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STAINLESS METAL

Charles Hardy, Pelham Manor, N. Y., assignor to
Hardy Metallurgical Company, a Corporation
of Delaware

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1 Claim. (Cl. 75—45)

This invention relates to the manufacture of stainless metal. It has for its object certain improvements in the method of manufacturing stainless metal as well as to the stainless metal itself as an article of manufacture. The invention relates more particularly to the manufacture of stainless iron and steel.

Stainless metals of various kinds are available on the market. In their customary form they comprise an alloy of iron with one or more other metals adapted to impart the stainless quality desired. Such metals as nickel, and/or chromium are employed in conjunction with the iron. Stainless steel comprises an alloy of iron and carbon together with one or more metals adapted to impart the stainless characteristic. Certain inherent difficulties are encountered in compounding stainless metal according to customary procedures. Since the stainless metal actually consists of an alloy of two or more metals, this means that an application of heat during the compounding operation sufficiently high to melt the metals employed is required. In the case of ferro-chrome or ferro-nickel or ferro-nickel-chrome alloys, a temperature sufficiently high to melt the most difficultly meltable metal present is required. It is evident that a very considerable expenditure of heat is necessary to effect the compounding of the alloy.

At the highly elevated temperatures required to alloy the metals, deleterious influences may well set in. Thus, unless extreme care is taken to keep the molten metal out of contact with oxygen, oxidation of the metal will take place. Stirring difficulties are encountered in properly distributing the alloying metals uniformly throughout the body of molten iron. A slag is apt to form on the top surface of the molten metal into which an appreciable amount of the added alloying metal or metals may tend to collect, thus disturbing the proper balance or proportions of metals within the main body of molten metal.

In the case of the manufacture of stainless steel, it is particularly difficult to regulate the amount of carbon present. The carbon content is usually lowered by an oxidation process, for example, by the introduction into a body of molten ferro-chrome of an oxide of iron. As a result of this purification step, the carbon is oxidized, but a substantial part of the chromium is also oxidized. In fact, at normal alloying temperatures, the chromium combines with the oxygen made available by the oxide of iron more rapidly than does the carbon. The net result is to cause a considerable portion of the chromium to enter the slag

on the top surface of the molten metal as an oxide of chromium. Special steps must be taken to cause the chromium in the slag to pass down into the body of molten metal. Thus, a reducing agent may be admixed with the slag as it rests on the top surface, in order to effect a conversion of the chromium oxide to metallic chromium, which may then be made to enter the molten body of iron below. It will be apparent that it is extremely difficult to regulate the carbon content of the stainless steel in this manner, and the same applies to the regulation of its chromium content.

The present invention relates to the manufacture of stainless metal in a manner that materially avoids many of the difficulties encountered in the manufacture of stainless metal according to the customary methods. Considerably less heat is required, which at the same time means that there is less danger of impairing the quality of the metal because of deleterious reactions that otherwise occur at highly elevated temperatures. A substantial economy in heat is effected. Moreover, the metal or metals or other ingredients going into the making of the stainless metal may be accurately proportioned. In the case of stainless steel, for example, the carbon content may be adjusted to any predetermined content. The metal or metals added to impart the stainless quality may likewise be accurately proportioned. According to the invention, the ultimate stainless metal may be given a predetermined porosity and density.

The present invention accordingly contemplates a process for making stainless metal which comprises intimately admixing finely divided metal iron powder with finely divided powder of at least one other metal that will impart the desired stainless quality; then molding or extruding said admixture of metal powders under pressure, and subjecting the compressed powders to a heat treatment operation adapted to bring them to their bonding point to form a substantially homogeneous product. The invention also contemplates the stainless metal product as an article of manufacture.

The metal powders to be employed are in an extremely finely divided state. In the preferred practice of the invention, all of the metal powders pass through at least a 200 mesh screen. The powders employed should have clean metallic surfaces. While it is not necessary that all of the metal powders added should have the same particle size, they may advantageously have the same size gradations. Various particle sizes

may be employed to impart any desired ultimate porosity and density in the finished product.

In order to obtain substantially uniform distribution of the different metal powders, they should be intimately admixed. This intimate admixing may be obtained by stirring the powders mechanically.

The metal powders employed are preferably accurately weighed so that the finished product may be composed of metals having optimum proportions to impart to the finished product the desired stainless qualities. Thus, in the well known "18-8" stainless steel, the proportions of metals may be iron 74%, nickel 8% and chromium 18%. In a similar manner, the carbon content of stainless steel may be accurately controlled by adding the proper amount of finely divided carbon.

The admixed metal powders are then placed in an appropriate mold and subjected to the required pressure. Any suitable mold or die may be employed, depending upon the article to be manufactured. It is of course required that the mold shall be able to withstand the pressure that is to be applied. Flexible molds, such as those made of rubber, may in some instances be employed.

Instead of a molding operation, it may be desired to extrude the material; say in the manufacture of tubes and wires. In this case, the metal powders are admixed with an appropriate binding agent adapted to give the metal powders a certain coherency and plasticity. The binding agent employed should be selected with care, having in mind that the binding agent may or may not chemically react with the powders, as the case may be. Water may in some instances be employed as the binding agent. Nitrocellulose, lacquer or varnish may in some instances be used.

The molded or extruded articles are then subjected to an appropriate heat treatment operation. In this heat treatment operation it is aimed merely to bond the metal particles. For this purpose the metal particles may be in effect sintered or fused together. The temperature should not be brought to the point at which the metals are melted. The heat applied is well below the melting point of the metals employed, but still adequate to effect the desired bond. In this respect the practice of the present invention is to be distinguished from the customary method of alloying metals, in which the metals are compounded in the form of a liquid metal bath.

The heat treatment step should be conducted

in a non-oxidizing atmosphere; this may be accomplished in a hydrogen furnace; which is adapted to provide a reducing atmosphere around the article undergoing heat treatment.

A better understanding of the invention may perhaps be had by considering briefly a typical example of the practice of the invention: Iron, nickel and chromium powders passing through a 200 mesh screen are employed. The metal powders were mechanically admixed in the proportions of 74% iron, 8% nickel and 18% chromium, and then introduced into a mold. Samples of the admixed powders were subjected to pressures varying from 20,000 pounds per square inch to 125,000 pounds per square inch in a hydraulic mold. These pressures were sufficient to compress the metal powders into the desired shape. The molded articles were then removed and transferred to a hydrogen furnace, in which they were heated to a temperature of about 1000° C. This temperature was sufficient to effect the sintering or fusing of the metal particles. Sintering began at around 900° C. and it was observed that a temperature higher than about 1200° C. appeared to affect the product deleteriously.

The melting points of the metals added are as follows: iron 1530° C., nickel 1452° C., and chromium 1520° C. According to customary practice, the metals would have to be heated to a temperature of at least the melting point of iron i. e. 1530° C. In the practice of the present invention, on the other hand, a temperature of only 1000° C. was employed, which is 530° C. lower than that of the usual practice. This alone indicates an important economy in the use of heat.

The iron-nickel-chromium stainless metal of the invention was made to have a density and physical characteristics substantially the same as that obtained when compounding the alloy according to the usual melt method.

I claim:

A process for making a stainless metal composition which comprises intimately admixing finely divided particles of iron, nickel and chromium, which have clean surfaces and are of a size sufficiently small to pass through a 200 mesh screen, substantially in the proportion of iron 74%, nickel 8% and chromium 18%, subjecting the resulting admixture to a pressure of not less than 20,000 pounds per square inch, and heating the compressed mixture in a non-oxidizing atmosphere to a temperature above 900° C. but not substantially above 1200° C. to form a substantially homogeneous product.

CHARLES HARDY.