No. 876,946. PATENTED JAN. 21, 1908.

E. A. CUSTER.

APPARATUS FOR CASTING METAL PIPES.

APPLICATION FILED MAY 11, 1907.

3 SHEETS—SHEET 1.

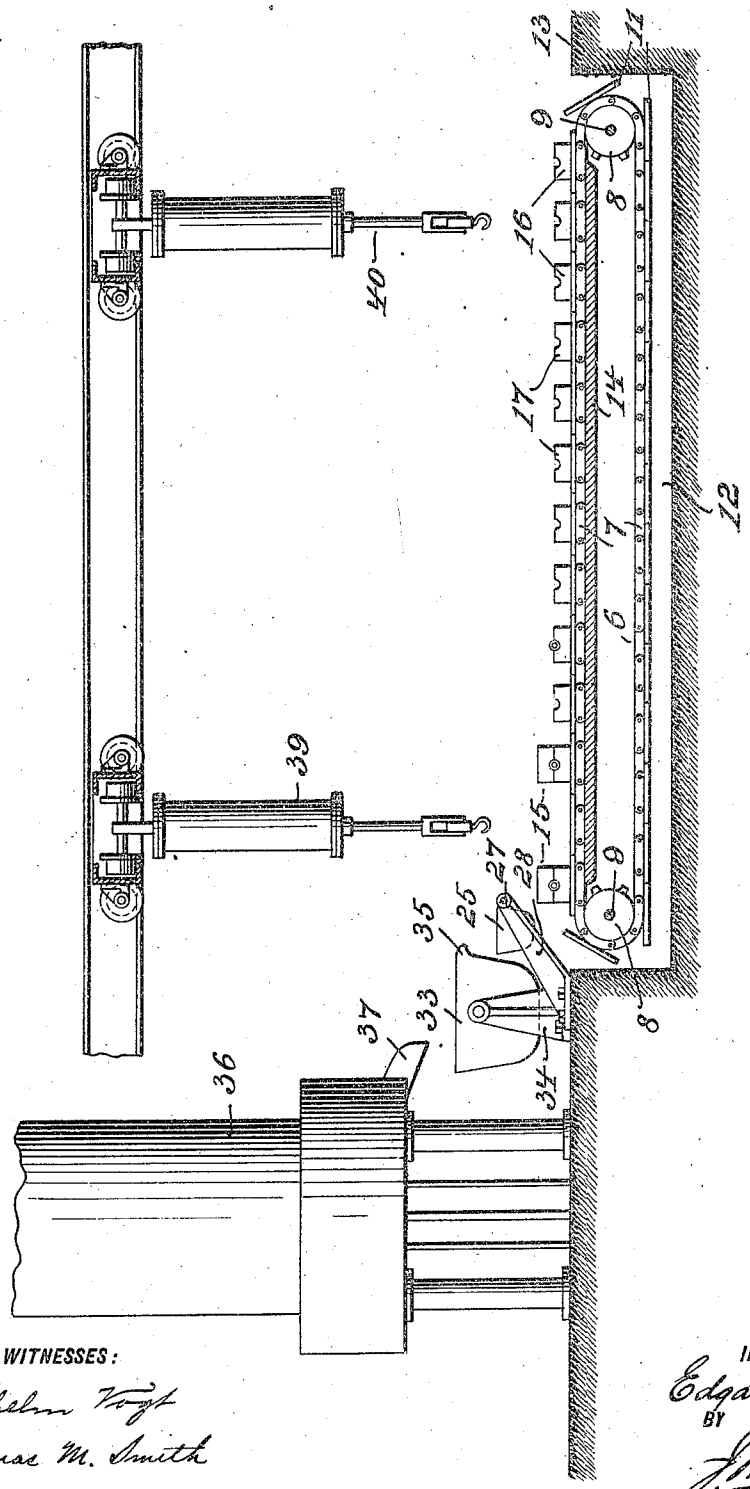


Fig. 1.

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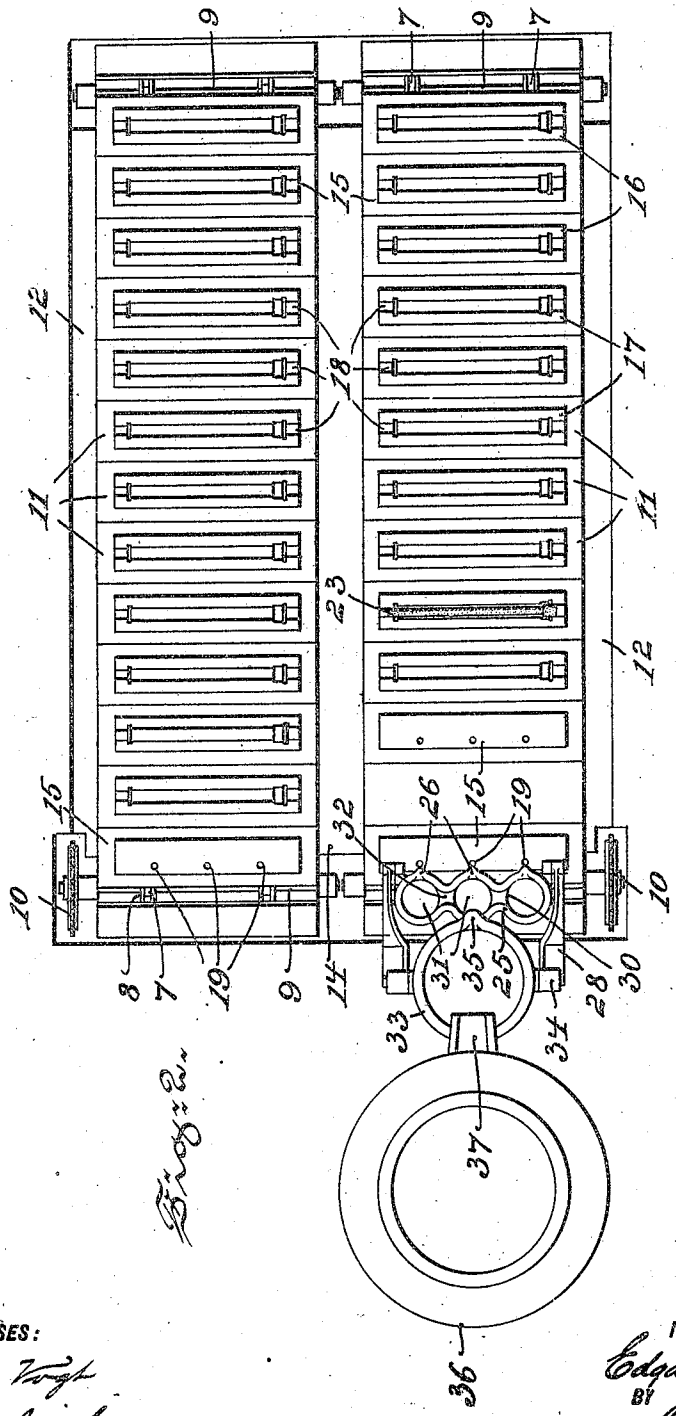


Fig. 2.

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Fig. 3.

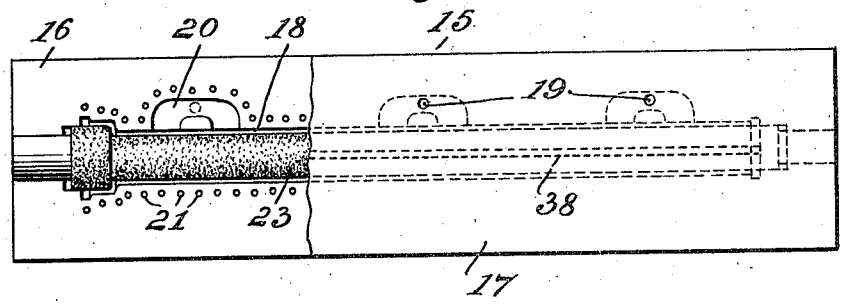


Fig. 4.

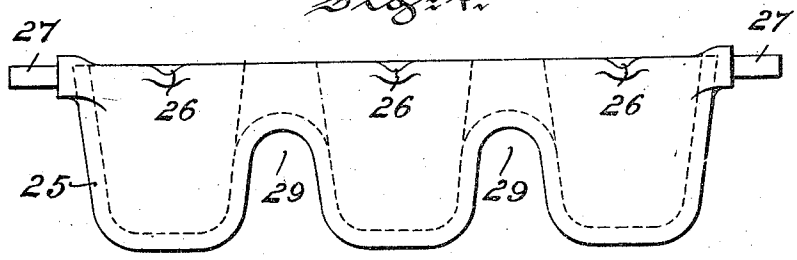
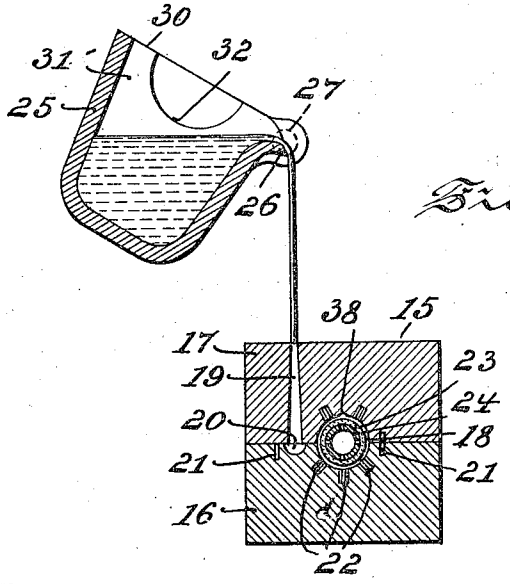


Fig. 5.



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APPARATUS FOR CASTING METAL PIPES.

No. 876,946. Specification of Letters Patent. Patented Jan. 21, 1908.

Application filed May 11, 1907. Serial No. 373,144.

To all whom it may concern:

Be it known that I, EDGAR A. CUSTER, a citizen of the United States, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Casting Metal Pipes, of which the following is a specification.

My invention has relation to an apparatus for casting metal pipes; and in such connection it relates more particularly first, to operating means to permit of the casting of a metal pipe perfect in outline or shape ready for use, after casting; second, to means to permit of the casting of said pipe from molten metal in a permanent mold, without employing gritty material such as sand, as a mold, for the formation of the pipe and third; to means to permit of the casting of a water, soil or other pipe free from blow and sand holes, cracks and shot formations thereon, to be removed, and a pipe which when removed from the permanent mold and after natural cooling, is ready for use, without further finishing thereof.

The nature and scope of my present invention will be more fully understood from the following description taken in connection with the accompanying drawings, forming part hereof, in which

Figure 1 is a view, illustrating partly in section and partly in elevation, an endless conveyer, a series of permanent unyielding molds placed thereon, hoisting means for raising and conducting the molds filled with metal from one to the other end of the active portion of the conveyer and for removing a cope from a drag and replacing, a melting furnace and a receiving ladle for molten metal, and a stationary pouring ladle for simultaneously introducing the metal into a series of pour-holes, in each of the molds, all forming main features of my present invention. Fig. 2 is a view, illustrating in top or plan, two conveyers arranged side by side, and the molds of unyielding permanent material carried by the same. Fig. 3 is a detail view, enlarged, illustrating in top or plan, a portion of a drag and a cope of the mold and a core for being transmitted by a conveyer to a pouring ladle. Fig. 4 is a similar view, illustrating in side elevation, the pouring ladle; and Fig. 5 is a detail view, enlarged, illustrating in section, the pouring ladle and a mold, and the manner of introducing molten metal into the mold.

Referring to the drawings 6, represents a conveyer, consisting of two parallel chains 7, passing over two sets of sprocket wheels 8, each set of which are carried by a shaft 9, to which, by means of a sprocket-wheel 10, and means not shown, is imparted a step-by-step rotary movement in one direction for the distance of two links of the chains 7. To two oppositely located links of both chains is secured a metal strip or slat 11, which during travel of the chains 7, in a horizontal plane, rest side by side and form an even surface.

In order to hold the conveyer and the strips thereof, in alinement with the floor 13, of a building not shown, the same is located in a pit 12, formed in the floor 13 thereof. At the same time the portion of the chains 7, and strips 11 traveling in the upper horizontal plane are supported by a stationary table 14, over which the same are conducted with a step-by-step movement from right to left in Figs. 1 and 2, to permit the conveyer 6, to carry heavy objects, in the present instance, molds 15, consisting of unyielding permanent material, such as metal, by an intermittent movement, towards a pouring ladle 25.

Each of the molds 15, consists of a drag 16, and a cope 17, which cope is held upon the drag, by its own weight, having been made for this purpose similar to the drag 16, of a solid block of metal, of comparatively large size, in cross-section, to retain heat absorbed from molten metal introduced into the mold, and to prevent warping or bending due to any want of uniformity in the heating of the mold, by the molten metal. The drag 16 and the cope 17, are each provided with a semi-circular depression 18, forming combined in the mold 15, an annular oblong chamber of the contour or outline of a pipe, as shown in Figs. 2 and 3. The cope at on side of the depressions 18, is provided with pouring-holes 19, arranged at defined distances apart, throughout the same, and registering with U-shape gates 20, arranged in the drag 16, which are centrally located to a section into which the depressions 18 of the mold 15, are divided by the arrangement of the gates 20, and pouring-holes 19, as will be readily understood from Fig. 3.

In order to permit of the free expansion of the metal of the mold adjacent to the depressions 18, thereof, the drag 16 and the cope 17, are provided with small openings 21, extending certain distances into the body of the mold. These openings 21, also provide a means, whereby any cracking of the metal of the mold extending from the depressions 18, will be limited and confined to the openings, thereby preventing any extensions of cracks through the drag and the cope, by extended use of the mold. In addition to the openings 21, both the drag and the cope are provided with grooves 22, extending radially from the depressions 18, and lengthwise through the drag and the cope. These grooves 22, form pockets, for the reception of inert material, such as mica, which permits of a compression by the expanding metal, and thus serves to counteract any cracking of the mold in parts throughout the same. The core 23, used in conjunction with the mold so formed, preferably, consists of a perforated hollow body 24, serving as a support for a coating, consisting of finely divided gritty material such for instance, as sand. The core 23, in conjunction with the depressions 18, in both drag 16 and cope 17, forms an annular space, into which the molten metal is introduced to form the pipe. Before however, the metal is poured into the mold, the depressions 18, of the cope and the drag may be coated with semi-liquid composition, to permit the molten metal to lay close to the depressions, during casting, and hence obviate any receding of the metal from the mold.

In order to cast a pipe, which when removed from the mold 15, is ready for use, free from cracks, blow and sand holes, and shot formations, upon the exterior surface, which must be removed if existing, before the pipe can be used, it is necessary to introduce simultaneously the metal in a molten state into each of the pouring holes 19, of the cope 17, in equal portions, with the same velocities and under the same pressures, to insure a uniform flow of the metal within the two parts of the mold 15. This is accomplished by a pouring ladle 25 beneath which the mold 15, is conducted and held stationary by the conveyer 6, which ladle is provided with three pouring spouts 26, equal in number with the pouring-holes of the cope 17, of substantially the same size, which are held in the central longitudinal axis of trunnions 27, at and during discharge of the liquid or molten metal therefrom. The trunnions 27, formed integral with the ladle 25, are engaged by brackets 28, which hold the ladle with their spouts 26, directly above the pouring holes 19, of the cope 17, and in the same horizontal plane, and thus at a uniform height above the mold 15, occupying the casting position on the conveyer 6, as shown in Fig. 1. By maintaining the spouts 26, of the ladle 25, in substantially the same position, irrespective of the extent of tilting of the ladle, and the spouts 26, of the same being of substantially the same size, equal quantities of molten metal will be discharged therefrom, which metal will assume the same velocities and pressures in the discharge, in the filling of the depressions 18, of the drag 16 and the cope 17, of the mold 15, by passing through the pouring holes 19, of the cope 17, and through the gates 20, of the drag 16 thereinto. The flow of each portion of the metal into the depressions 18, will thus be uniform, whereby is insured the casting of a pipe perfect in outline and shape with a smooth exterior surface and which is aided by mainly the character of the permanent unyielding metal mold, as defined.

To prevent undue cooling of the metal in the pouring ladle 25, the same is preferably contracted as at 29, and by partition walls 30, is divided into three sections 31, of substantially the same size, which are connected with each other by openings or passages 32, arranged in the upper portion of the partition walls 30, as shown in Figs. 4 and 5. Thus the molten metal introduced into the central section 31, of the pouring ladle 25, by a receiving ladle 33, will distribute itself from the central section through the passages 32, of the walls 30, into the end sections 31, of the ladle 25, and the quantity of metal held by each section 31, will be sufficient only to insure the casting of a pipe complete, for use.

The receiving ladle 33, is tiltably supported by standards 34, which hold the spout 35, of the ladle in proper position above the pouring ladle 25. The receiving ladle 33, is directly placed beneath the discharge spout 37, of any preferred type of cupola furnace 36, as shown in Figs. 1 and 2, and receives molten metal therefrom.

In order to permit of the concentration of gases arising from the flowing metal, the cope 17, of the mold 15, is provided with a depression or channel 38, extending lengthwise thereof, as shown in full and dotted lines in Figs. 3 and 5. The gases liberated during pouring of the metal will accumulate in the channel 38, located at the highest portion of the depression 18, of the cope 17, thus preventing the formation of a depression or depressions in the surface of the pipe cast, which is bound to occur should no provision be made for the concentration of such gases, as hereinbefore explained. The main portion of the gases, however, present in the casting of a structure, such as a pipe, are freed into the interior of the hollow body 24, of the core 23, by passing through the covering and perforations of the body into the interior thereof.

After the pipe has been cast the mold 15, occupying the position beneath the pouring

ladles 25, on the conveyer 6, is lifted preferably by a hoisting mechanism 39, such as shown in Fig. 1, and is replaced upon the conveyer 6, but in this instance, at the farthest end portion of the same, occupying the upper horizontal plane. In the meantime, the conveyer 6, will have been shifted for the distance of two strips 11, from right to left in Fig. 1, and two empty strips 11, will by such time have been shifted into an operative position upon the table 14, to receive the mold in which a pipe has been cast. By the forward movement of the conveyer 6, another mold 15, is brought into the casting position beneath the pouring ladle 25, while the cope 17, of the mold, previously occupying this position, is lifted from the drag 16, preferably by a second hoisting mechanism 40, and is then placed on the conveyer 6, alongside of the drag 16. The pipe cast is thus laid bare, and is then removed from the drag 16, after which the cope 17, and the drag 16, are cleaned and again coated and a cope replaced on its drag by the hoisting mechanism 40, during the further step-by-step movement of the conveyer 6, and prior to the reaching of the reassembled mold of the casting position beneath the pouring ladle 25.

Owing to the comparatively large size in cross-section of the drag 16, and cope 17, of each of the molds 15, the same will retain a sufficient amount of heat absorbed from the molten metal introduced therein to materially aid in the production of a perfect pipe, in that no appreciable lowering of the temperature of the molten metal occurs within the mold, during the casting operation. Moreover, the equal portions into which the depressions 18, are divided by the gates 20, and by the introduction of an equal quantity of molten metal under equal pressure into each section of the mold there will be insured a uniformity in the speed of the flow of the metal within the mold, a feature which has proven most essential to the obtaining of a perfect pipe structure.

Instead of using, one endless conveyer 6, two or more conveyers, arranged at certain distances apart may be employed and placed side by side, as shown in Fig. 2. In this instance, however, each of the conveyers 6, is provided with a pouring ladle 25, and a receiving ladle 33, but one cupola-furnace 36, will sufficiently supply two or more receiving ladles 33, with molten metal, for the casting operations.

Having thus described the nature and objects of my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an apparatus of the character described, a permanent unyielding mold provided with a cope and a drag, stationary means for permitting of the introduction of molten metal in equal portions simultaneously into the mold, a core, means for permitting of the freeing of gases or volatile matter from the metal in the mold during casting of the structure and means whereby removal of the cast structure from the mold can be had.

2. In an apparatus of the character described, a permanent unyielding metal mold provided with a cope and a drag, stationary means for permitting of the introduction of molten metal in equal portions, in unison and at uniform pressures and velocities into both cope and drag of the mold, an internal perforated core, means for permitting of the freeing of gases or volatile matter during the running of the metal in the casting operation and means whereby removal of the cast structure can be had.

3. In an apparatus of the character described, a permanent mold of unyielding material having a plurality of gates at determinate points thereof, stationary means for introducing molten metal in equal portions, simultaneously in the same horizontal plane through the gates of the mold and with like pressures and velocities, a core, and means to permit of removal of the cast structure from the mold.

4. In an apparatus of the character described, a permanent mold of unyielding material having a plurality of gates at determinate points thereof, stationary means for introducing molten metal in equal portions simultaneously in the same horizontal plane through the gates of the mold and with like pressures and velocities, a perforated unyielding material core whereby volatile matter and gases from the metal during the casting is freed therefrom, and means, to permit of the cast structure being removed.

5. In an apparatus of the character described, the combination with means for receiving and discharging molten metal, an endless conveyer arranged to support a plurality of molds, each consisting of a drag and a cope of permanent unyielding material, said conveyer adapted to conduct a mold to said metal discharging means to receive molten metal therefrom and means for removing the filled mold occupying the casting position and replacing it upon the conveyer, in advance of the metal discharging means.

6. In an apparatus of the character described, the combination with a ladle for receiving and discharging molten metal having discharge spouts, an endless conveyer arranged to support a plurality of molds, each consisting of a drag and a cope of permanent unyielding material, and each cope having a plurality of pour holes, said conveyer adapted to conduct a mold, below spouts of said ladle, and said ladle adapted by the spouts to discharge equal amounts of metal into each pour hole of a cope of said mold.

7. In an apparatus of the character described, the combination with a ladle for re-

ceiving and discharging molten metal having discharge spouts, an endless conveyer arranged to support a plurality of molds, each consisting of a drag and a cope of permanent unyielding material, and each cope having a plurality of pour-holes, said conveyer adapted to conduct a mold, below spouts of said ladle, and said ladle adapted by the spouts to discharge equal amounts of metal into each pour hole of a cope and arranged to be held with the spouts at and during discharge of metal in substantially a fixed position with respect to said mold.

8. In an apparatus of the character described, the combination with a ladle for receiving and discharging molten metal having discharge spouts at equal distances apart, and divided into sections, each communicating with a spout, an endless conveyer arranged to support a plurality of molds, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to spouts of the ladle, said conveyer adapted to conduct successively each mold to said ladle so as to bring the pour-holes of the cope thereof, below the spouts of the ladle, and said ladle adapted to discharge in equal amounts the metal through each of the pour-holes of the cope of said mold.

9. In an apparatus of the character described, the combination with a ladle for receiving and discharging molten metal, a pouring-ladle divided into communicating sections, each having a spout arranged to be charged with metal by the receiving ladle, an endless conveyer, a plurality of molds carried by the conveyer and conducted successively, below the pouring ladle.

10. In an apparatus of the character described, the combination with a ladle adapted to receive and discharge molten metal, a pouring ladle having a series of discharge spouts at equal distances apart, an endless conveyer, a plurality of molds carried by the conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour holes equidistant with respect to the spouts of said ladle, said conveyer, adapted to conduct successively each mold to the pouring ladle so as to bring the pour-holes of the cope below the spouts thereof, and said ladle adapted to discharge in equal amounts metal through each of the pour-holes of the cope of said mold.

11. In an apparatus of the character described, the combination with a ladle adapted to receive and discharge molten metal, a pouring ladle having a series of discharge spouts at equal distances apart, an endless conveyer, a plurality of molds carried by the conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour holes equidistant with respect to the spouts of said ladle, said conveyer, adapted to conduct successively each mold to the pouring ladle so as to bring the pour-holes of the cope below the spouts thereof, and said ladle adapted to discharge in equal amounts metal through each of the pour-holes of the cope of said mold and means for removing a filled mold from a position below said pouring-ladle and of the replacing of the same upon said conveyer at a certain distance from the ladle.

12. In an apparatus of the character described, the combination with two stationary tiltable ladles, whereof one is arranged to continuously receive molten metal and to discharge the same, at intervals and whereof the other is arranged to receive and discharge the metal at intervals, an endless conveyer, a plurality of molds carried by the conveyer, each consisting of a drag and a cope of permanent unyielding material, said conveyer adapted to conduct successively, each mold to said discharge ladle.

13. In an apparatus of the character described, the combination with two stationary tiltable ladles, whereof one is arranged to continuously receive molten metal and discharge at intervals and whereof the other having a series of pouring spouts is adapted to receive and discharge the metal at intervals, and to be held with the spouts in substantially a fixed position at and during discharge of the metal therefrom, an endless conveyer, a plurality of molds adapted to be carried by the conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to the spouts of said ladle, said conveyer adapted to conduct successively, each mold below the spouts of said second ladle, and said second ladle adapted to discharge by the spouts thereof an equal quantity of metal through each of the pour-holes of the cope of said mold.

14. In an apparatus of the character described, the combination with two stationary tiltable ladles, whereof one is arranged to continuously receive molten metal and discharge at intervals, and whereof the other having a series of pouring spouts, is divided into sections one for each spout, is adapted to receive and discharge the metal at intervals, an endless conveyer, a plurality of molds carried thereby, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to the spouts of said ladles, said conveyer adapted to conduct successively each of said molds below the spouts of said second ladle, and said second ladle adapted to discharge by the spouts thereof an equal quantity of metal through each of the pour-holes of the cope of said mold, and means for supporting said second ladle to hold the spouts thereof in a

fixed position with respect to the mold occupying the casting position at and during discharge of metal therefrom.

15. In an apparatus of the character described, the combination with two stationary tiltable ladles, whereof one is arranged to continuously receive molten metal and discharge at intervals, and whereof the other having a series of pouring spouts, is divided into sections one for each spout, is adapted to receive and discharge the metal at intervals, an endless conveyer, a plurality of molds carried thereby, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to the spouts of said ladles, said conveyer adapted to conduct successively each of said molds below the spouts of said second ladle, and said second ladle adapted to discharge by the spouts thereof an equal quantity of metal through each of the pour-holes of the cope of said mold, means for supporting said second ladle to hold the spouts thereof in a fixed position with respect to the mold occupying the casting position at and during discharge of metal therefrom and means for removing the mold from the casting position below said second ladle and replacing upon said conveyer at a certain distance from said second mold.

16. In an apparatus of the character described, the combination with a ladle having a series of pouring spouts, and trunnions arranged with their central longitudinal axis in alinement with the spouts, means for supporting said ladle by engaging the trunnions thereof, an endless conveyer arranged below said ladle, a plurality of molds, carried by said conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to the spouts of said ladle, said conveyer adapted to successively conduct each of said molds below the spouts of said ladle, and said ladle by the spouts thereof adapted to discharge equal amounts of metal during a uniformly maintained height of the spouts with respect to the mold, through each pour-hole of a cope of the same.

17. In an apparatus of the character described, the combination with a ladle having a series of pouring spouts, divided into sections, one for each of the spouts, trunnions secured to the ladle and arranged with the central longitudinal axis in alinement with the spouts, means for supporting said ladle by engaging the trunnions thereof, an endless conveyer arranged below said ladle, a plurality of molds carried by said conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equidistant with respect to the spouts of said ladle said conveyer adapted to successively conduct each of said molds, below the spouts of said ladle, and said ladle by the spouts thereof adapted to discharge equal amounts of metal during a uniformly maintained height of the spouts with respect to the mold through each pour-hole of a cope of the same.

18. The combination with two stationary tiltable ladles, whereof the first one is adapted to continuously receive and to discharge metal at intervals, and whereof the second one by partitions having passage-ways is divided into sections, each having a discharge spout, the partition-walls of said second ladle and its passageways arranged to permit of discharge of metal from said first ladle into one section of said second ladle and the entrance of the metal from the filled section into the remaining unfilled sections thereof, trunnions secured to said second ladle and arranged with their central longitudinal axis in alinement with the spouts of said second ladle, means for supporting said second ladle by engaging the trunnions thereof, an endless conveyer arranged below said ladle, a plurality of molds carried by said conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equi-distant with respect to the spouts of said second ladle, said conveyer adapted to successively conduct each of said molds below the spouts of said second ladle, and said second ladle by the spouts thereof adapted to discharge equal amounts of metal during a uniformly maintained height of the spouts with respect to the mold through each pour-hole of a cope of the same.

19. The combination with two stationary tiltable ladles, whereof the first one is adapted to continuously receive and to discharge metal at intervals, and whereof the second one by partitions having passage-ways is divided into sections, each having a discharge spout, the partition walls of said second ladle and its passageways arranged to permit of discharge of metal from said first ladle into one section of said second ladle and the entrance of the metal from the filled section into the remaining unfilled sections thereof, trunnions secured to said second ladle and arranged with their central longitudinal axis in alinement with the spouts of said second ladle, means for supporting said second ladle by engaging the trunnions thereof, an endless conveyer arranged below said ladle, a plurality of molds carried by said conveyer, each consisting of a drag and a cope of permanent unyielding material, and each cope having a series of pour-holes equi-distant with respect to the spouts of said second ladle, said conveyer adapted to successively conduct each of said molds, below the spouts of said second ladle, said second ladle by the

spouts thereof adapted to discharge equal amounts of metal during a uniformly maintained height of the spouts with respect to the mold through each pour-hole of a cope of the same, means for removing the mold from the casting position below said second ladle and replacing upon conveyer at a certain distance from said second mold and means for removing and replacing a cope upon a drag of each mold before reaching the casting position below said second mold.

In witness whereof, I have hereunto set my signature in the presence of two subscribing witnesses.

EDGAR A. CUSTER.

Witnesses:
THOMAS M. SMITH,
WILHELM VOGT.