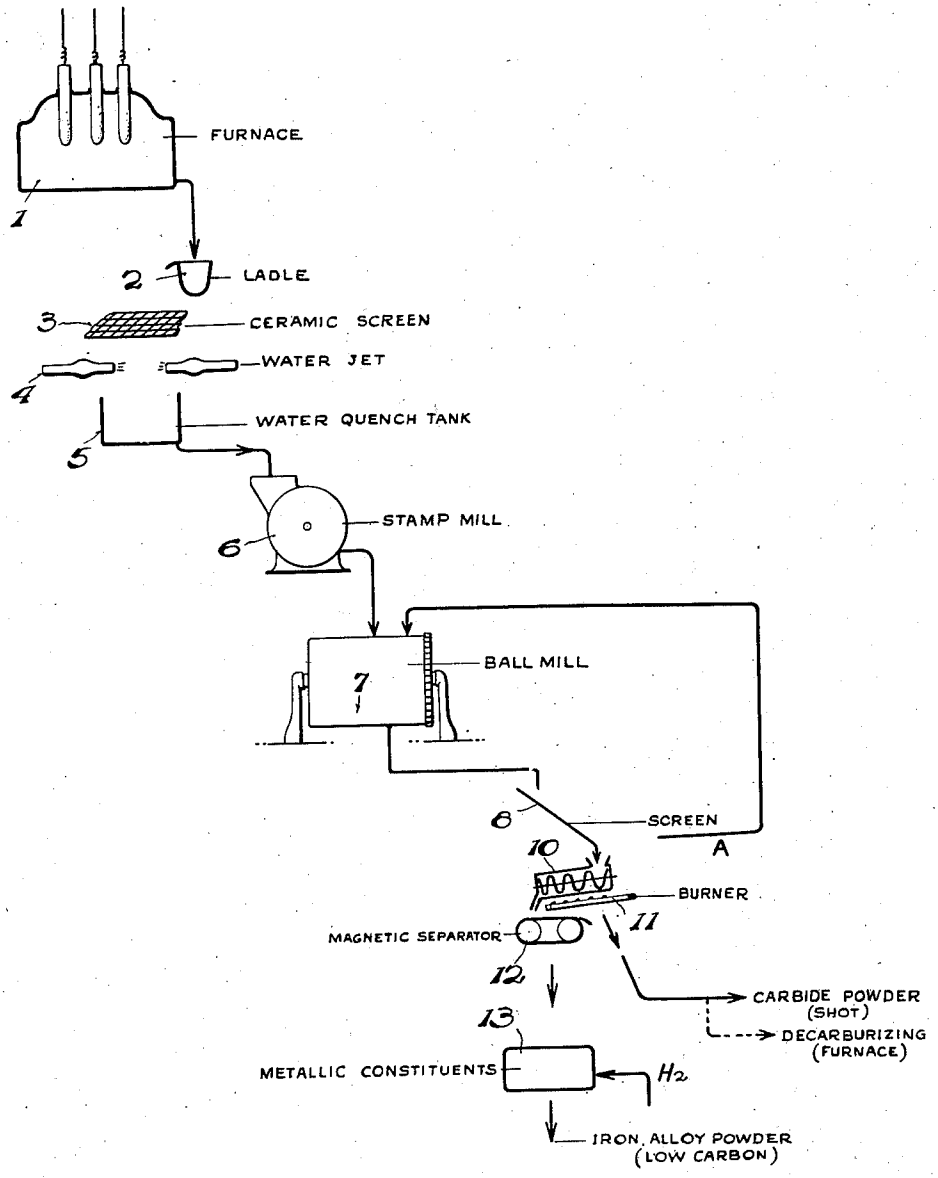
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PROCESS OF CLASSIFYING METAL POWDERS

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PROCESS OF CLASSIFYING METAL POWDERS

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5 Claims. (Cl. 75—28)

This invention relates to an improved process of classifying metal powders.

The present application is a continuation in part of the prior application of John Wulff Serial No. 338,826 filed June 4, 1940.

The present invention relates to the production and classification of iron and iron alloy powders.

One of the most recent and interesting developments in the field of metallurgy is the development of powder metallurgy, that is the fabrication of articles from metal powders. From a beginning in non-ferrous powders, as for example in the production of the so-called "oilless" bearings from copper powder, the art has extended rapidly and now includes the fabrication of articles, such as machine elements, from iron powders.

While the field of powder metallurgy is expanding rapidly its extension is restricted by a number of factors important among which is the present high cost of the starting material that is the pure iron powder. In the past such iron powders were produced from special raw materials, for example electrolytic iron and the like which in their nature imposed a high initial cost on the raw material.

An object of the present invention is to broaden the potential field of use of iron powders for powder metallurgy purposes by producing highly effective iron powders and iron alloy from cheap source material.

The invention comprehends the concept of utilizing a cheap source of iron, such as relatively high carbon pig iron, low in sulphur and phosphorus, producing a heat from such material by conventional equipment to produce a white iron shot, i. e. a shotted material low in austenite and high in pearlite, cementite and/or martensite. This material is then disintegrated to produce in effect two major phases or constituents, that is a carbon-rich phase or cementite and a carbon-poor phase, namely pearlite and the like.

According to the present invention these metallurgical phases are effectively segregated by subjecting the powdered material to a special type of magnetic separation. Considered briefly this separation step comprises heating the material to raise the temperature to the Curie point of one of the constituents and then passing the material through a magnetic separator. It will be appreciated that this novel method is applicable to the classification of any mixture of metallic powder constituents, the components of which are characterized by differential magnetic properties. In the illustrative embodiment it is utilized to separate a mixture of relatively non-magnetic carbide particles from relatively magnetic low carbon iron or iron alloy particles, such as pearlite. In such circumstances the cementite phase can be sharply separated or fractionated by heating the powder mixture to a temperature of substantially 215° C. and passing the heated material through the magnetic separator. The separated fractions may then be treated to modify their physical or chemical characteristics to the desired degree.

In order more fully to explain the invention a typical process of producing metallurgical powders is illustrated in the flow sheet on the drawing.

In carrying out the improved process a white cast iron powder is first produced and, as explained, this is subjected to magnetic separation at the Curie point of the less magnetic component, namely, the carbides so that the carbides are sharply fractionated from the cementite or pearlite. As shown on the drawing raw material, such as a suitable pig iron low in sulphur, phosphorus and silicon, is charged to a suitable furnace 1. As will be understood this furnace may be of any suitable type and for purposes of illustration is shown as an electric furnace. Depending upon the particular desired analysis of the ultimate ferruginous powder, alloy addition agents may be introduced into the melt. In order to simplify the description of the invention a simple procedure will be described, namely the production of a low carbon iron from high carbon iron raw material.

The charge in furnace 1 may be heated to the desired elevated temperature, say of the order of from about 1430° C. to about 1510° C. The heat is then transferred to ladle 2 and is poured through the refractory screen 3 constructed of graphite or a suitable ceramic. This screen serves to divide the molten metal into streamlets. Such streamlets are immediately quenched and shotted by means of water or other suitable quenching medium forced through the jets 4. Such quenching and shotting transforms the molten mass to solid shot of the order of ¼ to 1/16 of an inch or finer. Manifestly other specific methods of shotting and quenching may be utilized as for example by utilizing a ceramic stream divider and steam jets.

The shotted material collects in the quench tank 5. This material is essentially a white cast iron and because of its high percentage of cementite, pearlite and martensite is characterized

by a marked brittleness. If, as in the preferred embodiment, the silicon and other graphitizing elements in the melt are kept at a low value there will be a minimum of graphite or temper carbon in the shot and this material therefore will be very hard. This brittleness, as will be appreciated, will render the product amenable to rapid and effective disintegration in standard disintegrating equipment.

In the next step of the process the brittle shot is broken down into powder form comprised essentially of carbon-poor particles, i. e. particles rich in pearlite and carbon-rich particles, i. e. particles rich in iron carbide. In a typical method, as shown, the shot is first broken down in a suitable mill, such as the stamp mill 6 and is then further reduced in size by treatment in the ball mill 7. The product discharged from the ball mill may be classified by passing over the screen 8. Particles above a predetermined size may be recycled through the ball mill through line 9. It will be understood that in these reduction steps the brittle cementite will crush readily and will also assist in crushing the more metallic pearlite, troostite and undecomposed austenite of the shot. The product passing through the screen 8 which is to be treated according to the invention may comprise a powder of from about 100 to 200 mesh.

Due to the initial high carbon content of the raw material and of the quenching conditions this product is comprised preponderantly of cementite or more metallic constituents and a definite percentage of iron carbide. The pearlite is much more magnetic than the iron carbide which contains of the order of 6.6% C. In order to sharply fractionate the two constituents this magnetic characteristic is utilized to the fullest degree, that is to say the differential magnetic characteristics are accentuated or increased by heating the mass to the point of least magnetism of the carbides, i. e. the Curie point, and while at this point the mass is subjected to magnetic separation.

Since the Curie point of carbides is 215° C., in the preferred embodiment the fine powder mass is heated substantially to this point.

The heating of the powder mass to the desired optimum separating temperature may be achieved by any suitable efficient means. In a purely illustrative example, as shown in the drawing, the fine powder screenings from screen 8 are fed to one end of a cylindrical container 10 and are transported therethrough by means of a screen conveyor. During this passage the material is heated up to the desired temperature by means of the burner 11. In lieu of this the powder may be contacted in a tower or other vessel by hot gases to secure the desired increase in temperature. If desired the heating medium may be controlled thermostatically so as to insure a close control of the temperature of the powder.

After the powder has been heated to the desired temperature in heater 10 it is passed to the magnetic separator 12. The magnetic constituent is sharply fractionated from the carbide tailings. The carbide powder may be sold as such as a blasting powder or may be treated in a decarburizing furnace to reduce the carbon content to any desired low degree. The pearlite screenings may be admixed with reduced iron powder and employed for powder metal compacts. If desired a low carbon iron powder may be produced from the pearlite screenings by decarburizing in the decarburizing furnace 13. In this furnace the powder may be decarburized at a temperature of from about 800° C. to 1200° C. in a decarburizing atmosphere, such as hydrogen-steam, carbon monoxide-carbon dioxide mixtures.

Such decarburizing treatment is especially beneficial for powders which are to be employed for compacts in that in the decarburization the pearlite and cementite constituents are largely decomposed to give a surface skin of the more plastic ferrite.

It will be appreciated that the described process provides a simple and efficient method of sharply separating the more metallic low-carbon constituents from a mixture of these with high carbon constituents such as iron carbide. Such fractionation in turn renders particularly effective a method of producing low carbon iron powders from cheap source material, such as pig iron or high carbon scrap. Hence while a preferred embodiment of the invention has been described it is to be understood that this is given to exemplify the underlying principles of the invention and not as limiting it to the particular embodiment chosen for illustration.

I claim:

1. A method of producing classified iron powder which comprises forming a white cast iron shot, disintegrating the shot to a powder to form carbon-rich and carbon-poor components and magnetically separating the particles above the Curie point of the carbon-rich particles.

2. A method of producing low carbon-iron powder which comprises forming a high carbon shot of the white cast iron type, disintegrating the shot to a predetermined particle size to form pearlite-rich particles and carbide-rich particles and magnetically separating the carbide-rich particles at the Curie point of the carbide-rich particles.

3. A method of producing low carbon iron-containing powder which comprises forming a high carbon shot of the white cast iron type, disintegrating the shot to a predetermined particle size to form pearlite-rich and carbide-rich particles, heating the powder to a temperature of substantially 215° C. and passing the powder through a magnetic separator to separately recover the pearlite-rich and carbide-rich fractions.

4. A method of producing low carbon iron-containing powder which comprises forming a high carbon shot of the white cast iron type, disintegrating the shot to a predetermined size to form iron-rich and carbide-rich particles, heating the powder to a temperature of substantially 215° C. and passing the heated powder through a magnetic separator.

5. A method of producing low carbon iron-containing powder which comprises forming a high carbon shot of the white cast iron type low in graphitizing elements, disintegrating the shot to a predetermined size to form iron-rich and carbide-rich particles, heating the powder to the Curie point of the carbide-rich particles and magnetically separating the particles at such Curie point.

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