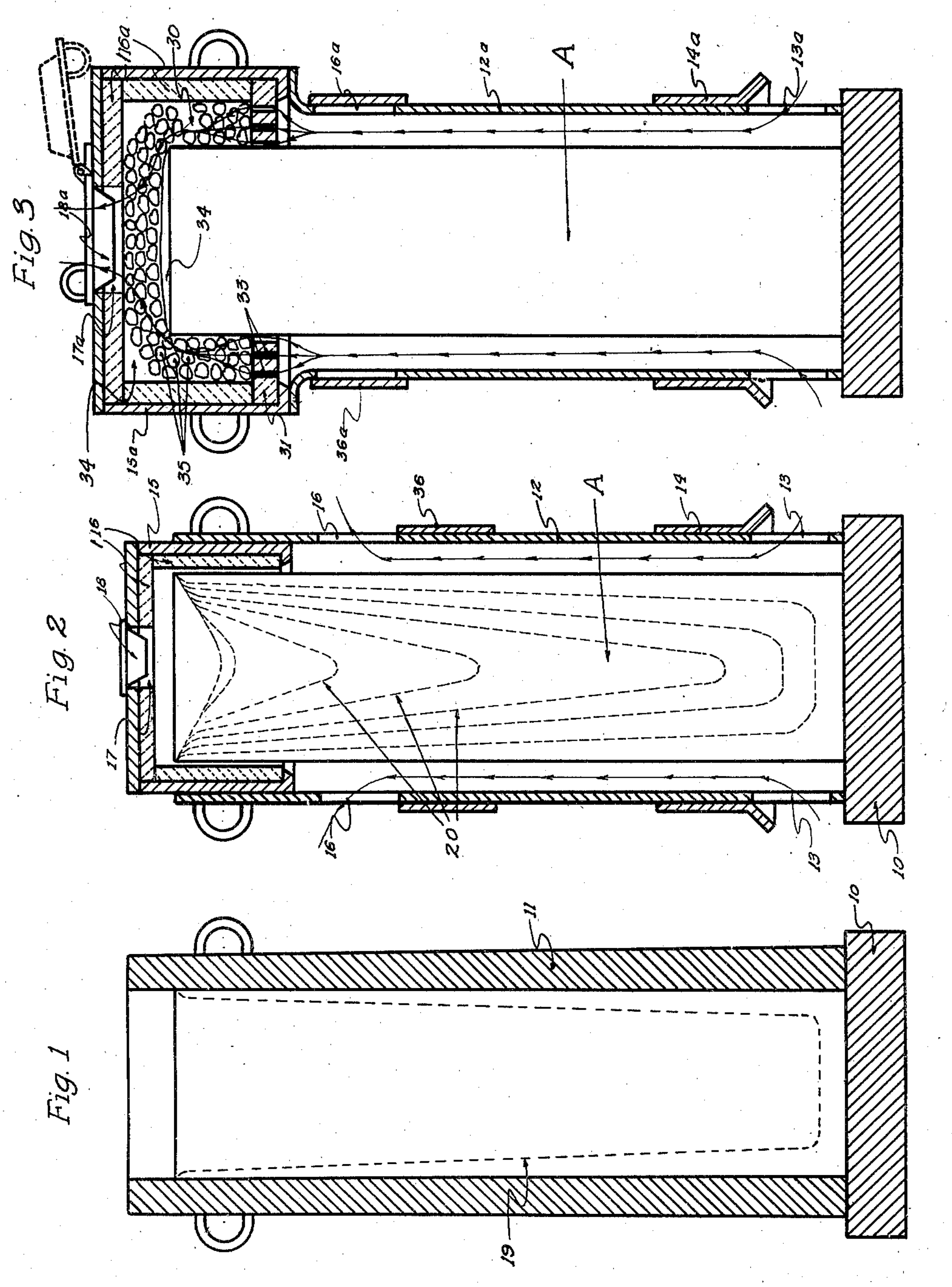
Dec. 14, 1937. G. A. DORNIN 2,102,258

METHOD OF PRODUCING INGOTS

Filed March 26, 1931 2 Sheets-Sheet 1




Inventor
George A. Dornin,
By Jesse B. Heller,
Attorney

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Fig. 4

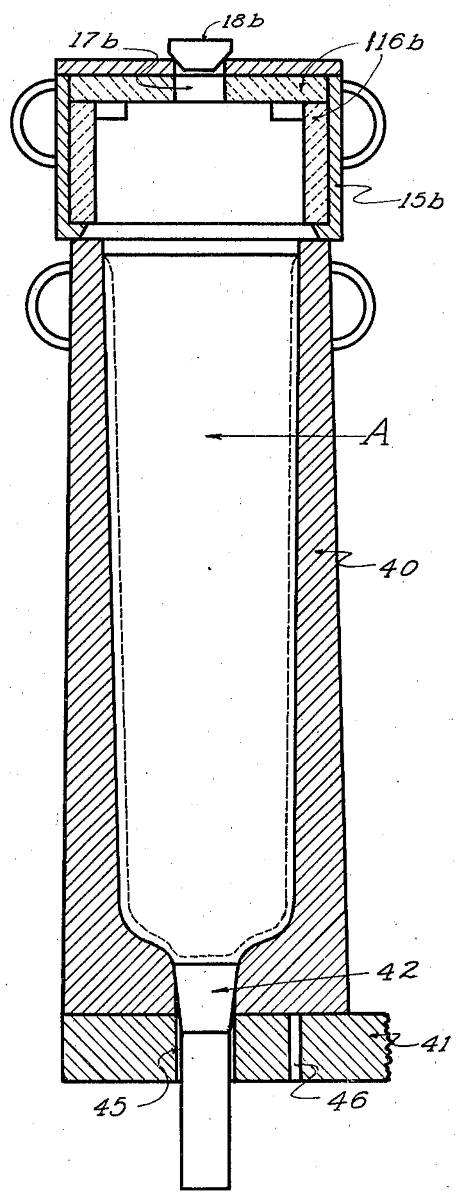
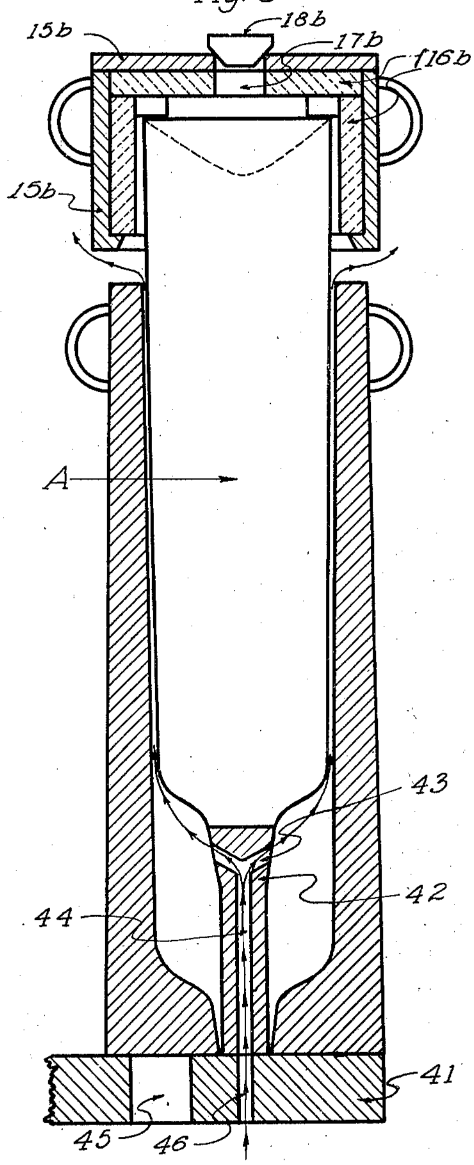



Fig. 5




Inventor
George A. Dornin,
By Jesse B. Heller
Attorney

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## METHOD OF PRODUCING INGOTS

George A. Dornin, Baltimore, Md.

Application March 26, 1931, Serial No. 525,525

25 Claims. (Cl. 22—216)

This invention relates to a method of producing ingots and more particularly steel ingots, although the method may be used for producing ingots of other metals.

The object of my invention is to produce ingots which are substantially free from flaws and strains in the ingots formed during the pouring and the cooling after pouring.

In the making of steel ingots the present day practice is to cast these in iron molds, these being sometimes fitted with hot tops on or within their upper ends, the mold or the mold and hot top, as the case may be, governing the cooling rate of the ingot in its various parts. The ingot, in these cases, is either allowed to solidify wholly within the mold or if withdrawn from the mold is merely withdrawn to conserve such heat as still remains in the ingot mass to cut down its reheating costs.

Numerous attempts have been made to control or vary the cooling rate of the ingot in its various parts, such as Gathmann's patents, No. 921,972 and No. 1,049,573; Hadfield's patent, No. 933,751; Giolitti's patent, No. 1,144,034; Ashdown's patent, No. 1,251,951; Washburn's patent, No. 1,670,329; and Heroult's patent, No. 807,028. Of these Hadfield deals only with a method for maintaining the top of the ingot fluid by applying heat thereto. Heroult attempts to cool the entire ingot by stripping while the interior is still molten and then spraying with water. The rest all attempted to affect the cooling rate of the ingot by the design of the mold or by means applied at the exterior or within the body of the mold affecting the ingot only through the mold.

In carrying out my invention I use the chilling effect of the mold to form a skin which is merely strong enough to withstand the internal static pressure of the molten interior, then withdraw the mold from the ingot, then control the solidification of the molten interior preferably by a confined envelope of gas, such as air, by controlling the cooling effect of the gas envelope along various portions of the ingot, and thereby affect the rate of cooling of the molten interior as well as the successive shaping of the bottom and sides of the molten interior. This rate of cooling control may be accomplished in several ways.

In my preferred method when a sufficiently strong skin has been formed as above described, the mold is drawn from the ingot and as soon as the mold is withdrawn, I place around the ingot an envelope so designed that I can retard the cooling of a portion of the ingot and accelerate the cooling of another portion. I propose to retard the cooling of the upper portion of the ingot by lining the portion of the envelope surrounding this part of the ingot with insulating material. I may, if I so desire, use means on this portion of the ingot to add heat at this point. The portion of the ingot below this upper end I propose to cool by air currents entering through openings in the bottom of the envelope and passing out through openings at the upper end of the envelope, but below that portion of the ingot that I desire to keep hot. I may so control the passage of these air currents between the ingot and envelope that I can progressively cool the ingot from the bottom upwardly. I may also at any time check and practically stop the cooling of the whole ingot by closing the aforementioned openings, letting the ingot equalize its heat in an atmosphere of hot still air which is an extremely poor conductor of heat. Where I desire to check the cooling of the whole ingot I may line the entire body of the envelope with refractory, insulating material leaving the openings as aforementioned.

There are three distinct types of steel. These are:

*First.*—Fully deoxidized steel which crystallizes quietly.

*Second.*—Open or rimming steel which is poured into molds with the carbon iron oxide reaction incomplete and the consequent evolution of CO as a gas, producing a violent boil in the mold.

*Third.*—Partly deoxidized steel which is a cross between the two types just mentioned.

Various charts in a book entitled "Ingot Contour and Its Relation to Sound Steel" by the Gathmann Engineering Company, Baltimore, Maryland, clearly illustrate the freezing lines, flaws, etc., in ingots made from the above mentioned types of steel.

Figure 4 on page 20 of this book shows the freezing lines of fully deoxidized steel when poured in a big-end-up iron mold with a hot top and when poured in a big-end-down iron mold without hot top.

Figure 1 on page 8 of this book shows the types of ingots and the flaws therein of fully deoxidized steel when poured in big-end-up and big-end-down iron molds with and without hot tops.

Figure 3 on page 18 of this book shows the types of ingots and the flaws therein of open or rimming steel when poured in big-end-up and big-end-down iron molds. This type of steel is not poured with hot tops. It will be noticed that the blow holes in all cases at the bottom end of the ingots are close to the surface and these in many cases when the ingot is re-heated and rolled develop into seams; and

Figure 2 on page 14 of this book shows ingots cast in big-end-up and big-end-down iron molds of semi-deoxidized or killed steel and the flaws that are found therein. It will be noticed here that in all cases blow holes are close to the skin of the ingot at its upper end.

In order to more clearly describe my method and apparatus for producing ingots, reference is had to the accompanying drawings, in which:

Figure 1 is a vertical section through my preferred form of mold, with a poured ingot therein;

Figure 2 is a vertical sectional view through an ingot envelope with an ingot therein;

Figure 3 is a sectional view through another form of envelope for carrying out my process;

Figure 4 is a vertical section through a big-end-up ingot mold with an ingot therein, and a hood over the top of the mold, illustrating another method of controlling the cooling of an ingot; and

Figure 5 is a view similar to Fig. 4 showing the ingot after it has been stripped from the mold and the mold is used as the body of an envelope for a portion of the ingot.

In Fig. 1 of these drawings, the reference character 10 designates the base of an ingot mold and 11 the body of the mold, which is of cylindrical form, is preferably formed of copper or some metal having a higher heat conductivity than iron, and has been machined to provide a smooth inner surface.

In Fig. 2 the reference character 12 designates the body of an ingot encasing envelope, having openings 13 in the lower portion of the side walls and 14 is a sleeve shutter slidably mounted on the casing and adapted to be moved downwardly from the position shown in Fig. 2 to fully or partially close the opening 13.

Supported on the upper portion of the casing is a hood 15, above openings 16 through the upper portion of the side walls of the body 12 of the casing, and 36 is a sleeve shutter for said openings. This hood 15 is lined with refractory insulating material 116, and 17 is an opening through the top of the hood and insulating material through which the top of the ingot under treatment can be inspected and through which access may be had to the upper portion of the ingot should it be desired to add heat thereto.

This opening 17 is normally closed by means of a refractory plug 18 during the cooling process of the ingot under treatment.

In carrying out the process of producing an ingot of fully deoxidized steel with apparatus illustrated in Figs. 1 and 2, the metal to form an ingot is poured into a mold such as illustrated in Fig. 1 at a relatively slow rate, to produce the desired skin thickness at the bottom of the ingot when the pouring has been completed.

By controlling the rate of pouring, I am enabled to get any desired thickness of skin at the bottom of the ingot when the skin has just begun to form at the top of the ingot, and when using a cylindrical mold having no taper or even a big-end-down mold, get an ingot whose molten interior has the same degree of inverted conicity that is now obtained in the big-end-up type of iron mold with the present day rates of pouring as shown in Fig. 4 on page 20 of the above mentioned book. By the use of molds made of copper or of a metal having high heat conductivity, I can obtain the same results at a faster rate of pouring than when using iron molds, and so preferably use molds made of metal having high heat conductivity.

In Fig. 1 the dotted line 19 illustrates the freezing line of the metal of the ingot A and it will be noted that there is an unusual difference in the skin thickness at the top and bottom of the ingot. This difference in skin thickness at the top and bottom may be obtained by slow pouring, or by slow pouring in a mold made of metal having high heat conductivity.

After the skin has formed sufficiently strong on the ingot to withstand the static pressure of the still molten interior, I withdraw the mold from the ingot, and as soon as the mold is withdrawn, I cover the ingot with the envelope as illustrated in Fig. 2, and control the cooling by controlling the admission of air through the openings 13 as above described, and as the insulated hood 15 retards the cooling of the upper portion of the ingot, I am enabled to cool the metal progressively, upwardly, as indicated by the dotted lines 20 in Fig. 2.

The present day practice in iron molds with hot tops from a surface flaw standpoint is unsatisfactory. These ingots cannot be made round except for small sizes and the round ingot is the only one which is free from corners and thereby cleavage planes which on rolling develop into seams, both external and internal. Furthermore, the round is the only shape that has uniform longitudinal shrinkage on cooling and thereby freedom from the strains which later develop into seams.

It must also be remembered that when steel is poured into a mold and crystallization begins, the ingot skin shrinks while the mold expands. Any roughness or unevenness of the mold cavity therefore tends to hang this skin thereby producing pulls or cracks. There is a fundamental tendency for an ingot in a big-end-up iron mold to hang or jam at its upper end where it joins and overlaps the sink head, and thereby produce seams. Iron molds also after repeated heatings and coolings have, due to their relatively low heat conductivity, a tendency to roughen up on the surface of the mold cavity, this being commonly called "fire-cracking".

When the mold is made of copper or of a metal having high heat conductivity, this tendency is minimized and it is therefore practical to machine finish the surface of the mold cavity and thereby attain a degree of smoothness sufficient to eliminate the objections just mentioned, and as this metal of high heat conductivity does not fire-crack the surface of the mold cavity remains smooth.

The ability to pour large round ingots in a mold made of metal that has a high heat conductivity such as copper comes from the fact that due to the high heat conductivity of the mold and the relatively long filling time that I use, the skin of the ingot at any given point is always heavy enough and strong enough to withstand the static pressure of the interior molten metal as this forms and increases during the filling of the mold.

Referring now to ingots made of rimming steel and semi-deoxidized steel it must be remembered that in both of these types of ingots there must be internal flaws and all that can be hoped for is to cut down the extent of these flaws and to prevent their occurring near the surface of the ingot where they will in later manufacture entail chipping costs. When ingots are made of rimmed steel the methods that I have just described will be applied except that either the upper end of the envelope will not be insulated or the envelope will be a casing entirely lined with refractory insulating material with openings at the bottom and open at the top with means for closing both openings. By the mold of high heat conductivity and the slow pouring I eliminate the blow holes close to the surface as shown in Fig. 3 of the Gathmann book, leaving only the deep seated blow holes. The cooling of the entire ingot by my method will be more rapid than present day methods and this lessens ingotism and the segregation attendant thereto.

Where ingots are made of killed steel by my method the procedure will be the same as herein described for deoxidized steel. The advantages are that as my method gives a control of the freezing rate and thereby of the shrinkage volume of the ingot at such slight additional cost it will be practical to add sufficient deoxidizers to be sure that surface blow holes in the upper end of the ingot do not exist and thereby eliminate a major source of trouble encountered in ingots of this type.

The advantages of the foregoing method will be obvious to those familiar with the art. The only present day practice which reliably gives sound ingots of deoxidized steel is to cast this metal in big-end-up molds with hot tops. This is expensive and as the metal within the hot top adheres thereto when rolled or forged, this part has to be entirely discarded because of the refractory mixed in the surface of the steel. Furthermore, hot tops in themselves are costly and in a majority of cases, are used but once. It will be noted in my method that the insulated portion of the envelope does not touch the ingot, there being a film of hot air, a poor conductor of heat, between the insulated portion of the envelope and the skin of the ingot.

There is therefore no erosive wear on the insulating lining of the envelope and this can hence be used so many times that its cost is practically negligible.

The structure shown in Fig. 3 is similar to that shown in Fig. 2, except that I have provided a space or combustion chamber in the hood for the reception of a combustible, such as crushed coke, to heat the upper portion of the ingot. As the structure shown in Fig. 3 is similar to that shown in Fig. 2, I have applied the same reference characters to corresponding parts with the letter *a* affixed.

As above stated there is a combustion chamber **30** in the hood **15*a*** surrounding the upper portion of the ingot. Supported on an inwardly extending flange at the lower end of the hood **15*a*** are fire bricks or other refractory **31**, which extend laterally close to the side of the ingot, and extending through these bricks are air inlet openings **33** for supplying air to the combustion chamber **30**. In the form shown in Fig. 3, I preferably connect the plug **18*a*** to the hood by means of a hinge as indicated, and I also provide a slidable sleeve shutter **36*a*** for the openings **16*a*** through the upper portion of the body **12*a*** of the envelope.

In carrying out the process of producing ingots with this apparatus, the ingot is covered as soon as the mold is stripped therefrom. I place a thin layer of crushed refractory **34** such as sand over the top crust of the ingot. I then fill the space between the refractory lining of the envelope hood and the top portion of the ingot with combustible **35** such as coke and the induced draft as shown by the air currents, indicated by arrows, causes this combustible to burn in direct contact with the skin of the upper portion of the ingot. While this is going on the closing plug **18*a*** is thrown back into the dotted position. By regulating the amount of air, I can maintain a temperature sufficiently high to even melt the top end of the ingot if I so desire. In practical operation I will permit this fire to burn until I have sufficiently heated the top end of the ingot when I will close the openings in the top of the envelope and open the openings **16*a*** in the envelope below the insulated portion by dropping the sleeve shutter **36*a***. The air currents will then pass through the body **12*a*** of the envelope and out through openings **16*a***.

In Figs. 4 and 5 I have shown how the Gathmann big-end-up iron mold without a hot top and with a hood may be used for carrying out my process. In these figures, **40** designates a well known form of big-end-up ingot mold, supported on a base **41**, and **42** is a movable plug which forms a portion of the bottom of the mold. This plug is hollow as indicated in Fig. 5, and is provided with lateral ports **43** below the upper end thereof extending through the sides of the stem from the vertical duct **44** extending from the lower end of the stem. The base **41** is provided with an opening **45** for the reception of the stem of the plug **42** when the mold is in pouring position on the base, and **46** is a smaller opening through the base **41**, which is in register with the vertical duct **44** in the stem of the plug when the mold is used as an envelope for treating an ingot therein.

The hood **15*b*** used in connection with the mold **40** is similar to the hood **15** shown in Fig. 2, and to which have been applied the same reference characters with the letter *b* affixed.

In carrying out my process by means of the apparatus shown in Figs. 4 and 5, the metal may be poured directly into the mold and the hood **15*b*** then placed in position as shown in Fig. 4, or the hood **15*b*** may be placed on the mold **40** and the metal poured through opening **17*b***. In this latter case, after the ingot has been poured the cap **18*b*** is placed in position to close the opening **17*b***. After the skin of the ingot has formed sufficiently, I push the ingot upwardly within the mold, as shown in Fig. 5, until its upper end is within the insulating cap which then may rest on the top skin of the ingot by raising the mold and shifting it from the position shown in Fig. 4, to that shown in Fig. 5. I may then blow air upwardly through the plug, as indicated by arrows, which air passes upwardly between the ingot and the mold and then outwardly between the top of the mold and the insulating hood.

By means of the above method and apparatus, I am enabled to control the freezing rate of the ingot, from the time it is poured until it is completely solidified, in a way not possible by present day methods where the solidification rate of a given ingot is controlled by the design of the mold and depends thereon.

By my improvements I am able to cast types of ingots not now practical and thereby comply with natural metallurgical laws, disobedience to which in present day metallurgical practices entails high costs, such as chipping for the correction of flaws directly due to the aforesaid disobedience.

I do not limit my invention to the use of air as a cooling medium, nor do I limit my invention to the use of the envelope just described, but have given these as practical means for carrying out my invention. The invention in its broadest sense, consists in pouring metal into a mold, relatively moving the mold and ingot when the ingot skin has formed sufficiently strong to withstand the internal static pressure of the still molten interior and thereafter controlling the further cooling of the ingot in its various parts as desired by means directly affecting the skin of the ingot and thus through the skin temperature affecting the cooling of the interior molten metal. When I use the term "skin of the ingot" I include in this the top crust, which I consider to be the top skin. In this way I am able to obtain a more rapid cooling of the entire mass thereby cutting down ingotism or the growth of large crystals and the segregation that is attendant thereto and I produce a much cleaner and more uniform piece of metal.

Having thus described my invention, what I claim is:

1. In the method of forming ingots, the steps consisting in casting an ingot entirely within a metal mold, removing the ingot from the ingot mold when the ingot-forming metal has only partially solidified, and confining the upper portion of the partially solidified ingot within insulation while permitting relatively more rapid cooling of the lower portion of the ingot so as to restrict the dissipation of heat from the upper portion of the ingot with relation to the dissipation of heat from the lower portion of the ingot.

2. The method of forming ingots, comprising casting an ingot entirely within a metal mold, hastening the solidification of the cast ingot by stripping the ingot when a skin has formed on its exterior and the major portion of the body of the ingot is still molten, confining the stripped ingot so as to surround said skin with a confined treating atmosphere while the major portion of the body of the ingot is still molten, and effecting the freezing of the interior of the ingot from the bottom upward by abstracting heat from the lower portion of the ingot to a greater extent than from the upper portion of the ingot.

3. The method of treating ingots comprising directly surrounding the skin of an ingot with a confined treating atmosphere while the major portion of the body of the ingot metal is still molten, controlling the movement of said atmosphere, and varying the movement of said atmosphere over different portions of the skin of the ingot in direct contact therewith to increase the cooling rate of the lower portion of the ingot relative to the rate of cooling of the upper portion to effect the freezing of the molten interior of the ingot from the bottom upward.

4. The method of treating ingots comprising directly subjecting the skin of an ingot to a confined treating atmosphere while the major portion of the body of the ingot is still molten, and maintaining the atmosphere surrounding the upper portion of the ingot substantially quiescent.

5. The method of producing ingots, comprising pouring the ingot forming metal at such a relatively slow rate into a mold as to form a relatively heavy skin about the bottom portion of the ingot by the time there is a relatively thin skin formed at the sides of the upper portion thereof, effecting relative endwise bodily movement between the mold and the ingot while the major portion of the body of the ingot is still molten so as to at least partially strip the ingot, and confining the upper portion of the partially solidified ingot within insulation while permitting relatively more rapid cooling of the lower portion of the ingot so as to restrict the dissipation of heat from the upper portion of the ingot with relation to the dissipation of heat from the lower portion of the ingot.

6. The method of producing ingots, comprising pouring the ingot-forming metal at such a relatively slow rate into a metal mold as to form a relatively heavy skin about the bottom portion of the ingot by the time there is a relatively thin skin formed at the sides of the upper portion thereof, effecting relative endwise bodily movement between the mold and the ingot while the major portion of the body of the ingot is still molten, maintaining a portion of the ingot within the mold after such movement but spaced from the mold, and confining the remainder of the ingot in an enclosure of different heat conductivity than that of the mold.

7. In the method of forming ingots, the steps consisting in casting an ingot substantially entirely within a metal mold, stripping the ingot at least partially when the ingot-forming metal has only partially solidified, and restricting the dissipation of heat from the upper portion of the partially solidified ingot with relation to the dissipation of heat from the lower portion of the ingot so as to promote the solidification of the ingot from the bottom upwardly.

8. A method of forming ingots as claimed in the preceding claim, in which the upper portion of the ingot is heated for bringing about the solidification of the ingot from the bottom upwardly.

9. In the method of forming ingots, the steps consisting in pouring an ingot, stripping the ingot at least partially when the ingot-forming metal has only partially solidified, confining the ingot so as to surround the skin of the ingot with a confined treating atmosphere, applying the heat of combustion of a fuel to the upper portion of the ingot, and producing movement of the treating atmosphere surrounding the lower portion of the ingot so as to increase the rate of cooling of said lower portion relative to the rate of cooling of the upper portion of the ingot and control the freezing of the ingot from the bottom upwardly.

10. The method of treating ingots, comprising surrounding the skin of an ingot with a confined treating atmosphere while the major portion of the body of the ingot metal is still molten, permitting the portion of the atmosphere surrounding the lower portion of the ingot to flow upwardly over the ingot while maintaining the atmosphere surrounding the upper portion of the ingot substantially still for at least a portion of the treating period.

11. The method of treating ingots, comprising surrounding the skin of an ingot with a confined treating atmosphere while the major portion of the body of the ingot metal is still molten, permitting the portion of the atmosphere surrounding the lower portion of the ingot to flow upwardly over the ingot while maintaining the atmosphere surrounding the upper portion of the ingot substantially still for at least a portion of the treating period, and controlling the movement of atmosphere surrounding the lower

portion of the ingot, and thereby controlling the freezing of the ingot from the bottom upward.

12. The herein described method of producing ingots which consists in pouring metal into a big-end-up mold, placing an enveloping insulating hood on the top of the mold, pushing the ingot upwardly within the mold until its upper end is within the insulating hood, forcing air currents upwardly between the mold and the ingot and outwardly between the ingot and insulating hood.

13. The herein described method of casting and treating ingots which consists in pouring metal into a big-end-up mold, placing an enveloping insulating hood on the top of the mold, pushing the ingot upwardly within the mold until its upper end is within the insulating hood, and continuing the solidification of the ingot while so confined.

14. In the method of forming ingots, the steps consisting in casting an ingot entirely within a big-end-up mold, bodily raising the ingot at least part-way out of the mold before complete solidification of the ingot, and restricting the dissipation of heat from the upper portion of the partially solidified ingot with relation to the dissipation of heat from the lower portion of the ingot so as to promote the solidification of the ingot from the bottom upwardly.

15. In the method of forming ingots, the steps comprising casting an ingot within a big-end-up mold, applying a heat insulating material to the top surface of the ingot within the mold, effecting relative movement between the ingot and the mold, and applying a heat confining casing to the upper portion of the ingot while permitting the remainder of the ingot to cool at a faster rate than the portion so confined so as to promote the solidification of the ingot from the bottom upwardly.

16. In the method of producing ingots, the steps comprising pouring an ingot, stripping the ingot when a skin has formed on its exterior and the major portion of the body of the ingot is still unsolidified, then confining the partially solidified ingot within an enclosing envelope and hastening the cooling of the portion of the ingot containing the segregate by introducing cooling medium within the enclosing envelope and into direct contact with a portion at least of the skin of the ingot.

17. In the method of producing ingots, the steps comprising pouring an ingot, stripping the ingot when a skin has formed on its exterior and the major portion of the body of the ingot is still unsolidified, then confining the partially solidified ingot within an enclosing envelope and retarding the solidification of the portion of the ingot containing the segregate by reducing the rate of heat dissipation from said portion of the ingot while introducing cooling medium within the enclosing envelope and into direct contact with the skin of other portions of the ingot.

18. In the method of forming ingots, the steps comprising applying a heat insulating hood to a big-end-up ingot mold containing a cast but only partially solidified ingot, and effecting movement of said ingot relatively to said mold to bring a portion thereof into said hood.

19. In the method of forming ingots, the steps comprising destroying heat conducting contact between an ingot mold and an ingot cast therein prior to complete solidification of said ingot by moving the ingot out of contact with the mold walls, and retarding the heat dissipation from a portion of said ingot to a greater extent than from the remainder thereof while maintaining the ingot at least partly confined within said mold.

20. The method of producing big-end-up metallic ingots which consists in pouring molten metal into a big-end-up mold, then raising the ingot only partially through the mold when the ingot forming metal has partially solidified, admitting air from the outside of the mold to the bottom of the annular space between the mold and ingot, and supporting the ingot in said partially raised position until solidification is complete.

21. The method of producing big-end-up metallic ingots which consists in pouring molten metal into a big-end-up mold, covering the top of the ingot with heat insulating material, then raising the ingot only partially through the mold when the ingot forming metal has partially solidified, admitting air from the outside of the mold to the bottom of the annular space between the mold and ingot, and supporting the ingot in said partially raised position until solidification is complete.

22. The method of producing big-end-up ingots which consists in pouring molten metal into a big-end-up mold, then raising the ingot only partially through the mold when the ingot forming metal has partially solidified, admitting air from the outside of the mold to the bottom of the annular space between the mold and ingot, and supporting the ingot in said partially raised position until solidification is complete.

23. The method of producing big-end-up metallic ingots which consists in pouring molten metal into a big-end-up mold, then raising the ingot only partially through the mold until the top portion of the ingot projects above the mold and with the bottom portion of the ingot still extending down into the mold when the ingot forming metal has partially solidified, admitting air from the outside of the mold to the bottom of the annular space between the mold and ingot, and supporting the ingot in said partially raised position whereby cool air will flow into the bottom of the mold and up through the annular space between the mold and ingot for cooling the latter at a progressively decreasing rate from the bottom to the top thereof.

24. The method of producing big-end-up ingots which consists in pouring molten metal into a big-end-up mold, then raising the ingot only partially through the mold when the ingot-forming metal has partially solidified, blowing air upwardly within the annular space between the mold and ingot, and supporting the ingot in said partially raised position until solidification is complete.

25. The method of producing big-end-up ingots which consists in pouring molten metal into a big-end-up mold, then raising the ingot only partially through the mold when the ingot-forming metal has partially solidified, blowing air upwardly within the annular space between the mold and ingot while maintaining the atmosphere surrounding the upper portion of the ingot substantially quiescent, and supporting the ingot in said partially raised position until solidification is complete.

GEORGE A. DORNIN.

CERTIFICATE OF CORRECTION.

Patent No. 2,102,258. December 14, 1937.

GEORGE A. DORNIN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 45, for the word "and" first occurrence, read or; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of February, A. D. 1938.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)