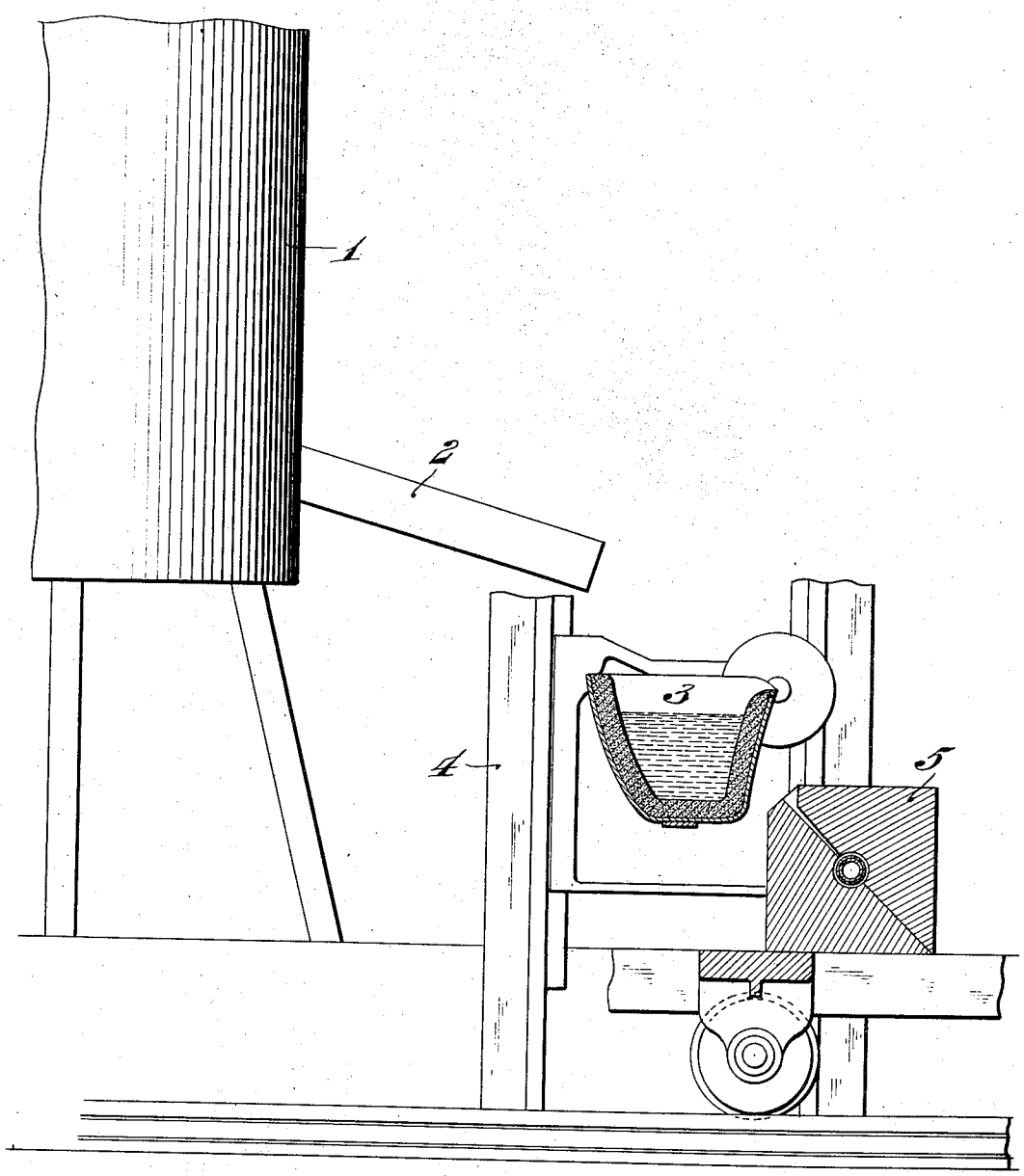
E. A. CUSTER.

ART OF CASTING PIPES.

APPLICATION FILED APR. 7, 1908.

906,204. Patented Dec. 8, 1908.



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ART OF CASTING PIPES.

No. 906,204. Specification of Letters Patent. Patented Dec. 8, 1908.

Application filed April 7, 1908. Serial No. 425,672.

To all whom it may concern:

Be it known that I, EDGAR ALAN 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 the Art of Casting Pipes, of which the following is a specification.

My invention has relation to the art of casting metal structures, such as pipe for soil, water and gas purposes; and in such connection it relates to the production of homogeneous cast structures definitively soft or hard or tough, as desired, without particular consideration of the constituency of the iron employed in deriving such resultant product.

My present invention is predicated upon the fact that molten iron when allowed to cool slowly separates the carbon in two forms, free or graphitic carbon and combined carbon. The amount of graphitic carbon present in iron depends upon the rate at which it is cooled. Further graphitic carbon when molten iron is cooled slowly, tends to segregate before the iron reaches the point at which it sets. Graphitic carbon forms very quickly and when the iron is cooled the free carbon divides into two forms, graphitic and annealing. The difference between the two is simply a difference in form, because both have the same chemical characteristics, which demonstrates that if molten iron is suddenly chilled to the point at which it sets, the formation of graphitic carbon in the iron is prevented and consequently all or nearly all the carbon exists in a combined state. This is equally true in respect to the action of sulfur and phosphorus in the iron and consequently segregation of these elements is prevented in the same said manner. The formation of annealing carbon in iron and of carbid carbon begins after the iron has passed the setting point and such action can only take place when the iron is permitted to cool normally, so that if a structure be cast, as a pipe, in the defined manner, that is, chilled suddenly from the molten state to the point at which it sets, and be then allowed to cool slowly at normal atmospheric temperature or at an established falling temperature, undesirable actions, as segregation and formation of graphitic carbon are prevented and desirable actions, as formation of annealing carbon and carbid carbon regularly begin. These actions produce with certainty a thoroughly homogeneous product with such changed molecular conditions as to give either a soft or hard or tough product, as may be preferred.

My invention broadly considered, consists in subjecting iron to the influence of heat in a furnace to bring to a molten state, then pouring into a permanent mold under existing conditions to chill suddenly to a setting point of the molten metal and then removing to permit the cast structure to then cool gradually to thereby derive a resultant homogeneous cast structure.

My invention as above defined will be more fully understood in connection with the accompanying drawing illustrating diagrammatically a plant, for carrying into effect the method of my present invention.

Referring to the drawing, 1 is a cupola or other type of furnace for bringing the metal, as iron, into a molten state.

The furnace 1, is provided with a discharge spout 2, below which is preferably arranged a pouring ladle 3, pivotally supported from standards 4. Beneath the ladle 3, is located a mold 5, of a type of Letters Patent No. 887,070 granted to me under date of May 12th, 1908, to which as to structural arrangement and the manner of operating recourse may be had; and also to my application Serial No. 421,054 filed March 14th, 1908, showing such type of mold, but arranged in series upon a turntable for carrying out economically and expeditiously the production of pipe according to the described method of my said invention.

The temperature of the molten iron as it leaves the cupola or other furnace 1, ranges between 2000° and 2800° Fahrenheit and in passing therefrom to the pouring ladle 3, the temperature is not materially changed or modified. The instant, however, the pourings from the ladle 3, enter the interior of the mold 5, around a perforated or other composition core there is effected a violent or sudden change on the molten mass due to the difference in maintained temperature between the permanent mold and poured metal. This results in preventing through the sudden chilling of the molten metal to the point of setting of the formation of graphitic carbon in the iron structure, because all or nearly all the carbon is held in a combined state as segregation only occurs

while the iron is in a molten condition. This is equally true in respect to the action of sulfur and phosphorus on the iron. From the period when the iron is set follows the formation of an annealing carbon and carbid carbon. This action takes place during the period of gradual cooling of the iron in its structural form.

In further explanation of essential features of my defined method, in a casting, such as a thin pipe, in an ordinary sand mold about a minute is required to cool the molten iron to the point at which the pipe sets. It is during this period detrimental effects on the cast iron are produced. Phosphorus, sulfur and carbon segregate and graphitic-carbon is formed. The iron, however, during this period is in a liquid state, with all its elements free to move. Once the casting is set segregation ceases and the carbon remaining begins its beneficent action. The iron loses its heat at a normal rate and annealing and carbid carbon are formed, which improves the quality of the metal. Therefore, if the molten iron be swiftly poured into a permanent iron mold it will very quickly set by chilling suddenly and any evil effects will thereby be appreciably reduced, in fact, to such an extent that the impurities the iron contained will be held in the position occupied, while in the molten state. Furthermore, the evil effects of sulfur and phosphorus in the iron are reduced to a minimum, since they are in practically an atomic condition distributed uniformly throughout the subsequent casting. If the cast structure is set by sudden chilling and the structure is then allowed to cool normally, practice has demonstrated that ideal conditions exist in the resultant product. Moreover, chilling of a cast iron structure to a point of extreme hardness is purely a mechanical action, and the point to which sudden chilling is carried can be determined to an absolute certainty by the said method with some regard to the constituency of the iron used, without fear of producing a pipe with a chilled surface or one incapable of being readily machined, drilled or threaded.

The method of my said invention, as hereinbefore described is not confined to pipe making alone, as other types of castings by the defined steps thereof, in permanent iron molds can be effected in a most satisfactory manner.

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

1. The art of casting metal structures, which consists in chilling suddenly metal in a molten state to the point of setting in the structure and then cooling gradually at atmospheric temperature, substantially as and for the purposes described.

2. The art of casting metal structures, which consists in chilling suddenly molten iron to the point of setting in the structure and then cooling normally thereafter at atmospheric temperature, substantially as and for the purposes described.

3. The art of casting metal structures, which consists in chilling suddenly molten iron to the point of setting in the structure and then cooling gradually at atmospheric temperature to prevent first undesirable actions as segregation and formation of graphitic carbon in the structure and second to permit of desirable actions as formation of annealing carbon and carbid-carbon therein, substantially as and for the purposes described.

4. The art of casting metal structures, which consists in maintaining molten metal at a temperature from 2000° to 2800° Fah., then quickly lowering the temperature of the same to from 1700° to 2200° Fah., by introducing into a permanent mold, and then permitting gradual lowering of such temperature by removing the cast structure from the mold, substantially as and for the purposes described.

5. The art of casting metal structures, which consists in maintaining molten metal at a temperature from 2000 to 2800° Fah., to hold the carbon of the same in solution, then quickly lowering such temperature between 1700° and 2200° Fah., by introducing the metal into a permanent mold to maintain the carbon in a finely divided state at a point at which the metal assumed form, and then permitting a gradual lowering of the temperature of the metal and by the same the formation of annealing carbon and carbid-carbon, substantially as and for the purposes described.

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

EDGAR ALAN CUSTER.

Witnesses:

WILHELM VOGT,

THOMAS M. SMITH.