

UNITED STATES PATENT OFFICE

PAUL D. MERICA, OF WESTFIELD, JAMES S. VANICK, OF ELIZABETH, AND THOMAS H. WICKENDEN, OF ROSELLE, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE INTERNATIONAL NICKEL COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

GRAY CAST IRON

No Drawing.

Application filed July 16, 1927. Serial No. 206,378.

This invention relates to gray iron castings, and in particular it has to do with the production of a novel gray cast iron that does not "grow" when it is repeatedly subjected to heating and cooling. The main object of the invention is to produce an improved and novel gray cast iron which does not increase in volume, or at least only increases to an extent that is not detrimental. Other objects and advantages of the invention will be pointed out as the detailed description herein is read.

It has been known for some time that ordinary gray cast iron increases in volume; often as much as thirty percent or more when it is repeatedly heated above its critical range, about 1300° F., and cooled below that range. Obviously this increase in size, or "growth," is a distinct liability and prevents the use of gray iron castings in many places where the iron would otherwise be of material advantage.

Many theories have been advanced in explanation of this growth and it seems probable that the growth may be due, at least in part, to oxidation by the atmosphere in which the iron is heated.

It is known that the silicon content of the iron has a very material influence upon the rate and extent of the growth. It may be said that the growth, roughly considered, is in proportion to the silicon content. Ordinary cast iron which has less than about .30% silicon does not grow, but with this low silicon the iron is white, brittle and unmachinable, and, therefore, not generally useful. Consequently, the presence of silicon may be generally considered as being a detriment. It is to be understood that one of the principal assets of gray cast iron as contrasted with white, chilled or mottled iron is its machinability and that silicon is normally added for the purpose of making iron gray and, therefore, machinable. The amount of silicon so added is varied according to the cross-sections of the castings; a smaller amount, for larger section castings, and a larger amount, for smaller section castings. It may, therefore, be stated that each cross-section requires a definite amount of silicon in the casting,

and that amount may be considered the normal amount of silicon for that casting. As is well known to those skilled in the art, such an amount of silicon usually varies between substantially one and three per cent, which is ordinarily sufficient to render the casting gray and machinable. These percentages are given by way of illustration only, as in particular instances, as above indicated, the silicon content may vary considerably therefrom.

When the term—gray cast iron—is employed it is to be understood that it contains the usual constituents or elements of such irons and that these elements are present in their usual ranges or percentages.

It has been discovered that gray cast iron which is machinable and which is practically free from growth upon repeated heating and cooling, may be readily produced when nickel, or an element acting equivalent thereto, is substituted for all or a major part of the normal amount of silicon employed in such castings. For this purpose about 2-4 parts of nickel may be substituted for approximately each part of silicon. Like silicon nickel renders iron gray and machinable yet unlike it, it does not affect growth.

It will, therefore, be seen that improved "no-growth" gray cast iron may be readily produced by using the normal amount of carbon, a sufficient amount of silicon to deoxidize the iron, and a sufficient amount of nickel to render the casting completely gray and machinable. For practical purposes in manufacture, some silicon may be left in the composition to assist in the production but the small amount of growth due to the very limited amount of silicon is not detrimental to the use of the castings.

Thus, it was found that a casting of cupola iron 1" x 2" in section with the following composition

	Per cent
Carbon-----	3.98
Silicon-----	0.19
Nickel-----	3.84

was completely gray and machinable and only showed a growth of 2.89% in volume after

twelve heatings to 1500° F. Under the same heating conditions a gray iron with no nickel and with 2% silicon showed a 25.9% increase in volume. The 2.89% increase in volume is not detrimental in most of the advantages uses of gray cast iron.

Thus it will be seen that a satisfactory gray cast iron with substantially no growth may be readily produced when there is a carbon content normal for cast iron, but with a very low silicon content less than about .30% and with nickel in an amount sufficient to render the casting gray and machinable. It will be understood that the amount of nickel may vary depending upon the section of the casting, and that the amount of the nickel will preferably be increased the thinner the casting is in cross-section. Thus in practice, amounts of nickel from .25% to 5.0% may be used.

If desired all of the silicon content may be replaced by nickel, or by an element acting equivalently thereto, but it is found that if the silicon content is maintained below about .30% that there is substantially no-growth and the small silicon content is not detrimental in this advantageous type of no-growth machinable gray cast iron.

In many instances it is not necessary, and sometimes not desirable, to eliminate all of the silicon. For some uses of gray cast iron the amount of growth is not necessarily a controlling factor when the growth is within a limited range. Thus, a low-growth instead of a substantially no-growth iron may be produced and be most efficient in use. Therefore, there are conditions existing when the convenience of production in the foundry may be compromised with, or balanced against, the amount of silicon introduced. Thus a satisfactory machinable gray cast iron with substantially no-growth, or low-growth, may be readily produced at a satisfactory cost figure and will be satisfactory for practically all desired uses in which gray cast iron is specified.

An actual test of low-growth, completely gray and machinable alloy having the following composition

	Per cent
Carbon-----	2.96
Silicon-----	0.70
Nickel-----	3.47

showed a growth of 8.54% in a series of heatings under which a 2% silicon iron (without nickel) showed 25.9% increase in volume.

It may be noted that some assistance may be secured in producing satisfactory castings of this type when it is understood that a high total carbon content promotes the precipitation of graphite, substantially the same as silicon, and effectively acts to gray the castings and to render them machinable, while on the other hand it does not effect nor

promote the growth rate in the same proportion. It is, therefore, advantageous in producing no-growth or low-growth gray iron castings with a low silicon content to use a high carbon content, usually in the neighborhood of 3.50%-4.0%.

It is well known in metallurgical work that certain elements such as chromium, manganese and sulphur give definite advantages to the alloys into which they are introduced. One of their uses in cast iron is to tend to reduce growth, but it is known that they also tend to chill the iron and render it white and unmachinable. Of course, when silicon is added to counteract the chilling effect and thereby render the casting machinable it is found that the growth is again very evident, substantially in proportion to the silicon content. Therefore, there is no net advantage obtained.

It has been discovered that by substituting nickel for silicon when any of the elements such as chromium, manganese or sulphur were present that the advantages of the presence of any of those elements in regard to the growth are completely conserved in the gray castings.

When introducing the nickel for the silicon, it was found that the chilling effects created by the presence of chromium, manganese or sulphur or other elements could be compensated for by introducing the proper amount of nickel. As an illustration, it was found that about three parts of nickel would counteract the chilling effect of one part of chromium. Approximately similar ratios pertain when manganese or sulphur or other like suitable elements are introduced instead of chromium.

It was also discovered when one or more of these desirable additional elements were present and nickel replaced a major portion of the normal amount of silicon, that the growth could be controlled to give a substantially no-growth or a low-growth casting. It is also desirable to have a small amount of silicon present for purposes of satisfactory and efficient manufacture, preferably in amounts not greater than .15%.

In carrying out this invention as a whole it will be understood that it may be used in conjunction with any of the ordinary processes designed to secure gray castings of silicon iron, such for instance as heating the molds, annealing the castings and so forth. It will also be understood that in using other processes that there may be some variations made in the amounts or percentages of the various elements employed.

It will be seen from the foregoing description that an advantageous no-growth, or low-growth, machinable gray cast iron may be readily produced by substituting nickel, or other equivalently acting element or elements, for all or a major part of the normal

silicon content. It will also be seen that advantageous effects of various elements and the advantages of non-growth or low-growth may be conserved without detriment to machinability.

It will be noted that there is herein disclosed a novel machinable gray cast iron which does not grow, or at least has only a reduced growth, and in particular, certain definite compositions have been stated specifically for the purpose of fully disclosing this invention, but it is to be understood that modifications therein may be made without departing from the scope of the invention.

What is claimed is:

1. A substantially no-growth gray cast iron consisting essentially of nickel from 0.5 to 5.0%, and silicon in appreciable amounts up to .30%, and the balance substantially

2. A substantially no-growth gray cast iron containing approximately .30% silicon for deoxidizing the iron, and nickel in amount from 0.5 to 5.0% to render the casting gray and machinable.

3. A substantially no-growth gray cast iron consisting essentially of 3 to 4% carbon, silicon in appreciable amounts up to .30%, .5 to 5.0% nickel, and the balance substantially iron.

4. A gray casting of alloy cast iron consisting essentially of silicon in appreciable amounts up to .5%, and nickel in an amount to gray the casting.

5. A gray cast iron, consisting of iron and carbon, silicon in substantial amounts up to .7%, and nickel .05 to 5%, wherein substantially three parts of nickel replaces each part of silicon below 2%.

In testimony whereof we have hereunto set our hands.

PAUL D. MERICA.
JAMES S. VANICK.
THOMAS H. WICKENDEN.