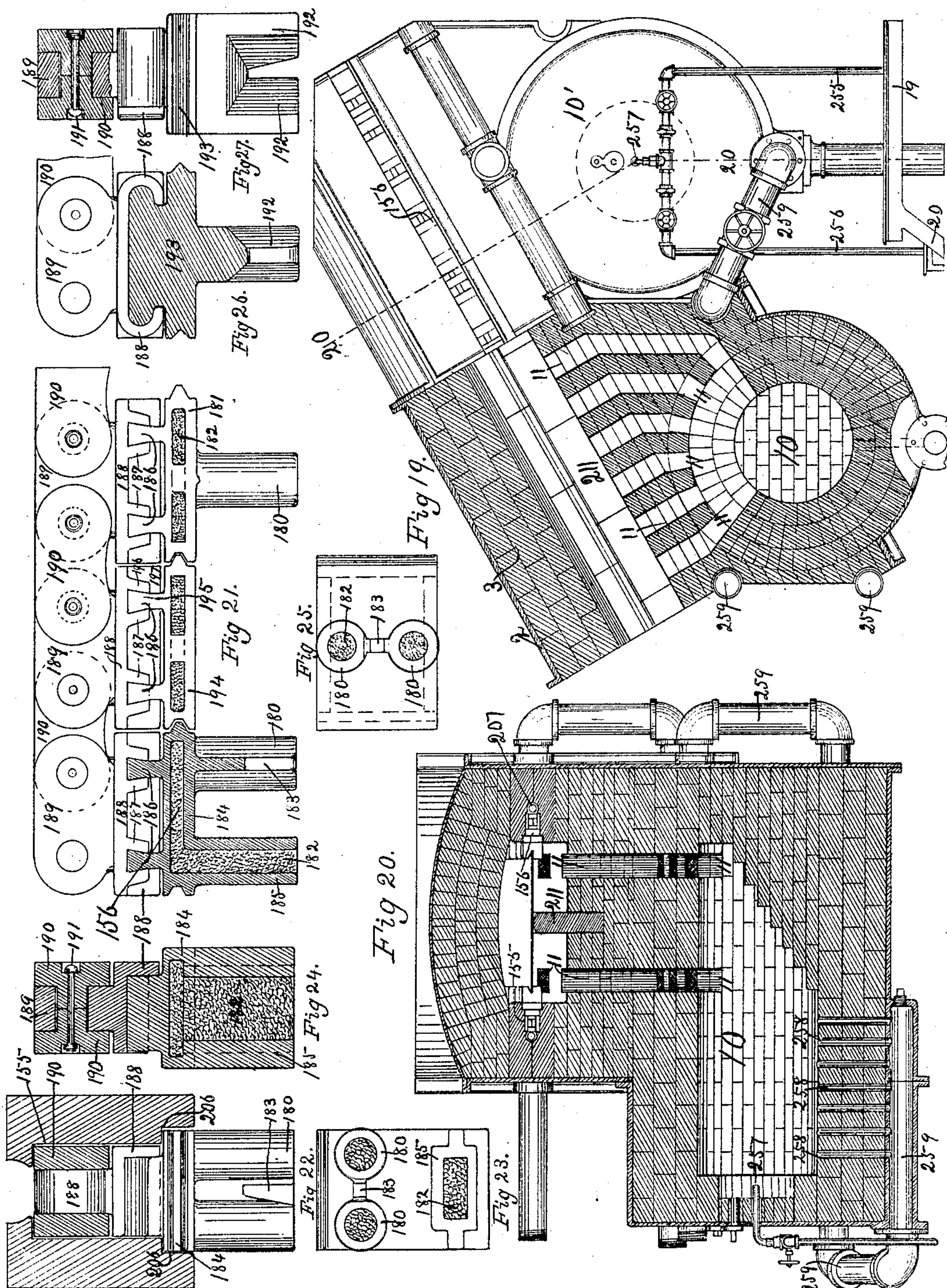
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FURNACE.

APPLICATION FILED OCT. 19, 1904.

7 SHEETS—SHEET 5.



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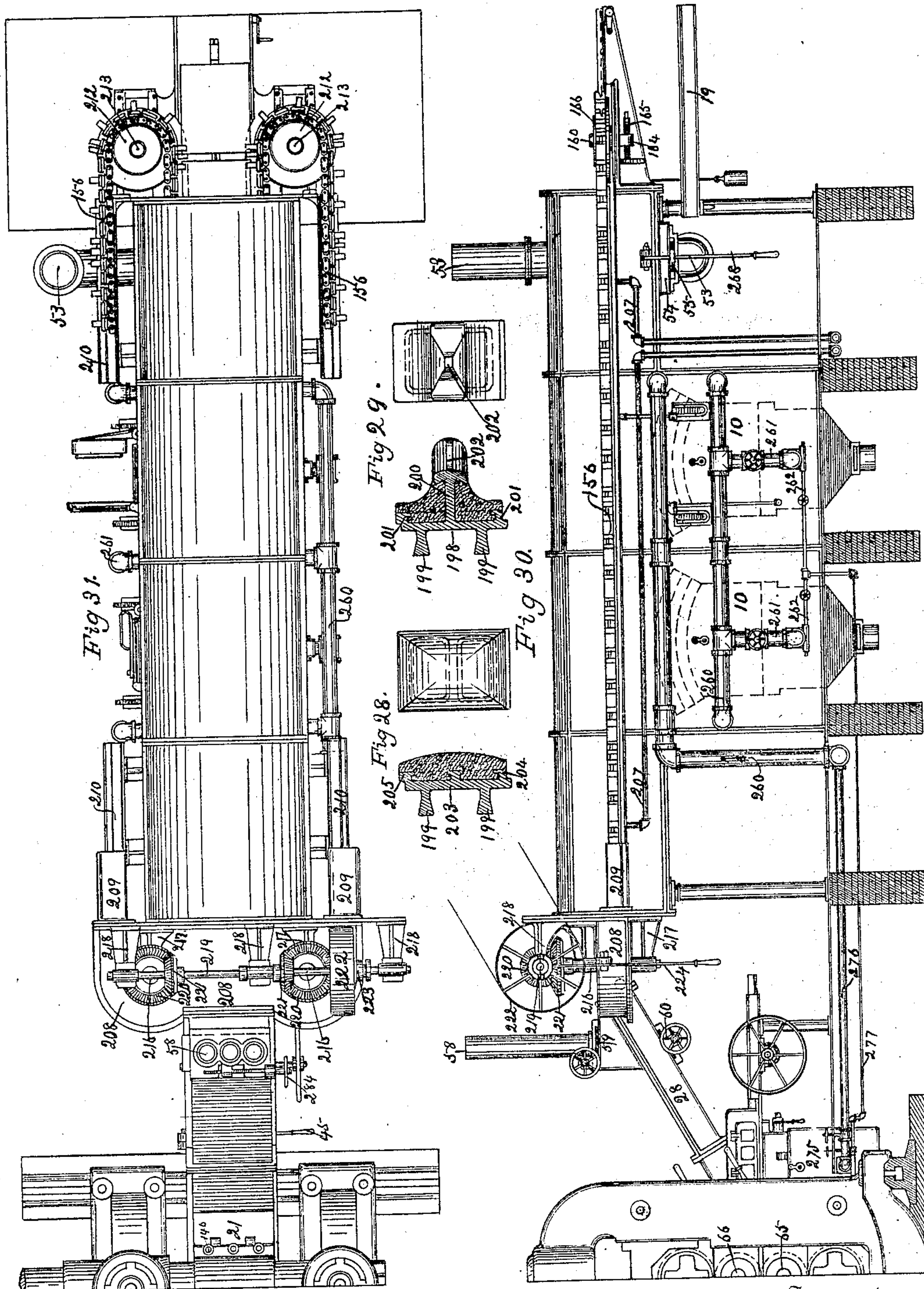
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D. M. SOMERS.
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7 SHEETS—SHEET 6.



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APPLICATION FILED OCT. 19, 1904.

7 SHEETS—SHEET 7.

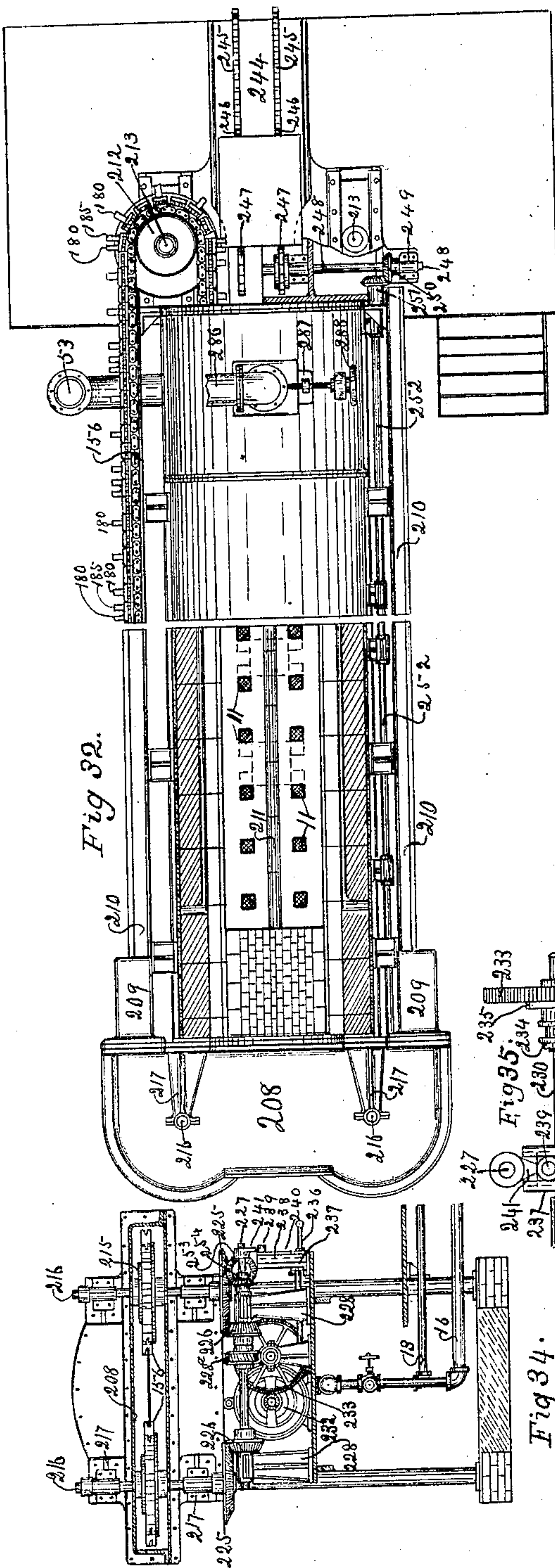


Fig 32.

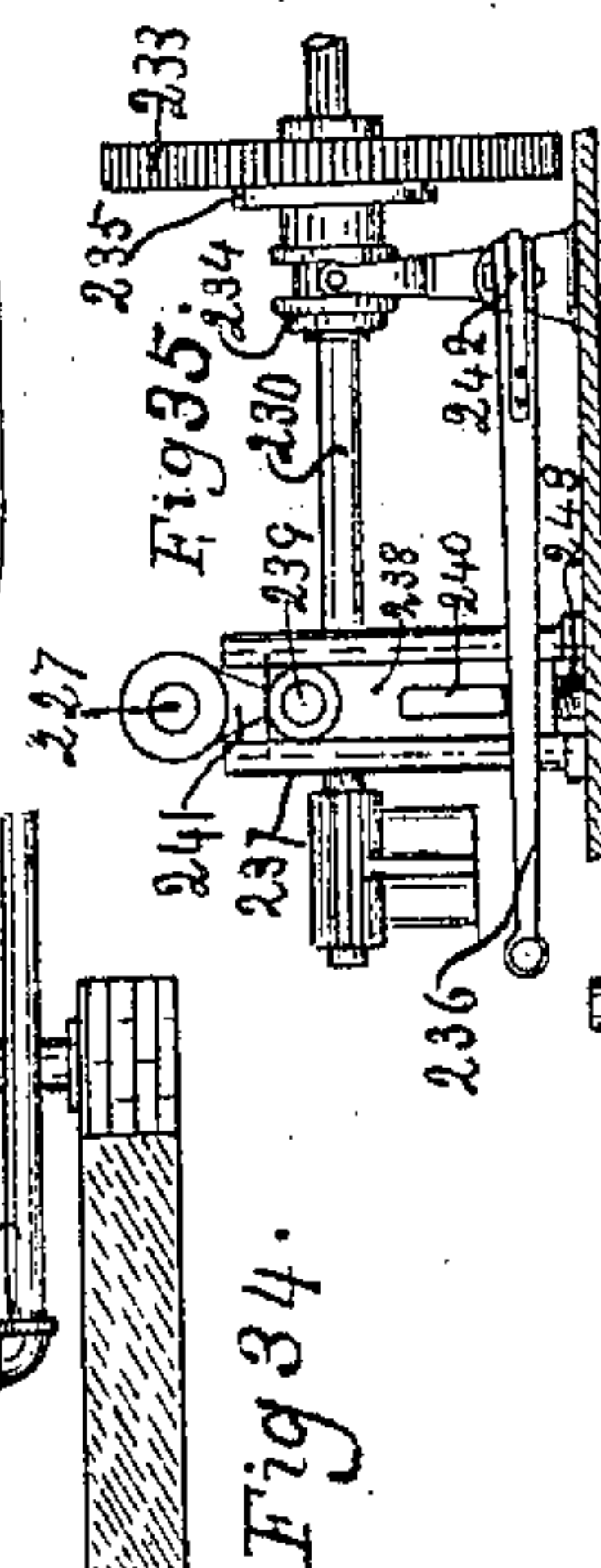


Fig 34.

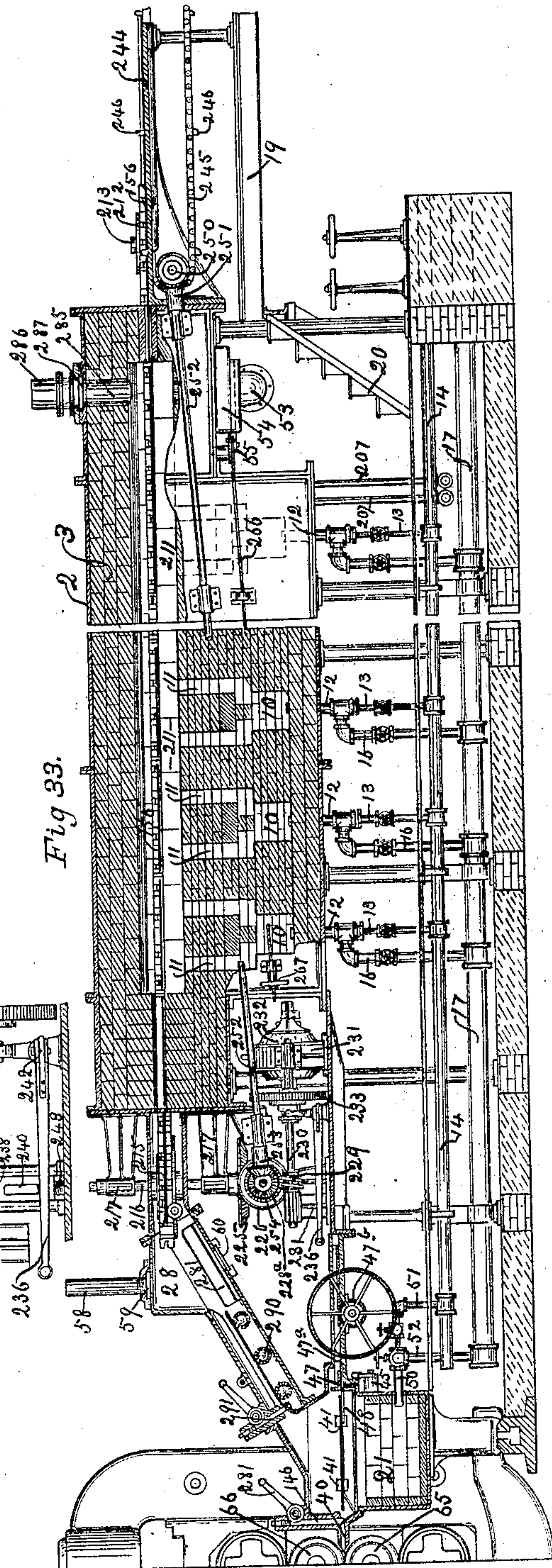


Fig 33.

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UNITED STATES PATENT OFFICE.

DANIEL M. SOMERS, OF NEW YORK, N. Y.

FURNACE.

No. 803,076.

Specification of Letters Patent.

Patented Oct. 31, 1905.

Application filed October 19, 1904. Serial No. 229,046.

To all whom it may concern:

Be it known that I, DANIEL M. SOMERS, a citizen of the United States, residing at New York, county of Kings, and State of New York, have
5 invented certain new and useful Improvements in Furnaces, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to certain improvements in furnaces for heating sheet metal.

One of the objects of the invention is to produce an improved heating-furnace for heating sheet-metal plates or packs of plates in which the plates or packs are subjected to the heating action of the furnace while in transit there-
15 through.

A further object of the invention is to produce a furnace for heating sheet-metal plates or packs of plates, said furnace having improved devices for causing the travel of the
20 plates or packs therethrough.

A further object of the invention is to produce an improved furnace for heating sheet metal in plates or packs, the heating-chamber
25 of the furnace being so constructed that the pressure of the products therein may be maintained at a pressure which is greater than atmospheric pressure.

A further object of the invention is to produce an improved furnace in which the reactions caused by combustion take place in the combustion-chamber under a pressure which is equal to or greater than atmospheric pressure, the products being conveyed to the heating-chamber of the furnace under a pressure
35 which is equal to or greater than atmospheric pressure and the pressure of the products in the heating-chamber being maintained during the heating operation at a pressure which is
40 equal to or greater than atmospheric pressure.

A further object of the invention is to produce an improved furnace for heating sheet metal from which a substantially continuous output of heated metal may be obtained.

45 A further object of the invention is to improve the details of construction of furnaces which are used for heating sheet metal.

With these and other objects not specifically referred to in view the invention consists in
50 certain constructions and in certain parts, improvements, and combinations, as will be hereinafter fully described and specifically pointed out.

Referring to the drawings, Figure 1 illustrates in side elevation a form of heating-furnace for sheet metal embodying the invention,

the furnace being shown in connection with a four-high hot roll. Fig. 2 is a plan view of the left-hand end of the construction shown in Fig. 1. Fig. 3 is a plan view of certain of
60 the devices at the right-hand end of Fig. 1. Fig. 4 is a sectional plan view of certain parts of the construction shown at the right-hand end of the furnace illustrated in Fig. 1. Fig. 5 is an end view, partly in section, of the construction shown in Fig. 1. Figs. 6 and 7 are
65 detail views of a construction forming a part of the feeding mechanism. Fig. 8 is a section on the line 8 8 of Fig. 1. Fig. 9 is a section on the line 9 9 of Fig. 1. Fig. 10 is a plan
70 view, partly in section, of the delivery end of the furnace. Fig. 11 is a sectional elevation on the line 11 11 of Fig. 10. Fig. 12 is a sectional detail on the line 12 12 of Fig. 10. Fig. 13 is a plan view of the intermediate devices
75 by which the sheet metal is conducted from the furnace to the rolls. Fig. 14 is a side elevation of the construction shown in Fig. 13. Fig. 15 is a sectional elevation of the delivery end of the furnace, showing the devices
80 by which the metal is carried from the furnace to the rolling-mill and the furnace for receiving the metal from the mill, certain parts of these devices being shown in elevation. Fig. 16 is a section on the line 16 16 of Fig. 15.
85 Fig. 17 is a section on the line 17 17 of Fig. 15. Fig. 18 is an interior plan view of the receiver intermediate the furnace and the mill. Fig. 19 is an elevation, partly in section, of a part of a furnace constructed in accordance
90 with the invention, this furnace being arranged to use hydrocarbon oil as fuel. Fig. 20 is a section on the line 20 20 of Fig. 19. Figs. 21 to 29 are detail views illustrating the construction of the conveyer employed and
95 modifications thereof. Fig. 30 is a side elevation of a furnace constructed in accordance with the invention, this furnace being arranged to use coal as fuel. Fig. 31 is a plan view of the construction shown in Fig. 30.
100 Fig. 32 is a plan view, partly in section, of a form of furnace constructed in accordance with the invention, the furnace being horizontally arranged. Fig. 33 is a sectional elevation of the form of furnace construction
105 illustrated in Fig. 32. Fig. 34 is an end view of the power mechanism for operating the feed used in connection with the furnace illustrated in Fig. 33. Fig. 35 is a detail view of a starting mechanism employed.
110

The furnaces illustrated in the drawings are more particularly adapted for heating packs

of metal sheets, which packs of sheets are to be subsequently treated to convert them into long thin plates used for various purposes—such, for instance, as bases for the manufacture of commercial tin-plate. These furnaces or others embodying some or all of the features of the invention may, however, be employed for other purposes, if desired.

Referring to the drawings, 1 indicates a furnace, which may be constructed in various ways. As shown the furnace comprises the usual metal casing 2, lined with a refractory substance 3—such, for instance, as fire-brick. In the form of furnace illustrated in Figs. 1 to 19 the furnace is inclined to the horizontal, so that the force of gravity may be utilized in causing the packs or plates to travel therethrough. The furnace may be supported in any usual manner—as, for instance, by pillars. The usual platforms 19 are provided, which afford access to the furnace and the valves, these platforms being reached by suitable steps, as 20.

The furnace will be provided with means for insuring the positive travel of the plates or packs therethrough, which means may vary widely in construction and will vary according to the type of furnace employed. In the construction shown in Figs. 1 to 19 gravity is alone depended upon for insuring the travel of the plates or packs therethrough, suitable means being provided, however, for controlling the travel. In the best constructions the means which insure the travel of the plates or packs through the furnace will operate in connection with the edges of the successive packs or sheets. While the specific construction of these edge controlling devices may vary widely, as shown, the side walls of the furnace are provided with ways 155, these ways being in the particular construction shown formed by grooving the fire-brick walls of the heating-chamber of the furnace. In the particular constructions illustrated a positive forwarding means is provided, which consists of a flexible carrier, this flexible carrier in its best form embodying a pair of endless chains 156, one run of each of said chains passing through the interior of the heating-chamber of the furnace and being guided in the ways 155, the other run returning on the outside of the furnace, so that the chains are cooled after delivering the plates by passing through the air. These chains, which in the particular construction shown constitute the conveyer, may be supported and operated in any desired manner. In the construction shown there are provided at the upper end of the furnace two vertical shafts 157, these shafts being supported in brackets 158 or in any other suitable manner. These shafts 158 are provided with sprocket-wheels 159, around which the chains pass.

The lower end of the furnace is provided with a pair of short shafts or studs 160, sup-

ported on slides 161, (see Figs. 10 to 14,) which move in ways 162, supported on a plate 163, forming a part of the furnace-casing. Means are preferably provided for adjusting these studs, which means may be of any suitable character. As shown the slides 161 have depending therefrom lugs 164, which are threaded, and through these lugs pass adjusting-screws 165. These short shafts or studs 160 are provided with sprocket-wheels 166, around which the chains 156 run.

Suitable connecting devices may be employed by which the movement of the two chains is rendered uniform. These connecting devices may be of any suitable character; but in the best constructions gearing will be provided for this purpose. As shown in Figs. 1 to 19, the shafts 157 (see Fig. 5) are provided with beveled gears 167, these beveled gears meshing with similar gears 168 on a shaft 169, mounted in bearings 170 on the upper end of the furnace.

In the best constructions suitable means will be provided for controlling the movement of the conveyer. These means will vary according to the type of furnace employed and more particularly according to whether the conveyer is gravity-operated or power-driven. In the construction shown in Figs. 1 to 19 the conveyer is gravity-operated. A convenient means for controlling the movement of the conveyer when it is gravity-operated is an escapement mechanism—such, for instance, as illustrated in Figs. 6 and 7. In these figures the shaft 169 is provided with a lug 171, which is positioned to engage a pair of stops 172 on a swinging escapement-lever 173, said lever being pivoted to any suitable point—as, for instance, at 174—on a part of the furnace-frame. This lever may be operated in any suitable manner—as, for instance, by a link 175, which is connected to a lever 176, located at the lower end of the furnace. By swinging the lever 173 in one direction it will become disengaged from the lug 171 and the conveyer will advance because of the weight carried thereby, this weight being sufficient to overcome the inertia of the conveyer. During the movement of the conveyer the shaft 169 makes a half-turn, the movement thus permitted being sufficient to admit a plate or a pack of plates into the furnace and at the same time to effect the discharge of the plate or pack of plates.

Any suitable means may be provided for starting the conveyer so as to load it. In the construction shown a hand-wheel 177 is provided for this purpose, this hand-wheel being mounted on one of the shafts 157. This hand-wheel 177 is or may be loosely connected to the shaft and is secured thereto in the construction shown (see Fig. 5) by a sliding bolt 178, which engages a notched collar 179, mounted on the shaft 157.

The particular construction of the flexible

vide a pocket or recess into which the head of the base 193 slips. It will of course be understood that these work-supports are spaced some distance from each other, and in order to prevent the heat from coming at the 70

working parts of the chain or conveyer as the same travels through the heating-chamber of the furnace shields are or may be provided intermediate the work-supports. These shields may vary in construction. As shown 75

in Fig. 21, the shields consist of hollow blocks 194, these blocks being provided with a filling of refractory material. These shields are also made so as to be readily removable from the conveyer, the devices by which they are con-

nected thereto being of any preferable construction. The means shown for connecting them are the same as those already described for connecting the work-supports—that is to say, the block 194 will be provided with dove- 85

tailed projections 195, which take into dovetailed recesses 196 on blocks 197, secured to the inner links in the chain in the same manner as the blocks 188 are secured. Fig. 29 illustrates another modification of these work- 90 supports. As shown in this figure, a metallic

supports. As shown in this figure, a metallic plate 198 is provided, having dovetailed projections 199, which take into dovetailed recesses, above described, on the blocks of the chain. These plates 198 are provided with a central projection or rib 200 and with shorter

side projections or ribs 201, a coating of fire-resisting composition being applied to the faces of the plates and being secured thereto by the ribs referred to. The inner central rib, as shown, is formed to provide a notch

Fig. 28 illustrates a modified form of shield. In the construction shown in this figure a base-plate 203 is provided; this plate having

dovetailed projections 204, which engage dovetailed recesses in the blocks on the chain similar to the construction heretofore described. These plates are provided with ribs or projections 205, which serve to retain

thereon a coating of fireproof composition, which is or may be applied thereto in a plastic state and pressed on,

It is to be understood that the links of the conveyer run in the ways 155, before referred

to. An excellent construction of these ways is well illustrated in Fig. 22. In the particular construction shown in this figure the ways are provided near their outer ends with offsets 206, along which the plates 181, 184,

and 194 travel, these plates being slightly higher vertically than the parts with which they are connected by the dovetailed connections heretofore described. The plates and shields therefore close or substantially close the recesses in which the working parts of

the recesses in which the working parts of the conveyer run, so that these parts are not directly affected by the heat in the heating-chamber of the furnace.

The fact that the conveyer runs on the outside of the furnace on its return after delivering the plate or pack of plates enables it to become cooled, and in some cases this cooling
5 may be sufficient. Additional cooling means may, however, be provided in some cases, if found necessary or desirable. This additional cooling may be advantageously effected by means of pipes 207, located in the rear of the
10 ways, water or cold air being forced through these pipes.

In order to prevent the entrance of air into the furnace at the point where the conveyer leaves it, the conveyer and its supporting devices are preferably inclosed in a hood 208,
15 (see Fig. 2,) this hood being secured to the plate 163. The chains pass through openings in the plate 166, and short boxes 209 are provided on the back side of this plate, registering with these openings, these boxes preventing the entrance of air into the hood. From these boxes extend wings or guides 210, which serve to direct the chains on their return movement.

25 The conveyer so far described operates, as has been stated, to support the plates or packs at their edges. In the best constructions means will be provided for supporting the plates or packs between their edges. While
30 these supporting devices may be of any suitable construction, as shown a guide 211 is provided for this purpose, this guide being of any suitable fire-resisting substance and being located on the floor of the heating-chamber and being high enough so as to prevent the plates from sagging at the center.

As has been indicated, the furnace in its best form is long enough to inclose a plurality of plates or packs, which plates or packs
40 are heated as they pass through the furnace. In the construction which has just been described the successive plates are introduced into the furnace and are carried forward by a step-by-step movement, the weight of the
45 plates being sufficient to actuate the conveyer-chains whenever the controlling-lever 173 is operated. Where a gravity-feed of this description is employed, the furnace is of course necessarily inclined to the horizontal, as illustrated in Fig. 1. In Figs. 30 to 34 there is
50 illustrated a construction of furnace in which the furnace is horizontal. As illustrated in these figures, the construction of the conveyer and work supports is the same as that
55 before described; but the conveyer is power-operated instead of being gravity-operated. In the particular construction shown in these figures the chains 156 at their upper ends pass around sprocket-wheels 212, mounted on
60 short studs or shafts 213, these shafts being adjustable to take up slack in the chain by means of screws 214. The particular construction by which these stud-shafts are mounted may be the same as that described in
65 connection with the mounting of the short

shafts or studs 160. At the discharge end of the furnace the chains pass around sprocket-wheels 215, mounted on vertical shafts 216, said shafts being supported on brackets 217,
70 which extend from the end plate of the furnace. In the construction shown in Fig. 31 a pair of brackets 218 are attached to the end plate of the furnace, this pair of brackets serving to support a cross-shaft 219, which carries a pair of beveled gears 220, these beveled gears meshing with similar beveled gears
75 221, mounted on the shafts 216, before referred to. This shaft 219 is provided with a belt-pulley 222, which is loosely mounted on the shaft and which is driven from any
80 suitable source of power. A clutch device 223 of ordinary construction, by which the belt is clutched to a clutch on the shaft, is preferably provided, the clutch-lever being indicated at 224 in Fig. 30.
85

In the construction shown in Figs. 32 to 34 the vertical shafts 216 are provided at their lower ends with beveled gears 225, these gears meshing with beveled gears 226, mounted
90 on a cross-shaft 227, which is supported in standards 228, rising from a part of the furnace-frame. This shaft 227 is provided with a worm-gear 228^a, which meshes with a worm 229 on a shaft 230, this shaft being supported in bearings in standards 231, rising from a
95 portion of the furnace-frame. A suitable electric motor is shown at 232, this motor being provided with the usual driving-pinion, which meshes with a gear 233, loosely mounted on the shaft 230. This shaft is provided with
100 a clutch-collar 234, having a friction-plate 235, which bears against a friction-plate on the side of the gear 233. This clutch-collar 234 is feathered on the shaft, as is usual, and is controlled by a clutch-lever 236, suitably pivoted on the frame. A standard 237 (see Fig. 35) is provided, this standard having a sliding plate 238 therein, which carries a cam-roll 239 and a latch 240. The cam-roll is arranged to be operated by a cam 241 on the shaft 227.
110 The handle end of the cam-lever 236 is connected to the operating part by means of a jointed connection controlled by a spring 242, which permits the lever to have a slight movement outward to clear it from the latch. When it is moved outward against the tension of the spring 242, it is raised and thrown by the friction-plate 235 against the gear. Beneath the sliding plate 238 is a spring 243 which as soon as the shaft 237 begins to revolve forces the slide 238 upward. In its uppermost position this plate is in position so that the latch 240 takes over the middle part of the lever 236, the middle part of the lever being thrown under the latch by means of
125 the spring 242. As the shaft 227 completes its revolution it forces the slide-plate 238 downward, which carries down the lever 236 and disconnects the clutch, thus stopping the movement of the shaft 227 and the parts con-
130

nected therewith. The parts are so proportioned that one revolution of the shaft 227 advances the conveyer an amount equal to the length of a plate or pack of plates. Each movement of this shaft therefore effects the discharge of a plate or pack of plates from the furnace and permits a fresh pack or plate to be fed thereinto.

The plates may be fed into the furnace in any desired manner—that is, either automatically or by hand. When fed automatically, the mechanism by which they are fed may be of any suitable description. As shown in Figs. 32 to 34, there is provided a feeding-table 244, having slots therein through which work forwarding-chains 245, these chains having pusher-fingers 246 secured thereon, these pusher-fingers being a distance apart equal to the length of a plate or pack of plates. These chains pass around sprocket-wheels 247, mounted on a cross-shaft 248, supported in suitable bearings 249 on the frame of the machine. This shaft 248 is provided with a beveled gear 250, which meshes with a beveled gear 251, mounted on a way-shaft 252, which extends along the sides of the furnace. This way-shaft is provided on its other end with a beveled gear 253, which meshes with a beveled gear 254, mounted on the shaft 227, before referred to. The infeeding and outfeeding mechanisms of the furnace are further controlled from this shaft 227. The forward movement of the feed-chains 245 is sufficient to bring the plate or pack of plates into the range of the positioning devices, before described, on the conveyer-chains 156, the forward edge of the plate or pack of plates being brought up against one side of these positioning devices at the beginning of the movement of the chains 245 and the rear edge of the plate or pack of plates coming in front of the next set of positioning devices on the conveyer-chains 156. The construction described will give the feed-chains a step-by-step movement, a plate or pack of plates passing into the range of action of the positioning devices on the conveyer-chains 156 on each rotation of the shaft 227. The packs may be placed on the table 244 in any desired manner—as, for instance, by hand.

The combustion in the furnace may be produced by employing any suitable fuel, constructions being illustrated in which water-gas, oil, and coal are employed as fuels. Whatever be the fuel employed, however, the best furnaces constructed in accordance with the invention will be provided with a plurality of combustion-chambers, so as to maintain an even heat throughout the length of the furnace.

Referring more particularly to the construction shown in Figs. 32 and 33, the furnace is provided with a plurality of combustion-chambers 10, which communicate by means of choked openings or flues 11 with the heating-

chamber of the furnace, these flues being arranged at the corners of each combustion-chamber. The two ends of the furnace are shown in Figs. 32 and 33 with the middle portion cut away, and in a furnace constructed in accordance with these drawings six combustion-chambers would be employed. The fuel, which in the construction referred to is intended to be water-gas, ($\text{CO} + \text{H}_2$), is introduced through burner-pipes 12 into the combustion-chamber, these pipes communicating through branch pipes 13 with the gas-main 14. Air-pipes 16 are employed to supply air for the combustion, these pipes connecting with an air-main 17. The air and gas will preferably be supplied to the combustion-chambers under a pressure, so that the combustion in the chambers 10 takes place under pressure. The products pass from the combustion-chamber 10 into the main heating-chamber of the furnace through the choked openings or flues 11, which act to maintain the pressure in the combustion-chamber, so that the products are delivered into the heating-chamber of the furnace under pressure. The pressure in the heating-chamber of the furnace is, however, somewhat less than the pressure in the combustion-chambers. This pressure is, however, equal to and preferably in excess of atmospheric pressure in order to prevent any air from entering the furnace through the conveyer or other similar openings.

The furnace illustrated in Figs. 1 to 18 is also adapted for burning water-gas, and the arrangement of pipes for supplying air and gas is substantially the same as that just described. The combustion-chambers 10 are, however, slightly different in form and are contained in part in bosses 10', extending from the sides of the furnace.

The furnace illustrated in Figs. 19 and 20 is constructed to use oil as a fuel. A plurality of combustion-chambers 10 is employed, as before, these combustion-chambers communicating, as before, with the heating-chamber of the furnace through contracted openings or flues 11. Oil and steam are introduced through pipes 255 256 in the combustion-chamber under high pressure, the mixed oil and steam being sprayed into the chamber through the pipe 257. The air for supporting combustion is introduced through a series of pipes 258, which connect with air-mains 259, running through the walls of the furnace. The air is supplied to these mains 259 through any suitable blast-producing means—as, for instance, a fan. (Not shown.)

The furnace shown in Figs. 30 and 31 is adapted to the burning of coal as a fuel. The combustion-chambers 10 are indicated in dotted lines. Hot air is introduced into the ash-pits beneath the grates from a hot-air main 260, which runs through the dead walls of the furnace, this main having branches 261, which lead to the ash-pits. Connecting to these

branches are steam-pipes 262, by which steam is introduced from a steam-blower, the steam and air maintaining a pressure in the combustion-chamber, as in the furnace hereinbefore described.

Whatever be the type of furnace employed and whatever the fuel employed, it is to be understood that the combustion takes place in the combustion-chamber under pressure and that the products are delivered into the heating-chamber of the furnace through the contracted flues or openings leading from the combustion-chambers thereinto under pressure, which is equal to or in excess of atmospheric pressure, so that air cannot enter the furnace through various openings and come in contact with the metal being heated. The furnace is especially adapted for the heating prior to rolling of pickled metal plates, and by excluding the air from the heating-chamber of the furnace while the plates are being heated the pickled plates are kept from oxidation.

The hot gases after having acted upon the plates or packs of plates which are advanced through the furnace are allowed to escape through the furnace from a suitable flue or flues. In the construction illustrated a single flue 53 is employed for this purpose. In the preferred construction this flue taps a box 54, located underneath the upper end of the furnace, the openings with which this communicates with the heating-chamber of the furnace being marked 54'. Suitable means are employed for controlling the escape of the gases through the flue, the means illustrated consisting of a damper or slide-valve 55. This slide-valve is controlled by means of an arm 263, mounted on a rock-shaft 264. This rock-shaft is provided with an arm 265, from which extends a rod 266. This rod 266 extends the length of the furnace and is adjusted near the delivery end of the furnace by means of a hand-wheel 267. In the construction shown this damper is controlled by a handle 268, located near the upper end of the furnace. As shown in Figs. 32 and 33, a swinging damper is employed which is controlled by the hand-wheel 267, which is connected directly thereto. It is to be understood that in the operation of the furnace the damper will also be so adjusted as to maintain a pressure in the heating-chamber of the furnace equal to or in excess of atmospheric pressure for the reasons before stated.

In the best constructions the furnace will terminate in a delivery-chamber 21, there being in the specific constructions illustrated an intermediate connection or throat 28, through which the sheets or packs of sheets pass, this throat being connected to the hood 208, which incloses the sprockets around which the conveyer-chains run. The sheets or packs pass through the delivery-chamber to the devices, such as rolls, which are to act further upon

them. This delivery-chamber in the best constructions will be provided with a receiver to which the sheets or packs are delivered and from which they are advanced out of the furnace. This receiver may be of any suitable construction; but in the form illustrated it consists of a table or platen 22, which is mounted on journals 23. This table or platen may consist of T-bars, the construction being illustrated in detail in Fig. 18. The table in the specific constructions of furnace illustrated normally occupies an inclined position in substantially the same plane with the floor of the throat 28, so that the sheets or packs of sheets can easily pass from the throat to the table. The table may be operated by hand, and for this purpose a hand-lever 24 is provided (see Figs. 14 and 18) by which it is operated. The receiver also will be automatically operated, the mechanism by which this automatic operation is effected being of any suitable character. As illustrated, (see Fig. 14,) there is provided an arm 269, which may be fixed to one of the journals 23, but which is shown (see Fig. 14) as being fixed to the hub of the hand-lever 24 before referred to. This arm 269 takes into a notch in a block 270, which is mounted on a rod 271, this rod being normally held forward by a spring 272, which surrounds the rod and abuts against a collar 273, mounted on the rod, an adjusting-nut 274 being provided, if desired. The tension of this spring 272 is not sufficient to hold the table in its inclined position against the force exerted by the weight of a sheet or pack of sheets on the table. When, therefore, a sheet or a pack of sheets passes onto the table from the throat 28, the table lowers from its inclined into a horizontal position. A suitable latch (not shown) may be provided, if necessary, to hold the table in its horizontal position while the plate is being delivered therefrom. As before indicated, the sheets or packs of sheets will pass from the furnace to suitable mechanism by which they are further treated or acted upon. The particular furnace shown is employed as a preliminary heating-furnace, especially intended for use in an apparatus for forming the sheets which serve as the basis for making commercial tin-plate, and the furnace will therefore deliver its product directly to a rolling mechanism. The furnace is accordingly illustrated in connection with a stand of four high rolls, the operating-rolls being marked 65 66. The furnace is arranged with respect to the rolls so that the product will be delivered thereto without any substantial loss of heat and without in the preferred construction permitting the sheets to come in contact with the air. To effect this in the best constructions, the delivery-chamber will be provided with a contracted outlet 40, through which the sheets pass out of the furnace. In the best constructions, furthermore,

devices will be provided for truing up the sheets or packs prior to passing out of the furnace. This truing mechanism may be widely varied in construction. As shown, it includes a pair of slides 41, (see Figs. 13, 15, and 18,) which pass through small orifices in one side of the delivery-table. The means for operating the slides may be of any suitable character; but in the construction shown there is provided a rock-shaft 42, which is journaled in suitable bearings secured on the side of the delivery-table. This shaft may be provided with any suitable means for enabling it to operate the slides—as, for instance, arms. (Not shown.) The shaft may be provided with an operating-handle, as 45, and, if desired, may be provided with a torsion-spring 46 for returning the shaft and the slide to their inoperative position after the sheets have been trued.

In the best constructions positive means will be provided for ejecting the sheets or packs of sheets from the furnace or delivery-chamber, which means may be of any desired character. As shown, (see Figs. 15 and 33,) there is provided a pusher 47, which strikes the rear edge of the pack of sheets, this pusher in the specific construction illustrated being further provided with fingers 48, which underlie the lower edges of the pack. These fingers as the pusher is advanced pass through the openings in the T-bars, which constitute the table or receiver 22 before referred to. The means for operating the pusher 47 may be of any suitable character. As shown, the pusher is provided with a pair of rack-bars 47^a, these rack-bars being in mesh with gears 47^b, mounted on a hand-wheel shaft 47^c.

In the best constructions the delivery-chamber 21 will be provided with heating means. The character of this heating means will vary according to the type of fuel to be employed in the furnace, the fuel in this delivery-chamber being preferably the same as that used for heating the heating-chamber of the furnace. In the construction shown in the furnace illustrated in Figs. 1 to 18 and Figs. 32 and 33 the heating means, as before stated, are adapted to the employment as fuel of water-gas and air. In these constructions, therefore, the chamber 21 will be provided with the usual Bunsen burners 50, connected by means of a branch 51 with the gas-main and by means of a branch 52 with the air-main. In the furnace shown in Figs. 30 and 31, in which coal is to be burned, there is provided a combustion-chamber of any usual type, this chamber being marked 275. Leading into this chamber is a branch pipe 276, which connects with the air-pipe 260 before referred to, and steam is led into the chamber through a branch pipe 277, which connects with the steam-pipe 261 before referred to.

It is important, especially when a pack of sheets is being operated upon, that the front

edge of the pack be trued up before it leaves the furnace to be further operated upon, and it is also important that the roller man be prevented from forwarding sheets or packs to the rolls except at the proper times. In the best constructions, therefore, there will be provided a stop against which the front edges of a pack of sheets may be caused to abut to true them up and which will prevent the discharge of the sheets except at the proper times. This stop, as shown, (see Figs. 10, 13, 14, and 15,) comprises three plungers 146, which are located at the entrance to the contracted delivery-orifice 40 before referred to. These plungers may be operated in any desired manner. As shown, there is provided a rock-shaft 278, this shaft being provided with gears 279, which mesh with racks formed on the plungers and when the shaft is rocked raise the plungers against springs 280. This rock-shaft may be operated in any suitable manner. As shown, a handle 281 is provided for this purpose. In the operation of the furnace the sheets or packs of sheets will be advanced by means of pusher 47 against these plungers 146, and after the pressure of the pusher has caused the front edge of the sheets to be trued up the plunger will be raised and the pusher further operated to eject the plate from the furnace.

It has been stated that the products of combustion after heating the sheets or packs of sheets in the main heating-chamber of the furnace are allowed to escape through a flue 53, this flue being controlled by a suitable damper mechanism, which will be so operated as to allow the products of combustion to escape slowly enough, so that there is always maintained in the furnace a pressure equal to or in excess of atmospheric pressure. While the flue 53 may be sufficient to control the outflow of the products from the furnace, there may be provided additional flues for this purpose. In the specific construction shown these means consist of flues 58, which are located near the delivery end of the furnace and may be conveniently located in the intermediate throat 28. Three of these flues 58 are shown, these flues being controlled by a sliding damper 59, which may be operated in any desired manner. As shown, (see Figs. 10 and 12,) the damper is provided with a screw-threaded locking-ear 282, which is engaged by a screw-shaft 283, this shaft having an operating hand-wheel 284 mounted thereon. Under the best working conditions the pressure in the furnace should be such as to cause a slight escape of flame through these flues 58. The escape of the products from the heated delivery-chamber through the flues 58 causes a portion of the products in the main-heating-chamber to flow downward in the furnace, thus causing an even distribution of the heat.

Means are preferably provided for admitting air to the furnace should it be desired to

cool it down for any purpose. Any suitable number of air-inlet openings may be provided for this purpose, and they may be located at any suitable point. In the construction illustrated two such openings are shown, one of these openings being located in the intermediate throat 28 and is marked 60, (see Fig. 15,) this opening being controlled by a sliding damper 61. The other opening is located at the upper end of the furnace and is marked 285, (see Figs. 32 and 33,) this opening being provided with a flue 286 and being controlled by a sliding damper 287, which is controlled by a hand-wheel and screw 288.

The intermediate throat 28 will preferably be of a width so that the sheets or packs of sheets will be truly guided by the sides of the chamber. Preferably, also, the bottom of the chamber will be provided with guides, which serve to hold the plates off the bottom and permit them to move readily through the chamber. These guides may be of any suitable description. In the constructions of furnace shown in Figs. 1 to 30, inclusive, they consist (see Fig. 16) of T-bars 289. In the construction shown in Figs. 32 and 33 these guides consist partly of T-bars; but in addition to these bars small toothed rollers 290 are provided, which are located below the bars and which receive the sheets therefrom.

It has been heretofore stated that the sheets pass from the throat into the delivery-chamber. Under certain conditions it may be desirable to control the movement of the sheets in this throat 28—as, for instance, should it be desired to allow the plates to cool slightly before passing into the delivery-chamber. When this is deemed necessary, a suitable stop will be provided for this purpose. A suitable construction of stop is illustrated in Fig. 33, this stop being marked 291. This stop is in construction and operation precisely similar to the stop 280 before referred to, and a further specific description of it is therefore unnecessary.

In the apparatus in which the specific furnaces illustrated are intended to be used the sheets or packs of sheets will be passed through a plurality of sets of rolls and will be heated after being operated upon by each set of rolls. There is therefore located behind the first set of rolls a suitable furnace the construction of which is indicated at 77, the sheets or packs being advanced through this furnace by feed-rolls 87.

Changes and variations may be made in the construction by which the invention is carried into effect. While, therefore, several specific embodiments of the invention have been illustrated, it is to be understood that the invention may be embodied in constructions which differ widely therefrom. It is also to be understood that certain features of the invention may be used independently of other features, and such use is contemplated.

What is claimed is—

1. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of means for insuring the travel of the sheets or packs therethrough, said means including devices for controlling opposite edges of each of the sheets or packs during their travel through the heating-chamber, substantially as described.

2. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of means for insuring the travel of the sheets or packs therethrough, said means including devices for controlling opposite edges of the sheets or packs during their travel through the heating-chamber, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

3. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of means for insuring the travel of the sheets or packs therethrough, said means including devices for controlling opposite edges of the sheets or packs and for supporting them between the edges during their travel through the heating-chamber, substantially as described.

4. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of means for insuring the travel of the sheets or packs therethrough, said means including devices for controlling opposite edges of the sheets or packs and for supporting them between the edges during their travel through the heating-chamber, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

5. In a furnace for heating plate, the combination with a heating-chamber, of a conveyor working through said chamber, said conveyor operating on the edges of the sheets of plate or packs of sheets to insure their travel through the heating-chamber, substantially as described.

6. In a furnace for heating plate, the combination with a heating-chamber, of a conveyor working through said chamber, said conveyor operating on the edges of the sheets of plate or packs of sheets to insure their travel through the chamber, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or

greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

7. In a furnace for heating plate, the combination with a heating-chamber, of a continuous conveyer for forwarding sheets of plate or packs of sheets therethrough, said conveyer operating on the edges of the sheets or packs, substantially as described.

8. In a furnace for heating plate, the combination with a heating-chamber, of a continuous conveyer for forwarding sheets of plate or packs of sheets therethrough, said conveyer operating on the edges of the sheets or packs, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

9. In a furnace for heating plate, the combination with a heating-chamber, of a continuous conveyer operating on the edges of sheets of plate or packs of sheets to forward them through the chamber, and means for supporting the sheets or packs between their edges, substantially as described.

10. In a furnace for heating plate, the combination with a heating-chamber, of a continuous conveyer operating on the edges of sheets of plate or packs of sheets to forward them through the chamber, means for supporting the sheets or packs between their edges, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

11. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including two continuous members for the side edges of the sheets or packs, each of said members having work-supporting devices for successive sheets or packs, substantially as described.

12. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including two continuous members for the side edges of the sheets or packs, each of said members having work-supporting devices for successive sheets or packs, edge-supporting devices for successive sheets or packs, and means in the chamber for supporting the sheets or packs between the edges, substantially as described.

13. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including two continuous members for the side edges of the sheets or packs, each of said members having work-

supporting devices for successive sheets or packs, edge-supporting devices for successive sheets or packs, means in the chamber for supporting the sheets or packs between the edges, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

14. In a furnace, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer operating to forward the material to be heated therethrough, said conveyer controlling opposite edges of the sheets or packs and cooling means for the conveyer located in the heating-chamber, substantially as described.

15. In a furnace, the combination with a heating-chamber, of a conveyer, and ways in the side walls of the chamber in which the conveyer moves, substantially as described.

16. In a furnace, the combination with a heating-chamber, of a conveyer including two endless members, ways in the side walls of the chamber in which the members move, and pipes located in the ways and serving to cool the members, substantially as described.

17. In a furnace, the combination with a heating-chamber, of ways in the side walls thereof, conveyer members running in the ways, and means for positively driving the members, substantially as described.

18. In a furnace, the combination with a heating-chamber, of ways in the side walls thereof, conveyer members running in the ways, means for positively driving the members, and pipes located in the ways and serving to cool the members, substantially as described.

19. In a furnace, the combination with a heating-chamber, of a conveyer comprising two continuous members, one run of each member being located inside the heating-chamber and the other run of each member being located on the outside of the chamber and devices on the members for holding opposite edges of the sheets to be forwarded, substantially as described.

20. In a furnace, the combination with a heating-chamber, of a conveyer including two members, ways in the inner walls of the chamber in which the inner runs of the members move, the outer runs passing outside the chamber, and cooling-pipes located in the ways and serving to cool the inner runs, substantially as described.

21. In a furnace, the combination with a heating-chamber, of a conveyer including two members, ways in the inner walls of the chamber in which the inner runs of the members move, the outer runs passing outside the chamber, cooling-pipes located in the ways and serving to cool the inner runs, and means for

positively driving the conveyer, substantially as described.

22. In a furnace, the combination with a heating-chamber, of a conveyer including two members, ways in the inner walls of the chamber in which the inner runs of the members move, the outer runs passing outside the chamber, cooling-pipes located in the ways and serving to cool the inner runs, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

23. In a furnace, the combination with a heating-chamber, of a conveyer including two members, ways in the inner walls of the chamber in which the inner runs of the members move, the outer runs passing outside the chamber, cooling-pipes located in the ways and serving to cool the inner runs, means for positively driving the conveyer, means for directing the products of combustion into said chamber, and means for maintaining a pressure of the products in the furnace which is equal to or greater than atmospheric pressure, whereby the furnace is sealed against the admission of air, substantially as described.

24. In a conveyer for heating-furnaces, the combination with a flexible carrier, of refractory work-supporting members and refractory shields between the members, substantially as described.

25. In a conveyer for heating-furnaces, the combination with a flexible carrier, of detachable refractory work-supporting members, and detachable shields between the members, substantially as described.

26. In a conveyer for heating-furnaces, the combination with a flexible carrier, of refractory work-supporting members secured thereto, certain of said members being constructed to operate as positioning devices, substantially as described.

27. In a conveyer for heating-furnaces, the combination with a flexible carrier, of refractory work-supporting members detachably secured thereto, certain of said members being constructed to operate as positioning devices, substantially as described.

28. In a conveyer, the combination with a flexible carrier, of work-supports comprising metallic bases having refractory material secured thereon, detachable connections between the bases and the carrier, shields consisting of metallic bases having refractory material secured thereto, and detachable connections between the shields and the carrier, the shields being located between the supports, substantially as described.

29. In a furnace, the combination with a heating-chamber, of a conveyer comprising a plurality of carriers, ways in the heating-chamber walls in which the carriers run,

refractory work-supports secured to the carriers, and non-conducting shields between the work-supports, substantially as described.

30. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including flexible carriers having positioning devices thereon, and means for giving the conveyer an intermittent movement through the chamber, substantially as described.

31. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including a plurality of continuous flexible members working through the furnace, said members carrying devices for supporting opposite edges of the work, means for operating the conveyer, and means for bringing the sheets or packs within the range of action of the work-supporting devices on the conveyer, substantially as described.

32. In a furnace for heating plate, the combination with a heating-chamber long enough to inclose a plurality of sheets of plate or packs of sheets, of a conveyer including a plurality of continuous flexible members, one run of each of said members passing through the chamber and the other run of each of said members passing outside the chamber, means for driving the members, positioning devices carried by the members, a flexible feeding device for forwarding the sheets or packs, and means for driving the feeding devices so as to bring the sheets or packs of sheets successively into the range of operation of successive positioning devices on the carrier, substantially as described.

33. The combination with the heating-chamber of a furnace, of a delivery-chamber in open communication with the heating-chamber, means for controlling the temperature in said chamber, and a delivery mechanism in the delivery-chamber, substantially as described.

34. The combination with the heating-chamber of a furnace, of means for continuously advancing plate therethrough, a delivery-chamber in open communication with the heating-chamber, means for controlling the temperature in said chamber, and a delivery mechanism in the delivery-chamber, substantially as described.

35. The combination with the heating-chamber of a furnace, of positively-operated means for continuously advancing plate there-through, a delivery-chamber in open communication with the heating-chamber, means for controlling the temperature in said delivery-chamber, and a delivery mechanism in the delivery-chamber, substantially as described.

36. The combination with the heating-chamber of a furnace, of a conveyer working there-through and operating to continuously ad-

vance plate through the chamber, and a delivery-chamber in open communication with the heating-chamber, substantially as described.

37. The combination with the heating-chamber of a furnace, of a conveyer operating to continuously forward plate therethrough, a receiving-chamber, an ejecting mechanism located in said chamber, and means coacting therewith to true a side of the plate not operated upon by the ejecting mechanism, substantially as described.

38. The combination with the heating-chamber of a furnace, of a conveyer operating to forward plate therethrough, a delivery-chamber, ejecting mechanism in said chamber, and a feed-controller, substantially as described.

39. The combination with the heating-chamber of a furnace, of a conveyer operating to forward plate therethrough, a delivery-chamber, an ejecting mechanism in said chamber, truing devices, and a feed-controller, substantially as described.

40. The combination with the heating-chamber of a furnace through which sheets or packs of sheets are successively advanced, of a receiver, and means whereby the receiver may be moved to an inclined position to receive the plate from the heating-chamber and into a horizontal position to deliver the sheets or packs, substantially as described.

41. The combination with the heating-chamber of a furnace, of means for positively advancing sheets or packs of sheets therethrough, a delivery-chamber, a receiver in said delivery-chamber, and means for moving the receiver into one position to receive the plate from the heating-chamber of the furnace and into another position to deliver the sheets or packs, substantially as described.

42. The combination with the heating-chamber of a furnace, of means for positively advancing sheets or packs of sheets of plate therethrough, a delivery-chamber, a receiver, means for moving the receiver into one position to receive the plate from the heating-chamber of the furnace and into another position to deliver the plate, and an ejecting mechanism, substantially as described.

43. The combination with the heating-chamber of a furnace, of means for positively advancing sheets or packs of sheets of plate therethrough, a delivery-chamber, a receiver, means for moving the receiver into one position to receive the plate from the heating-chamber of the furnace and into another position to deliver the plate, an ejecting mechanism, and truing devices, substantially as described.

44. The combination with the heating-chamber of a furnace, of means for positively advancing sheets or packs of sheets of plate therethrough, a delivery-chamber, a receiver, means for moving the receiver into one position to receive the plate from the heating-

chamber of the furnace and into another position to deliver the plate, an ejecting mechanism, truing devices, and a feeding-controller, substantially as described.

45. The combination with the heating-chamber of a furnace, of means for positively advancing sheets or packs of sheets therethrough, a delivery-chamber, a throat between the heating-chamber and the delivery-chamber, ejecting mechanism including rear-edge-truing devices, side-edge-truing devices, and a feed-controller, substantially as described.

46. The combination with the heating-chamber of a furnace, of means for positively advancing plate therethrough, a receiver, means for moving the receiver into an inclined position to receive the plate from the furnace and into a substantially horizontal delivery position, and a pusher for moving the plate off the receiver, substantially as described.

47. The combination with the heating-chamber of a furnace, of means for positively feeding plate therethrough, a receiver, means for moving the receiver into an inclined position to receive the plate from the furnace and into a substantially horizontal delivery position, a pusher for moving the plate off the receiver, and a truing mechanism operating on the plate on the receiver, substantially as described.

48. The combination with the heating-chamber of a furnace, of means for positively forwarding plate therethrough, said means acting on opposite edges of the plate, a pivoted receiver, and means for swinging the receiver into an inclined position to receive the plate and into a delivery position, substantially as described.

49. The combination with the heating-chamber of a furnace, of means for positively forwarding plate therethrough, a receiver, means for moving the receiver into an inclined position to receive the plate from the chamber and into a delivery position, a slide mechanism for truing up the plate, and a pusher for moving the plate off the receiver, said pusher also operating to true the plate, substantially as described.

50. The combination with the heating-chamber of a furnace, of a conveyer working therethrough, said conveyer having devices for holding opposite edges of the work, driving means for the conveyer, a feeding device for the conveyer, and means for simultaneously controlling the operation of the conveyer and feeding device, substantially as described.

51. The combination with the heating-chamber of a furnace, of a conveyer comprising two members, said members working at the sides of the chamber and operating to control the edges of sheets or packs of sheets to be advanced through the furnace, a feeding device operating to introduce the sheets or packs of sheets between the conveyer members, and

driving means for the conveyer and said feeding device, substantially as described.

5 52. The combination with the heating-chamber of a furnace, of a conveyer comprising two members, said members working at the sides of the chamber and operating to control the edges of the sheets or packs of sheets to be advanced through the furnace, a feeding device operating to introduce the sheets
10 or packs of sheets between the conveyer members, driving means for the conveyer and

said device, and a single means for controlling said driving means, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

DANIEL M. SOMERS.

Witnesses:

J. A. GRAVES,
A. WHITE.