No. 629,480. Patented July 25, 1899.

E. A. UEHLING & J. W. MILLER.

CASTING AND CONVEYING APPARATUS.

(Application filed June 30, 1897.)

(No Model.) 6 Sheets—Sheet 1.

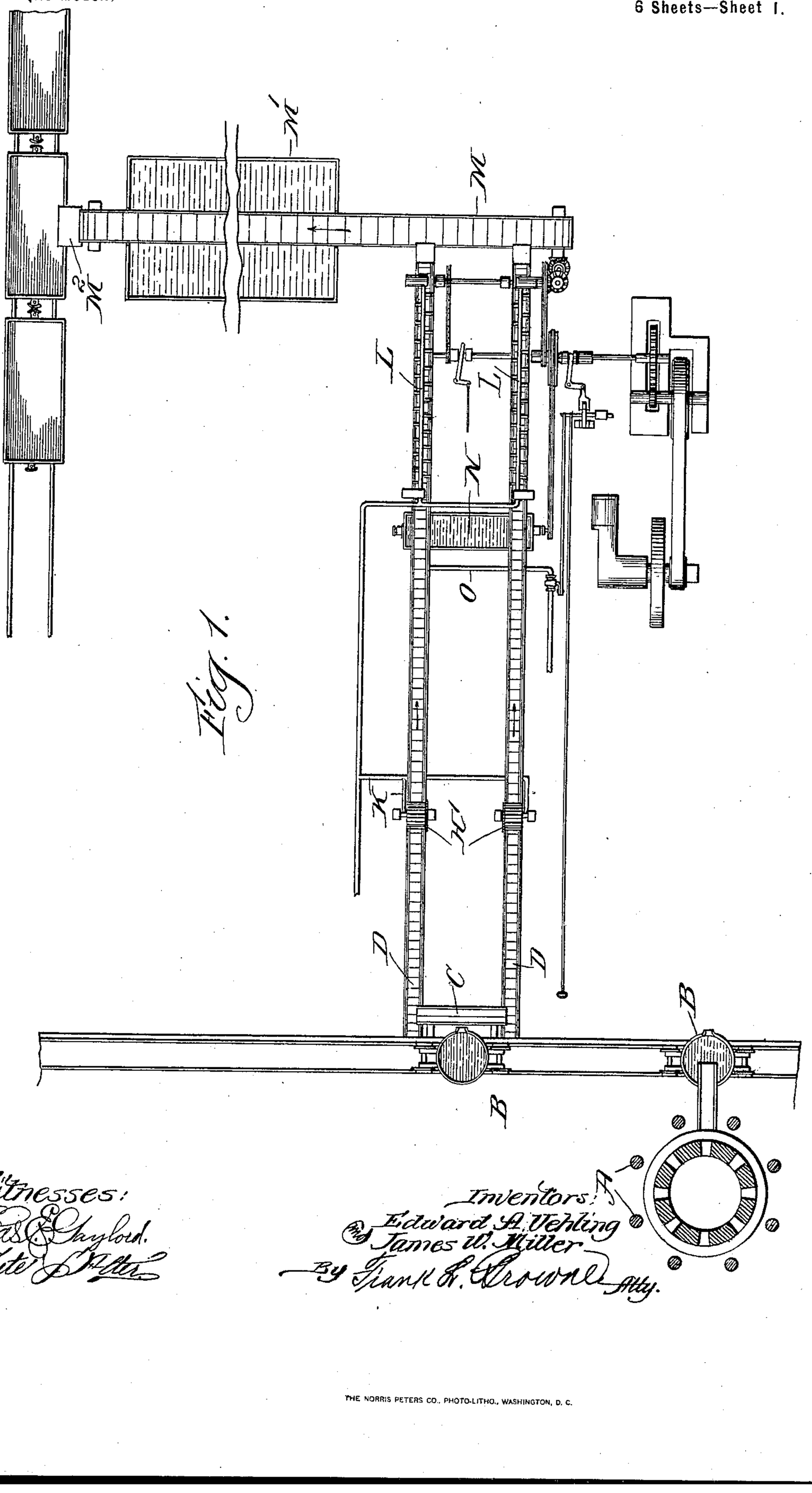

Fig. 1.

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Luther L. Miller

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(No Model.) 6 Sheets—Sheet 2.

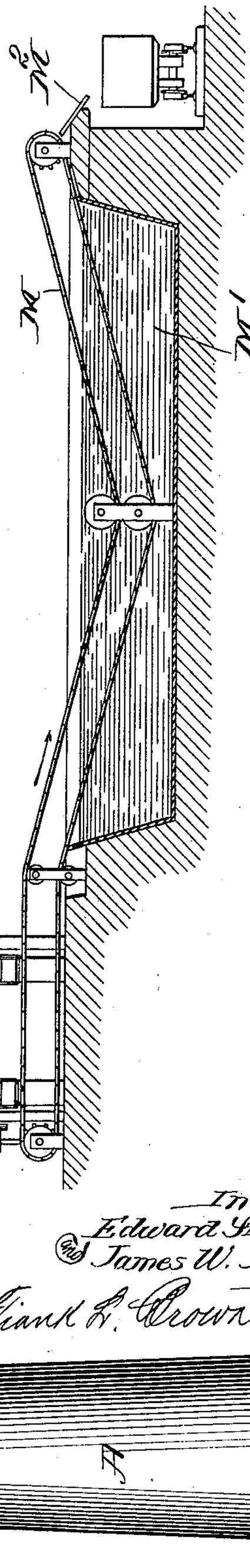

Fig. 3.

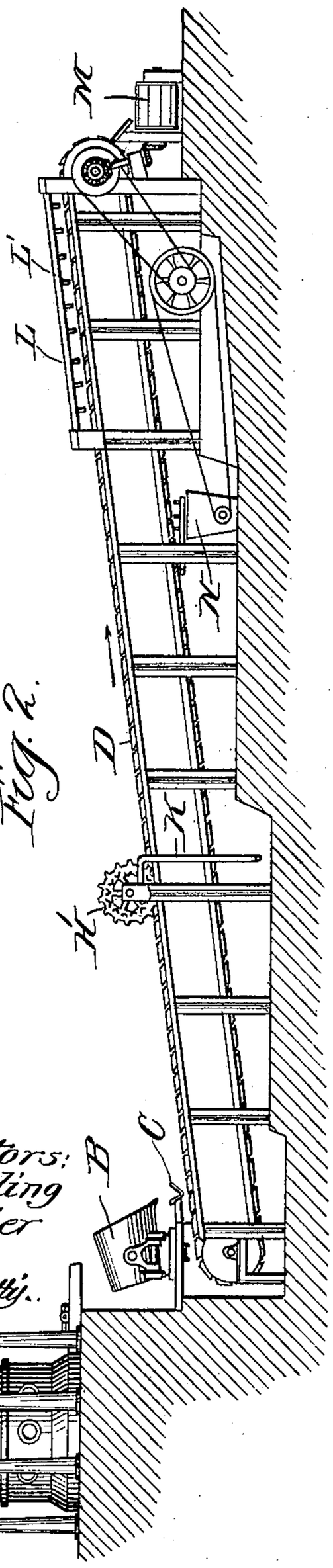

Fig. 2.

Witnesses:
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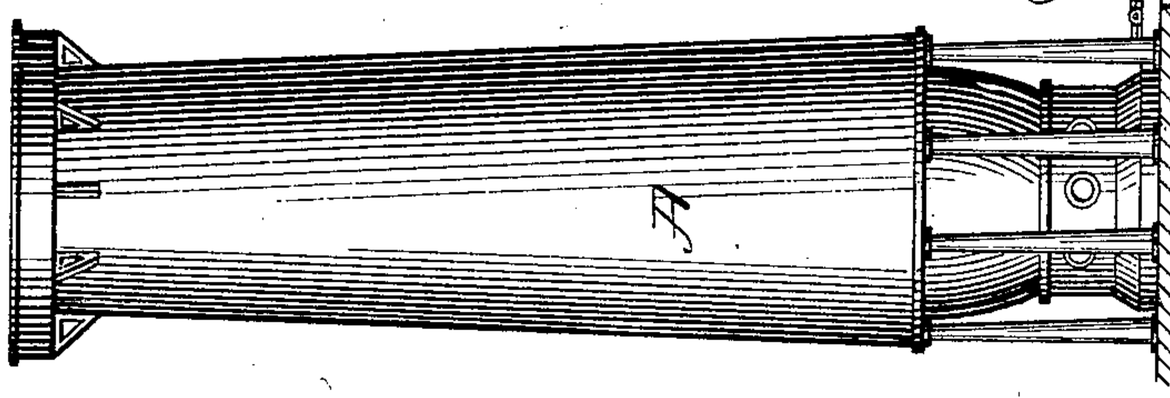

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(No Model.) 6 Sheets—Sheet 3.

Fig. 5.

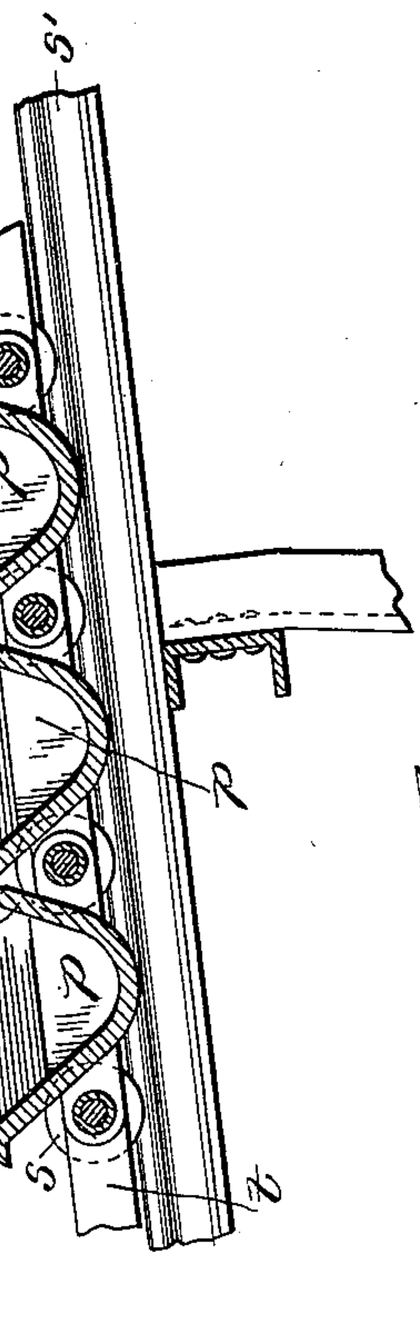


Fig. 6.

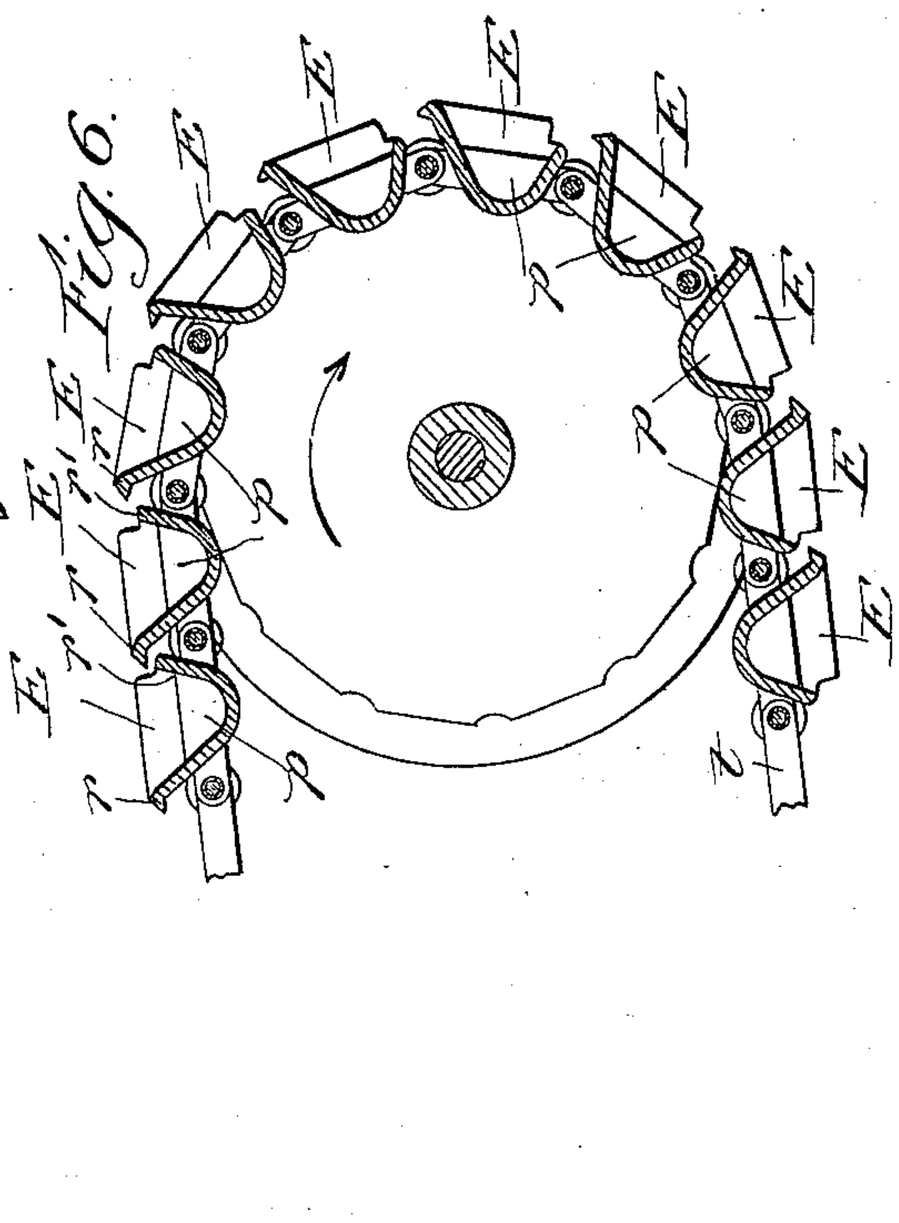
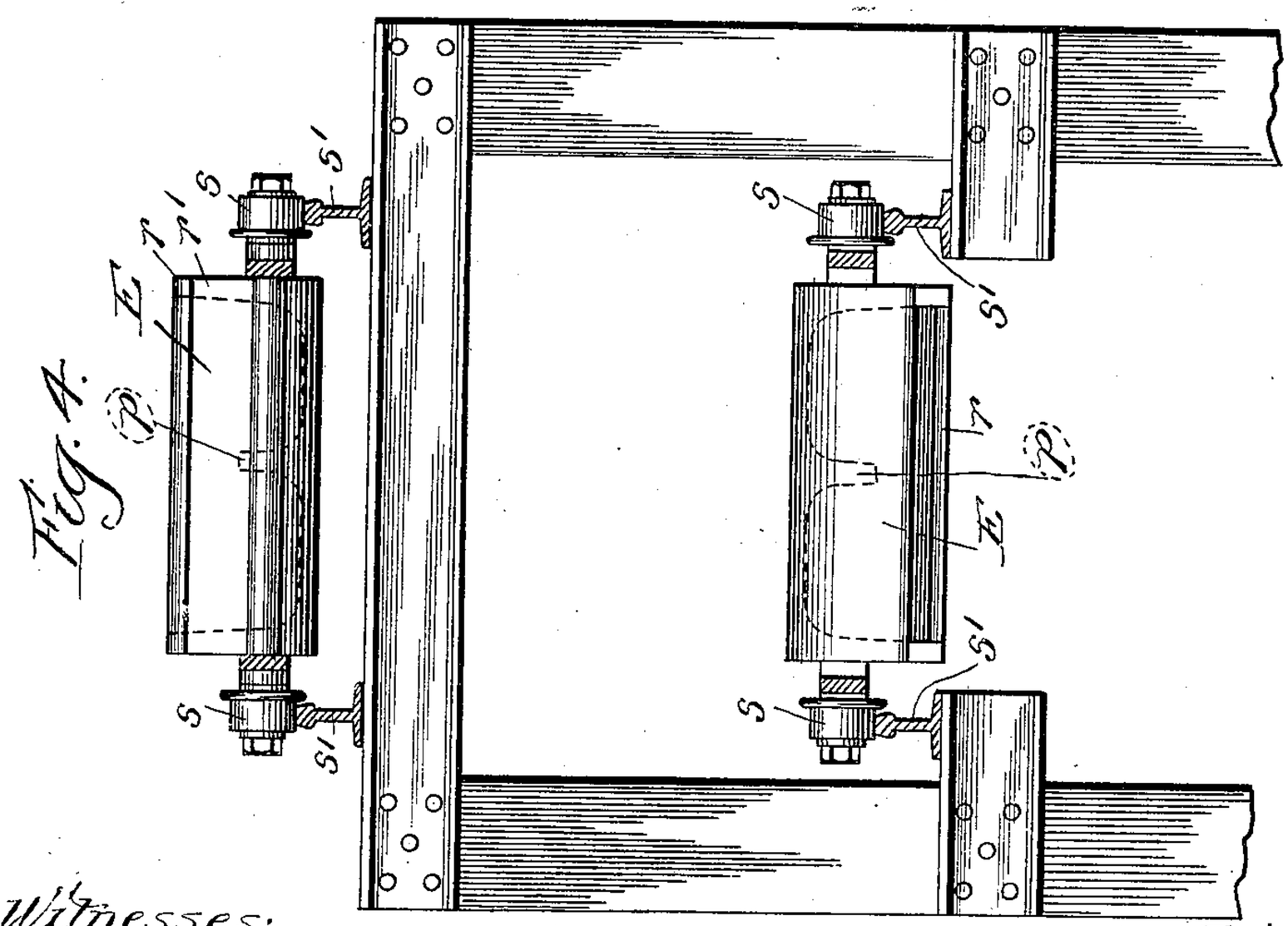


Fig. 4.



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CASTING AND CONVEYING APPARATUS.

(Application filed June 30, 1897.)

(No Model.) 6 Sheets—Sheet 4.

Fig. 6a.

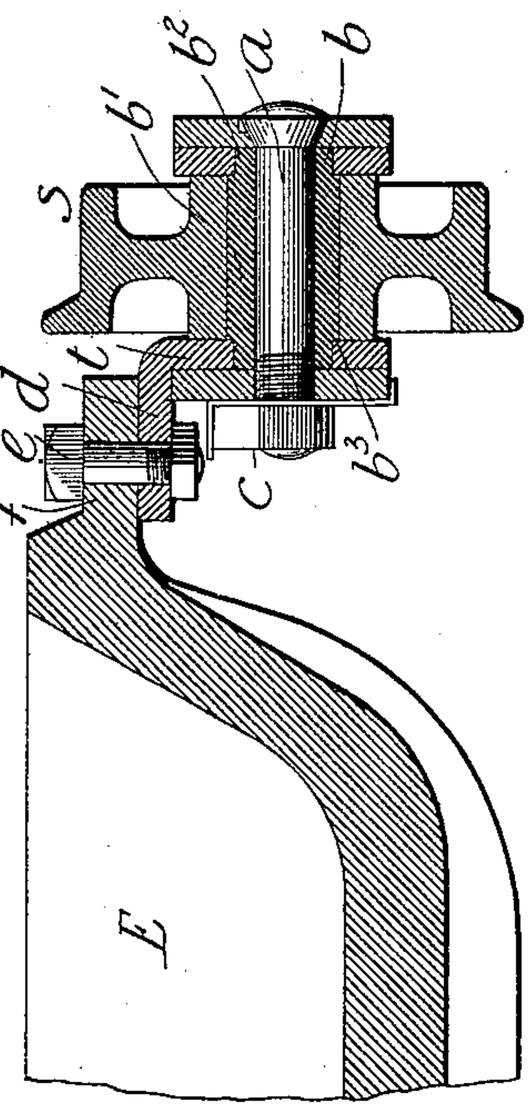
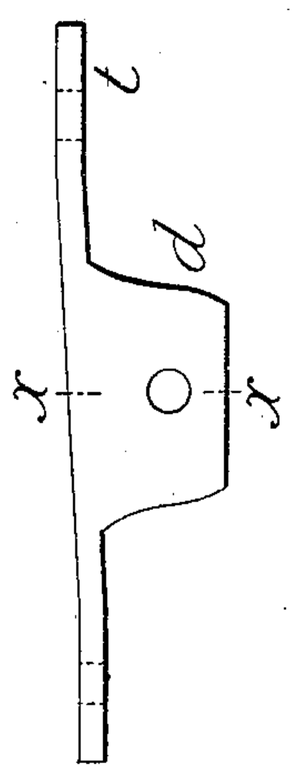


Fig. 6b.



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No. 629,480. Patented July 25, 1899.

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CASTING AND CONVEYING APPARATUS.

(Application filed June 30, 1897.)

(No Model.) 6 Sheets—Sheet 5.

Fig. 9.

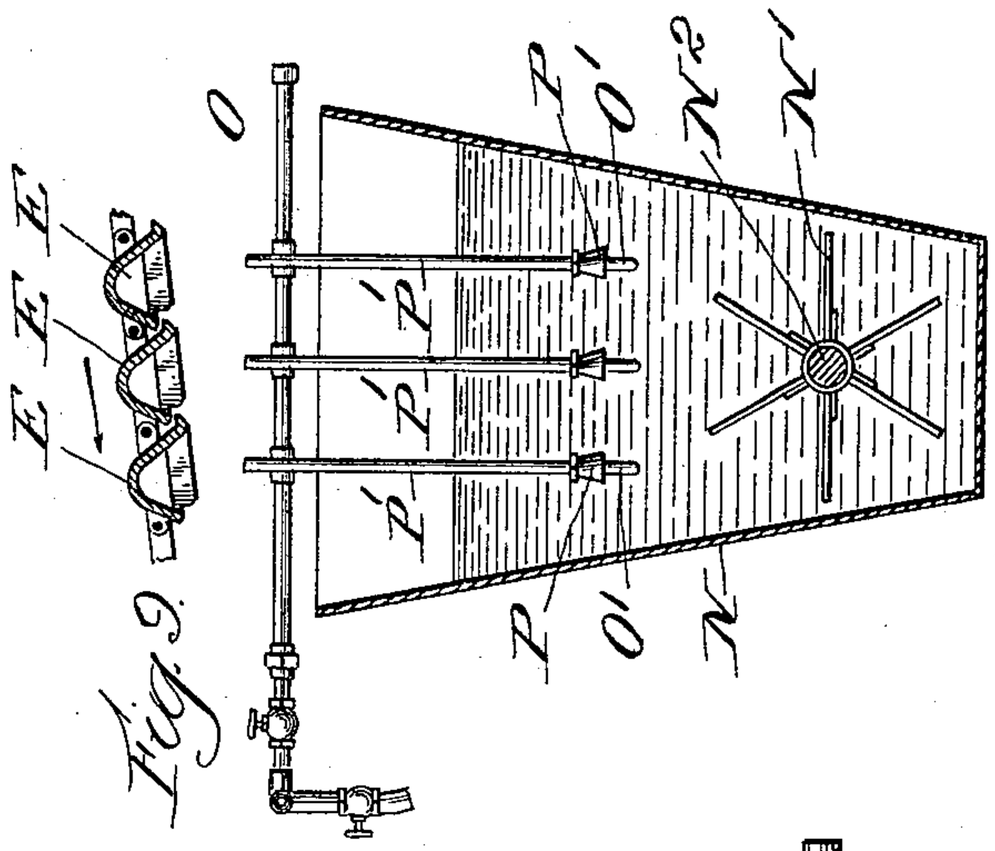


Fig. 7.

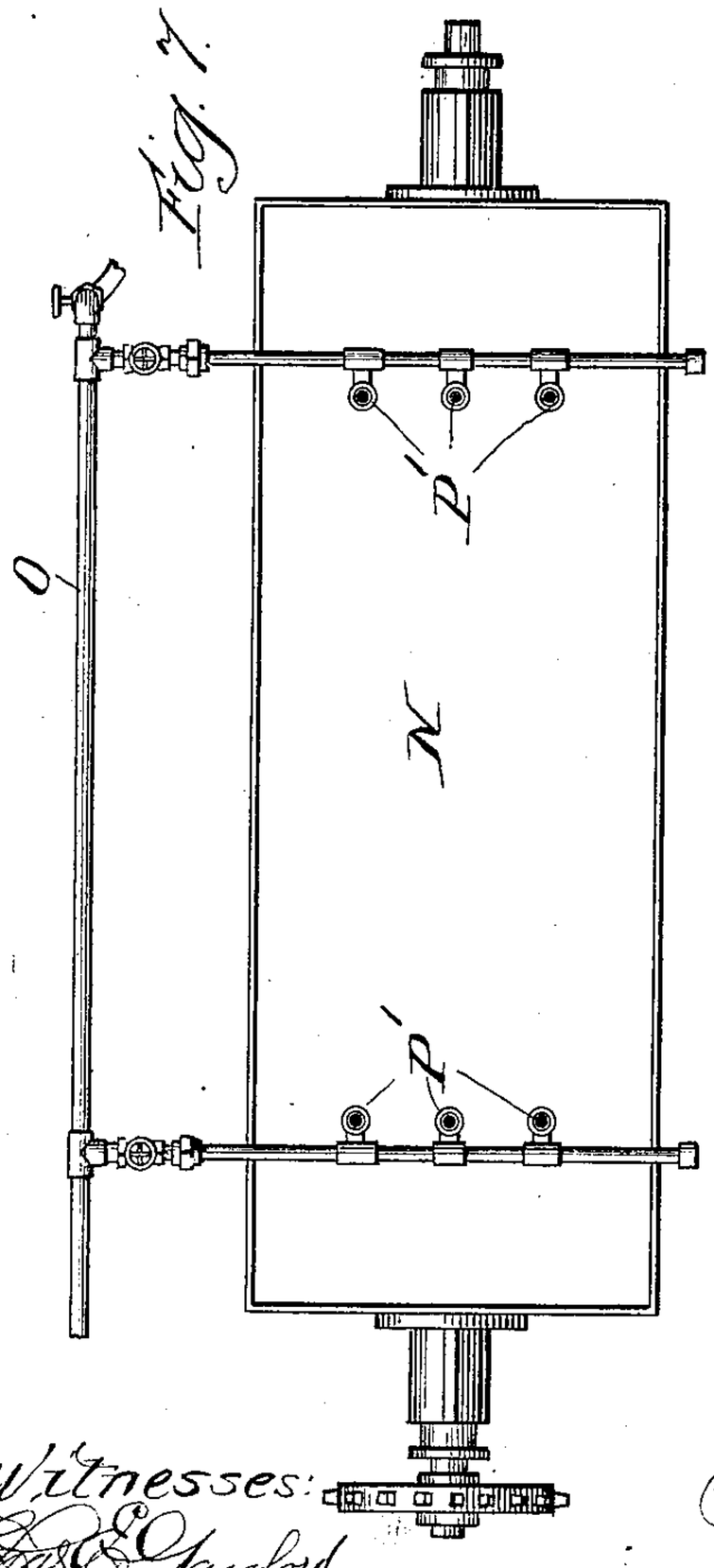
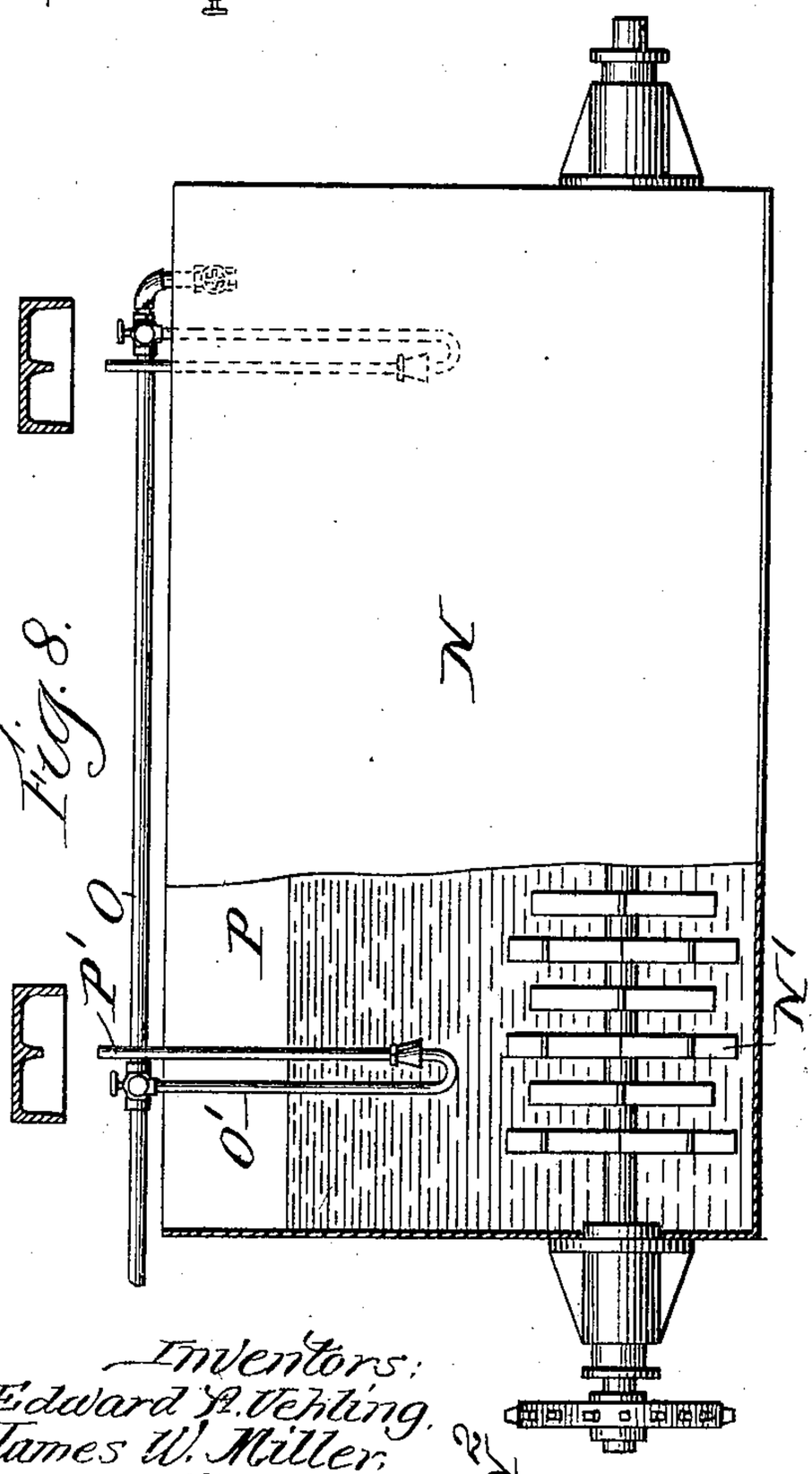


Fig. 8.



Witnesses:
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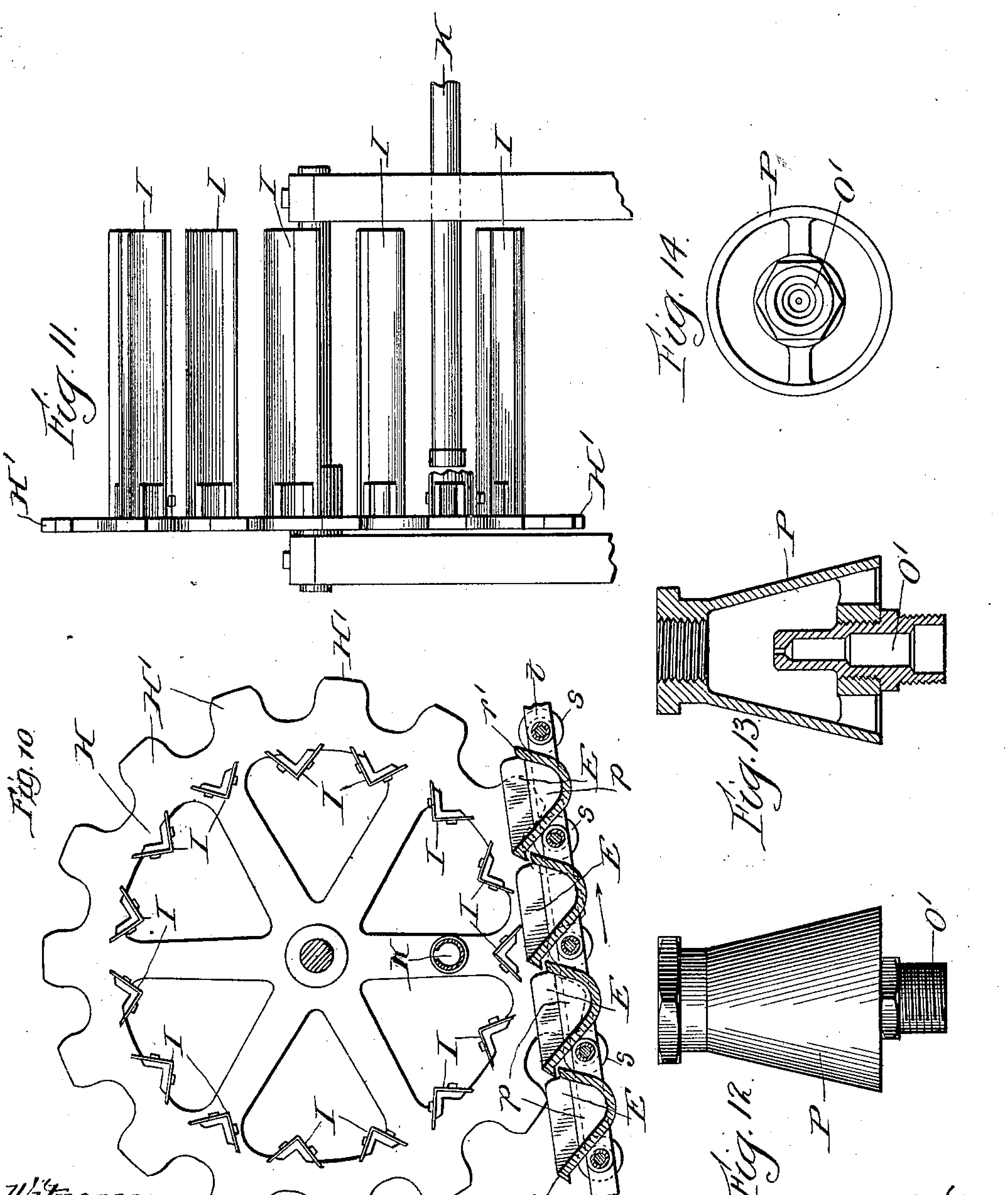
E. A. UEHLING & J. W. MILLER.

CASTING AND CONVEYING APPARATUS.

(Application filed June 30, 1897.)

(No Model.) 6 Sheets—Sheet 6.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD A. UEHLING, OF NEWARK, NEW JERSEY, AND JAMES W. MILLER, OF CHICAGO, ILLINOIS.

CASTING AND CONVEYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 629,480, dated July 25, 1899.

Application filed June 30, 1897. Serial No. 642,924. (No model.)

To all whom it may concern:

Be it known that we, EDWARD A. UEHLING, residing in Newark, in the county of Essex and State of New Jersey, and JAMES W. MILLER, residing in Chicago, in the county of Cook and State of Illinois, citizens of the United States, have invented certain new and useful Improvements in Casting and Conveying Apparatus, (for which we have applied for Letters Patent of foreign countries as follows, to wit: in Germany, No. 2,586, filed April 23, 1897; in France, No. 283,872, filed April 23, 1897; in Belgium, No. 99,010, filed April 23, 1897; in Austria, filed April 23, 1897; in Sweden, No. 576, filed April 23, 1897, and in Russia, No. 1,795, filed April 30, 1897;) and we hereby declare the following to be a full, clear, and exact description thereof.

Our invention is in the nature of an improvement upon the apparatus described and claimed in Letters Patent of the United States No. 548,146, granted October 15, 1895, to Edward A. Uehling, and has relation to the treatment of metal in a molten condition with particular reference, first, to changing or altering the metal after it comes from the furnace in which it is melted or produced, and, second, to handling it and conveying it away from the furnace. The invention is applicable to the treatment of all kinds of metal while in a molten state and can be used with success in casting copper, in casting basic pig, or in casting other metals, but is in its completest form particularly and especially useful in the casting of pig-iron which is to be adapted for use in making foundry-castings.

The greatest evil in casting pigs of any metal in sand molds is due to the fact that when the metal congeals it takes up silica from the sand, whereby the quality of the pig becomes deteriorated from its desired condition. The making of these sand molds or pig-beds is troublesome and expensive, and the pigs are irregular in shape and inconvenient to handle. Moreover, under previous methods of casting, where it has been the practice to convey the metals through runways to sows and pig-beds, it is well known that the pigs farthest from the tapping-hole of the furnace are much inferior in quality to those nearer to the furnace, the variation in quality being much greater than should be expected from any variation in the action of the furnace itself. This is generally known to be due to the fact that the molten iron in the course of its travel takes up impurities and changes in its character to a lower grade of metal, and the farther it travels necessarily the more marked becomes its deterioration. After the pigs have been made and after they have cooled they must be deported from the pig-bed, which is destroyed in the operation, and loaded upon cars for shipment, and for a new casting new pig-beds must be made. When it is remembered that in basic pig it is of the utmost importance that the percentage of silicon contained therein be the lowest possible and that the utmost care is practiced in smelting the ore to produce a pig thus low in silicon, it becomes manifest that the silica adhering to the outside of the pig because of the use of sand in the pig-bed is most objectionable. This contamination by sand is avoided by the use of our apparatus and method of casting, and the pigs are uniform, smooth, and shapely.

In making pig metal for foundry purposes it is manifestly of the highest importance that the carbon content of the iron shall, if possible, exceed the carbon content obtainable in the blast-furnace and that its form shall be that best suited for castings. With this object in view and to the end that this carbon content may be either increased or changed to a form where its value in the production of foundry-castings shall be improved it has been suggested that the iron should be introduced into a vessel previously charged with pulverized carbonaceous material, such as ground coke or graphite, and cast into iron molds previously coated heavily with powdered carbonaceous material. The operation has been entirely successful, and the iron thus treated is found in many instances to contain an increase of carbon and in all instances to contain the carbon, whether increased or not, in such a form or combina-

tion that the metal is vastly superior for foundry uses, producing castings of greatly-increased strength and softness. It is believed that this process of treating the metal with carbonaceous material while molten produces its beneficial effect by changing the carbon or carbids that form the matrix or cement between the crystals of iron. In this changed condition the carbon materially contributes to the strengthening of the metal, at the same time increasing its softness to a marked degree and also improving its elasticity and resilience. Much difficulty has been found, however, in producing iron in large quantities by the process just described, and our invention has been successfully employed and is directed more particularly to an apparatus by which the entire output of a furnace or any number of furnaces can be successfully converted into the high-class foundry-iron here described.

In the drawings, Figure 1 is a view, diagrammatic in its nature, showing in a general way the entire apparatus and the operation of it, beginning with the tapping of the furnace and ending with the loading of the pigs on the cars. Fig. 2 is a side elevation showing the apparatus for casting and conveying the metal from the furnace to the carrier which leads to the car and also showing the method of treating the metal for improving it when the apparatus is used for that purpose. Fig. 3 is a view of the conveyer which transfers the pigs from the molds to the cars. Fig. 4 is a cross-section through the carrier, showing the frame and the supports for the molds. Fig. 5 is a side elevation of the carrier, showing the way of supporting the molds. Fig. 6 is a view at the end of the carrier at the point where the metal is dropped into the transverse conveyer; Fig. 6^a, a transverse sectional view on the line $x\,x$, Fig. 6^b, of the preferred means of supporting the molds; Fig. 6^b, a plan view of one of the links. Fig. 7 is a plan view of the box which contains the refractory or carbonaceous pulverulent material which is to be sprayed against the molds; Fig. 8, a front elevation, partly in section, of the same; Fig. 9, an end sectional elevation of the same. Fig. 10 is a view in side elevation of our device for cooling the center of the pig without cooling the molds, which might easily be fractured if they were cooled before the mass of iron which they contain is cooled. Fig. 11 is a front view of the same apparatus. Fig. 12 is a view in elevation, Fig. 13 a view in vertical section, and Fig. 14 a view in horizontal section, of a pneumatic spraying device the function of which is to spray against the molds either carbonaceous material or refractory material, depending upon whether the conveyer is to be used in making a pig for foundry purposes or a basic pig.

A indicates a blast-furnace.

B represents a ladle mounted on a truck, so that it may receive the iron from the blast-furnace and carry it to the casting apparatus. Where the iron is to be treated for the purpose of changing or increasing its carbon, we place ground carbonaceous material in the ladle before introducing the bulk of the molten iron, and as, for many reasons, the preferred method of doing this we coat its sides and bottom with pulverized carbonaceous material—such as graphite, coke, or the like—in such quantity as may be necessary to bring about the desired change in the iron. The carbonaceous material need not be an impalpable powder, but ought not to be too coarse. The time taken to carry the ladle from the blast-furnace to the casting apparatus is entirely sufficient to enable all the action that is to take place to be completed. When the iron is already high in carbon or is sufficiently treated without requiring further treatment with carbon in the ladle, this treatment may be dispensed with and the treatment in the molds, presently described, may be found entirely sufficient.

C represents a trough located between two carriers D and serving to deflect the metal poured into the trough from the tipped ladle B, so that the metal passes to the molds in the carriers D. Each carrier D is constructed of links t, the ends of which are connected in endless relation by axles the ends of which have loose flanged wheels s, running on rails s' outside of the links. The rails are secured in a supporting structure so that the flanged wheels will be supported alike on the under and traveling sides of the endless mold-carrier, while the carrier is maintained in position upon the supporting structure by a suitable drum mounted in each end of the structure. The respective drum-shafts at the delivery ends of the mold-carriers are connected by suitable mechanism with an engine, by which either or both of the carriers can be operated. The molds or buckets E are of a size and shape suitable for forming the pigs, and they are fixed by means of lugs on their ends to the links, so that each mold is caused to turn over at the end of the carrier to deliver the pig and to bring the upper side of the mold down in its travel back to the spout, where the open side of the mold is again turned uppermost to be again filled with metal. It will thus be understood that when the open side of the mold is up it travels forward, conveying the molten metal to the point of delivery, and as the mold travels back in the endless movement of the carrier, having been heated by the hot iron which it previously contained, it is at the proper point in its travel sprayed with carbonaceous material, if a foundry pig is to be made, or with a basic refractory material, if a basic pig is to be made. The molds are of peculiar construction, being made of cast-iron and formed so as to present at one side an upwardly-curved lip r, adapted to overhang the side r' of the

contiguous mold, and in this manner the rear side of one mold forms a lapping guard or shield over the space between the molds, and thereby prevents the metal as it is poured from the spout from falling between the molds. In order that the pig may easily drop out of the mold at the end of the conveyer and also to afford as large a surface as possible for treating the pig with carbonaceous material, the bottom of the mold or bucket has the central upward projection *p*.

It should be stated that it is desirable that the molds or buckets E shall be secured to the carrier in such a manner that in case one should crack or break it can be readily withdrawn and a new one put in its place. Such a means is illustrated in detail in Figs. 6ª and 6ᵇ. Within the wheel *s* is a bolt *a*, on which the wheel rotates. Around the bolt *a* is a bushing *b*, having its central portion *b'* somewhat thicker than the end portions b^2 to afford shoulders b^3. The links *t* extend from wheel to wheel on each side, being received at their ends on the bolt *b*. The links are held firmly in place by the lock-nut *c*. The shoulders b^3 prevent the inner links from pressing against the wheel *s*, and the ends of the bushing *b* serve similarly to prevent too close contact between the links. Each link *t* on the inner side of the carrier is provided with the integral laterally-extending perforated ear *d*, through the hole in which extends the bolt *e*, which also passes through the lug *f* on the end of the mold E. By this arrangement any broken part may be readily removed and replaced.

It is of the utmost importance that the pig shall be cooled in such a manner that the mold shall not break, and it is also important that the pig shall be permitted to solidify, so that when deposited upon the conveyer or platform which leads to the car it will be sufficiently cooled to be carried on this platform. In order to cool the pig without cooling the mold, we have contrived the apparatus shown in Figs. 10 and 11. It consists of a wheel H, having large spurs H', which fit in the links *t*, so that as the carrier moves forward the links engaging the spurs H' serve to rotate the wheel H. On this wheel H and extending transversely from its side across the line of the molds are inverted-**V**-shaped deflector-plates I, these plates being in such relation to each other and to the molds carried by the carrier that as the molds advance and the wheel H rotates the deflecting-plates I will cover the meeting edges of the molds and the open space between the deflecting-plates will be centrally over the center of the pig. Projecting into the space within the series of deflector-plates I is a water-pipe K, having perforations, so that the water can come out of the pipe. It will thus be seen that while there is a constant stream of water coming out of the pipe K and falling down toward the carrier the water is deflected so that it strikes the center of the pig and does not strike the mold itself. In this manner the pig is caused to be partly cooled first at the center, so that it contracts and solidifies without danger of breaking the mold. To complete the cooling and solidifying, we provide means for spraying with water the pig-molds and the pigs, which means may consist of a water-pipe L, extending longitudinally of the carrier and having spraying-nozzles L'. In this way the surface of the pig-molds and the pigs therein are sprayed with water, which cools them without danger of breaking the mold.

When the pig is conveyed to the end of the carrier and the molds pass around the drum at this end, the pigs fall out of the molds upon the traveling platform M. The platform M travels past the end of the carriers and down through a water-trough M' and thence up to a chute M^2, at which point the conveyer drops suddenly down. The pig is thus transferred to the chute and from the chute to the car which is to receive the iron. The object of the water-trough M' is to complete the necessary cooling of the pig before it is delivered to the car. The car may be placed upon a weighing-scale, so that when the necessary weight of pig metal has been deposited thereon it can be moved away and another car take its place. It may be stated that while it is usual to use ladles B, having a capacity of, say, fifteen tons, the capacity of the carrier is only limited by the demand upon it, and the entire output of a furnace contained in several ladles can be cast in a continuous operation.

When the molds have been heated and before they take a second pig in their endless movement forward, it is necessary that they shall be recoated either with a refractory material or with carbonaceous material. It is found that it is impracticable to effect this recoating by hand or by mechanical brushing devices; but we accomplish the operation with unqualified success by the use of the apparatus shown in Figs. 7, 8, 9, 12, 13, and 14. It comprises a tank N, in the bottom of which are stirring-arms N', rotated by a shaft N^2, connected with the driving power preferably by means of a clutch. (Shown in Fig. 1.) The upper end of the tank is open. This tank contains either lime and water or other refractory material and water or finely-divided carbonaceous material and water, and the stirring-arms keep the mass thoroughly mixed. Leading down into the tank N, which is located immediately beneath the carrier, are branches of an air-pipe O, these branches terminating in the crook O', and the ends enter the under side of the bell-shaped mouth P of the spraying-pipes *p'*. The ends of the pipe O' constitute an ejector. The bell-mouth P is located below the level of the mixture of refractory material and water in the tank N just above the stirring-arms N', and the other end of the spraying-pipe P' extends above the

tank just below the line of the carrier being conveyed back to the ladle. The air-pipe O has a cock which can be operated by hand at the time the stirring-arms are started to rotate. The effect of the operation is to coat the molds uniformly throughout their interior with sufficient refractory or carbonaceous material for all purposes desired. The fact that the tank is considerably wider at its upper end than the mold which is being coated prevents the loss of refractory or carbonaceous material by waste, as all that is not deposited upon the hot surface of the mold falls back into the tank.

The mold-carrier may move in a perfectly horizontal line or it may be on a higher level where it receives the iron than it is at the point where it transfers the pig to the conveyer; but we prefer to have it move in an upward-inclined direction, so that the usual conditions of the formation of the ground at furnaces will enable the apparatus to be put into place without any special topographical engineering. This is a matter, however, of slight importance when the vast economy effected by the apparatus is taken into consideration. We have not gone into detail as to the kind of engine to be used, nor as to the connection between the engine and the driving-drums, which should drive the links, and thus drive the molds, all these being matters as to which any skilled engineer has already full information. Neither have we deemed it necessary to show the connections for obtaining the necessary pneumatic pressure or the water-supply, as it is to be understood that any suitable source for air-pressure and for water-supply which the furnace surroundings present can be availed of in this connection. The conveyer which carries the pig from the carrier to the car may be dispensed with and the pig deposited directly upon the car or filed and then conveyed to the car; but in all respects we consider the arrangement shown as the best, as it enables us to transfer the pig metal to the point of transportation in a period not to exceed eleven minutes from the moment that the ladle is poured, and as this is accomplished without any manual labor whatsoever and presents, moreover, a pig free from sand and scruff and, if desired, materially improved in its quality in the matter of its carbon content the great importance of the invention to foundrymen and to manufacturers of pig metal will be immediately apparent.

Although we have made special reference to basic pig, on the one hand, and to high-carbon pig, on the other, these are merely referred to as examples. Pigs of any metal, as well as any kind of iron pigs, can be cast and conveyed by this method and apparatus with great advantage, both in the matter of economy of handling and in the quality of product. In the mere matter of handling basic pig an approximate saving of two-thirds of the labor cost is effected, while the machinery itself need not be expensive or complicated in any sense.

The conveyer illustrated in Fig. 3 is much to be preferred under all conditions where the ground-space at the plant and the quantity of iron produced in the furnace justifies its use; but it is not an indispensable feature of the apparatus. We have with entire success omitted the conveyer M and water-trough M′ and in place thereof have caused the pigs to be deposited from the carrier directly upon a receiving-car of metal, the pigs having been sufficiently solidified in the travel from the ladle to the dumping end to permit them to be received in this car. It is sometimes desirable to permit the subsequent cooling of the pig to take place naturally; but we have sometimes aided the cooling with artificial means, such as the injection of water into the receiving-car. From the receiving-car the metal may be quickly conveyed to any point—as, for instance, to a car for shipment or to the metal pile for storage.

What we claim as new, and desire to secure by Letters Patent, is—

1. The apparatus herein described for treating and casting metal comprising, in combination, an endless conveyer, molds supported on said conveyer to move therewith in one direction with the open side up and in the reverse direction in an inverted position, means for cooling the contained metal in the movement from the receiving to the discharge end of the carrier, and a spray device located below the line of movement of the molds on their return to the receiving end and means for automatically operating it coincidently with the movement of the molds to spray against said molds while in a heated condition, a coating of pulverulent material, substantially as described.

2. In an apparatus for treating and casting metal, the combination with an endless carrier and molds supported thereon and adapted to receive the cast metal as it is discharged from the furnace, mixer or ladle, of a water-pipe having a fixed relation to the upper line of movement of the carrier, and a rotating wheel carrying spray-deflecting plates, said wheel arranged to rotate with the movement of the carrier, and said spray-deflecting plates arranged to cover and protect the meeting edges of the molds, whereby the water for cooling the pig is deflected to the center of the casting, substantially as described.

3. In an apparatus for casting metal, the combination with an endless carrier and with the molds carried thereby in a manner to present their open face upward on the outward movement and downward on the return movement, of means for cooling the center of the pig without cooling the mold, comprising a rotating wheel carrying deflecting-plates, said wheel having means for moving it in unison with the carrier, and said deflecting-plates operating to cover the meeting edges of the

molds, a water-pipe for conveying water to a point above the molds to cause it to fall upon the deflecting-plates and be deflected to the center of the casting, and means for cooling the molds and contained pig immediately before the removal of the pig from the molds, comprising a longitudinally-extending rotary spray-pipe located above the line of movement of the molds and toward the discharging end thereof, whereby the metal received on the carrier is first centrally cooled and then cooled throughout before its discharge from the carrier, all as set forth.

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