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PROCESS FOR MANUFACTURING HIGH DENSITY PRESS-FORMED ARTICLES

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3 Claims

ABSTRACT OF THE DISCLOSURE

High density press-formed articles may be formed from a powder mixture, consisting predominantly of high alloy metals, which can be forged only with difficulty, if at all. A prepressed workpiece is formed from the powder mixture at a pressure of about 6 t./cm.², and is then heated to between 800 and 1100° C. The heated workpiece is then compacted or deformed at a pressure of about 8 t./cm.² in a press tool which has been preheated to a temperature between 150 and 350° C. and which is held constant at this temperature during the compacting operation. There is no sintering of the workpiece in the press tool. The resultant press-formed article may then be annealed in a vacuum for 4 to 5 hours at 1250° C.

This invention relates to a process for manufacturing high density press-formed articles in which a preheated prepressed workpiece is compacted or deformed in a preheated press tool.

It has been proposed to heat a prepressed workpiece consisting mainly of iron powder, without sintering it, to a temperature between 800 and 1100° C., and then to compact it in a press tool which has been preheated to between 300 and 350° C. and is then held at constant temperature. The product has a comparatively high density between 7.4 and 7.8 g./cm.³. The process does not involve the usual time-dependant sintering. The prepressed workpiece is merely heated to between 800 and 1100° C. and then compacted in a press tool which has been preheated to between 300 and 350° C. The temperature gradient between the preheated press tool and the workpiece remains substantially constant and in consequence recrystallisation conditions are always the same. This applies in particular to the series production of compacted articles, where the prepressed workpieces follow each other in rapid succession through the same compacting tool.

It has now been discovered that the proposed process mentioned earlier is suitable for manufacturing high density press formed articles not only from prepressed workpieces consisting mainly of iron powder, but also, and with the most excellent results, from prepressed workpieces made of powder alloys which cannot be forged, or only with difficulty. A further discovery is that the process can be conducted at even lower pressed tool temperatures.

According to the present invention therefore, a process for manufacturing high density press-formed articles from a powder mixture predominantly of high alloy metals which can be forged only with difficulty if at all, comprises forming a prepressed workpiece from the powder mixture, heating the workpiece to between 800 and 1100° C., and compacting or deforming the heated workpiece without sintering in a press tool which has been preheated to a temperature between 150 and 350° C. and which is held constant at this temperature during the compacting operation.

Preferably, the workpiece is prepressed under a pressure of substantially 6 t./cm.², and the final compacting operation is conducted using a pressure of 8 t./cm.². The

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temperature of the preheated press tool is held constant during the compacting operation by controlled cooling.

The process in accordance with the invention may be called "powder forging," and compared with conventional forging processes such as die forging an advantage of this process is that it can be used for manufacturing press formed articles having good mechanical strengths from raw material substances which cannot be forged by conventional methods, or at least only with difficulty. A further advantage is that there is no waste product and no flash is produced in the press-forming. The press-formed articles made by a process in accordance with the present invention are more accurate in their dimensions than those produced by conventional forging methods. Internal passages and complex external shapes can be produced with high accuracy. Finally, the hot deformation can be obtained with less consumption of deformation energy, compared with conventional forging processes.

The compacting step may, if desired, be followed by annealing the press-formed article for 4 to 5 hours at 1250° C. in a vacuum.

Several examples of the production of press-formed articles by a process in accordance with the present invention will now be described.

EXAMPLE 1

Starting out with a mixture of electrolytic iron powder containing 5% chromium powder, 59% nickel powder and 26% molybdenum powder, a prepressed workpiece was formed under a pressure of 6 t./cm.². The prepressed workpiece was heated to 850° C. and then compacted under a pressure of 8 t./cm.² in a press tool which had been preheated to 350° C. and then held constant at this temperature. The resulting product had a density of 8.51 g./cm.³. The product was then annealed in a vacuum for four and a half hours at 1250° C. After annealing the product showed a tensile strength of 48 kp./mm.².

EXAMPLE 2

A prepressed workpiece was formed under a pressure of 6 t./cm.² from a mixture of electrolytic iron powder containing 16% chromium powder, 57% nickel powder, 17% molybdenum powder and 4% tungsten powder. The resulting prepressed workpiece was preheated to 850° C. and compacted under a pressure of 8 t./cm.² in a press tool which had been preheated to 350° C. and was then held constant at this temperature. The product was annealed in a vacuum at 1250° C. for four and a half hours, the final product having a density of 8.78 g./cm.³, a tensile strength of 39 kp./mm.², an elongation at rupture of 6.4% and a Brinell hardness of 120.

EXAMPLE 3

A prepressed workpiece was formed under a pressure of 6 t./cm.² from a mixture of electrolytic iron powder containing 1% chromium powder, 65% nickel powder and 30% molybdenum powder. The prepressed workpiece was heated to 850° C. and compacted under a pressure of 8 t./cm.² in a press tool preheated to 350° C. and then held constant at this temperature. The resulting product was annealed in a vacuum at 1250° C. for four and half hours, the final product having a density of 8.35 g./cm.³, a tensile strength of 57 kp./mm.² and an elongation at rupture of 4%.

EXAMPLE 4

A prepressed workpiece was formed under a pressure of 6 t./cm.² from a mixture consisting of 20% finely divided chromium powder, 79% carbonyl-nickel powder and 1% titanium carbide powder. The resulting prepressed workpiece was heated to 850° C. and compacted under a pressure of 8 t./cm.² in a press tool preheated to 350° C. and then held constant at this temperature. The result-

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ing product was annealed in a vacuum at 1250° C. for four and a half hours, the final product having a density of 7.6 g./cm.³, a tensile strength of 30 kp./mm.², an elongation at rupture of 16.5% and a Brinell hardness of 105.

I claim:

1. A process for manufacturing high density press-formed articles from a powder mixture which consists predominantly of high alloy metals and which can be forged only with difficulty, if at all, comprising the steps of forming said powder mixture, forming a pre-pressed workpiece from said powder mixture, heating said workpiece to between 800 and 1100° C., providing a press tool for press-forming said articles, pre-heating said press tool to a temperature between 150 and 350° C., holding said press tool constant at said temperature, and compacting said heated workpiece without sintering it in said press tool while said press tool is maintained at said constant temperature.

2. A process as claimed in claim 1, wherein said pre-pressed workpiece is formed at a pressure of about 6

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t./cm.², and said workpiece is compacted in said press tool at a pressure of about 8 t./cm.².

3. A process as claimed in claim 1, wherein said compacting stage is followed by an annealing stage, whereby said press-formed article is annealed in a vacuum for 4 to 5 hours at 1250° C.

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