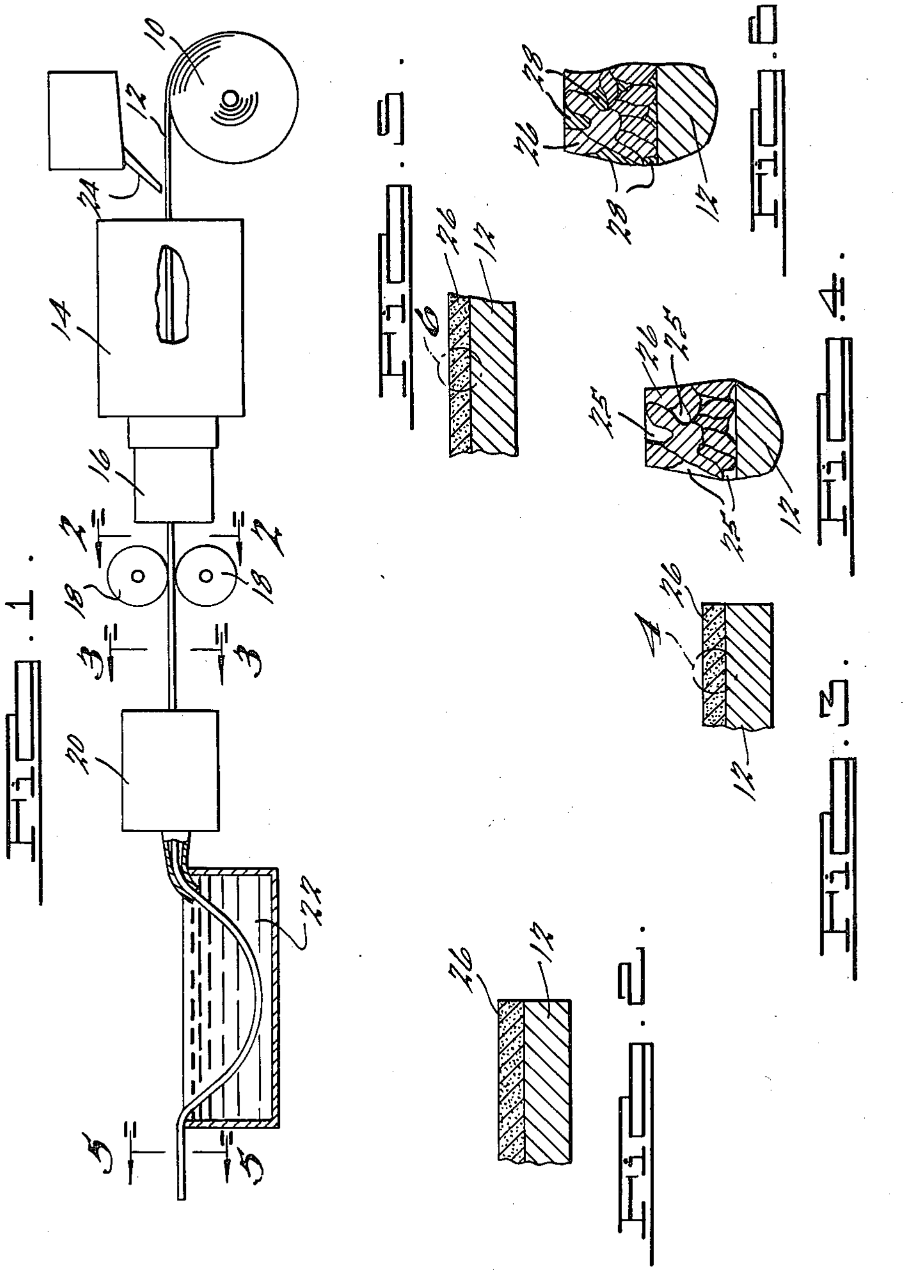
May 30, 1961 E. J. LEWIS ET AL 2,986,464

METHOD FOR MANUFACTURING BEARING MATERIALS

Filed April 27, 1959



INVENTORS.
Edward J. Lewis.
James W. O'Brien.
BY Hedley R. Colby.

Harness, Dickey & Pierce
ATTORNEYS.

United States Patent Office

2,986,464

Patented May 30, 1961

1

2,986,464

METHOD FOR MANUFACTURING BEARING MATERIALS

Edward J. Lewis, James W. O'Brien, and Hedley R. Colby, Greenville, Mich., assignors to Federal-Mogul-Bower Bearings, Inc., Detroit, Mich., a corporation of Michigan

Filed Apr. 27, 1959, Ser. No. 809,148

3 Claims. (Cl. 75—208)

This invention relates generally to bearings and more particularly to a composite bearing of the type which includes a layer of metal powder bonded to a backing layer.

It is difficult to eliminate the objectionable porosity in the powder surface layer of a composite bearing. Such a bearing is usually manufactured by spreading loose metal powder, to the desired thickness, on a metal backing strip, sintering the powder for a short time to partially bond it to the backing strip, cooling the composite strip, rolling the strip to compress the powder layer to a maximum density, and finally sintering to complete the bonding of the powder particles to the backing strip. It has been found that it is difficult to eliminate the porosity in the powder layer, particularly in the case of bronze powders because a layer of such a powder is sufficiently rigid to resist full compression by rolling. The backing material starts to compress and spread out before the voids in the powder layer have been eliminated. Another reason it is difficult to remove the voids by rolling is that the thickness of standard gauge steel affects the extent of rolling of the sintered powder. For example, when a strip with a .010 inch layer of metal powder is rolled, a .001 inch variation in the thickness of the backing layer will cause a significant variation in the porosity of the powder layer.

Streaks of increased porosity caused by separation and segregation of coarser powder particles, have been observed in some sintered layers. It is difficult to eliminate these streaks by rolling.

The method of this invention involves quenching the composite strip, following sintering and rolling, to fill the pores in the powder layer with lead which is a soft metal suitable for satisfactory bearing use and is a constituent of the sintered layer. A loose powder is deposited on a moving strip of backing metal which then travels through a sintering furnace so that as the strip emerges from the furnace it has a layer of sintered powder bonded thereto. After cooling of the composite strip, it is subjected to rolling to reduce porosity, followed by heating and then quenching in a lead bath.

A composite strip made according to the method of this invention has the following advantages.

(*a*) A sounder composite strip is obtained since the pores in the powder layer are filled with lead.

(*b*) There is less oxidation of the composite strip.

(*c*) Because the pores are lead-filled, the strip will not pick up foreign particles which interfere with machining of the strip.

(*d*) There is less corrosion because the porosity is eliminated.

The object of this invention, therefore, is to provide an improved method of manufacturing composite bearing material.

Further objects, features and advantages of this invention will become apparent from a consideration of the following description, the appended claims and the accompanying drawing in which:

2

Figure 1 is a diagrammatic view illustrating the steps in the method of this invention;

Fig. 2 is a fragmentary transverse sectional view of the composite strip of this invention following sintering and looking substantially along the line 2—2 in Fig. 1 ;

Fig. 3 is a transverse sectional view, illustrated similarly to Fig. 2, showing the strip following sintering and rolling and looking substantially along the line 3—3 in Fig. 1;

Fig. 4 is an enlarged view of the position of Fig. 3 enclosed within the circle "4" in Fig. 3;

Fig. 5 is a transverse sectional view, illustrated similarly to Figs. 2 and 3, showing the strip following sintering, rolling and quenching and looking substantially along the line 5—5 in Fig. 1; and

Fig. 6 is an enlarged view of the portion of Fig. 5 enclosed within the circle "6" in Fig. 5.

With reference to the drawing, the method of this invention is illustrated diagrammatically in Fig. 1 which shows a roll **10** of a metal strip **12** suitable for a backing layer. The strip **12** is unwound from the roll **10** and a loose metal powder **26** from a powder dispensing member **24** is deposited on the top side of the strip. The composition of this powder is such that during travel of the strip through a sintering furnace, the powder is initially bonded to the strip **12**. The strip **12** with the powder **26** thereon travels through a sintering furnace **14**, and then through a cooling chamber **16**. After cooling of the composite strip in the chamber **16**, the strip is subjected to the pressure of a pair of rolls **18** which function to compress the sintered layer of powder **26** to reduce the voids **25** in the layer.

The layer of powder **26** is porous after it leaves the sintering furnace **12** (Fig. 2). Subjecting the strip to the action of the rolls **18** reduces the porosity of the powder layer (Fig. 3) but some pores **25** remain in the strip.

After the composite strip leaves the rolls **18**, it is heated in a furnace **20** and guided into a lead bath **22** which is at a substantially lower temperature than the temperature of the strip after it leaves the furnace **20**. Consequently, the strip is cooled in the lead bath **22** and the molten lead **28** in the bath flows into the voids and pores **25** in the layer of powder **26**. Fig. 6 shows the lead **28** filling the pores **25** in the bearing surface layer. The cooling of the powder layer provides for a lowering of the pressure in the voids between the powder particles and this partial vacuum in the voids assists the flow of lead into these voids when the strip is in lead bath **22**. The surface tension of the molten lead with the sintered particles is such that the lead tends to displace the cracked gas in the pores to further assist the flow of lead into the pores. As a result, when the strip leaves the lead bath **22** the voids in the powder layer have been filled with lead. The powder layer with the lead filled voids may then be wiped followed by further cooling.

In one form of the invention, a steel backing strip **12** was utilized and a powder consisting of approximately 80 percent copper, 10 percent tin, and 10 percent lead was deposited on the strip. The powder is of a particle size such that substantially all of it will pass through a 100 mesh screen, so the maximum particle dimension is 0.0058 inch. Furthermore, about 40 percent of the powder will pass through a 325 mesh screen so that it has a maximum particle dimension of 0.0017 inch. This powder was sintered at 1475 degrees Fahrenheit for ten to twelve minutes and then rolled to approximately half its original thickness. It is estimated that following rolling the largest pore diameter is in the 0.0001 to 0.0003 inch range. The lead bath was maintained at a temperature between 700 and 900 degrees Fahrenheit and the temperature in the furnace **20** was maintained at about 1500 degrees Fahrenheit. A test of the strip prior to quenching showed that it had a 9.5 percent lead content. The first sample tested had a final lead content of 11.6 percent; a second sample had a final lead content of 12.75 percent, and the last sample, which was intentionally formed more porous than the others, had a final lead content of 14.7 percent lead.

In another test example, having an 80 percent copper, 10 percent tin and 10 percent lead powder layer or lining applied to a steel backing strip, an analysis of the powder before quenching disclosed a 10.4 percent lead content. The strip was rolled to a Rockwell hardness of 85 on the 15 W scale (a hardness rating relating to the impression made in the lining layer by a one-eighth inch ball under a fifteen kilogram static load) and then quenched. A subsequent analysis showed a 13.38 percent lead content. When the same strip was rolled to a lining hardness of 95 on the 15 W scale, so as to reduce the porosity below that of the first test, and then quenched, an analysis showed an 11.70 percent final lead content.

In still another example, a 75 percent copper, 1 percent tin and 24 percent lead powder layer applied to a steel backing strip, an analysis of the powder before quenching showed a 24.51 percent lead content. When the strip was rolled to a lining hardness of 52 on the Rockwell 15 W scale and then quenched, analysis showed a final lead content of the lining of 31.48 percent. When the same strip was rolled to an increased hardness, namely, 75 to 80 on the Rockwell 15 W scale, and then quenched it had a final lining lead content of 25.54 percent.

Backing strips provided with copper-lead-tin powder layers in the following respective percentages have also been quenched in lead according to the above process to improve the bearing characteristics of the composite strip: 88–8–4; 73–23–4 and 64.5–35.0–0.5.

Such a bearing material is very desirable for manufacturing bearings that require some machining because, since the pores are filled with lead, there cannot be any foreign particles in the pores to interfere with machining.

Although the invention has been described with respect to a preferred embodiment thereof, it is to be understood that it is not to be so limited, since changes can be made therein which are within the scope of the invention as defined by the appended claims.

What is claimed is:

1. The method of manufacturing composite bearing material consisting of a steel backing strip and a layer of metal powder of approximately 64 to 88 percent copper, 8 to 35 percent lead and 0.5 to 10 percent tin composition bonded to the backing member, said method consisting of applying said powder in loose form to said backing strip, heating said powder to a temperature sufficient to sinter it and bond it to the backing strip, cooling the composite backing and powder strip, rolling the composite backing and powder strip to substantially eliminate the pores in the powder layer, re-heating said strip to substantially said sintering temperature, and dipping said strip in a lead bath at a temperature of between 700 and 900 degrees Fahrenheit to provide for a filling of the pores which remained after said rolling step with lead from the bath.

2. The method of manufacturing composite bearing material consisting of a steel backing strip and a layer of metal powder which is composed predominantly of copper and lead bonded to the backing member, said method consisting of applying said powder in loose form to said backing strip, heating said powder to a temperature sufficient to sinter it and bond it to the backing strip, cooling the composite backing and powder strip, rolling the composite backing and powder strip to substantially eliminate the pores in the powder layer, reheating said strip to substantially said sintering temperature, and dipping said strip in a lead bath at a temperature of between 700 and 900 degrees Fahrenheit to provide for a filling of any pores remaining in said powder layer following sintering with lead from the bath.

3. The method of manufacturing composite bearing material consisting of a steel backing strip and a layer of metal powder which is composed predominantly of copper and lead bonded to the backing strip, said method consisting of applying said powder in loose form to said backing strip, heating said powder to a temperature sufficient to sinter it and bond it to the backing strip, rolling the composite strip to substantially eliminate the pores in the powder layer so that the largest pore diameter remaining in the powder layer is in the .0001 to .0003 inch range, heating said composite strip to substantially said sintering temperature, and immediately quenching said strip in a lead bath at a temperature of between 700 and 900 degrees Fahrenheit to provide for a filling of the pores which remain after said rolling step with lead from said bath.

References Cited in the file of this patent

UNITED STATES PATENTS

2,198,254	Koehring	Apr. 23, 1940
2,289,658	Koehring	July 14, 1942
2,902,748	Schaefer	Sept. 8, 1959