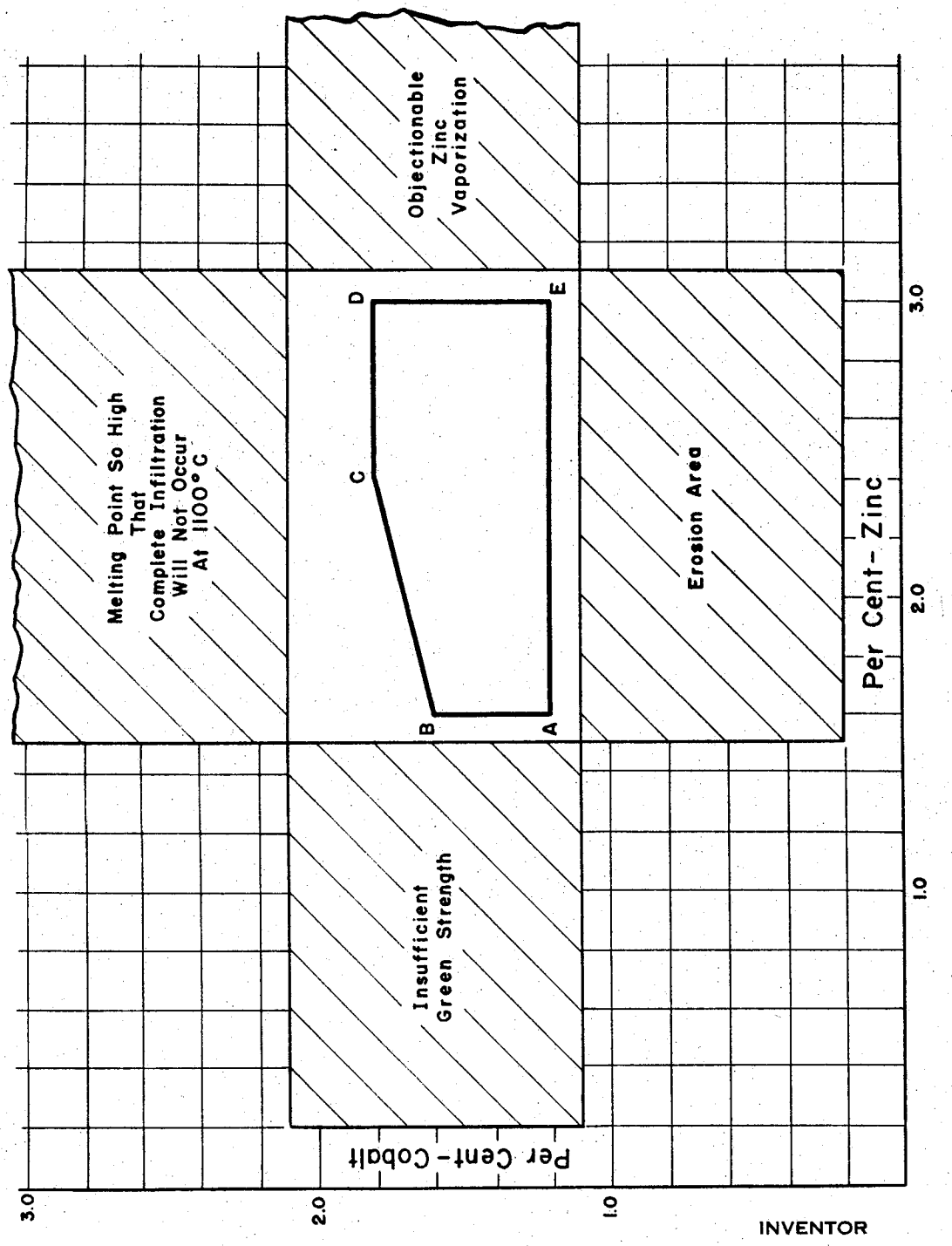
Feb. 25, 1969 G. L. WERLEY 3,429,696

IRON POWDER INFILTRANT

Filed Aug. 5, 1966



INVENTOR

George L. Werley

BY

Pennie, Edmonds, Morton, Taylor & Adams

ATTORNEYS

United States Patent Office

3,429,696

Patented Feb. 25, 1969

3,429,696

IRON POWDER INFILTRANT

George L. Werley, Palmerton, Pa., assignor to The New Jersey Zinc Company, New York, N.Y., a corporation of New Jersey

Filed Aug. 5, 1966, Ser. No. 570,547

U.S. Cl. 75—157.5 4 Claims

Int. Cl. C22c 9/06, 9/04

This invention relates to powder metallurgy and, more particularly, to a novel infiltrant for iron powder compacts.

It is a well established practice to increase the strength of iron powder compacts by infiltrating the iron compact with another metal having a melting point lower than that of iron. This is generally done by placing an amount of the infiltrant metal on the surface of the sintered iron compact sufficient to fill the voids between the iron particles and by then bringing the compact up to a temperature sufficient to cause the infiltrant metal to become molten and infiltrate the iron compact. In some instances the infiltrant metal is applied to the surface of a green compact of the iron powder and then the resulting mass is heated to a temperature sufficient to sinter the iron and concurrently cause the infiltrant to melt and impregnate the sintered compact, this operation being known as "sintration." Although the resulting infiltrated compact has a final strength greater than that of the noninfiltrated sintered compact, there is a frequent drawback to the infiltrated compact in that it needs machining or similar treatment to remove either a residue left from the infiltrant or a pitted surface produced by the erosive action of the molten infiltrant on the surface of the iron compact. These difficulties are particularly displayed by copper and copper-base alloys which are favored infiltrants because of the high strength and ductility which they impart to iron powder compacts and because of their favorable wetting action for iron and their suitable melting points.

The United States patent to Rennhack, No. 3,128,177, describes the inclusion in copper of a certain amount of cobalt to impart to the copper the ability to infiltrate an iron powder compact without leaving any residue on the surface of the compact and without pitting its surface. To achieve this result, the sintered iron powder compact with its superposed copper-cobalt infiltrant mass had to be heated to a temperature of at least about 1100° C. to insure complete melting of the infiltrant and not leave a residue on the surface of the compact. In commercial practice, however, temperature controllers are occasionally inaccurate and furnace operators often maintain furnace temperatures on the low side to prolong furnace life. As a result, it has been found that the copper-cobalt infiltrant of Patent No. 3,128,177 is not always completely melted and leaves a residue which must be machined or ground off the surface of the finished compact.

I have now found that within a narrower range of cobalt contents than that of the aforementioned patent, the melting point of the infiltrant can be lowered and its effectiveness can be maintained, all without erosion of the iron powder compact and without leaving a residue, if a certain range of zinc content is included in the infiltrant. The novel infiltrant of the present invention consists essentially of 1.2 to 1.8% by weight of cobalt, 1.6 to 3.0% by weight of zinc, and the balance copper, with the amounts of cobalt and zinc being substantially within the boundaries of the curve ABCDEA in the figure of the accompanying drawing. Infiltrants having these compositions are capable, when melted in contact with an iron powder compact at a sintration temperature not in excess of about 1100° C., of infiltrating the compact without pitting the compact surface or leaving a residue thereon.

FIG. 1, the single figure of the drawing, consists of a plot of cobalt content versus zinc content in the copper-cobalt-zinc infiltrants of the invention, and the curve ABCDEA encloses amounts of cobalt and zinc which are useful in these compositions. As shown by the curve, amounts of cobalt from 1.2 to 1.6% can be used with amounts of zinc ranging from 1.6 to 3.0%. With increasing amounts of cobalt from 1.6 to 1.8%, the minimum amount of zinc increases from 1.6 to 2.4%. As also shown in the drawing, amounts of zinc of 1.5% and less yield infiltrant powder compacts having insufficient green strengths (below 640 p.s.i.), and amounts of zinc 3.1% and higher cause objectionably high zinc vaporization in the sintration furnace. The drawing also shows that amounts of cobalt as low as 1.1% and lower cause the infiltrant to be corrosive to the iron powder compact, and that amounts of cobalt of 2.1% and higher produce infiltrants with melting points so high that complete infiltration will not occur at a sintration temperature of 1100° C.

The infiltrant may be applied to the iron compact either in the form of a green compact of a copper-cobalt-zinc alloy powder, in the form of a mixture of copper-cobalt alloy and copper-zinc alloy powders, or in the form of a solid mass of the copper-cobalt-zinc alloy. When used in the powdered form, the infiltrant or its components are obtained by conventional air-atomization techniques. In each of these forms the proper amount of infiltrant for each iron powder compact can be readily determined and can be controlled by the shape and size of the mass of infiltrant pursuant to conventional infiltration technique.

The following table presents examples of infiltrant compositions within the scope of the present invention. In each instance, the infiltrant was used with an iron powder compact obtained by compacting iron powder, which contained 1% by weight of zinc stearate as a lubricant, at a pressure of 30 t.s.i. into the form of a 200 gram disc 2 inches in diameter and ⅝ inch thick.

Powder compositions						Infiltrant composition	
Cu	Cu+ 2.7 Co	Cu+ 2.8 Co	Cu+ 3.26 Co	Cu+ 3.2 Zn	Cu+ 5.7 Zn	Cu+ 10.0 Zn	Percent Co	Percent Zn
X	X			X			1.2	1.6
		X		X			1.2	1.8
		X		X	X		1.2	2.4
		X		X	X		1.2	2.6
		X		X	X		1.2	2.8
		X		X	X		1.2	3.0
		X		X			1.4	1.6
		X		X	X		1.6	1.6
		X		X	X		1.6	1.8
		X		X	X		1.7	2.0
		X		X	X		1.7	2.2
			X	X	X		1.8	2.4
			X		X	X	1.8	2.6
		X			X	X	1.8	2.8
		X			X	X	1.8	3.0

The infiltrant wafers were 2 inches in diameter, weighed 50 grams, contained 1% of lithium stearate as a lubricant, and were compacted at a pressure of 30 t.s.i. The infiltrant wafers were made from mixtures of the listed powder compositions, and in the table the X indicates the use, in an infiltrant wafer, of the powder composition at the head of its column. In each instance, more than one metal powder was used in order to obtain an infiltrant composition containing the specified cobalt and zinc contents. All sintrations were made in a muffle furnace having a hydrogen atmosphere and comprised preheating at 600° C. for 15 minutes and sintration at 1100° C. for 30 minutes. Each infiltrant composition completely penetrated the iron powder compact without erosion and without leaving a residue.

I claim:

1. An infiltrant for iron powder compacts having a melting point lower than that of iron and capable, when melted in contact with an iron powder compact at a sintration temperature not in excess of about 1100° C., of infiltrating the compact without pitting the surface of the compact and without leaving a residue on the surface of the compact, and consisting essentially of 1.2 to 1.8% by weight of cobalt, 1.6 to 3.0% by weight of zinc, and the balance copper with the amounts cobalt and copper being substantially within the boundaries of the curve ABCDEA in FIG. 1 of the drawing.

2. An infiltrant according to claim 1 in which the copper, cobalt and zinc are present in the form of an alloy thereof.

3. An infiltrant according to claim 1 in which the cobalt is provided in the form of a copper-cobalt alloy powder and the zinc is provided in the form of a copper-zinc alloy powder, the powders constituting the infiltrant being in the form of an intimate mixture thereof.

4. An infiltrant according to claim 2 in which the copper, cobalt and zinc are present in the form of a powder of the alloy of these constituents.

References Cited

UNITED STATES PATENTS

2,126,827	8/1938	Smith	75—157.5
2,146,722	2/1939	Darby	75—157.5
2,169,188	8/1939	Kelly	75—157.5
2,778,742	1/1957	Shipe	75—208 X
3,128,172	4/1964	Wagner et al.	75—.5
3,128,177	4/1964	Rennback	75—153

CHARLES N. LOVELL, *Primary Examiner.*

U.S. Cl. X.R.

75—.5, 153