

UNITED STATES PATENT OFFICE.

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MANUFACTURE OF ARTICLES FROM CAST-IRON.

No. 842,906.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ALEXANDER E. OUTERBRIDGE, Jr., of No. 8 Summit avenue, in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Articles from Cast-Iron, whereof the following is a specification.

One of the difficult problems of foundry practice where miscellaneous castings are made is to economically obtain the proper grades of iron from one melt in a cupola suitable for different classes of castings requiring different qualities of iron. Thus the articles may range from castings of many tons weight usually of thick section requiring strong iron of close-grained texture often having high chilling properties to small objects of a pound or so in weight, frequently of thin sections, which may require to be machined, and therefore must be of softer metal having little or no tendency to chill. Under these circumstances it is the effort of the founder to vary as best he can the grade of metal in the cupola itself at different periods of heat and to so group and time his castings as to utilize to the best advantage the different grades of iron which run from the cupola in one continuous melting operation. Even with the utmost care this practice is only approximately correct, since the transition from one grade to another in the cupola is not absolutely ascertainable or, indeed, definite at all, and hence the effort has been to interpose between the period of the widely-different castings certain others, which are termed "buffer-castings," as to which intermediate or uncertain grades of iron can be used with comparative indifference.

I have ascertained that by following the procedure about to be indicated I can produce in the ladles themselves a great variety of grades of iron with respect to hardness, chilling properties, and other important characteristics, so that the general run of iron in the cupola need not be practically varied and may, moreover, be of what would be termed a "low" grade, the necessary treatment to control the physical qualities being restricted to the relatively small quantity commonly used in a foundry-ladle and the changes within the desired limits being immediately attainable. By this means I am enabled to cast from the same cupola charge small articles, such as pulleys, with rims, say, one-quarter of an inch thick, soft enough to

permit of machining and with negligible chilling tendency, and heavy castings having, if desired, high chilling properties and close-grained texture.

In carrying out my process I proceed as follows: I may melt in the cupola iron of a character capable for the castings of the lowest grade to be made, which may have close-grained texture and high chilling properties, and then tap into a ladle a charge sufficient for a particular casting or group of castings which it is desired to make of softer iron having but little chilling tendency. I then combine with the molten metal in the ladle a definite amount of a silicon compound in such form as to be thoroughly and quickly diffusible and without attendant additions which would impair the desired result. For this purpose I prefer to use powdered ferrosilicon containing a large proportion of silicon—say fifty per cent. of silicon—and I usually add it at the time of tapping of the metal into the ladle or soon thereafter in order to insure thorough combination. The casting is then poured in the usual manner.

Other ladles may be tapped from the same charge and treated with different quantities of ferrosilicon, depending upon the qualities desired for the ultimate product.

I have found that hard iron can be modified so as to produce a relatively soft gray iron by the addition of even so little as one pound of fifty-per-cent. ferrosilicon to two hundred pounds of iron and that within certain limits the desired physical characteristics of the metal can be accurately controlled in correspondence with the percentage of the ferrosilicon thus added.

I have named fifty-per-cent. ferrosilicon as the preferred ingredient to be practically used, because it affords the desired vehicle for the introduction of the silicon (which is the efficient agent) under such circumstances as are most favorable for the end to be obtained. If a low grade of ferrosilicon be added, (containing, say, only twenty per cent. of silicon,) the relatively large amount of iron contained in the addition tends not only to chill the contents of the ladle, but may in itself injuriously modify the total mass with relation to its intended purpose. Moreover, under these circumstances the addition does not exhibit the immediate and thorough diffusibility which characterizes the relatively high grade ferrosilicon and which is essential for the practical conduct of

the operation, since it will be noted that the addition is made after the cessation of the actual melting process and that the reaction must be effected during the period when cooling is taking place.

I have given the above proportions as typical of my invention, but do not wish to be understood as restricting myself thereto, since they may be obviously modified to obtain the desired grade of cast-iron.

I am of course aware that it is not broadly new to utilize ferrosilicon in the manufacture of cast-iron, and I do not claim the same; but so far as my experience goes in commercial practice the addition has been made in the cupola itself, which is not only wasteful of the ingredients, but results either in what may be considered as a fixed product or if varied during the heat in a product which is indeterminate, so as not to be predictable at a given moment of tapping.

I am also aware that it has been suggested to employ silicon in its elemental form as an addition to cast-iron in the ladle. Careful tests, however, have determined the fact that the silicon thus designated is not diffusible to any substantial extent in the cast-iron under the conditions characteristic of actual practice, and therefore will not produce the result attained by my process. I believe that the reason for this practical non-diffusibility is due to one or both of two factors—viz., first, the high melting-point of the so-called “elemental” silicon, (or silicon not associated with such a vehicle as is present when ferrosilicon is used,) and, second, the low specific gravity of such silicon. Whatever be the cause, I have found that at the temperature and under the conditions which are characteristic of molten cast-iron in the ladle in normal foundry practice and which are necessitated by commercial limitations the addition of such silicon does not produce any efficient or beneficial reaction which can be utilized in the process of making castings. I therefore do not claim the use of the so-called

“elemental” or “practically pure” silicon. I believe, however, that I am the first to practically note the immediate diffusibility of silicon in combination with a proper vehicle, such as the high-grade ferrosilicon above mentioned when added to a relatively small quantity of melted cupola-iron, which has been withdrawn from the source of heat-supply and its capacity when thus diffused to produce definitely-controllable results in the physical characteristics which are essential in different grades of castings.

The limits of my invention may be said for practical purposes to depend upon the characteristics that the silicon compound shall be readily diffusible throughout the metal in the ladle at the temperature normally employed at that stage of foundry practice and that the vehicle shall not substantially impair the resultant product. Such characteristics do not practically exist when, on the one hand, the vehicle preponderates too greatly in the compound which is added, or, on the other hand, when it is present in such small percentage as not to substantially modify the indiffusible character of pure silicon at the temperature and under the conditions just mentioned.

Having thus described my invention, I claim—

The hereinbefore-described improvement in the manufacture of articles from cast-iron, which consists in diffusing throughout the metal in the ladle, after tapping, a silicon compound containing a relatively high percentage of silicon, and thereby modifying the grade of iron in the ladle itself, in accordance with the predetermined requirements of a given casting, or group of castings.

In testimony whereof I have hereunto signed my name, at Philadelphia, Pennsylvania, this 8th day of November, 1905.

ALEXANDER E. OUTERBRIDGE, JR.

Witnesses:

JAMES H. BELL,
E. L. FULLERTON.