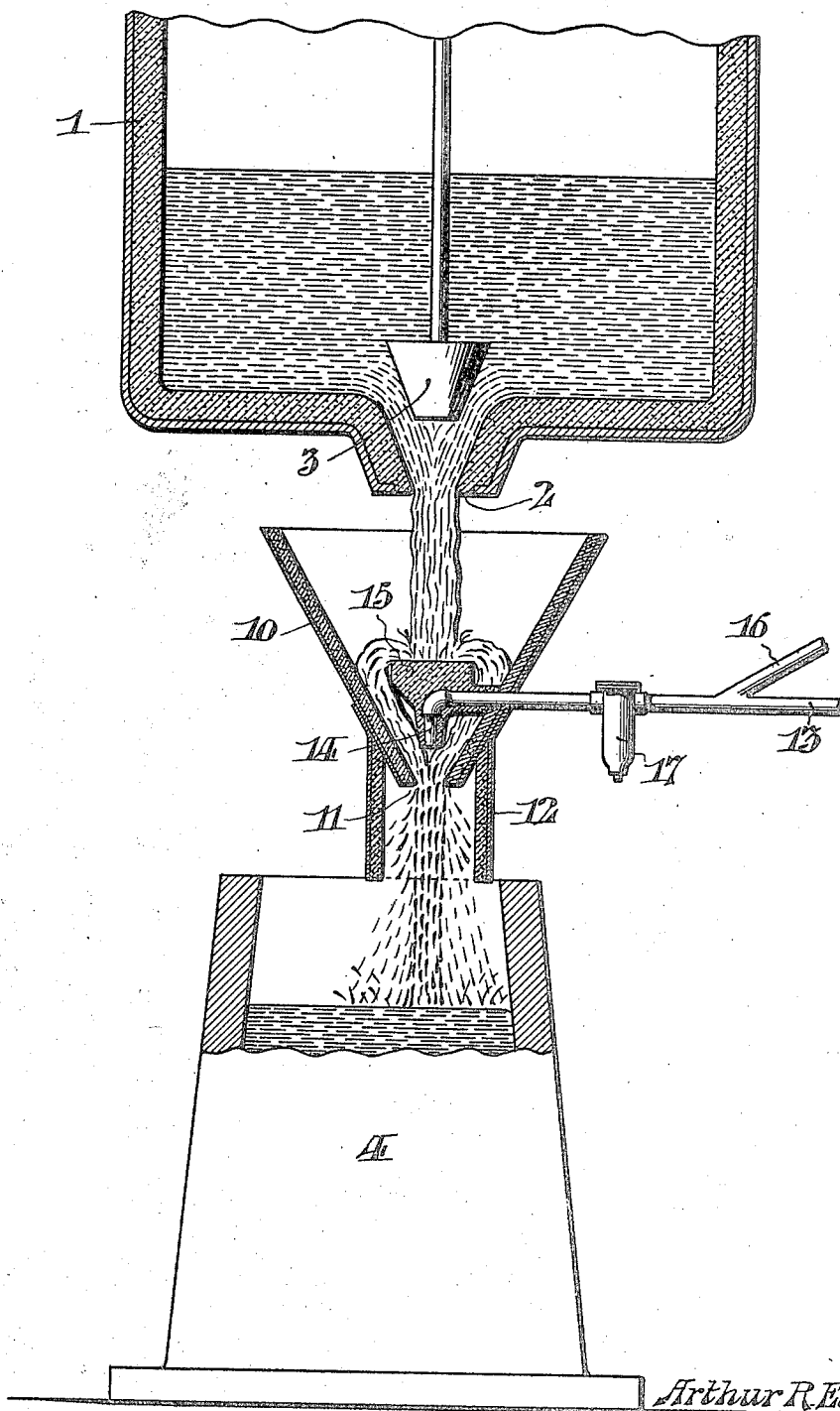


A. R. EARNSHAW.
ART OF CASTING MOLTEN METAL.
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1,323,583.

Patented Dec. 2, 1919.



Witnesses
John C. Burgess
James H. Bell

Inventor
Arthur R. Earnshaw

By *Ray & Paul*
Attorneys

UNITED STATES PATENT OFFICE.

ARTHUR R. EARNSHAW, OF RIVERTON, NEW JERSEY.

ART OF CASTING MOLTEN METAL.

1,323,583.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ARTHUR R. EARNSHAW, of Riverton, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in the Art of Casting Molten Metal, whereof the following is a specification, reference being had to the accompanying drawings, which illustrate in vertical section an apparatus adapted to carry out my invention.

My invention relates particularly to the casting of ingots from steel, or steely metals, although it is not limited to that specific purpose, and the ultimate result to which it is addressed is the formation of an ingot or body of metal as nearly as possible homogeneous in character, and relatively free from internal cavities, whether due to the presence of blow holes or to the formation of "pipes".

The relation of the procedure characteristic of my invention, to these ultimate purposes, will be explained after the invention itself has been described.

Referring to the drawings, 1, represents a container for molten metal, in this instance, an ordinary ladle having a tap hole 2, controlled by the plug 3. The mold is indicated at 4, and may be of any desired type. Beneath the tap hole 2, I provide a funnel 10, preferably conical, and having its axis in line with the center of the tap hole. The outlet 11, at the lower extremity of the funnel is surrounded by a cylindrical apron, or shield 12, the exposed surfaces of the ladle, funnel and shield being provided with refractory linings, as indicated in the cross sectional view.

An induction pipe 13, is introduced through the side of the funnel 10, near the lower extremity thereof, and terminates in a downwardly projecting nozzle 14, whose axis coincides substantially with the center of the outlet 11. The upper surface of the inwardly projecting portions of the pipe 13, and the nozzle, are protected by a refractory shield 15.

The pipe 13, communicates with a suitable apparatus (not shown) for supplying air or gas under pressure, and said pipe is also preferably provided with a branch 16; communicating with a source of steam supply, which may be used under some circumstances. The pipe 13, is also provided with a drip or trap 17, adjacent to the funnel,

in order to avoid blowing any undesirable water of condensation into the system.

In the drawing I have conventionally represented the stream of molten metal flowing from the ladle into the funnel and thence to the mold, from which it will be seen that said stream, when it impinges upon the protective shield 15, of the pipe 13, assumes, for the time, a hollow conical form on its way to the outlet 11, of the funnel, the nozzle 14, of the induction pipe 13, being located within the hollow of the cone of melted metal.

Air under pressure is forced through the pipe 13, and downwardly through the nozzle 14, into the interior of the descending stream of metal and passes therewith through the outlet 11. The air blast, reinforced by the expansion effect of heat, acts in the nature of an atomizer, dispersing the metal into relatively small drops or globules, and thus affording a maximum of surface of the metal for contact with the air.

On the emergence of the stream from the outer end of the funnel, some of the metallic drops are splashed laterally against the shield or apron 12, from which the metal descends into the mold still under the expansive action of the air. The stream of metal is thus confined by the funnel-apron structure until it leaves the lower end of the apron. The dispersion of the main portion of the stream of metal continues downward, the air, however, tending to escape from the upper portion of the mold and hence without necessarily having any large percentage carried down into the body of metal already in the mold. The effect of this action of the air is to cool the metal uniformly throughout the entire stream in its passage from the ladle into the mold, the metal being in what may be termed a uniformly divided condition through the action of the expanding air blast discharged centrally within the descending stream.

By this means the metal may be cooled as nearly as may be found advisable to its critical temperature of solidification, while on the way to the mold, so that the solidification in the mold itself can proceed uniformly and with such rapidity as to avoid segregation and as to prevent the formation of blow holes. Furthermore, for the same reason, the change of volume in passing from the liquid to the congealed condition

is reduced and the formation of pipes in the ingot is minimized.

By this method an ingot homogeneous and uniform in character can be obtained and the necessity for cropping off and discarding a relatively large percentage of the product is avoided. If desired, a blast of steam or aqueous vapor may be supplied through the pipe 16, in connection with the air blast, and instead of air, a cooling gas, of any desired character for reaction with the metal, or metallurgically inert, can be employed.

I recognize that it is not new to introduce air or steam as an incident to the casting of metal and for the same general purposes as that herein described, but, so far as I am aware, the apparatus and methods used for this purpose have differed substantially in mode of operation and effect from those which are characteristic of my invention, in particulars of which the following may be taken as distinctive.

In one type of treatment, the flow of the stream from the ladle into the mold was protracted and the metal was superficially exposed to the action of air in the course of such protracted passage, as for instance; in Letters Patent of the United States No. 1,024,722, dated April 30, 1912.

In another type of treatment, a current of air was forced from the top of the mold to the bottom, during the period of pouring, so as to rise through the body of metal in the mold, as for instance, in Letters Patent of the United States No. 974,934, dated November 8, 1910.

In another type, a blast of gas was caused to impinge upon the surface of the metal in the mold, as set forth in Letters Patent of the United States No. 866,497, dated September 17, 1907.

My process differs from these processes and others of the same general character in that I discharge the blast of gas or vapor practically at the central axis of the descending stream of molten metal before it reaches the mold and in such manner as to disperse the metal symmetrically on its way from the ladle to the mold, and thereby I am enabled to effect the desired cooling with great uniformity, and with a very brief exposure to contact with the air, or vapor. I thus obviate excessive oxidation and also avoid the irregular cooling action, which is characteristic of former processes and which is largely due to the inability to make the surface of contact between the cooling agent and the metal large enough to render the

reaction easily controlled and give the maximum efficiency, in the shortest time.

In my claims I use the term "gas" as a convenient one to comprehend air, steam, aqueous vapor, or any other desired cooling medium of similar physical character.

Having thus described my invention, I claim:

1. The improvement in the art of casting metal which consists in dispersing the molten metal into relatively small globules on its way from the container to the mold, and subjecting it, while thus dispersed, to the action of a gaseous cooling medium.

2. The improvement in the art of casting metal which consists in dispersing the molten metal into relatively small globules while on its way from the container to the mold, subjecting it, while thus dispersed, to the cooling action of a gaseous blast, and permitting escape of the gas from the metal above the level of the latter in the mold.

3. The improvement in the art of casting metal which consists in subjecting the molten metal, on its way from the container to the mold, to a gaseous blast, so as to disperse it into relatively small globules and cool it by the action of the gas on it while thus dispersed.

4. The hereinbefore described improvement in the art of casting metal, which consists in introducing a blast of gas under pressure into the interior of the stream of descending metal during the passage of the latter from the container to the mold, thereby dispersing and cooling the metal with substantial uniformity; restraining the area of dispersion of the metal; and permitting the substantial escape of the gas from the descending stream at a point above the level of the metal collecting in the mold.

5. The improvement in the art of casting metal which consists in confining the stream of molten metal during its passage from the container to the mold and introducing a blast of gas under pressure into the stream of metal while so confined, so as to disperse and cool it and cause it to leave the confining means under the expansive action of the gas, permitting escape of the gas from the metal above the level of the latter in the mold.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this fourth day of June, 1918.

ARTHUR R. EARNSHAW.

Witnesses:

JAMES H. BELL,
E. L. FULLERTON.