

[54] **SINTERED GLASS CONTAINING FERROUS MATERIAL**

[75] Inventor: **Terence M. Cadle**, Coventry, England

[73] Assignee: **Bries Engineering Ltd.**, Coventry, England

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** **C22c 1/05**

[58] **Field of Search** **29/182.5; 75/201, 206; 148/126**

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Primary Examiner—Benjamin R. Padgett

Assistant Examiner—R. E. Schafer

Attorney, Agent, or Firm—Mason, Mason & Albright

[57] **ABSTRACT**

This invention relates to sintered ferrous materials. Sintered ferrous materials in accordance with the invention contain at least 50 percent by weight of iron and glass in an amount of not more than 2 percent by weight. The iron can be present as pure iron or as an alloy thereof. The materials can be produced by known powder metallurgical methods, for example by compression in the presence of a lubricant and subsequent heating. The glass generally serves to seal the pores between the particles of the iron-containing powder, and the materials have been found to have low porosity to gases and liquids and increased corrosion resistance compared with similar materials containing no glass. Sintered ferrous materials in accordance with the invention can be used for producing valve seats.

11 Claims, No Drawings

SINTERED GLASS CONTAINING FERROUS MATERIAL

This invention relates to sintered ferrous materials.

According to the invention there is provided a sintered ferrous material made by powder metallurgy, the material including iron in an amount of at least 50 percent by weight and not more than 2 percent by weight of glass.

Further according to the invention there is provided a process for the production of a sintered ferrous material by powder metallurgy which includes sintering a mixture of a powder consisting of at least 50 percent by weight of iron and not more than 2 percent by weight of glass powder.

Sintered ferrous materials in accordance with the invention contain at least 50 percent by weight of iron. If desired, the materials can consist of only iron and not more than 2 percent by weight of glass. However, the iron can be present as an alloy. Typical alloys which may be used include low carbon steels and low alloy steels.

By "low carbon steels" we mean alloys of iron and from 0.05 to 0.3 percent by weight of carbon, with or without other alloying elements.

By "low alloy steels" we mean alloys of iron and small quantities of alloying elements such as nickel, molybdenum or copper, with substantially no carbon.

The sintered ferrous materials may contain one or more elements which are not homogeneous with the iron. Such elements, which may also be alloyed with the iron, include, for example, copper and molybdenum. In general, the iron will be alloyed and homogeneous with nickel or carbon.

The particle size of the iron-containing powder used to produce sintered ferrous materials in accordance with the invention may be of a value conventionally used in the powder metallurgical art. Preferably the particle size is not more than 100 British Standard Mesh, i.e., not more than 0.152 mm mesh aperture.

The chemical composition of the glass is generally not critical for the purposes of the present invention and, for example, soda glass, borate glass, borosilicate glass or lead glass can be used. Typical soda glasses which can be used contain from 71 to 73 percent by weight of SiO_2 , from 13 to 16 percent by weight Na_2O , from 5 to 10 percent by weight CaO , from 2 to 5 percent by weight of MgO , and from 0.5 to 1.5 percent by weight of Al_2O_3 . Typical lead glasses can contain from 30 to 36 percent by weight of PbO , from 10 to 13 percent by weight of K_2O and from 53 to 50 percent by weight of SiO_2 . Although specific chemical composition ranges have been set forth, the invention is in no way limited thereto.

In general, the glass should be present in an amount of at least 0.125 percent by weight.

Known powder metallurgical methods can be used in producing sintered ferrous materials in accordance with the invention. Thus a mixture of the powder containing at least 50 percent by weight of iron and not more than 2 percent by weight of glass powder will in general be compressed, preferably to the desired shape for the sintered ferrous material, for example under a pressure above 5 Kg/mm^2 . Pressures of up to 100 Kg/mm^2 will usually suffice.

Sintering of the powder mixture may, for example, be effected at a temperature of from 1,000° to 1,300° C,

preferably at about 1,100° C. As will be appreciated by those skilled in the art, the time required for sintering will depend upon various factors, in particular upon the temperature of sintering. Periods of up to 5 hours are generally sufficient and periods of from 1 to 3 hours are preferred.

Sintering is preferably effected in a reducing atmosphere, for example in dissociated ammonia ($\text{N}_2 + 3\text{H}_2$) or an endothermic gas such as a mixture of propane and air which has been partially combusted in the presence of a catalyst.

The powder mixture which is sintered can contain not only the iron-containing powder and glass powder but powders of other metals, for example of copper and/or molybdenum. Furthermore, materials which are conventionally used in the powder metallurgical art can also be added to the powder mixture prior to sintering. For example, lubricants which aid compressing of the powder mixture can be added. Suitable lubricants include, for example, zinc stearate, Acrawax (an organic stearate) and graphite. When graphite is used, it can act not only as a lubricant in compressing the powder mixture but as a source of carbon in the sintered materials. If desired, other forms of carbon than graphite can be added to the powder mixture for the purposes of increasing the carbon content of the sintered materials.

After production of sintered ferrous materials in accordance with the invention, they may, if desired, be subjected to one or more conventional metallurgical treatment steps, for example case hardening and tempering or quench hardening and tempering. The case hardening may be a carburizing or a nitriding process. Tempering can be effected under known conditions, for example at a temperature of about 175°C, preferably for a period of about an hour.

The glass in the sintered ferrous materials in accordance with the invention generally serves to reduce the porosity of the materials when compared with similar materials not containing glass, while generally retaining the good mechanical strength of sintered ferrous materials not containing glass. The reduced porosity has been found of value in applications where the sintered materials are required to have low permeability of liquids or gases. Furthermore, the low porosity can enable case hardening of the materials to be effected, attempts to case harden similar sintered materials containing no glass usually resulting in unsatisfactory products which have been hardened throughout.

Sintered ferrous materials in accordance with the invention have been found particularly useful in producing valve seats for use in corrosive media where pressure tightness of the valve is important.

The following Examples are given by way of illustration only. All parts are by weight unless otherwise stated and all powdered materials had a particle size small enough to pass through a No. 100 British Standard Mesh.

EXAMPLE 1

0.25 percent of glass powder was mixed thoroughly with 99 percent of a pre-alloyed stainless iron powder of composition 12 percent chromium and 88 percent iron, and 0.75 percent of Acrawax as a lubricant. The mixture was processed by pressing at 63 Kg/mm^2 and sintered at 1100°C in dissociated ammonia having a dew point of -35°C.

EXAMPLE 2

0.25 percent of powdered glass was thoroughly mixed with 98.8 percent of a powdered alloy consisting of 1.75 percent Ni and 0.5 percent Mo, the remainder

being Fe (pre-alloyed powder), 0.2 percent of Bavarian graphite and 0.75 percent of zinc stearate as a lubricant. The mixture was processed by pressing at 63 Kg/mm² and sintered at 1100°C in an endothermic gas (produced by partially combusting a propane/air mixture in the presence of a catalyst) having a dew point -4° to -7°C. This was followed by a case hardening treatment in a carburizing atmosphere. Finally, tempering was effected at 175°C for 1 hour.

EXAMPLE 3

0.25 percent of powdered glass was thoroughly mixed with 98.6 percent of a powder consisting of 1.75 percent Ni and 0.5 percent Mo the remainder being Fe (pre-alloyed powder), 0.4 percent of Bavarian graphite, and 0.75 percent of zinc stearate.

The mixture was pressed at 63 kg/mm² and sintered in an endothermic gas (similar to that used in Example 2) of dew point -7° to -10°C at 1100°C. The material was then quench hardened from 850°C into oil at ambient temperature and finally tempered at 175°C for 1 hour.

EXAMPLE 4

0.25 percent by weight of glass powder was thoroughly mixed with 4% of copper powder, 0.2 percent of carbon, 0.75 percent of zinc stearate as a lubricant, and 94.8 percent of iron powder.

The mixture was pressed at 63 kg/mm² and sintered in an endothermic gas (similar to that in Example 2) having a dew point of 0° to -5°C, at 1100°C.

EXAMPLE 5

0.25 percent by weight of glass powder was thoroughly mixed with 2 percent of copper, 0.75 percent zinc stearate as a lubricant, and 97 percent of iron powder.

The mixture was pressed at 63kg/mm² and sintered in dissociated ammonia having a maximum dew point of -35°C at 1100°C.

EXAMPLE 6

0.25 percent by weight of glass powder was thoroughly mixed with 99 percent of a powdered alloy consisting of 1.75 percent Ni and 0.5 percent Mo, the remainder being iron (pre-alloyed powder) and 0.75 percent of zinc stearate as a lubricant.

The mixture was pressed at 79kg/mm² and sintered at 1100°C in an endothermic gas (similar to that used in Example 2) having a dew point of -15° to -17°C. This was followed by a case hardening treatment in a carburizing atmosphere. Finally, tempering was effected at 175°C for 1 hour.

EXAMPLE 7

0.5 % percent glass powder was thoroughly mixed with 4 percent of copper, 0.4 percent of carbon, 0.75 percent of zinc stearate as a lubricant and 94.35 per-

cent of iron powder. The mixture was pressed at 47kg/mm² and sintered at 1100°C in an endothermic gas (similar to that used in Example 2) having a dew point of -7° to -10°C.

EXAMPLE 8

0.25 percent of glass powder was thoroughly mixed with 99 percent of a pre-alloyed stainless iron powder containing 12 percent Cr, the remainder being Fe with usual impurities, and 0.75 percent of zinc stearate as a lubricant. The mixture was pressed at 71kg/mm² and sintered at 1120°C in dissociated ammonia having a dew point of -35°C.

EXAMPLE 9

0.25 percent of glass powder was thoroughly mixed with 0.2 percent of carbon, 0.75 percent of zinc stearate as a lubricant and 98.8 percent of iron powder. The mixture was pressed at 63kg/mm² and sintered at 1080°C in an endothermic gas (similar to that used in Example 2) having a dew point of 0° to -5°C. This was followed by a case hardening treatment in a carbonitriding atmosphere. Finally, tempering was effected at a temperature of 175°C for 1 hour.

I claim:

1. A sintered ferrous material made by powder metallurgy, the material including iron in an amount of at least 50 percent by weight and from 0.125 to 0.5 percent by weight of glass.

2. A material as claimed in claim 1, consisting only of iron and from 0.125 to 0.5 percent by weight of glass.

3. A material as claimed in claim 1, consisting of a ferrous alloy and from 0.125 to 0.5 percent by weight of glass, the alloy containing at least 50 percent by weight of iron.

4. A material as claimed in claim 3, wherein the alloy contains from 0.025 to 0.3 percent by weight of carbon.

5. A material as claimed in claim 2, wherein the alloy contains a small quantity of an alloying element and substantially no carbon.

6. A material as claimed in claim 1, in case hardened form.

7. A sintered ferrous material made by powder metallurgy, the material comprising stainless iron and from 0.125 to 0.5 percent by weight of glass.

8. A material as claimed in claim 1 wherein the glass is selected from the group consisting of soda glass, borate glass, borosilicate glass, and lead glass.

9. A material as claimed in claim 8, wherein the glass contains from 71 to 73 percent by weight SiO₂, from 13 to 16 percent by weight of Na₂O, from 5 to 10 percent by weight of CaO, from 2 to 5 percent by weight of MgO and from 0.5 to 1.5 percent by weight Al₂O₃.

10. A material as claimed in claim 8, wherein the glass contains from 30 to 36 percent by weight PbO, from 10 to 13 percent by weight K₂O and from 53 to 56 percent by weight SiO₂.

11. A material as claimed in claim 7, in case hardened form.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,891,399 Dated June 24, 1975

Inventor(s) Terence M. Cadle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page one, the assignee should be corrected from
"Bries Engineering Ltd." to -- Brico Engineering Ltd. --

Signed and Sealed this

fourth Day of *May* 1976

[SEAL]

Attest:

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