ABSTRACT OF THE DISCLOSURE

A generally cylindrical body such as the roll for a rolling mill or calender is manufactured from at least two metallic powders. The powders are introduced into different parts of a thin-walled mould and the mould and the powder therein are compacted to compact the powder into a solid body and the compacted powder is sintered. It is preferable for one of the powders introduced into the mould to constitute a core which is surrounded by the other powder or powders. To introduce the powders into the mould it is preferred for the mould to be rotated about its longitudinal axis and one of the powders is introduced into the mould so as to form a layer on at least part of the inner longitudinally extending wall of the mould and a second powder is introduced into the mould to form a core surrounded by the first powder. When loading the mould to produce a composite generally cylindrical body such as a roll, a powder which may be of iron or steel alloy and which has the property of high surface hardness is introduced into the rotating mould and the powder is thrown into contact with the inner surface of the mould which defines the roll barrel until a layer of the required thickness is built up. If a different type of powder is required for the roll necks then this powder is introduced into the mould so as to build up a layer on each of the axially end parts of the inner wall of the mould and a third powder which does not have the property of high surface hardness and which is cheaper than the powders used for the roll barrel and the roll necks is added to the container to fill up the space inside the layers and form a core which supports these layers.

The mould and the powder therein are conveniently compacted by an isostatic process. This process can either take place at an ambient temperature or it may take place at an elevated temperature.

When the process takes place at ambient temperature the mould may be of rubber or plastic material and the mould and the powder therein is subjected to a squeezing action on all sides of the mould by fluid such as hydraulic oil at a pressure of the order of 50 to 100 tons per sq. in. When the squeezing action compacts the powder to form the required generally cylindrical body. The compacted powder is subsequently removed from the mould and is sintered at a temperature in the order of 2000° F. for twenty minutes to one hour. When the isostatic compaction takes place at an elevated temperature a hot fluid such as argon gas may be used. With this arrangement the mould is of metal and the compaction and sintering takes place simultaneously. The compaction pressure is in the order of 30,000 lbs. per sq. in. and the temperature is of the order of 1200 to 1300° F. The mould is subsequently machined off of the compacted and sintered body.

An alternative method of compacting the powder is for the mould and the powder to be compacted between dies in a forging press or other impact machine. The compacted body is then sintered. With such a compaction process the mould is usually of metal and after the sintering process the metal mould is machined off of the compacted body.

In order that the invention may be more readily understood it will now be described, by way of example only, with reference to the accompanying drawing, in which:

FIG. 1 is a side elevation, partly in section of a mould suitable for the manufacture of a roll for a rolling mill or calender, showing how the metallic powders may be introduced into the mould,

FIG. 2 is a plan of the apparatus shown in FIG. 1, and

FIG. 3 shows diagrammatically isostatic compaction equipment.
end 5 thereof. The powder is fed into the lower frusto-conical portion 3 of the mould. The tube is gradually withdrawn upwardly as the powder is introduced into the mould thereby causing a uniform filling of the lower frusto-conical portion 3.

To fill the central cylindrical portion of the mould, a powder of an iron or steel alloy which has the properties of a high surface hardness is introduced into the mould through a further tube 6. The tube is gradually withdrawn upwardly as the powder is introduced into the mould thereby depositing the powder in a layer around the inside of the mould wall. Simultaneously with the introduction of the powder into the mould through the tube 4, a different powder, which need not have the property of a high surface hardness, and which is cheaper than the powders used for the roll barrel and the roll necks, is introduced into the centre of the mould through the tube 4. The mould is thus gradually filled with the two powders and when the central part of the mould has been completely filled, the upper frusto-conical part of the mould is filled with an appropriate powder through the tube 4. The tubes 4 and 6 are rotatable about their vertical longitudinal axis to enable the tubes to be manoeuvred into and out of the mould. When the mould is completely filled with powder the upper end is closed and the mould is evacuated. The mould with the powder therein is then transferred to an isostatic compaction chamber 7 (FIG. 3) where the mould and powder is subjected to a compaction force on all sides of the order of 30,000 lbs. per sq. in. by a hot gas such as argon at a temperature in the range of 1200 to 1300° F. which enters the chamber through a pipe 8. The hot gas compacts and sinters the powder into a composite solid body. The metal mould is subsequently machined off of the compacted and sintered body.

This method of manufacturing a cylindrical body has the advantages that the compacted and sintered body can be made to higher dimensional tolerances than can be obtained using conventional casting techniques and consequently there is a reduction in the amount that can be used in powder form which cannot be used in molten form for conventional casting techniques because the constituents of the alloys tend to separate out when the molten metal cools.

What is claimed is:

1. A method of manufacturing a composite generally cylindrical body, which method comprises the steps of:
   a. rotating a thin-walled generally cylindrical mould which is open at one end about its longitudinal axis, introducing a quantity of a first metallic powder into the mould through the open end thereof and bringing said first metallic powder into contact with the inner surface of the side walls of the mould by centrifugal force, introducing a quantity of a further metallic powder into the mould through the open end thereof to fill the remaining space therein, stopping the rotation of the mould, closing the open end of the mould, subjecting the mould and the powder therein to a compaction process to compact the powder into a solid body, and sintering the compacted powder.

2. A method of manufacturing a composite generally cylindrical body as claimed in claim 1 in which the said first metallic powder in the form of a layer is supported by centrifugal force on a central part of the inner surface of the side walls of the mould, a different metallic powder is introduced into the mould through the open-end thereof and is brought into contact with the inner surface of the side walls of the mould to form two separate layers supported on end parts of the inner surface of the mould side walls by centrifugal force, one on each side of the central part of the inner surface, and the further metallic powder is introduced into the mould to fill the remaining space therein.

3. A method of manufacturing a body as claimed in claim 1 in which the mould and the powder are compacted isostatically.

4. A method of manufacturing a body as claimed in claim 3 in which the compaction process takes place at an elevated temperature and the sintering process takes place simultaneously with the compaction process.

5. A method of manufacturing a body as claimed in claim 3 in which a gas is under pressure is employed as the compaction and sintering medium.

6. A method of manufacturing a body as claimed in claim 5 in which the gas is argon.

7. A method of manufacturing a body as claimed in claim 4 in which the thin-walled mould, is of metal and is machined off of the compacted and sintered body.

8. A method of manufacturing a roll for a rolling mill or calender which method comprises the steps of:
   a. arranging a tubular thin-walled metal mould open at one end with its longitudinal axis vertical and with its open end uppermost, rotating said mould about its vertical longitudinal axis, introducing a first ferrous metal powder which has the property of high surface hardness into the mould through the open end thereof so as to be deposited by centrifugal force in the form of a layer on the inner surface of the side wall of the mould, introducing a second ferrous metal powder which does not have the property of high surface hardness into the mould to form a core surrounded by said layer of first powder, stopping the rotation of the mould, closing and evacuating the mould, subjecting the mould and the powders therein to an isostatic compaction at an elevated temperature to compact the powders into the solid sintered body, and machining the metal mould off of the sintered body.

9. A method of manufacturing a roll for a rolling mill or calender as claimed in claim 8 in which the powders are introduced into the mould through separate feed tubes inserted into the mould and withdrawn therefrom before the mould is closed.

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