United States Patent Office

3,549,357

Patented Dec. 22, 1970

1

3,549,357

DRY IMPACT COATING OF POWDER METAL PARTS

Earl H. Osborne, Colorado Springs, Colo., assignor to Allegheny Ludlum Steel Corporation, Brackenridge, Pa., a corporation of Pennsylvania

No Drawing. Filed June 24, 1968, Ser. No. 739,198
Int. Cl. B22f 7/02
U.S. Cl. 75—208 4 Claims

ABSTRACT OF THE DISCLOSURE

Described herein is a method of producing coated powder metal parts by tumbling a sintered article with impacting elements in the presence of a coating material.

Powder metallurgical processes are well known techniques for producing metal articles in forms that are otherwise difficult to manufacture. Powdered metal, such as iron and iron alloys, is used in the manufacture of many useful articles by processes in which the powders are first compacted by pressure alone into the approximate shape of the finished article and sintered at an elevated temperature, e.g., 1400–2100° F., in furnaces provided with the protective atmosphere to prevent oxidation. In sintering, the powders coalesce and are bonded into an integral metallurgical structure. When desirable, the sintered atricles may be additionally processed.

It is sometimes also desirable to provide coatings on powder metal parts. Such coatings may be applied for protection against corrosion or to achieve other special affects. The present invention provides a unique method of producing coated powder metal parts by dry impact coating. In accordance with the invention there is provided a method which comprises compacting and sintering powder metal into an article of desired configuration. The compacted and sintered article is then tumbled in a confined area in contact with impacting elements such as grinding balls and in the presence of a coating material. During tumbling, the powder metal article is coated, and, after coating excess coating material is removed. Thereafter the coated powder metal article is sintered to bond the coating to the base metal. Specific sintering temperatures and conditions for various metals are disclosed in textbooks such as "Fundamentals of Powder Metallurgy" by W. D. Jones, 1961 edition.

Although the method in accordance with the invention is useful in processing powder metal parts of various compositions, it is particularly well adapted for producing articles of iron and iron alloys. Powder metal parts may be produced by conventional techniques in which iron or iron alloy powder is compacted to a medium density of about 5.5 grams per cubic centimeter to 7.4 grams per cubic centimeter. Small additions of copper or other metals may be added to the base metal to improve physical properties. The compacted metal powder is then sintered, usually in a conventional sintering furnace, in either a batch or continuous operation. For an iron bearing compact, a sintering schedule of 10–40 minutes at a temperature of 1900–2150° is preferred. The sintering temperature is, of course, a function of the material and the physical properties required and will vary with different metals. However, the powder metallurgical arts are sufficiently well developed so that this information is well known to those skilled therein. The compacted and sintered iron alloy article is then placed in a tumbler, preferably substantially immediately after sintering to avoid and/or minimize contamination of the powder metal article by, for example, oxidation or soiling. The sintered article is tumbled in contact with impacting elements such as steel balls of varying diameters.

2

It is desirable to employ impacting elements of different sizes to assure contact with all surfaces of the powder metal article. Particulate coating material such as powdered copper, tin, cadmium, or zinc of high purity is added to the tumbler to coat the sintered compact. The coating material need not be of any special particle size or shape, but the speed of the coating process can be generally increased by using smaller particle sizes.

It has been observed that tumbling is best performed with the impacting elements and the sintered compact experiencing a falling rather than sliding action. This may be achieved with tumbler operations of between 30 and 60 revolutions per minute. Desirably, the tumbling cycle should be from 30 to 45 minutes, depending upon the thickness of the coating desired.

After tumbling to coat the powder metal article, it is removed from the tumbler and any loose powder removed from the surface. Thereafter, the coated article is sintered, preferably in a conventional sintering furnace, for a time and at a temperature which is a function of the metal coating. Thus, for example, with a copper coating on an iron alloy compact, the coated article may be satisfactorily sintered in 20 to 45 minutes at 1400–1600° F. in a non-oxidizing atmosphere. Inert or reducing gases may be used and a hydrogen-containing gas is preferred. The object of sintering the coated article is to metallurgically bond the coating to the base metal. Following sintering the coated powder article may be subsequently processed as desired. Thus, for example, the articles may be sized, coined or impregnated in accordance with well known practices.

The following is presented as a specific example of the practice of the invention according to the presently preferred embodiment.

Iron powder of 99% purity is blended with a die lubricant, e.g. stearic acid, for about 20 minutes. The blended powder is pressed in a die under pressure of about 30 tons/inch to form a "green" compact suitable for handling. Green compacts of iron will usually be of medium density in the range of about 5.5 gr./cc. to 7.4 gr./cc. and for the purposes of the invention must be less than the theoretical density. The compact is transferred to mesh belt continuous furnace and sintered at about 2050° F. for about 30 minutes.

The sintered article is then placed in a rotary tumbler with metal beads and shot. The coating material, fine copper powder of 99% purity which is used in this example, is added to the tumbler. The tumbler is rotated to provide an impacting rather than a sliding action of the beads and shot on to the sintered article and the relatively soft copper powder is smeared or impacted on the article to coat same. Since the sintered article has a density less than theoretical, minute pores are present on the surface and the coating material lodges into these pores or crevices.

The copper coated article is removed from the tumbler and excess coating material is shaken off. The coated article is then sintered at a temperature below the melting point of the coating material. In this example, sintering would be performed by heating at about 1550° F. for about 20 minutes. During sintering the copper is metallurgically bond to the iron base.

It is apparent from the above that various changes and modifications may be made without departing from the invention.

Accordingly, the scope of the invention should be limited only by the appended claims wherein what is claimed is:

1. A method of producing coated powder metal articles which comprises:

(a) compacting and sintering metal powder consisting essentially of iron and iron alloys in the configuration of said article,

(b) tumbling said article in a confined area in contact with impacting elements and in the presence of particulate coating material from the group consisting essentially of copper, tin, cadmium, and zinc whereby said article is coated with said coating material,

(c) removing excess coating material from said coated metal article, and

(d) sintering said coated article at a temperature below the melting point of a said coating material to bond said coating thereto.

2. A method according to claim **1** wherein the initial compacting and sintering are performed at a temperature of 1900° F. to 2150° F. for from 10 to 40 minutes.

3. A method according to claim **1** wherein the coating material is copper powder and the copper coated article is sintered from 20 to 45 minutes at 1400° F. to 1600° F.

4. A method according to claim **1** wherein said coating material is a metal from the group consisting of tin, cadmium and zinc.

References Cited

UNITED STATES PATENTS

2,251,410	8/1941	Koehring	29—182.2
2,490,543	12/1949	Robertson	29—191.2X
3,142,559	7/1964	Ruf et al.	75—208
3,287,157	11/1966	Brown	117—31X
3,328,197	7/1967	Simon	117—31X

CARL D. QUARFORTH, Primary Examiner

A. J. STEINER, Assistant Examiner

U.S. Cl. X.R.

29—182.2; 117—31