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W. F. DURFEE & T. EGLESTON.

APPARATUS FOR CASTING INGOTS OF METAL.

No. 308,405. Patented Nov. 25, 1884.

Fig. 1.

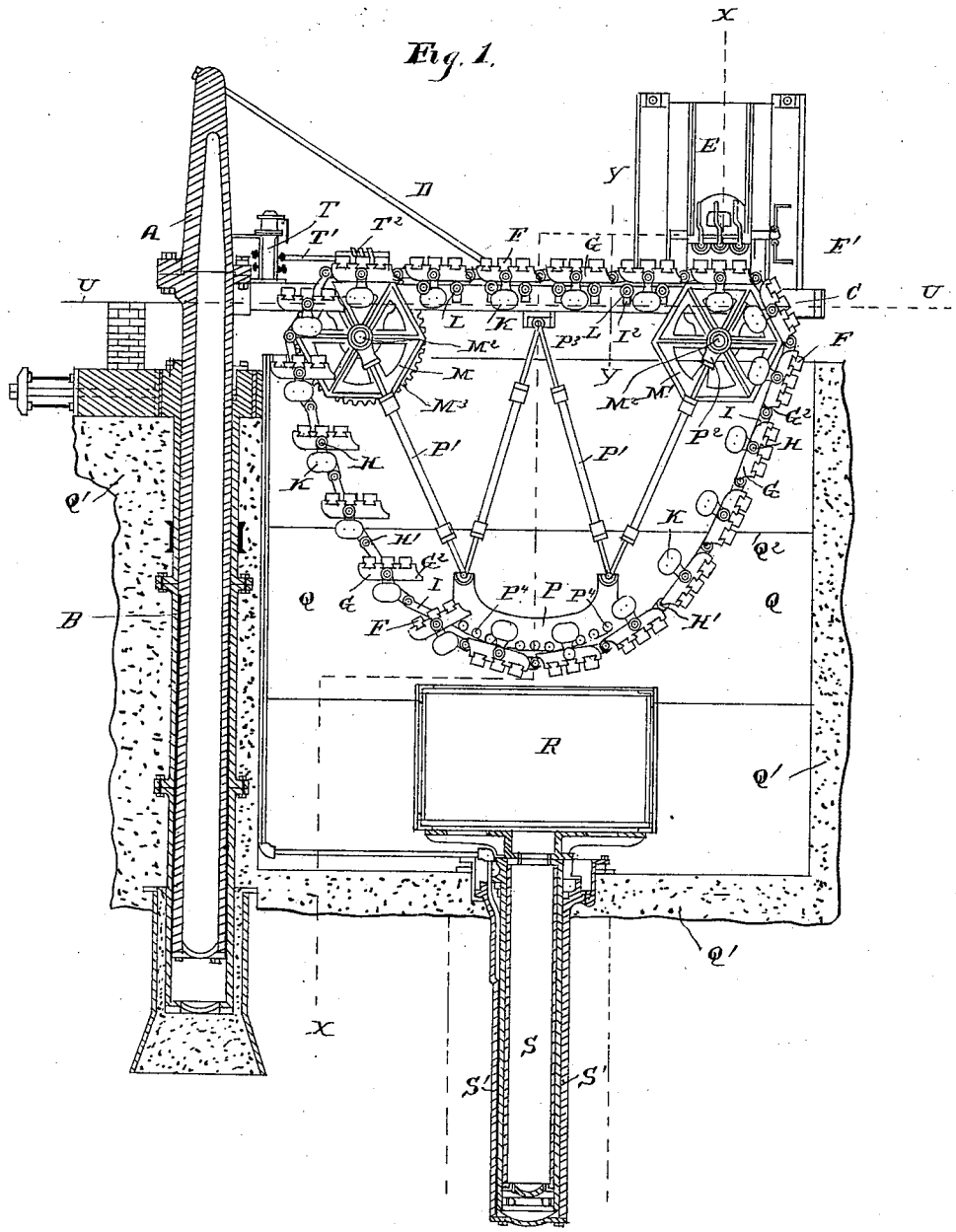

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Fig. 2.

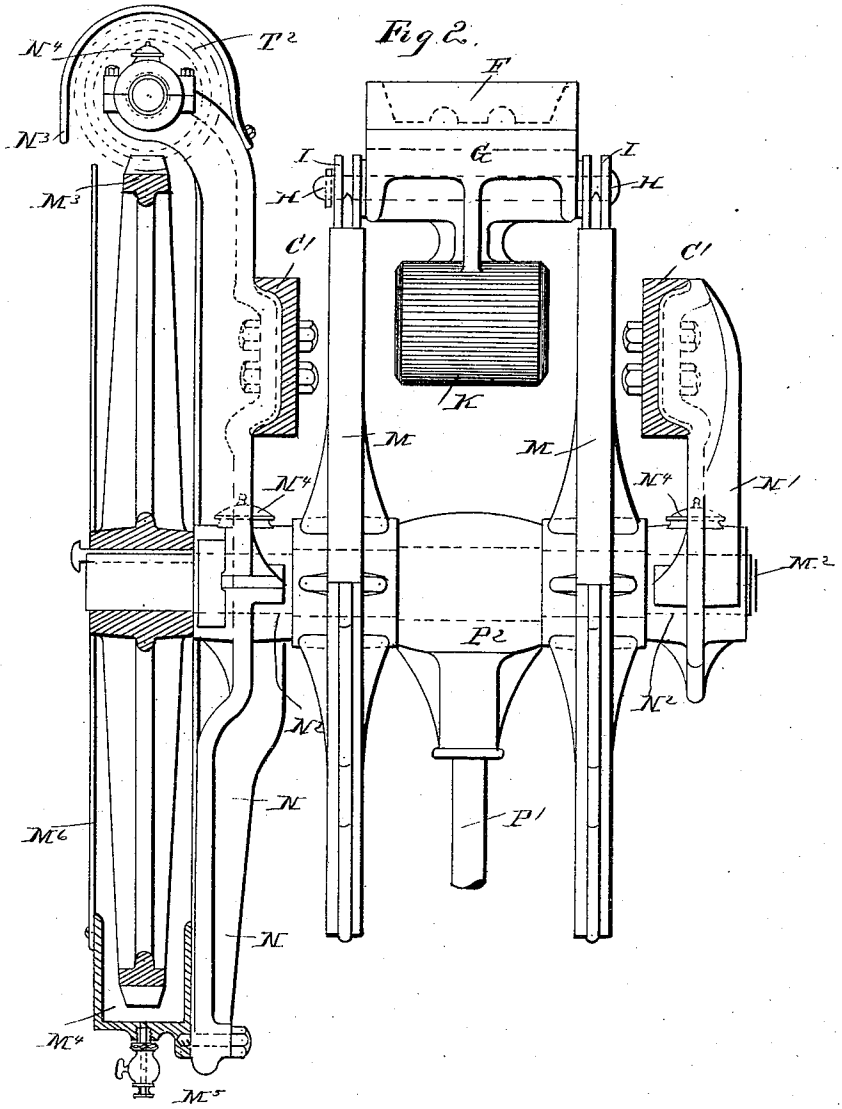

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Fig 3

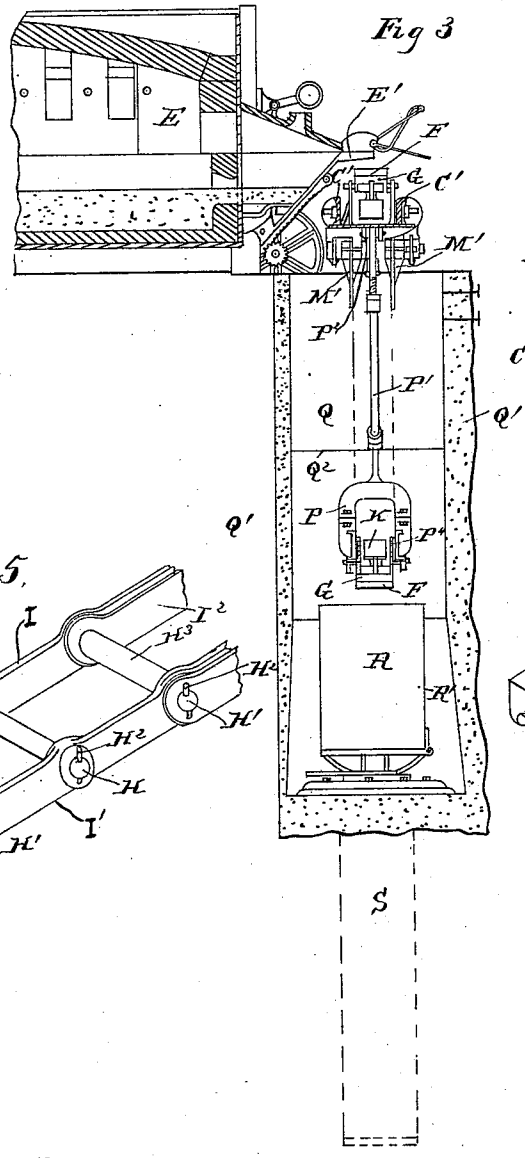

Fig. 4.

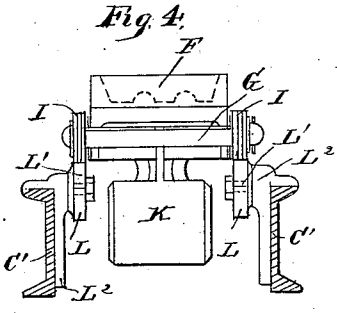

Fig. 5.

Fig. 6.

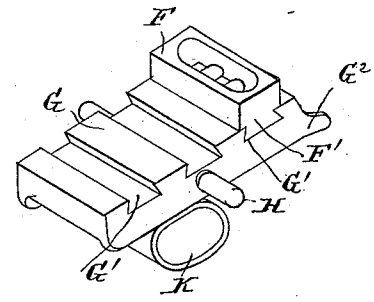

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Fig. 7.

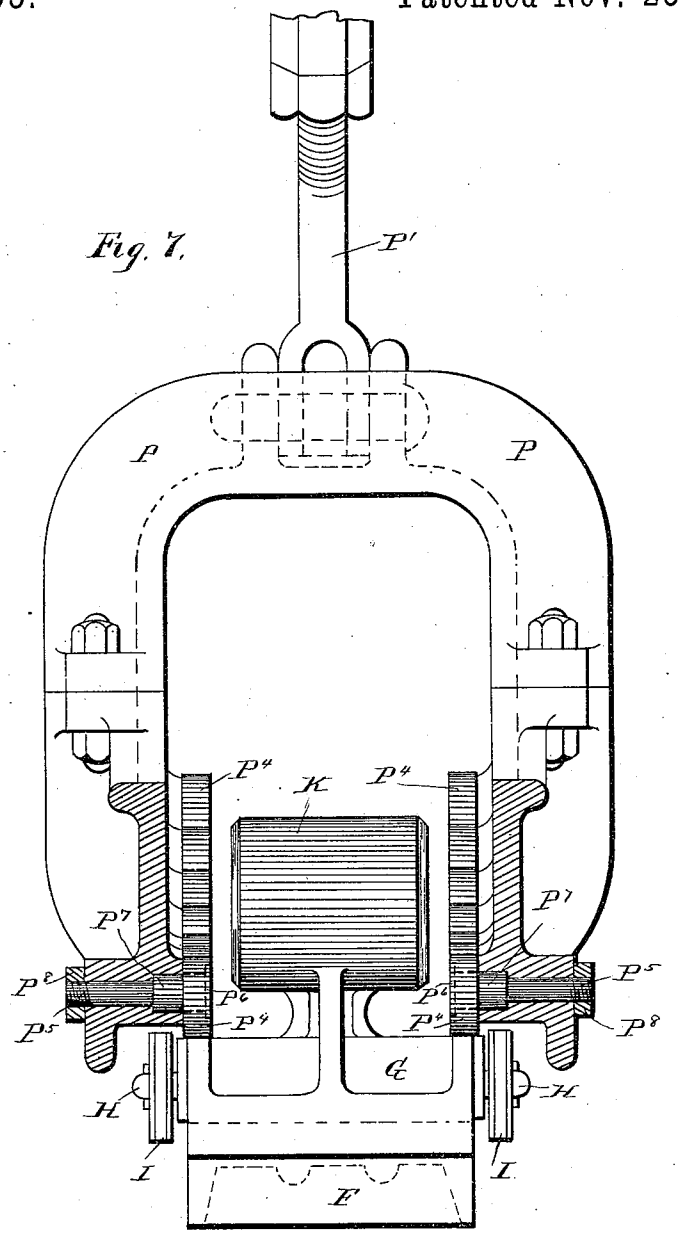

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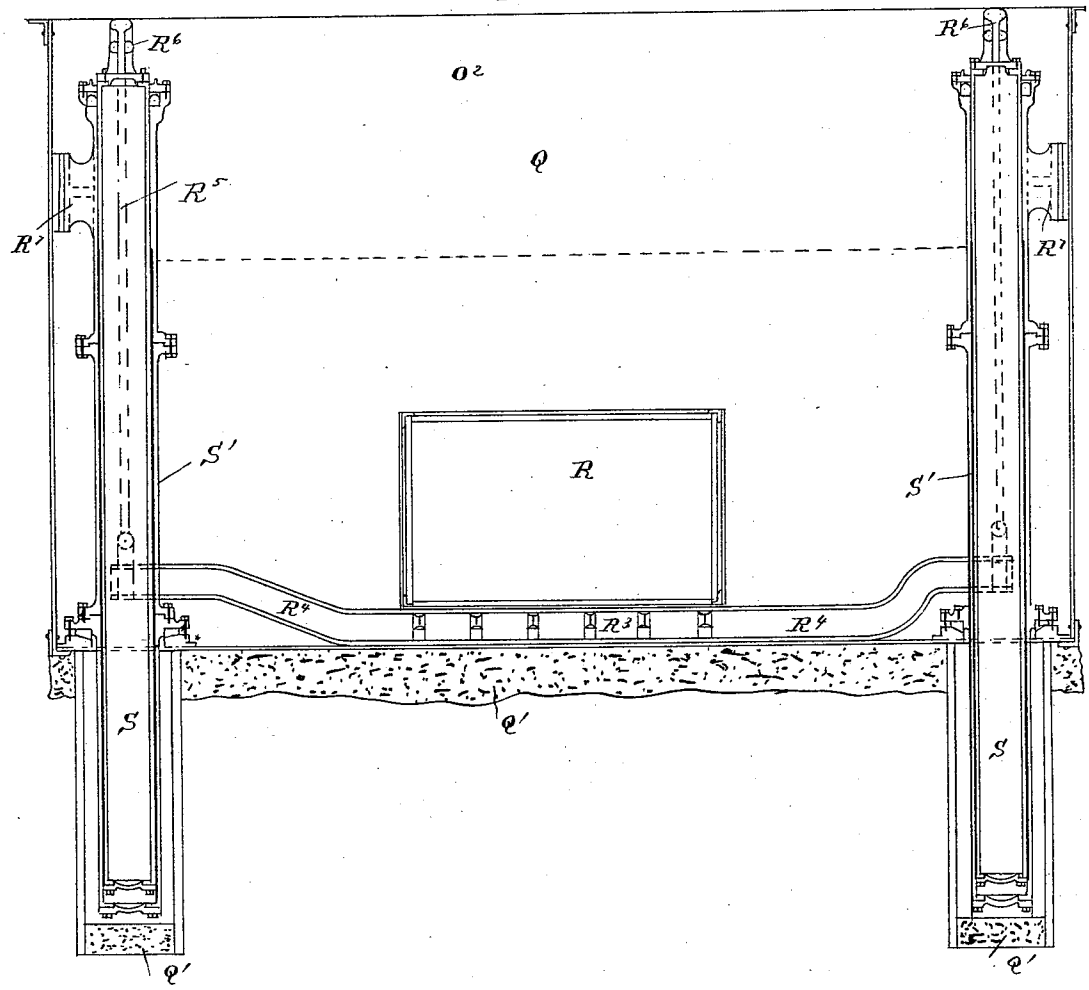
Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM F. DURFEE, OF BRIDGEPORT, CONNECTICUT, AND THOMAS EGLESTON, OF NEW YORK, N. Y.

APPARATUS FOR CASTING INGOTS OF METAL.

SPECIFICATION forming part of Letters Patent No. 308,405, dated November 25, 1884.

Application filed April 18, 1884. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM F. DURFEE, of Bridgeport, in the county of Fairfield and State of Connecticut, and THOMAS EGLESTON, of the city, county, and State of New York, both citizens of the United States, have invented certain new and useful Improvements in Apparatus for Casting Ingots of Metal; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention has for its object to produce mechanical means for rapidly casting and cooling ingots of copper or other metal which shall be easy to manage, not liable to get out of repair, and which shall materially diminish the manual labor required in handling the metal. With these ends in view we have devised the novel mechanism, which we will now proceed to describe, and then point out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a vertical section of the hydraulic crane, the cooling-tank, the receiving-box, and the hydraulic lift therefor, and also showing the ingot-molds with their carriers, and the mechanism for manipulating the same in side elevation, the polygonal wheel and beam shown at the right in Fig. 2 being removed, also the housing for the worm and gear. Fig. 2 is an end elevation of the left-hand carrier-wheels in Fig. 1, showing one of the mold-carriers at the top, the beams and operating-wheel being in section, the end of a double link appearing in elevation, and the worm being indicated in dotted lines, but the rollers and the supports therefor not being shown. Fig. 3 is a vertical cross-section on the line *x x* in Fig. 1, showing the receiving-box and mold-carriers in elevation, and also showing in cross-section a portion of a reverberatory furnace and of the casting apparatus which forms the subject of our Patent No. 287,646, dated October 30, 1883. Fig. 4 is a detail cross-section of the crane-arm on the line *y y* in Fig. 1, showing the rollers which support the endless double chain that carries the ingot-molds in elevation. Fig. 5 is a detail perspective illustrating the construction of the endless chain, the mold-carriers and weights being removed. Fig. 6 is a detail perspective of one of the mold-carriers, with a mold in place. Fig. 7 is a vertical cross-section of the casting which carries the rollers that invert the mold-carriers, a portion of which are shown in elevation, also a mold-carrier and weight in their inverted position, the shape of the roller stud or pin being shown in dotted lines; and Fig. 8 is a vertical section of a tank and receiving-box, in which the receiving-box is raised by means of a hydraulic lift at each end of the tank.

Similar letters indicate like parts in all the figures.

A represents the mast of a hydraulic crane, and B the cylinder therefor, which is shown as sunk in the ground.

C is the crane-arm, which we preferably make of two channel or other beams, C′, bolted together at their extremities through distance-pieces, (not shown,) or secured together in any suitable manner, and bolted rigidly to the mast.

D is a supporting-rod extending from the arm to the top of the mast, and E represents a furnace.

The furnace forms no part of our present invention, which may or may not be used in connection with the apparatus which forms the subject of our former patent, referred to above. So far as our present invention is concerned, the melting of the crude metal and the delivery of the molten metal to the ingot-molds may be accomplished in any preferred manner.

F F represent the molds, which are arranged in groups, preferably of three, each group being carried by a cast-iron plate or carrier, G. The molds are provided with dovetails F′, which engage in corresponding grooves, G′, in the carriers, thus providing a firm but detachable connection for the molds.

H H are strong cylindrical pins which pass through each of the carriers just below the center of the middle ingot. The ends of these pins pass through holes in the centers of the links of a double endless chain, I, said chain being composed of alternate single and double bars I′ I² of flat wrought-iron. The single bars are provided with re-enforcement I³ at their centers, in order to give equal strength at the bearing-points with the double links.

The carriers are adapted to turn freely on pins H.

K K are heavy balance-weights cast upon or secured to the under side of the carriers, the functions of which will be more fully hereinafter explained. The links of the double chain are coupled together, and the parallelism of the two chains preserved by pins H′, which pass through sleeves H^3, then through enlargements at the ends of the links, thus constituting the double chain. The ends of pins H and H′ project slightly beyond the outer sides of the links, and are held by key-pins H^2, as shown in Fig. 5. This figure clearly illustrates the construction and arrangement of the links of the chain and pins H and H′, pins H being shown without the carriers and weights. The position of the carriers and weights relatively to the chain and beams of the crane-arm is shown in Figs. 2 and 4.

L L (see Figs. 1 and 4) represent two series of rollers journaled upon pins L′, projecting from castings L^2, which are secured to the beams of the crane-arm. The chain rests upon these rollers and also upon polygonal wheels M and M′, the shafts M^2 of which turn in bearings N^2 in brackets N N′, which are rigidly bolted to the beams which constitute the crane-arm. We ordinarily use but two pairs of polygonal wheels, one of which, M M, I place at the inner end, and the other, M′ M′, at the outer end, of the crane-arm, the chain between the two pairs of wheels resting on and being supported by the rollers L, as already described. The chain, each corresponding pair of links of which supports a mold-carrier, is of sufficient length to form a loop reaching from the polygonal wheels some distance down into the cooling-tank Q, as clearly shown in Fig. 1. The lower portion of this loop is inclosed and steadied by an inverting device, P, (see Figs. 3 and 7,) which may be adjusted vertically and held in any desired position by the adjustable brace and suspension rods P′, whose lower ends are secured to the inverting device P, and whose upper ends are fastened to the sockets P^2, through which the shafts of wheels M M′ pass, and to a distance-piece casting, P^3, midway between the two pairs of polygonal wheels.

P^4 P^4 represent a series of rollers, which revolve on pins P^5, projecting from the inner sides of inverting device P. (See Figs. 3 and 7.) These rollers engage and act upon the under side of the carriers G as they are carried around to the left by the double chain, as indicated in Fig. 1, and which will be more fully explained hereinafter.

Q is a water-tight cooling tank or cistern, preferably made of wrought-iron, the lower portion being made slightly flaring, and the entire tank embedded in concrete, as shown at Q′. This tank is kept filled with water to the level indicated at Q^2 in the drawings. The water is renewed from time to time as it becomes heated, or a steady flow of water may be maintained through the tank in order to keep the water therein at a uniform low temperature. Within the tank and near the bottom thereof, and consequently below the water-line, is placed a receiving-box, R, which is also made of wrought-iron, and has one of its sides, R′, hinged at the bottom in such a manner that it can be let down to a horizontal position in order to permit easy access to the contents of the box when in its elevated position. This box rests upon and is rigidly secured to the top of a hydraulic lifting-ram, S. This ram works in a cylinder, S′, for which an excavation is made below the bottom of the tank. We have shown a ram of the telescopic variety, but the particular style of ram used is not of the essence of our invention. The telescopic variety will be found best adapted for this use when from the nature of the ground deep excavations are impracticable or inconvenient. When this apparatus is used in connection with a furnace having two or more discharge-nozzles, as indicated at E′ in Fig. 1, it will be apparent that the distance between the centers of the molds in each group should be the same as the distance between the nozzles.

In describing the operation, suppose that a group of molds—that is to say, one of the carrier-plates and the molds carried thereby—is in proper position relatively to the nozzles, or, if no nozzles are used, in proper position for filling the molds with molten metal in any suitable manner, the first molds to be filled are preferably those farthest out upon the crane-arm, being the group which at that time is supported by wheels M′ M′, as shown at the right in Fig. 1. Having filled the first group of molds with molten metal, an attendant causes motion to be imparted to the double chain and the parts carried thereby. The motion, which is toward the left in Fig. 1, or toward the inner end of the crane-arm, is continued until another group of molds is in position for filling with molten metal. We have shown as a means of imparting this motion to the double chain a rotary water-pressure engine, T, which is placed at the inner end of the crane-arm. Water-pressure is communicated to this engine by means of a flexible hose (not shown) of sufficient length to permit of the necessary vertical and rotary motion of the crane to the arm of which the engine is securely bolted.

T′ is the shaft of the engine, to which rotary movement is imparted when the engine is running. This shaft carries a worm, T^2, which meshes with a gear, M^3, rigidly secured to the shaft of the polygonal wheels M M at the inner end of the crane-arm.

M^4 (see Fig. 2) is an oil-well which incloses the lower portion of gear M^3.

M^5 is a cock for draining off surplus oil; M^6, a housing for gear M^3; N^3, a housing for the worm, and N^4 are oil-cups, all of ordinary construction. It will be observed that the two pairs of polygonal wheels are identical in construction, but that the pair M′ has no motion,

except as it moves with the chain. The planes which constitute the periphery of these wheels are of sufficient length to support the mold-carriers, and the wheels are placed at such distance apart that the periphery of each carries one side of the endless double chain, the weights K hanging between the wheels, as clearly shown in Fig. 2.

In placing this apparatus in position for use the parts are so adjusted that the crane-arm is horizontal, and the uppermost plane in each of the polygonal wheels is parallel therewith when a group of molds is being filled. As each group of molds is filled the wheels M M are turned toward the left by means of engine T until the next plane is brought into a horizontal position. This movement of wheels M M carries the double chain and wheels M′ M′ along also, thus bringing another group of molds up into position ready for filling. The movement of wheels M M is repeated as often as a group of molds is filled, thus giving the fluid metal ample time to solidify on the outside before the molds and their contents are immersed in the water in the cooling-tank, where the solidification of the ingots is completed. As the links of the chain pass over the top of wheels M M the mold-carriers, without regard to whether the molds are filled or not, turn on pins H just sufficiently to keep them in a horizontal position. This turning of the carriers upon the pins is caused by the weights K K upon the under side of the mold-carriers. The horizontal position of the carriers and ingot-molds is preserved as they pass down into the cooling-tank and some distance below the water-line until the under side of each carrier in regular rotation comes in contact with rollers P^4 upon the inverting device P, which act as the chain is moved forward to turn the carriers and the ingot-molds thereon bottom upward, as clearly shown in Fig. 1. The position of rollers P^4 relatively to the double chain, mold-carriers, and weights is clearly shown in Fig. 7. The rollers are journaled upon enlargements P^7 of studs or pins P^5. These enlargements rest in corresponding sockets in the inverting device, the shoulders of the enlargements being drawn against corresponding shoulders in the inverting device when nuts P^8 are tightened up. The rollers are held upon the studs or pins P^5 by means of heads P^6 upon their inner ends, which rest in countersinks in the inner faces of the rollers, (see dotted lines in Fig. 7,) so that the inner ends of the studs are flush with the surface of the rollers. The enlargements P^7 are slightly longer than the combined depth of the socket and width of the rollers, so that when the nut is tightened up and the enlargement drawn against the shoulder in the inverting device it will be impossible to cramp the rollers. By the time the carriers have reached the position shown in Figs. 1 and 7 the ingots will have become sufficiently solidified, so that they will drop out of the molds or be discharged into the receiving-box R.

In order to prevent the carriers from making a complete revolution when acted upon by rollers P^4, we provide them with projecting horns G^2, (see Figs. 1 and 6,) which, when the carriers are inverted, come in contact with the coupling-pins H′ of the endless double chain. (See Figs. 1 and 5.) The carriers are held in this position—*i. e.*, with the horns G^2 in contact with the coupling-pins—by rollers P^4, beneath which the carriers pass, until they have passed from under the inverting device P, and have commenced their upward movement, at which moment weights K K again act to prevent them from turning, the arrangement being such that the center of gravity of the combined weight and carrier will be to the left of pin H. This position of the carriers relatively to the double chain is preserved until they again pass over wheels M M and begin their descent into the receiving-tank. After all the metal in the furnace has been cast into ingots and deposited in that form in the receiving-box R, an attendant swings the arm of the crane away from the furnace until it is clear of the nozzles or other filling apparatus. Water under pressure is then admitted to the cylinder B of the hydraulic crane, causing the same to rise until the lowest portion of the molds F depending from the loop of the endless double chain is lifted above the level of the floor U. The water is then shut off from cylinder B, and the crane is swung around toward the front until it is in a position at right angles to that shown in Fig. 1, after which water under pressure is admitted to cylinder S′ of the hydraulic lifting-ram S to lift the receiving-box R and the ingots contained therein to or slightly above the level of the floor, the water in the box escaping through holes in the bottom provided for that purpose. The hinged side R′ of the receiving-box is then unfastened and turned down, and the ingots may be removed, after which the hinged side is again fastened up in any suitable manner, the box lowered to the bottom of the tank, and the crane-arm lowered and returned to the position shown in Fig. 1. The apparatus is then ready for the casting of another charge of metal. During the casting of a charge, as the level of the molten metal in the furnace is lowered, it may become necessary to slightly lower the arm of the crane, in order to bring the ingot-molds into proper position for filling. This may readily be accomplished by allowing the necessary amount of water to escape from the cylinder B of the hydraulic crane.

As the details of the operation of the hydraulic crane and the hydraulic lifting-ram form no part of our present invention, we have merely referred to them in a general way as of ordinary construction.

In the modification in Fig. 8 we have shown a larger cooling-tank and receiving-box, and have shown the box as arranged to be lifted by a ram, S, at each end of the tank instead of one under the box at the center thereof. The

box rests upon curved cross-pieces R^3, the ends of which are secured to heavy beams R^4, (one only of which is shown,) extending lengthwise of the tank and attached to bars R^5, (see dotted lines,) which depend from the cross-heads R^6 of the rams.

R^7 represents heavy castings or brackets which support the cylinders S′ of the rams. The operation is precisely the same as in the other form, except that water must be let into or taken from both cylinders simultaneously.

Having thus described our invention, we claim—

1. In an apparatus for casting ingots of metal, a series of mold-carriers, in combination with an endless double chain to which they are pivotally secured.

2. The mold-carriers and an endless double chain to which they are secured, in combination with a crane-arm which carries the chain.

3. The crane-arm, the chain, and the mold-carriers, in combination with mechanism for moving the chain along the crane-arm.

4. In a casting apparatus, molds having dovetails upon the bottom thereof, in combination with a series of mold-carriers having grooves corresponding with the dovetails, and mechanism for imparting motion to the carriers.

5. The molds and mold-carriers and an endless double chain which carries them, in combination with a crane arm carrying a pair of polygonal wheels whose axes are in a horizontal plane, by which motion is imparted to the chain.

6. The crane-arm having rollers L and wheels M and M′, in combination with the mold-carriers upon an endless chain, and mechanism for imparting rotation to wheels M M.

7. In a casting apparatus, the crane-arm consisting of beams C′ C′, to which brackets N N′ are bolted, and the double chain and mold-carriers, in combination with a shaft, M^2, polygonal wheels M, and gear M^3, carried by said shaft, and worm T^2, which meshes with the gear.

8. The combination of the crane-arm, the wheels M M′, the double chain, the mold-carriers, and means, as a water-pressure or other engine upon the arm, and connecting mechanism, whereby the chain is operated.

9. The crane-arm and the endless chain, and means for supporting and moving the chain, in combination with a cooling-tank into which the loop of the chain depends.

10. The crane-arm and the endless chain carrying the mold-carriers, and means for moving the chain, in combination with an inverting device held in the tank by suspension-rods, under which the chain passes.

11. The crane-arm having rollers L and wheels M M′, and the chain and mold-carriers, in combination with inverting device P, held in the tank by suspension-rods P′, and provided with rollers P^4, over which the chain passes.

12. In a casting apparatus, a series of mold-carriers pivoted to their support, and having weights K on their under sides at the center thereof, and horns G^2 at one end, as described, and for the purpose set forth.

13. The mold-carriers having horns G^2 and weights K on their under sides, in combination with pins H, which pass through the carriers, and pivot them to opposite links of the double chain, and pins H′, which couple the links of chain and are engaged by the horns on the carriers.

14. The polygonal wheels M, upon which the double chain rests, in combination with a series of mold-carriers pivoted to the chain, and balance-weights upon the under side of the carriers, which hang between the wheels and act to hold the mold-carriers in a horizontal position as they descend into the cooling-tank.

15. In a casting apparatus, a double endless chain, in combination with a series of mold-carriers pivoted thereto, and balance-weights upon the carriers, which hold them in a horizontal position when they are not otherwise acted upon.

16. The endless double chain and the mold-carriers pivoted thereto, in combination with mechanism for moving the chain, and mechanism for inverting the ingot-molds at a certain regular time.

17. The crane-arm, the double chain, and the mold-carriers, in combination with inverting device P, having rollers P^4, which act to invert the mold-carriers as they come in contact therewith, and upon which the bottoms of the carriers bear as they pass under the inverting device.

18. The endless double chain, the mold-carriers pivoted thereto, and having weights upon their under side and horns at one end, in combination with rollers upon inverting device P, which invert the carriers, and pins H′, which are engaged by the horns to prevent the revolution of the carriers.

19. The combination, with the ingot-molds and carriers therefor, pivoted in an endless double chain, of a cooling-tank in which the loop of the chain depends, mechanism for inverting the carriers and molds, and a box for receiving the ingots.

20. The combination, with the nozzles of a furnace, of molds carried by an endless chain, which depends in a cooling-tank, mechanism for imparting motion to the chain, mechanism for inverting the molds, and a receiving-box into which the ingots are discharged.

21. The combination, with the endless double chain and the mold-carriers pivoted thereto, of a hydraulic crane, upon the arm of which the double chain is carried, whereby the chain and mold-carriers may be raised or lowered or swung into or out of position at any time.

22. A hydraulic crane the arm of which carries an endless double chain to which a series of mold-carriers is pivoted, in combination with a cooling-tank, and a receiving-box

within the tank, into which the ingots are discharged.

23. A hydraulic crane the arm of which carries an endless double chain, a series of ingot-mold carriers pivoted to said chain, and mechanism upon the arm for imparting motion to the chain, in combination with a cooling-tank and mechanism therein for discharging the ingots into a receiving-box within the tank.

24. The crane, the endless double chain, and ingot-molds carried thereby, and mechanism for inverting the mold-carriers, in combination with a receiving-box attached to a hydraulic lifting-ram, whereby the receiving-box may be lifted to the level of the floor when its contents are to be removed.

25. The endless double chain and mold-carriers pivoted thereto, and mechanism for inverting the mold-carriers, in combination with a receiving-box having a hinged side, and a hydraulic lifting-ram for raising the same.

26. The hydraulic crane whose arm carries the polygonal wheels M M′, gear-wheel M^3 upon one of the shafts, and the rollers L, in combination with the water-pressure engine T, whose shaft is provided with a worm engaging said gear-wheel, substantially as described.

27. In a casting apparatus, the endless double chain I, formed of alternate links of single and double bars of metal coupled together by pins H′, which pass through sleeves H^3, in combination with the mold-carriers, the crane-arm, and wheels M M′, whose axes are in a horizontal plane on said arm.

28. In a casting apparatus, the mold-carriers which turn upon pins H, and are provided with weights K, grooves for the ingot-molds, and horns G^2, in combination with the endless double chain by which the pins are carried.

29. In a casting apparatus, the inverting device P, which bestrides the loop of the double chain, and is suspended from the shaft of wheels M M′, and from a distance-piece, P^3, midway between the wheels, by adjustable suspension-rods P′, and is provided with rollers P^4, which invert the carriers and ingot-molds carried thereby.

30. The cooling-tank, in combination with the receiving-box having a hinged side, and a hydraulic lifting-ram, as described, and for the purpose set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

WILLIAM F. DURFEE.
THOMAS EGLESTON.

Witnesses:
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WM. A. JONES.

Witnesses as to Thos. Egleston:
JAMES QUINLAN,
JOS. M. SIMONSON.