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(54) **POST-DELUBRICATION PEENING FOR FORGED POWDER METAL COMPONENTS**

(60) Provisional application No. 60/219,516, filed on Jul. 20, 2000.

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(57) **ABSTRACT**

A process of forming powder metal components which minimizes decarburization and oxidation of the component prior to final forging. The process begins by molding powder metal material into a preform configuration. The preform is delubricated to extract lubricant found in the pores of the preform. Passing the preform through a shot peening operation closes a majority of the surface pores creating a densified layer within which interconnected pores are eliminated. Following post-delubrication peening (PDP), the component is sintered and then forged into its final configuration.

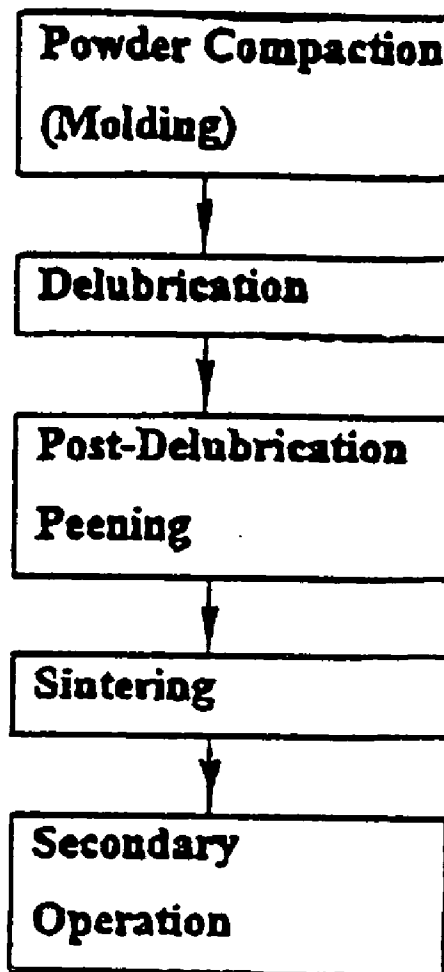
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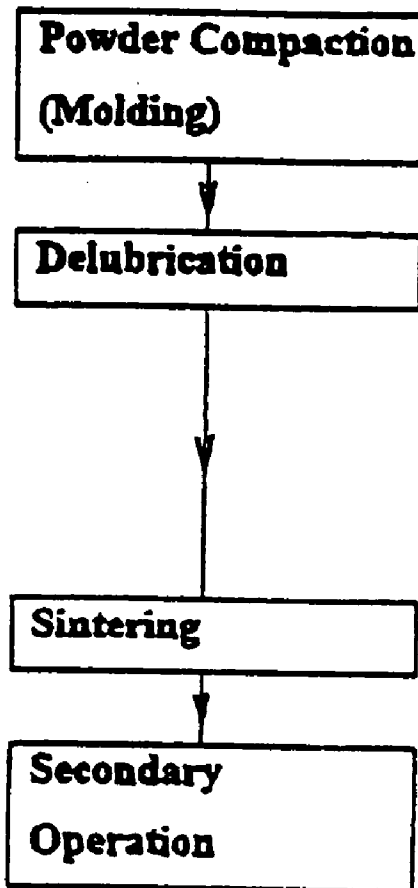
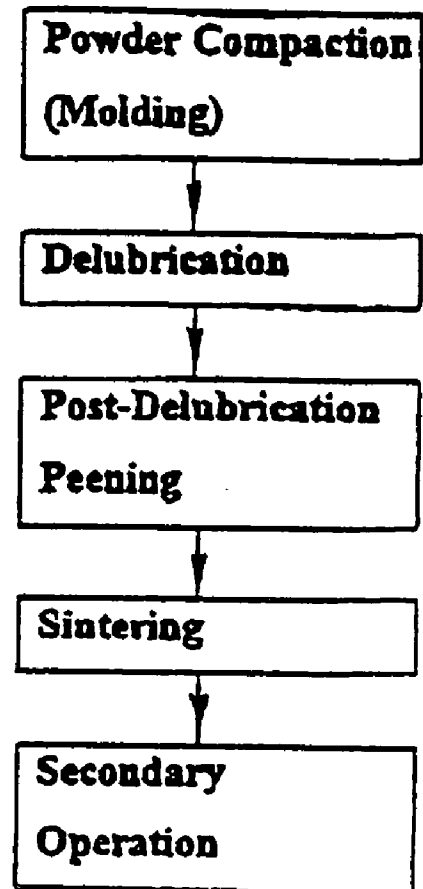
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Related U.S. Application Data

(63) Continuation of application No. 09/653,889, filed on Sep. 1, 2000, now abandoned.

New Process



Old ProcessFig-1**New Process**Fig-2

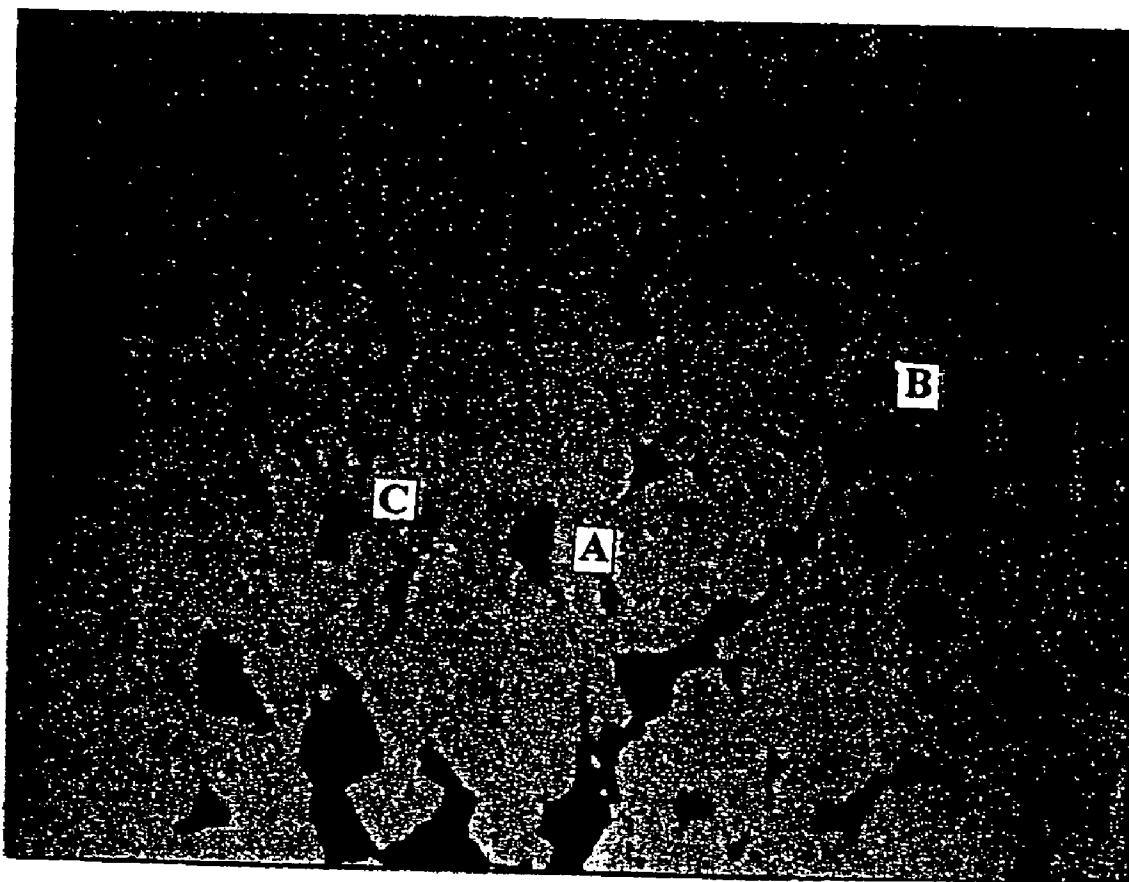


FIGURE 3

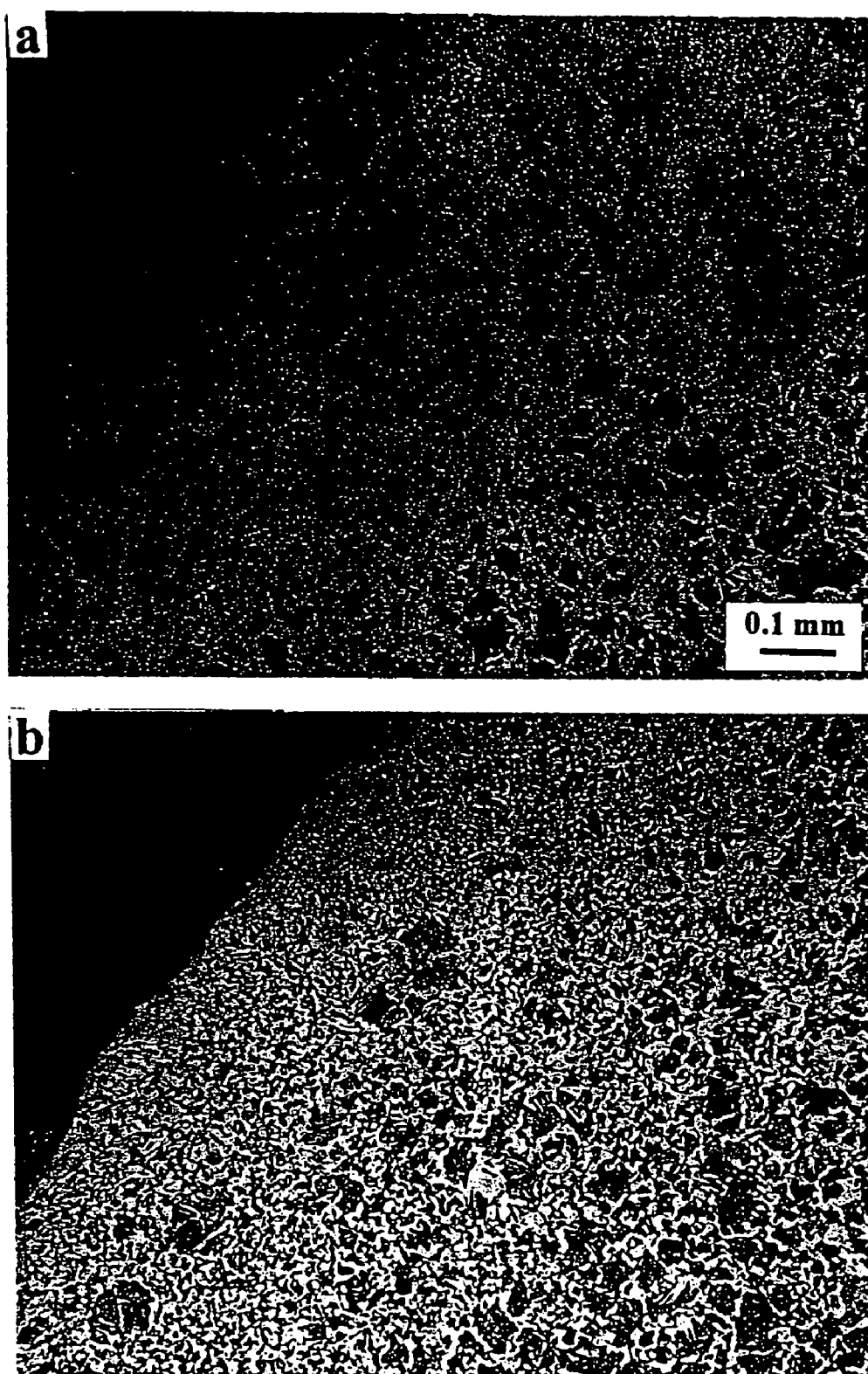


FIGURE 4

POST-DELUBRICATION PEENING FOR FORGED POWDER METAL COMPONENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. Provisional Application No. 60/219,516 filed on Jul. 20, 2000, and is a continuation of U.S. patent application Ser. No. 09/653,889, filed Sep. 1, 2000.

BACKGROUND OF THE INVENTION

[0002] I. Field of the Invention

[0003] This invention relates to shot peening a powder metal component and, in particular, to shot peening the powder metal forged component following delubrication but prior to sintering the powder metal component.

[0004] II. Description of the Prior Art

[0005] In the currently utilized method of forming powder metal components, the powder metal is molded to a desired configuration then sintered to retain the configuration of the component and finally forged to its final configuration. However, it has been determined that decarburization and oxide penetration occurs between sintering and forging. After exiting from the sintering furnace, the hot part is exposed to the air and the moisture created by lubricant/coolant spraying prior to forging, the part has interconnected pores throughout. Oxygen and moisture penetrates the surface through these interconnected pores leading to decarburization and oxide penetration. Once the surface and pores are oxidized between sintering and forging, it is difficult to close the pores by forging resulting in a weakened component. Although post-forging shot peening removes the oxide on the surface of the component, the oxide entrapped in the channels and pores below the surface remain.

SUMMARY OF THE PRESENT INVENTION

[0006] The present invention overcomes the disadvantages of the prior known processes for manufacturing powder metal components by shot peening the preform after delubing and prior to sintering to create a densified outer layer to reduce decarburization, oxide penetration and surface porosity on the finished components.

[0007] The process of the present invention begins by molding powder metal material into a preform configuration. The preform is passed through a delubrication furnace to extract or decompose lubricant found in the preform. This delubrication creates an interconnected porosity. Passing the preform through a shot peening operation closes a majority of the surface pores creating a densified layer with increased ductility and enhanced resistance to cracking. Following post-delubrication shot peening (hereinafter "PDP"), the component is sintered and then forged into its final configuration. The post-delubrication shot peening eliminates oxide in pores and between particles allowing the forging to be more effective in closing pores and establishing inter-particle bonding.

[0008] Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the following drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0009] The present invention will be more fully understood by reference to the following detailed description of a preferred embodiment of the present invention when read in conjunction with the accompanying drawing, in which like reference characters refer to like parts throughout the views and in which:

[0010] **FIG. 1** is a flow chart of a prior art process for forming powder metal components;

[0011] **FIG. 2** is a flow chart for the process of the present invention;

[0012] **FIG. 3** is an optical micrograph showing the porosity of a preformed powder metal component; and

[0013] **FIG. 4** is an optical micrograph showing the decarburization of a typical and a component manufacture with the present process.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE PRESENT INVENTION

[0014] Referring first to **FIGS. 1 and 2**, there are shown flow charts for the prior known process **100** of forming a powder metal component and the new process **10** of the present invention. The process **10** can be used in the manufacture of a variety of powder metal components particularly where the strength and reliability of the component is critical. The present process was developed in connection with the manufacture of connecting rods for vehicle engines. The prior known process of sintering and forging powder metal components resulted in oxides trapped in the channels and pores of the preformed powder metal component which can cause fatigue and stress cracks in the component.

[0015] The process of the present invention begins with compaction or molding **12** of powder metal material into a preform configuration. The molding process **12** utilizes a lubricant to facilitate the molding process. The next step involves delubrication **14** of the preform. In a preferred embodiment of the process, delubing **14** is accomplished by passing the preform through a furnace which preheats the component to 1200° F.-1800° F. in an atmosphere which includes H₂ and N₂.

[0016] In a variation from the prior known processes, the delubed preform component is subjected to shot peening **16** which creates a densified outer layer within which interconnected pores are eliminated on the component. This Post-Delubrication Peening (PDP) eliminates oxides in pores and between particles throughout an outer layer of the component. Since approximately 60% of component failures are caused by crack initiations within 0.20 mm of the surface, PDP increases the fatigue life of the end product. With PDP, applicant has successfully manufactured powder metal components with improved surface conditions. Furthermore, the densified layer resulting from the PDP **16** increases ductility and enhances resistance to cracking during forging. In a preferred embodiment of the process, post-delubrication peening **16** is carried out with a shot speed of less than 100 m/second with a shot hardness of 47-51 Re.

[0017] Following the PDP step **16**, the component is sintered **18** and then forged **20** to form the powder metal component. Additional steps such as removal of flash or

additional machining may also be applied to the component. In one example, the component is sintered in a furnace less than 2450° F. for less than 60 minutes.

[0018] The concept of PDP was inspired by analysis of powder metal connecting rods which showed fatigue cracks just below the surface of the component. An optical micrograph of the component in **FIG. 3** shows that porosity morphology is affected by oxidation. **FIG. 4** depicts the reduction of decarburization achieved by PDP on the surface of the connecting rod. Accordingly, it has been found that post-delubrication peening reduces oxides and decarburization by over 70% creating a surface condition better than that of the prior known process. The densified surface layer achieved by PDP enhances powder metal component performance whether forging is applied as a secondary operation or not.

[0019] The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations should be understood therefrom as some modifications will be obvious to those skilled in the art without departing from the scope and spirit of the appended claims.

What is claimed is:

1. A process for the manufacture of powder metal components comprising the steps of:

molding a powder metal material into a preform configuration;

delubricating said powder metal preform;

subjecting said powder metal preform to shot peening to density an outer layer of said preform;

sintering said shot peened preform; and

forging said sintered preform.

2. The process as defined in claim 1 wherein said powder metal preform is subjected to a shot speed of less than 100 meters per second.

3. The process as defined in claim 1 wherein said powder metal preform is delubricated at a temperature between 1200° F. and 1800° F. in an atmosphere which includes N₂ and H₂.

4. A process for the manufacture of powder metal components comprising the steps of:

molding a powder metal material into a preform configuration; subjecting said preform to a process for densifying the surface of said preform;

sintering said preform; and forging said preform.

5. The process of claim 4 wherein said surface densification process comprises shot peening.

6. The process of claim 5 wherein the shot hardness is between 47 to 51 Re.

7. The process as defined in claim 5 wherein said powder metal preform is subjected to a shot speed of less than 100 meters per second.

8. The process as defined in claim 4 wherein said sintering of said preform is preformed in a furnace less than 2,450° F.

9. The process as defined in claim 8 wherein said perform is sintered in said furnace for less than 60 minutes.

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