United States Patent Office 3,574,671 Patented Apr. 13, 1971

3,574,671

METHOD FOR COATING METAL POWDERS

Thomas S. Cloran, East Liverpool, Ohio, assignor to Crucible Steel Corporation, Pittsburgh, Pa.

No Drawing. Filed Nov. 20, 1968, Ser. No. 777,495
Int. Cl. B22f 1/00
U.S. Cl. 117—100 5 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a method for preparing metal powders for compacting by powder metallurgy techniques. In particular it relates to an arrangement for uniformly coating the powder with an element, such as a carbon-containing material, for example lampblack, prior to compacting. This is achieved by agitating a charge of metal powder containing water while increasing the temperature of the powder to vaporize at least a portion of the water. In this manner the water is substantially evenly dispersed throughout the powdered metal. A quantity of the element to be coated on the powder is added in finely divided form and the powdered metal and element are further agitated in the presence of the water vapor, which causes the element to be substantially uniformly coated over and throughout the powder.

It is known to produce metal articles by powder metallurgy techniques. Powder metallurgy is particularly advantageous in the production of high-alloy tool steel articles, because a very fine, even carbide distribution can be produced. As is well known, this structure serves to enhance the properties of the steel in tool applications. Broadly, the steps of producing such articles from powdered metal involve heating a powder charge within a container to an elevated temperature and thereafter compacting the powder by the application of pressure, which may be either mechanical or fluid pressure. In this operation because of the metal being in finely divided form an extremely large surface area thereof is exposed to the atmosphere. This results in extremely rapid and substantial oxidation of the metal, particularly with high-alloy tool steels which contain quantities of readily oxidizable elements, such as chromium, molybdenum, tungsten and vanadium. If oxidation to any appreciable extent is permitted to occur, the product resulting after final compacting will be of poor cleanliness.

To protect against oxidation of the powdered metal charge it is known to place the charge in a gas-tight container that is heated to elevated temperature and evacuated to a subatmospheric pressure, for example on the order of 50 microns or less. In the case of tool steel, the charge may be heated to a temperature of around 2000° F. Under these conditions of low pressure and elevated temperature, oxygen is removed from the metal charge by gaseous reaction with carbon present in the charge. The reaction products are, of course, removed by the pumping action of evacuating the container. The deoxidation cycle, as described hereinabove, is facilitated by coating the particles of the charge with a carbon-containing material, such as lampblack, so that there is carbon present in readily available form.

For this purpose, and in this operation, it is desirable that the carbon-containing material, for example lampblack, be uniformly coated over the particles throughout the entire charge. This is difficult to achieve in the customary practice wherein a mixer is used to agitate the powder charge and lampblack, because the lampblack tends to agglomerate or "ball-up" in globules throughout the charge. Consequently, after the outgassing cycle has been completed, there will remain areas throughout the charge of extremely high carbon concentration. These areas remain throughout compacting to final products and consequently remain present in the final products as areas of high carbon concentration. This is, of course, contrary to the desired object of obtaining a fine, even carbide distribution throughout the final tool-steel articles.

It is accordingly the primary object of the present invention to provide a method for uniformly coating particles of a powdered metal charge with an element, such as a carbon-containing material, in finely divided form.

A more particular object of the invention is to provide a method for uniformly coating a powdered metal charge with a carbon-containing material by agitating the charge in the presence of the carbon-containing material in finely divided form.

These and other objects of the invention as well as a complete understanding thereof may be obtained from the following description and specific examples.

In the practice of the invention, in its broadest aspects, a chage of metal powder to be compacted is agitated in a suitable mixing device with a quantity of water. During this operation the temperature of the powder is increased to a temperature suitable to vaporize at least a portion of the water. Temperatures on the order of 90 or 100° F. are typical. Satisfactory temperatures can be achieved customarily by vigorous tumbling without the use of any supplemental heat source. However, in applications wherein the tumbling apparatus does not provide sufficient agitation to achieve adequate temperatures any auxiliary heating means, such as radiant heating, may be employed to achieve vaporization of the water. Upon vaporization of the water, in combination with continued agitation of the powdered metal charge, the water is substantially evenly dispersed throughout the charge. When this has been achieved a quantity of an element in finely divided form to be coated over the particles of the charge is added. In the present practice of the invention this would be a carbon-containing material, such as lampblack or powdered graphite, the presence of which is desired to provide carbon in readily available form to achieve deoxidation during a subsequent low-pressure, high temperature out-gassing operation. It has been found that by agitating the carbon-containing material in finely divided form with the powdered metal charge in the presence of the dispersion of water vapor, such will cause the carbon-containing material to be substantially uniformly coated over the particles throughout the charge. Upon completion of this operation, in accordance with the present invention, the powdered metal charge, which is coated with carbon-containing material, is transferred to a gas-tight container and subjected to out-gassing in accordance with the conventional practice as described hereinabove. In a preferred practice of the invention, prior to placing the coated charge in the container for out-gassing such may be heated for a time sufficient to remove substantially all of the water from the charge. Preferably, the carbon-containing material is of a size of less than about one micron. Lampblack and powdered graphite are the preferred carbon-containing materials for use in the practice of the invention.

As a specific example of the practice of the invention a charge of AISI M–2 tool steel powder of minus 100 mesh in a quantity of about 800 pounds was placed in a conventional V-blender. Water in the amount of 40 cc. was added to the charge and such was tumbled for one-half hour. During tumbling, temperatures on the order of about 90 or 100° F. were achieved, which caused substantial vaporization of the water throughout the

charge. Lampblack of a submicron size in an amount of about 1.36 pounds was added to the charge in the tumbler and tumbling was performed for an additional one-hour. Tumbling time may vary from one-half to as long as eight hours, depending upon the size of the charge, the amount of carbon-containing material to be added and the efficiency of the blending apparatus. At the end of the tumbling operation the charge was visually examined to determine the degree of uniformity with respect to coating of the particles of the charge with lampblack. This examination revealed that substantially total and uniform coating of the powders of the charge with lampblack had been achieved.

Similar operations with identical materials to those used in the above-described example were performed wherein the powdered metal charge and lampblack in finely divided form were agitated on the order of one-half to eight hours. In the absence of including the steps of the invention, wherein water is uniformly dispersed throughout the charge prior to adding the lampblack, complete and uniform coating of the particles throughout the charge with lampblack was not achieved. Instead, during tumbling the lampblack tended to ball-up and thus form globules throughout the charge, and also it tended to settle on top of the charge when operation of the V-blender stopped. As pointed out hereinabove, these resulting areas of high-carbon concentration throughout the charge do not achieve the object of having a uniform quantity of carbon in readily available form dispersed throughout the charge to facilitate deoxidation during a subsequent out-gassing operation. In addition, these areas of high-carbon concentration can have an adverse effect on the quality of final products produced by compacting the powdered metal charge. It may be seen, therefore, that the present invention provides advantage from the standpoint of rendering the manufacturing operation more efficient, as well as improving the quality of the final product.

Although various embodiments of the invention have been described hereinabove, it is obvious that other adaptations and modifications may be made by those skilled in the art without departing from the scope and spirit of the appended claims.

What is claimed is:

1. A method for preparing metal powders for compacting comprising agitating a charge of metal powder containing a quantity of water, while increasing the temperature of the powder to vaporize at least a portion of the water and disperse said water substantially evenly throughout said powdered metal charge, adding to the thus treated charge in the presence of the vaporized water a quantity of a carbon material in finely divided solid form, said material being in a particle form finer than that of said metal powder and in a quantity less than that of said metal powder charge, further agitating said charge with said material therein until said material is substantially uniformly coated over said metal powder throughout the charge.

2. The method of claim 1 wherein the water is removed from said charge after the charge has been further agitated to coat the powder with said carbon material and prior to any compacting of said charge.

3. The method of claim 2 wherein said carbon material in finely divided form is of a size of less than about one micron.

4. The method of claim 3 wherein said metal powder is steel.

5. The method of claim 1 wherein said carbon material is at least one material selected from the group consisting of lampblack and powdered graphite.

References Cited

UNITED STATES PATENTS

2,499,295	2/1950	Bruce	117—100X
2,682,483	6/1954	Erbe	117—226
2,788,297	4/1957	Louis	117—109
2,817,604	12/1957	Louis	117—109
2,993,816	7/1961	Blake	117—226
3,039,172	6/1962	Egan	117—160X
3,066,391	12/1962	Vordahl	75—212
3,320,057	5/1967	Palmateer	75—212

MURRAY KATZ, Primary Examiner

M. R. P. PERRONE, JR., Assistant Examiner

U.S. Cl. X.R.

75—212; 117—109, 222