(No Model.) 3 Sheets—Sheet 1.

W. H. FOLLETT.

PLANT FOR CASTING INGOTS.

No. 343,954. Patented June 15, 1886.

Fig. 1.

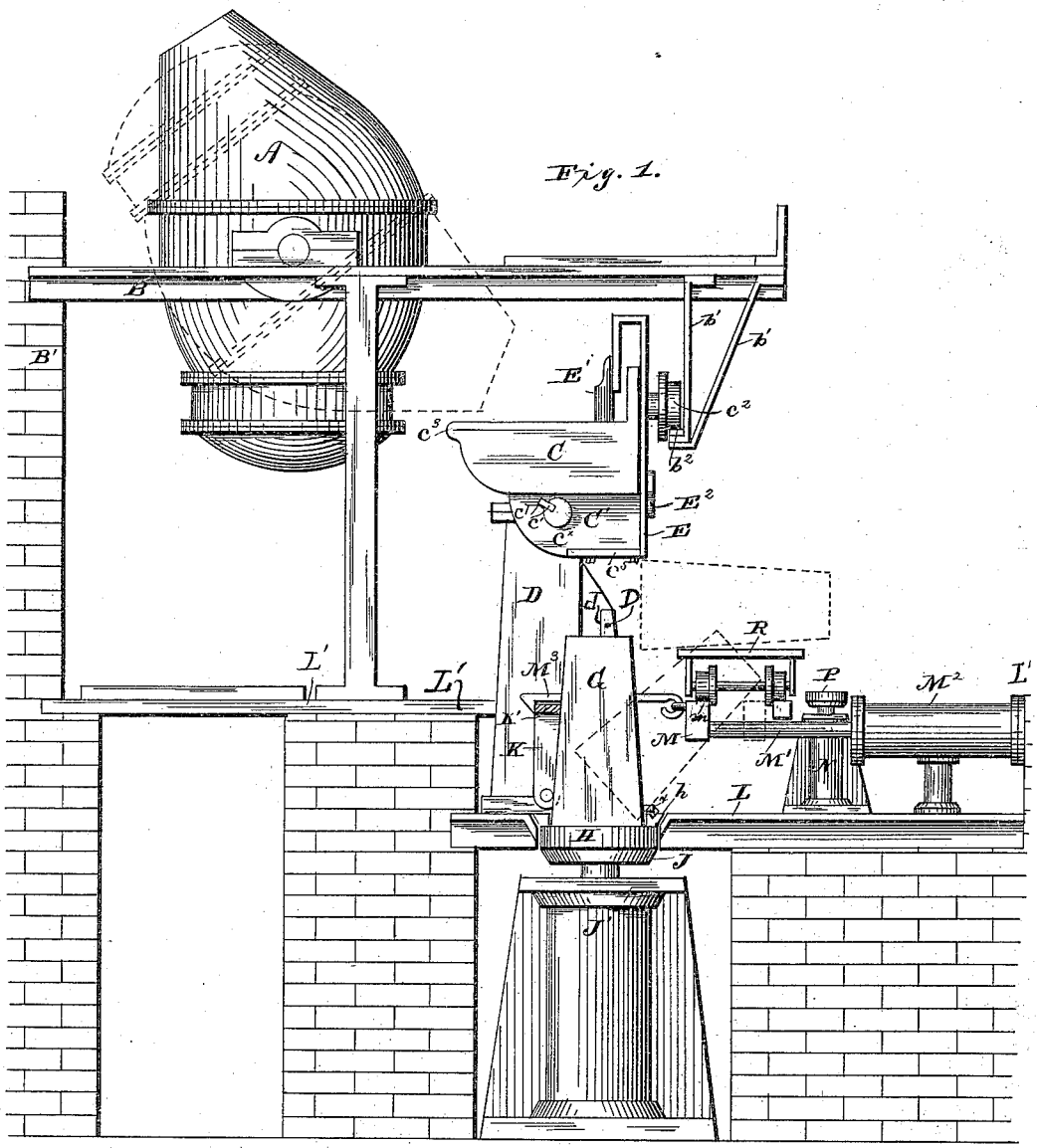
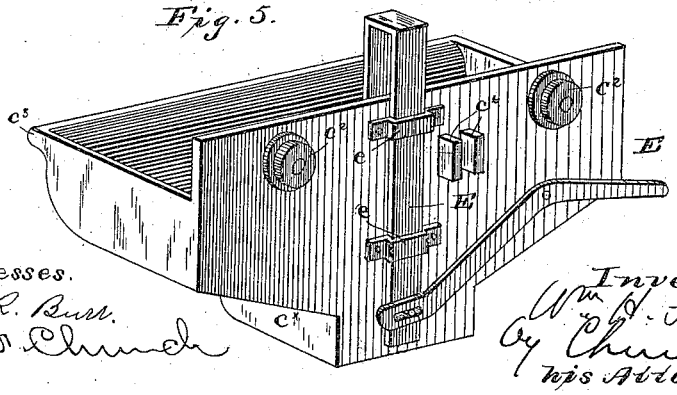


Fig. 5.



Witnesses.
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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

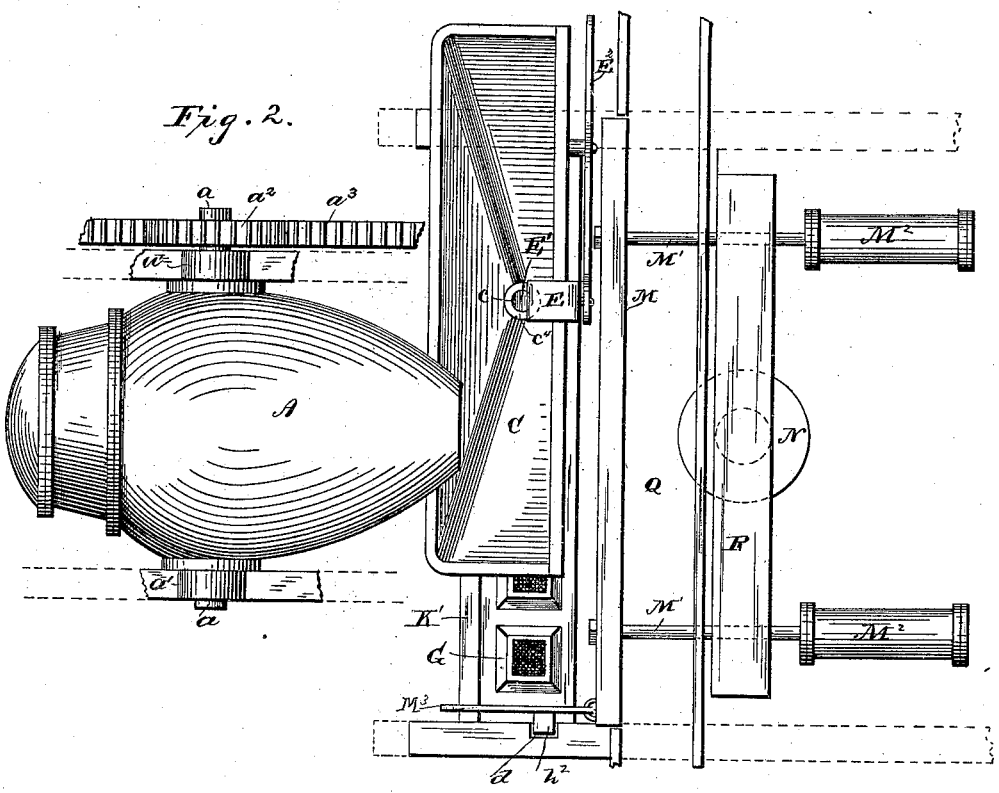
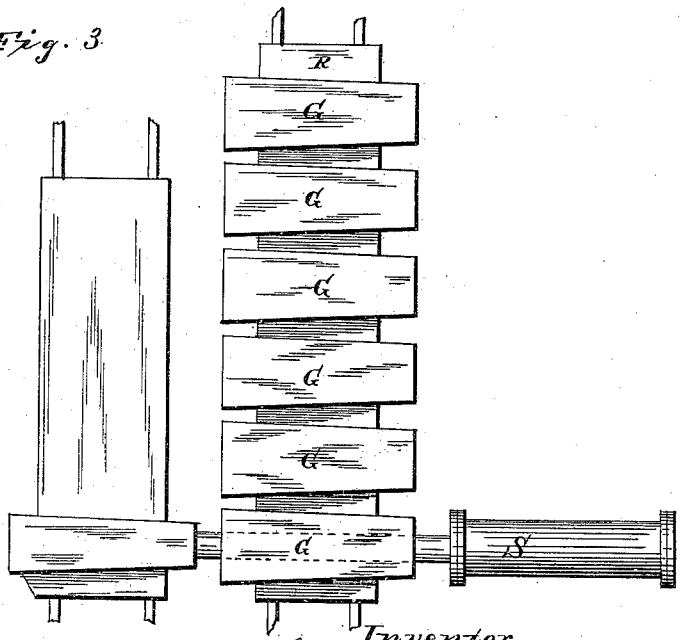


Fig. 3.



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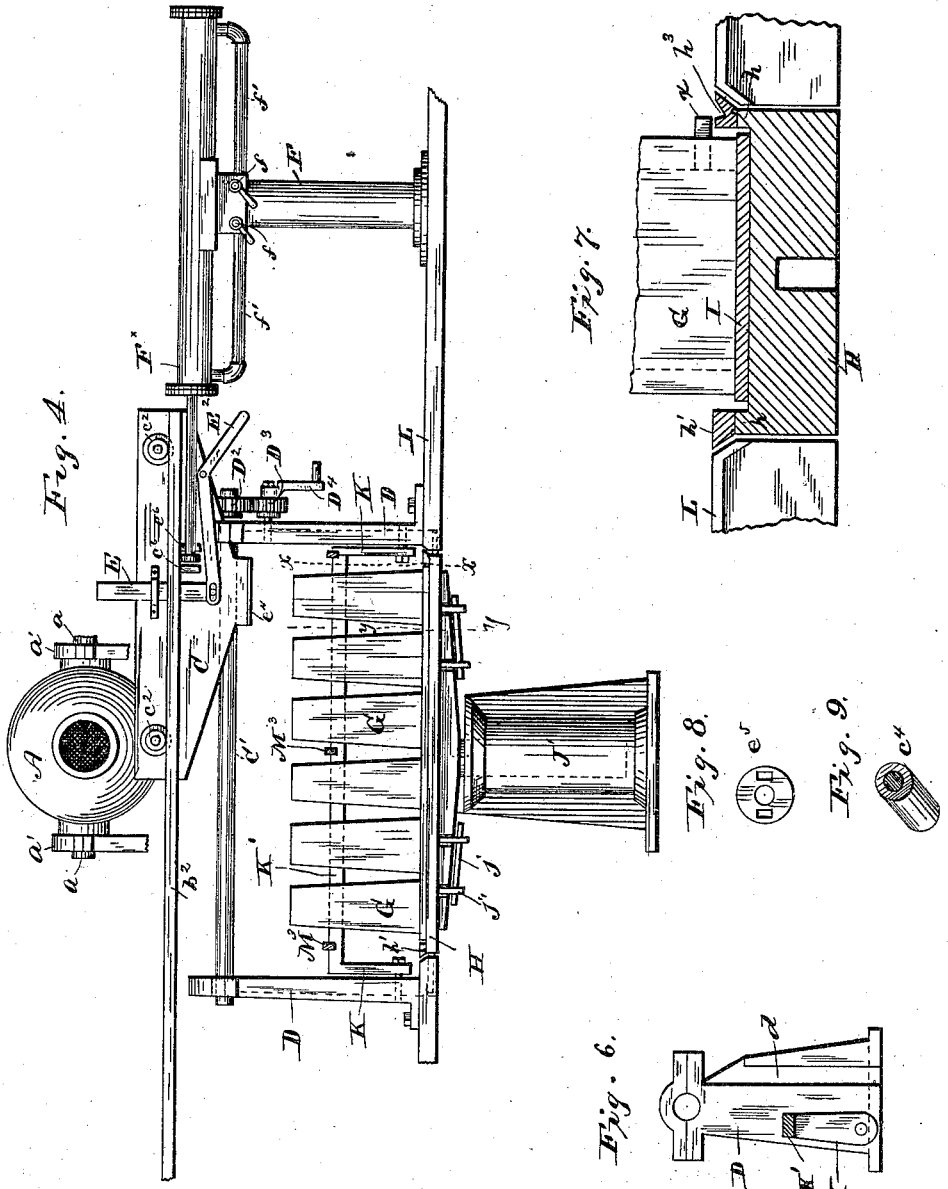

Fig. 4.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM H. FOLLETT, OF STEELTON, PENNSYLVANIA, ASSIGNOR OF ONE-THIRD TO HARRISON A. POTTEIGER, OF SAME PLACE.

PLANT FOR CASTING INGOTS.

SPECIFICATION forming part of Letters Patent No. 343,954, dated June 15, 1886.

Application filed October 22, 1885. Serial No. 180,655. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. FOLLETT, a subject of the Queen of Great Britain, residing at Steelton, Dauphin county, Pennsylvania, have invented certain new and useful Improvements in Bessemer Plants for Casting Steel Ingots; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

At present in a Bessemer mill running three converters there are usually required about thirty men to run the heats into the mold, remove the ingots, and reset the molds by the aid, mainly, of hydraulic cranes, the men working in turns. About twenty-four of the above number of men are termed "pit-men," and draw the ingot-molds out of the pits, load the ingots on trucks running on suitable tramways, reset the molds, and help to pour the heats, and four men, termed "ladle-runners," handle the well-known ladles, while the remaining two men are termed "ladle-liners," and bank and cover the molds. By the employment of my improved plant the same work can be accomplished by four men working in turn, two of said number doing the work of the ladle-liners and the other two attending to the ladle-runner machines and remaining machinery.

The object of my invention is therefore to lessen the labor and danger in casting steel ingots and the cost of handling the same; and it consists in certain improved apparatus, which I will now proceed to describe, and point out the particular features of novelty in the claims at the end of this specification.

In the accompanying drawings, Figure 1 is a side view of a portion of my improved plant, a portion of the frame-work being broken away to show the construction better; Fig. 2, a top plan view of the same. Fig. 3 is a view of a portion of the grounds of the mill, showing the means for removing the ingots from the mold. Fig. 4 is a front view of a plant shown in Fig. 1. Fig. 5 is a perspective view of the pouring-ladle; Fig. 6, a sectional view on the line *x x* of Fig. 4; Fig. 7, a sectional view taken on the line *y y*, Fig. 4; Figs. 8 and 9, views of details.

Similar letters of reference in the several figures indicate the same parts.

A represents an ordinary Bessemer converter provided with trunnions *a*, having their bearings in blocks *a'*, the latter being supported on a suitable frame-work, B, constructed, as shown, and secured to the masonry B' in the usual manner. One of said trunnions is extended beyond the bearing, and is provided with a gear, a^2, engaging with a movable toothed rack, a^3, operated by any suitable mechanism to turn the converter on its trunnions and pour its contents when desired. At the front end of the frame-work B are provided suitable hangers, b' b', supporting at their lower end the horizontal track or rail b^2, on which the rollers or wheels on the pouring-ladle are arranged to run.

C represents the pouring-ladle, constructed, as shown in Fig. 5, with the hopper bottom tapering to the perforation *c* at its center, and provided with a horizontal perforation in the projection $c^\times$ on its under side, through which passes its supporting-shaft C', journaled in suitable bearings in the ends of standards D D, at opposite sides of the frame-work, as shown. This shaft is adapted to be rotated on its bearings by means of the gear D^2 on its end, with which engages another gear, D^3, mounted on a stud-axle on one of said supporting-posts, and provided with an operating-handle, D^4. A small spline, *c'*, extends the length of this shaft and fits a corresponding groove, c^7, in the projection on the ladle-bottom, so that as said shaft is rotated the ladle will be tipped over backward, although it is permitted to slide freely longitudinally of the shaft and parallel to the trunnions of the converter. On the front side of the ladle C are provided two supporting-wheels, c^2 c^2, mounted upon short axles extending out, as shown, the wheels traveling on the track b^2 and serving to support the forward side of the ladle and prevent displacement or strain, owing to the impetus of the metal when the pouring begins, the shaft C' and the track b^2 constituting guides on which the ladle is moved. At the rear of the ladle is provided a lip, c^3, adapted to project a short distance under the mouth of the converter when it is turned down to the position shown in dotted lines, Fig. 1, to dis-

charge its contents into the ladle, for preventing the molten metal from running down the side of the ladle, and to take all the metal from the converter without spilling. It will be noticed that the front side of the ladle is extended somewhat above the level of the other sides, and this is done for the purpose of preventing the metal splashing over as it comes from the converter; also secured to this front side of the ladle are two loops, *e*, through which a narrow plate or rod, E, is adapted to slide, said plate projecting over the top of the ladle down into it, and bearing at its lower end a stopple or plug, E′, preferably of fire-brick, adapted to close the opening *c* in the bottom, said opening being provided with a fire-brick lining, c^4, held in place by a perforated plate, e^5, secured to the bottom of the ladle by bolts, as shown. This rod is adapted to be raised and lowered by means of a lever, E^2, pivoted upon the side of the ladle and extending out at one end within convenient reach of the operator. This ladle is moved back and forth by means of a hydraulic piston, F^x, operating in a cylinder, F, placed to one side of the main frame, and having the end of a piston-rod projecting parallel with the ladle, and a knob or projection on its end which projects between the two lugs c^6 c^6 on the side of the ladle, so that as said piston is operated back and forth the ladle will be drawn back and forth, sliding upon the shaft *c′* and rail b^2, as will be readily understood, and when the ladle is to be tipped backward by rotating the supporting-shaft, the piston can remain stationary, the lugs c^6 moving over and disengaging themselves from the end of the piston-rod. The piston is operated back and forth by two valves, *f f*, connecting with pipes *f′ f′* at opposite ends of the cylinder and with the water or steam supply, so that by opening one and closing the other the piston can readily be moved forward or backward, as desired.

The same workman that attends to the cocks *f f* may also operate the crank-handle and the lever E, since the latter is operated only after a mold is filled, and to begin the cast of another ingot, and before or after the said piston is advanced. The crank-handle need be operated only after a heat is cast. If desired, the mechanism for tipping the converter may be operated by the same hand.

The mechanism for supporting and handling the molds is constructed as follows: The ingot-molds G, about six being sufficient to contain one heat, are placed upon the lifting-table H, near together at their bases and directly under the path described by the ladle-outlet *c*, so that each mold may be cast into in succession from said outlet as the table is advanced. On the top of said table is provided a fixed rim, *h*, forming thereon a receptacle for admitting the plates I, used to protect the table against damage by the molten steel when cast into the molds standing on the plates. These plates may be made of metal and covered with sand when an ingot is to be cast, or may be of fire-brick or any suitable material. The table itself is removable, being attached to the platen J, on the upper end of the hydraulic piston J′, by keys *j*, inserted through eyebolts *j′* on said table, projected through slots in said platen. Upon the outer edge of the rim *h* are hinged the beveled side and end strips, *h′*, adapted to fold flat on the rim and to close the crevices between them and the wall of the aperture in the pit-floor L, to prevent metal or dirt running down into the lifting machinery, while the inner edges of the strips serve to hold in place the sand tamped around the bases of the molds in a manner to allow the latter to expand when heated. If the rim of the table were solid, the tendency of the molds when expanded by the hot metal would be to either bind in the recess on the table, so as to prevent their removal therefrom, or else to bend the rim out of shape; but by making the rim in sections and hinged to the table the molds may expand, which will cause the rim-sections to turn on their hinges slightly.

The table H, as before stated, is secured to the top of the platen on the piston or plunger working in the cylinder J′, and is operated in the usual manner, lifting said table with the set of molds and ingots thereon, for a purpose hereinafter described. It may also be used to bring the tops of the molds closer to the outlet of the ladle, to obtain better results in casting. Upon the ends of the table are the extensions or tongues h^2, moving in grooves *d* in the standards D, and serving to guide and steady the movements of the table. These standards are secured rigidly to the floor L by means of bolts or in any other suitable manner, and have pivoted to their inner sides two short levers, K K, connected at their upper ends by a cross-rod or connecting-bar, K′, adapted to normally rest against the ingot-molds and operating to tip them over when operated by suitable mechanism, about to be described.

The mechanism for casting the metal into the molds having now been explained, I deem it best to describe its operation before describing the mechanism for disposing of the ingots and molds after casting. When the metal in the converter has reached the proper heat, the ladle is moved by means of the hydraulic piston so that its outlet will be over the mouth of the first mold, and the stopple E′ is placed in the outlet, closing it. The converter is now inverted by means of the rack and gear and its contents turned into the ladle. The stopple is then withdrawn and the metal allowed to flow out into the first mold until it is filled. Then the stopple is replaced and the ladle is moved by means of the piston until the opening is over the mouth of the next mold, the stopple is again withdrawn and this mold filled, and so on until all the molds are filled. As the ladle is adapted to contain just enough metal for six molds, there will usually be nothing left in it, except possibly slag or re-

fuse matter, which can readily be turned out by rotating the handle E, turning the shaft, and turning the ladle over backward, as will be readily understood, the wheels c^2 leaving the track and the shaft supporting the entire weight of the ladle.

When the molds are filled, and the metal has solidified, the next operation is to dispose of them, which is accomplished in the following manner.

M is a heavy rail placed in front of the table H, having on its upper side a tramway-rail, *m*, and supported at its ends in a manner to permit of its being moved sidewise by means of piston-rods M′ M′, connected to its opposite ends and operating in hydraulic cylinders M^2 M^2. To the outer side of this rail are secured two or more links, M^3, having hooks at their outer ends adapted to project by or between the molds on the table and engage the bar K′ connected to the links K.

P represents a table or platen, about as long as the table H, and adapted to be raised and lowered by means of a piston working in a hydraulic cylinder, N, placed parallel with the cylinder J, but some distance above it.

Q represents a tramway, of which a part is formed by the rail *m*, as stated, extending out into the grounds of the mill or to the blooming-furnace, as desired, and R represents a small flat tram-car for running on said way and transporting the ingots in a manner to be described.

The filled molds are now standing upon the table H, with about one-third of their length projecting above the level of the rail M. The links M^3 are then passed by or between them and engaged with the bar K′. Then the rail is drawn over to the position shown in dotted lines by the piston-rods M′ M′, and the bar K′ will draw over the molds until they rest against said rail, being prevented from sliding back at the base by the pins *x* on the bottoms of the molds entering the groove h^3 in the hinged strips *h*′ on the table, as shown in Fig. 7. The table H is now moved up by the cylinder J, and the molds and ingots are lifted and moved to the right until one end rests upon the top of a table or platen, P. Then the two tables are raised together, and the molds lifted some distance above the level of the floor L. The rail M is now moved out to its normal position, in line with the rail Q of the tramway, the flat car R run in under the molds, and the two tables H and P returned to normal position, leaving the molds lying upon their sides upon the car, which is then run out into the grounds or another portion of the mill, and the ingots removed from the mold by means of a hydraulic or steam operated piston, S, pushing them out, as shown in Fig. 3. This piston may operate to remove the ingots and place them upon another car, as shown in the drawings, or upon the hearth of the blooming-mill, and in this manner part of the original heat be utilized.

In replacing the empty molds upon the table H erectly the handling occurs in reverse order. The tram-car with the molds in place is run in between the tables H and P, which latter then lift them above the car, which is then run away and the rail moved back. The molds can then be lowered to the level of the mill-floor L, where the table P stops, and the table H descending to its normal position in the pit, the piston M′ returns the rail to its projected position, which erects the molds upon the table H, the pins *x* stepping into the grooves h^3 and assisting to seat the bases of the molds correctly, and the bar K′ serving to curb the rapid motion of the tops of the molds as they are tipped back upon their bases.

From the above description the various advantages of my invention over the ordinary plants in use will be evident. The ladle while at work is moved only endwise—that is, in a direction parallel with the axis of the converter's trunnions—and as it is tipped or turned on the shaft C′ only at the end of a heat, to rid it of slag or residuum, the liability of spilling metal or splashing it in moving from one mold to another is lessened; also, by reason of the raised dash-plate and the lip projecting under the converter-mouth the first or full flow can be received as well as the last small stream, thus receiving the metal at all stages of the pouring without raising and lowering the ladle.

If desired, the flow from the converter into the ladle may be continuous, and the stopple mechanism operated as described, if the rate of flow is an average one, the capacity of the ladle being such that it will not overflow, or the whole contents of the converter poured in at once and the ladle moved over each mold in succession and the stopple manipulated, as usual.

I claim as my invention—

1. The combination of the converter, the ladle mounted on stationary guides parallel to the trunnions of the converter, mechanism for moving the converter along the guides, and a device for closing its outlet and interrupting the flow of metal therefrom, substantially as described.

2. The combination of the converter, the ladle mounted on stationary guides parallel to the trunnions of the converter, in position to receive the metal from the mouth of the converter at all stages of the pouring, mechanism for moving the ladle along the guides, and a device for opening and closing its outlet and regulating the flow of metal therefrom, substantially as described.

3. The combination of the converter, the ladle mounted on stationary guides parallel to the trunnions of the converter, in position to receive the metal from the converter at all stages of the pouring, and having its front higher than the other sides, mechanism for moving the ladle along the guides, and a device for opening and closing its outlet and regulating the flow of metal therefrom, substantially as described.

4. The combination of the converter, the ladle mounted on stationary guides parallel to the trunnions of the converter, in position to receive the metal from the converter at all stages of the pouring, and having the lip at the side toward the converter, mechanism for moving the ladle along the guides, and a device for opening and closing its outlet and regulating the flow of metal therefrom, substantially as described.

5. The combination, with the converter, the ladle movable on stationary guides parallel to the converter-trunnions, having the outlet, and a device for closing the outlet, of the series of molds, the table on which they are mounted, and means for raising and lowering said table, substantially as described.

6. In a Bessemer plant, and in combination with the converter, the ladle movable on stationary guides parallel to the converter-trunnions, having the outlet, a device for opening and closing said outlet, a series of molds, the table upon which they are mounted, means for raising and lowering said table, a vertically-movable table arranged parallel with said mold-supporting table, and a bar or rod operated by a suitable motor to tip the whole series of molds, so that one end will rest upon the said second table, a tramway arranged between the tables, and a tram car or truck mounted thereon, substantially as described.

7. In a Bessemer plant, and in combination with the converter, the longitudinally-movable ladle having the outlet, and a device for opening and closing said outlet, the series of molds, the table on which they are mounted, means for raising and lowering said table, the pivoted rail on one side the molds, the sliding rail on the other side, and means for operating the latter toward and from said molds, links or hooks connecting said rails, a table arranged parallel to the table on which the molds are mounted and means for raising and lowering it, and a tramway between the two tables, one of the rails of said tramway being formed by the sliding rail, and a suitable truck or car mounted on the tramway, substantially as described.

8. In a Bessemer plant, and in combination with the converter, the longitudinally-movable ladle having the outlet and a device for opening and closing said outlet, the series of tapering molds, the table on which they are mounted, means for raising and lowering said table, a vertically-movable table arranged parallel with said mold-supporting table, and a bar or rod operated by a suitable motor to tip the whole series of molds, so that one end will rest upon said second table, a tramway arranged between said tables, extending out from between them, and a truck or car mounted thereon, a rod or piston operated by a suitable motor arranged in proximity to the tramway and projecting at right angles thereto, for the purpose of forcing the ingots out of the molds one at a time, substantially as described.

9. The combination, with the converter and the series of molds, of the ladle having the wheels on one side running on the stationary track and supported at the other side upon a shaft or guide capable of being rotated, whereby said ladle may be tipped over and the slag or other refuse matter discharged therefrom, and means for moving said ladle longitudinally on the guides, substantially as described.

10. The combination, with the converter and the series of molds, of the ladle having the recess, the shaft on which it is mounted capable of being rotated, and having the spline and means for moving said ladle longitudinally on said shaft, substantially as described.

11. The combination, with the converter and the series of molds, of the ladle mounted upon the shaft, and having the outlet and a device for opening and closing it, a rod operated by a suitable motor for moving said ladle longitudinally on the shaft, connected detachably to the ladle, so that as the ladle is tipped to dump slag and refuse matter it will be automatically disengaged from the ladle, and will be automatically re-engaged when the ladle returns to normal position, substantially as described.

12. The combination, with the converter and the series of molds, of the ladle mounted upon the shaft, and having the outlet and a device for opening and closing it, and the two lugs mounted on the side, a rod operated by a suitable motor for moving the ladle longitudinally, having the lug or projection on its end placed between the lugs on the ladle, whereby when the ladle is tipped to dump the slag, &c., it will be automatically disengaged from the operating-rod, and upon being returned to normal position will be automatically re-engaged, substantially as described.

13. The combination, with the molds having the pins or projections near their bases, of the table on which said molds are supported, having the groove at one edge into which said pins project when the molds are tilted to prevent their bases from slipping, substantially as described.

14. The combination, with the molds, of the mold-supporting table having the strips hinged to its edges, for the purpose of permitting the expansion of the molds when heated, substantially as described.

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