April 28, 1925. 1,535,194

E. H. WILLIAMS

METHOD OF CASTING AND MOLD

Filed April 21, 1921

Fig. 1.

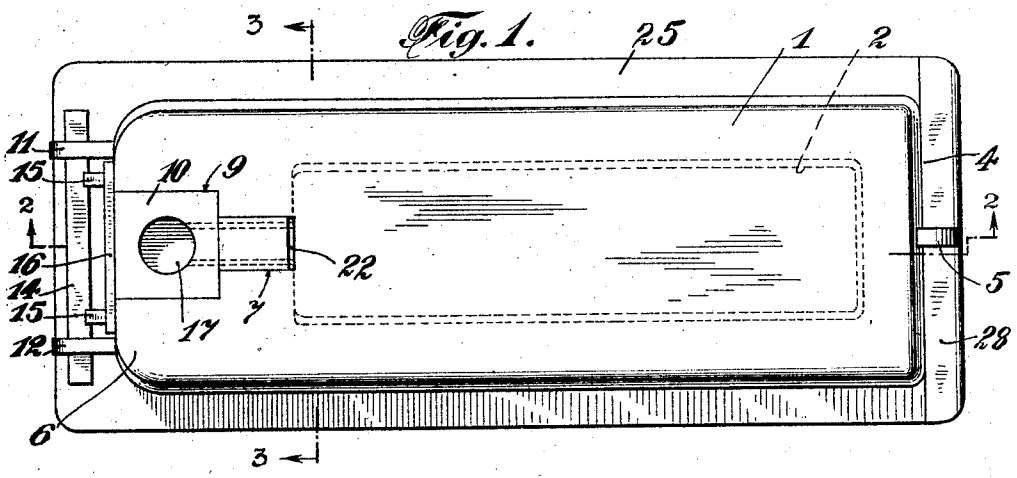


Fig. 2.

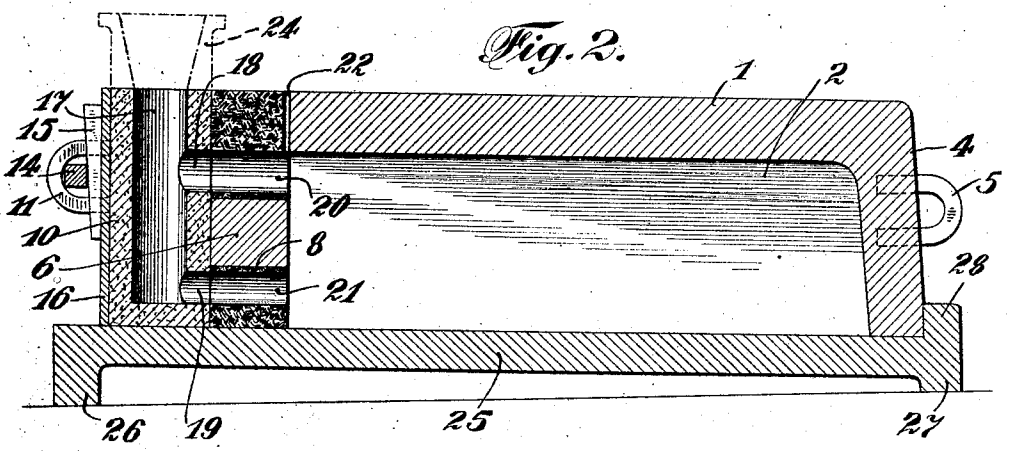
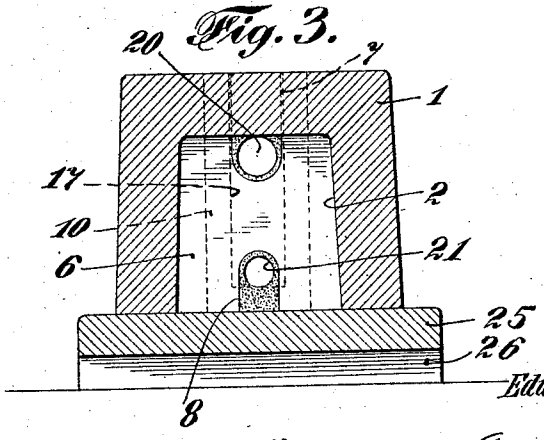


Fig. 3.



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Patented Apr. 28, 1925. 1,535,194

UNITED STATES PATENT OFFICE.

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METHOD OF CASTING AND MOLD.

Application filed April 21, 1921. Serial No. 463,230.

To all whom it may concern:

Be it known that I, EDWARD H. WILLIAMS, a citizen of the United States, residing at Sharon, in the county of Mercer, State of Pennsylvania, have invented certain new and useful Improvements in Methods of Casting and Mold, of which the following is a specification.

This invention relates broadly to metallurgy and more specially to a mold and method of casting steel ingots.

The principal object of the present invention is the method of casting steel ingots in a horizontal closed chill mold and with the axis of the top surface of the matrix inclined to the horizontal within predetermined limits.

An equally important object of the present invention is an ingot mold provided with an outside runner and with leads from said runner to the matrix of the mold whereby the gate may be broken from the ingot when the mold is ready to be stripped.

Another and more specific object of the present invention is the method of casting horizontal ingots and wherein the inclination of the top surface of the matrix of the mold is between the limits of one degree and ten degrees inclination to the horizontal.

Another and further object of the present invention is an ingot mold for casting horizontal ingots and the like and wherein one end of the mold is provided with a channel to receive a runner tile and with openings leading from the channel to the matrix of the mold whereby suitable clay or the like inlets may extend from the runner tile to the matrix, whereby the runner tile and conduit may be broken away and the steel gate broken off before the ingot is stripped from the mold.

Another object of the present invention is a mold for casting horizontal ingots and the like and wherein substantially the entire surface of the mold matrix comprises chilled metal walls and with means being provided to supply molten steel to the matrix through one end wall of the mold.

A still further object of the present invention is a mold for casting horizontal ingots which mold is provided with an open channel adjacent one end thereof adapted to receive a runner tile in such manner that the side walls of the runner tile are supported by said channel, and wherein a removable plate is arranged to cover said channel and retain said runner tile in position.

Other and further objects of this invention will in part be obvious and will in part be pointed out hereinafter in the specification following by reference to the accompanying drawings forming a part hereof.

Realizing that the present invention may be embodied in constructions other than those specifically herein disclosed, it is desired that the disclosure herewith shall be considered as illustrative and not in the limiting sense.

Figure 1 is a plan view of one form of mold carrying out the present invention:

Figure 2 is a sectional view taken on line 2—2 Figure 1;

Figure 3 is a sectional view taken on line 3—3 of Figure 1.

Heretofore in the art it has been proposed to cast steel ingots in horizontal molds in order to avoid segregation and to form an ingot all of which could be rolled into finished product. In the present invention the inclination of the mold to the horizontal is predetermined in order to prevent entrapping gases in the top of the mold matrix, and in order to cause slag or any foreign matter, such as loam or chunks of sand, to be placed where desired in the ingot when cast instead of permitting the substances to lodge by chance anywhere in the longitudinal upper surface of the ingot. Where the placing of these deleterious substances, when they occur, is controlled it is possible to remove the flaw from the ingot without effecting but a very small part of the ingot body. Where the inclination of the top surface of the matrix of the mold is too slight, gas is liable to be entrapped in the top portion of the molten metal and consequently leave a bad upper surface on the ingot. Also there is a possibility of the slag accumulating in a spot on the top of the ingot along one side thereof, and this likewise might leave a rough spot or bad place in the ingot which would greatly interfere with rolling or hammering of the ingot into finished product. Therefore, there is an angular limit below which the inclination of the top of the matrix cannot safely go. As the inclination is increased a condition is reached which also measures the maximum limit of inclination. Where the upper surface is in-

clined beyond this maximum limit the tendency is to invite segregation; to produce piping in the upper corner of the ingot; and to produce a condition wherein spongy metal and a bad surface is encountered in the upper corner of the ingot. It will be obvious that if the inclination were continued the final result would be a vertical mold which would cast the vertical ingot together with all the difficulties which attend casing ingots vertically, and which are overcome by my improved method of horizontal casting. A large number of experiments have determined that the minimum limit to the inclination of the upper wall of the matrix of the ingot mold is approximately one (1) degree and the maximum limit is approximately ten (10) degrees from the horizontal. It therefore follows that the best results in casting horizontal steel ingots are obtained by inclining the upper surface of the matrix wall between the minimum limit of one degree and the maximum limit of ten degrees. The inclination runs towards the gas outlet from the mold and preferably this gas outlet is located adjacent the inlet of molten steel to the mold, in fact in practice the gas outlet may comprise space between the runner and the mold side wall.

It has also been proposed in the casting of steel ingots heretofore to provide runner tiles which would set in the body of the mold in such manner that a portion of the runner tile becomes a part of the matrix wall. In the use of "gaseous" or "non-piping" steel to cast the ingot it is desirable that the entire mass of steel in the mold matrix be chilled on all surfaces as quickly as possible after the mold is filled and where the runner tile touches the molten steel this particular portion of the steel does not chill as quickly as the portion in contact with the chill metal walls of the mold. Furthermore, where the runner tiles are set in an opening through the mold wall and are enclosed between the ingot and the mold, difficulty is encountered in breaking the gate of steel which forms in the runner tile when the ingot cools since the gate is within the mold and cannot be readily reached from the outside. It is necessary that this stem or gate be broken off before the mold can be stripped from the ingot.

To obviate these difficulties I have provided a construction wherein the runner tile while being supported by the mold body is in effect outside of the mold, that is, it is so constructed that the entire runner title may be reached from outside the mold and may be broken away and removed from the mold. The runner is so arranged as to be completely supported while in position and to have removable supports provided so that when the runner is broken the gate may be easily pried or broken away after the metal has cooled so that the mold may be easily stripped from the ingot.

Referring to the drawings it is to be understood that the particular form of mold exemplifies but one of the many forms in which the present invention may be embodied. The body portion 1 is provided with a suitable matrix 2, and one end 4 of the wall is inclined so that that end of the body portion may be raised by inserting a suitable crane hook or the like in the staple 5 as will later be explained. The runner tile end 6 of the mold body is preferably straight and is provided with an upper recess opening 7 and a lower recess opening 8. The end wall of the body is provided with a channel 9 which is adapted to receive a runner tile 10 of fire clay or the like. Staples 11 and 12 are provided on the end of the mold body and are adapted to receive a bar 14 which forms an abutment for the wedges 15 that press a suitable plate 16 against the runner tile 10 and thereby support the runner tile in position at the end of the mold body. The runner tile is provided with a substantially vertical opening 17 from which lead outlet openings 18 and 19. These outlet openings preferably are of different sizes in order that substantially equal volumes of steel will issue from both openings during the pouring operation. Since the lower opening is under a greater ferro static head than the upper opening, the lower opening may be a slightly lesser area in cross section than the upper opening. The recesses 7 and 8 in the mold body adjacent the runner channel 9 are adapted to be filled with suitable material either fire clay, loam, or fire brick, which is provided with conduits 20 and 21 that connect with and form continuations of the openings 18 and 19. Preferably the upper member carrying the conduit 20 is arranged to be slightly shorter than the recess 7 so that a gas outlet opening 22 is provided adjacent the upper end of the mold. A suitable fountain 24 is placed over the runner tile and is adapted to lead the molten steel into a substantially vertical conduit 17. The mold as illustrated in the drawings has a matrix top surface which is substantially parallel to the bottom side edges of the mold. This mold therefore is adapted to be set on a stool 25 which may be inclined by means of supports 26 and 27 and the stool may have a ledge 28 on the lower edge in order to prevent any sliding of the mold on the stool. The supports 26 and 27 are so constructed as to produce an inclination to the upper top surface of the matrix of the mold which inclination is greater than one (1) degree and less than ten (10) degrees. An ideal inclination is one near the lower limit of inclination and yet sufficiently great, so that all gases are caused to escape through the

gas outlet during the pouring operation and wherein any foreign material in the steel is caused to rise into that portion of the ingot adjacent the upper connecting gate or stem which is formed in the conduit 20, so that such foreign material will be carried away when the gates are broken from the ingot. It is preferred, where plural inlet openings are utilized as illustrated in the drawings, that the upper opening shall be directly over the lower opening and that the upper opening shall be as high as the upper limits of the matrix top wall so that deleterious material will tend to float into the conduit and also so that the steel flowing from the upper conduit will flow directly upon the steel flowing from the lower conduit and cause a vertical mixing action which will prevent any segregation during the pouring operation. My invention, however, is not limited to a tile having a plurality of inlet openings since the invention may be carried out with a single inlet. When the steel in the mold has solidified and the ingot is sufficiently cool for stripping, the runner column and runner conduits may be broken away. This leaves the gate clear where it may be broken off. However, the gate breaking operation may be carried out by inserting a crane hook in the staple 5 and raising that end of the mold, using the other end as a pivot. The weight of the ingot will cause the ingot to remain on the stool while the mold end rises and thus the mold becomes a pry which breaks the gate from the ingot. Then crane hooks may be inserted in the staples 11 and 12 and the mold may be lifted free of the ingot and reset where desired.

The present invention is illustrated as a single mold unit. It will be noted that the construction is particularly adapted for use with a plurality of mold units stacked one over the other so that the runner tiles connect one with another and gas outlets of a lower mold opens directly into the matrix of the next mold above and the top of one mold becomes the stool for the next mold above. When these molds are arranged in vertical stacks the runner columns extend, as units, through the whole stack and the opening of an upper tile connects with the opening in the next lower tile and so on throughout the series, with the fountain over the top tile.

From the foregoing disclosure it will appear that the present invention provides a method for casting and also an ingot mold wherein all sides of the ingot are adapted to be chilled and wherein the gate or stem may be easily broken from the ingot when the ingot is cool.

Having thus described my invention, what I claim is:

1. The method of casting steel ingots in horizontal molds which comprises providing a chill for the upper surface of the mold matrix, arranging a gas outlet in the highest part of the matrix, and inclining the upper surface of the mold matrix to the horizontal and toward the gas outlet with the lower limit of inclination being substantially one degree from the horizontal, and introducing the molten steel into one end of the matrix.

2. The method of casting steel ingots in horizontal molds which comprises providing a chill for the upper surface of the mold matrix, arranging a gas outlet in the highest part of the matrix, and inclining the upper surface of the mold matrix to the horizontal and toward the gas outlet with the lower limit of inclination being substantially one degree from the horizontal.

3. The method of casting steel ingots in horizontal chill covered molds which comprises inclining the upper portion of the mold matrix to the horizontal with the lower limit of inclination being substantially one degree from the horizontal, and introducing the molten steel into one end of the matrix.

4. The method of casting steel ingots or the like which comprises casting the ingots in a horizontal closed chill mold body provided with a gas outlet and mounted on a suitable stool, and wherein the upper portion of the mold matrix is inclined to the horizontal and toward the gas outlet with the maximum inclination being substantially ten degrees, and introducing the steel adjacent the gas outlet.

5. The method of casting steel ingots or the like which comprises casting the ingots in a horizontal covered chill mold body provided with a gas outlet and mounted on a suitable stool, and wherein the upper portion of the mold matrix is inclined to the horizontal and toward the gas outlet with the maximum inclination being substantially ten degrees.

6. The method of casting steel ingots in horizontal molds provided with a gas outlet and mounted on a suitable stool wherein the upper surface of the mold matrix is a chill surface and is inclined toward the gas outlet and to the horizontal between the limits of inclination of one degree minimum to ten degrees maximum introducing the steel rapidly into the mold and chilling the steel in the mold as quickly as possible.

7. The method of casting steel ingots in horizontal molds provided with a gas outlet and mounted on a suitable stool wherein the upper surface of the mold matrix is inclined toward the gas outlet and to the horizontal between the limits of inclination of one degree minimum to ten degrees maximum.

8. The method of casting steel ingots in closed chill molds mounted on suitable stools wherein the upper surface of the mold matrix is inclined to the horizontal between

the limits of inclination of one degree minimum to ten degrees maximum introducing the steel rapidly into the mold and chilling the steel in the mold as quickly as possible.

9. The method of casting steel ingots in full covered full chill molds mounted on suitable stool wherein the upper surface of the mold matrix is inclined to the horizontal between the limits of inclination of one degree minimum to ten degrees maximum.

10. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, one end of said body portion being formed in such manner that said end will clear an ingot cast in the mold when the said end is lifted about the opposite end of the mold as a pivot, and wherein the runner end of said mold is provided with an open channel adapted to receive a suitable runner tile.

11. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, one end of said body portion being formed in such manner that said end will clear an ingot cast in the mold when the said end is lifted about the opposite end of the mold as a pivot, and wherein the runner end of said mold is provided with an open channel at substantially right angles to the axis of the matrix of the mold and adapted to receive a suitable runner tile.

12. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, one end of said body portion being formed in such a manner that said end will clear an ingot cast in the mold when the said end is lifted about the opposite end of the mold as a pivot, and wherein the runner end of said mold is provided with an open channel adapted to receive a suitable runner tile said body portion having an opening leading from said channel to the matrix of the mold.

13. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, and wherein the runner end of the said mold is provided with an open channel adapted to receive a suitable runner tile.

14. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, and wherein the runner end of said mold is provided with an open channel at substantially right angles to the axis of the matrix of the mold and adapted to receive a suitable runner tile said body portion having an opening or openings leading from said channel to the matrix of the mold.

15. A mold for casting horizontal steel ingots comprising an inverted trough-like body portion having heavy chill body walls adapted to quickly absorb heat of molten steel within the mold matrix, said body having an opening adjacent one end of the matrix portion and adapted to receive a runner conduit, in combination with a runner tile adapted to fit said opening.

16. A mold for casting horizontal steel ingots comprising an inverted trough-like body portion having heavy chill body walls adapted to quickly absorb heat of molten steel within the mold matrix, said body having an opening adjacent one end of the matrix portion and adapted to receive a runner conduit in combination with a runner tile adapted to fit said opening and means to retain said tile in said opening.

17. A mold for casting horizontal steel ingots comprising an inverted trough-like body portion having heavy chill body walls adapted to quickly absorb heat of molten steel within the mold matrix, said body having an opening adjacent one end of the matrix portion and adapted to receive a runner conduit, in combination with a runner tile adapted to fit said opening, means to retain said tile in said opening, and a gas outlet adjacent said runner tile.

18. An article of manufacture comprising a mold for horizontal ingots, said mold being provided with heavy metal side walls to absorb heat quickly from molten steel within said mold, one end of said mold being provided with an opening adapted to receive a conduit, an open channel across said opening and adapted to receive and support a suitable runner tile, and means to retain a runner tile within said channel.

19. An article of manufacture comprising a mold for horizontal ingots, said mold being provided with heavy metal side walls to absorb heat quickly from all sides of molten steel within said mold, one end of said mold being provided with an opening adapted to receive a conduit, an open channel across said opening and adapted to receive and support a suitable runner tile, and means comprising a wedge retained plate to support a runner tile within said channel.

20. As an article of manufacture a mold for horizontal ingots, said mold being provided with heavy metal side walls to absorb heat quickly from molten steel within said mold, one end of said mold being provided with an opening adapted to receive a conduit, an open channel across said opening and adapted to receive and support a suitable runner tile, a bar removably mounted on the end of the mold, a plate over the runner tile, and means between the bar and plate to hold the parts in position.

21. As an article of manufacture a mold for horizontal ingots, said mold comprising an inverted trough provided with heavy metal side walls to absorb heat quickly from molten steel within said mold, one end of the mold being inclined upwardly and inwardly the other end of said mold being

provided with an opening adapted to receive a conduit, an open channel across said opening and adapted to receive and support a suitable runner tile, a bar removably mounted on the end of the mold, a plate over the runner tile, and means between the bar and plate to hold the parts in position.

22. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, wherein the runner end of the said mold is provided with an open channel adapted to receive a suitable runner tile, a runner tile in the channel, and removable means to enclose and support said runner tile.

23. An article of manufacture a mold for casting horizontal steel ingots and comprising a trough-like body portion, wherein the runner end of the said mold is provided with an open channel adapted to receive a suitable runner tile, a runner tile in the channel, and removable means to enclose and support said runner tile, said means comprising a supporting plate over the runner tile, and wedge means to hold the plate in position.

24. A horizontal ingot mold comprising an inverted trough-like body set on a stool, one end of the body being shaped to clear the ingot cast in the matrix when said end is lifted about the other end as a pivot, an open vertical channel formed in said other end outside the mold, and a stool to receive a runner tile.

25. The combination of a mold for casting ingots and comprising an inverted trough-shaped body portion with heat absorbing walls, said body portion being provided at one end with a runner receiving opening, a heat absorbing closure for the bottom of the body portion, and means movably mounted with respect to said body portion for closing one side of the said opening.

EDWARD H. WILLIAMS.