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[54] DIE-CASTING ALLOY COMPOSITIONS
6 Claims, No Drawings

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[56] References Cited

UNITED STATES PATENTS

2,338,756 1/1944 Crampton et al. 75/161

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ABSTRACT: A low liquidus temperature, ductile alloy containing 2–20 percent arsenic, and either manganese (15–45 percent), zinc (15–50 percent) or a combination (15–55 percent) thereof, the balance being 40–65 percent copper, highly suitable for die casting.

DIE-CASTING ALLOY COMPOSITIONS

This application is a continuation-in-part of Ser. No. 664,244 filed Aug. 30, 1967, now abandoned.

BACKGROUND OF THE INVENTION

Conventional copper base casting alloys generally have a liquidus temperature above about 1,600° F. They are, therefore, difficult to die-cast in that they cause considerable wear on the die. On the other hand, known copper base alloys which melt at lower temperatures are too brittle for practical use in die casting. For example, the copper base alloy containing 9.7 weight percent of magnesium melts at 1,332° F. (722° C.) while the copper base alloy containing 31 weight percent of antimony melts at 1,193° F. (645° C.); both alloys, however, are brittle.

Crampton (U.S. Pat. No. 2,338,756) discloses a ductile copper-base alloy containing 0.1 to 5.0 percent As, 0.5 to 20 percent Mn and up to 30 percent Zn; the copper content being at least 67 percent. However, alloys within these ranges have relatively high liquidus temperatures.

A primary object of the present invention is to provide a copper base alloy having a low liquidus temperature and ductility.

THE INVENTION

The present invention comprises a novel copper base alloy composition consisting essentially of from about 2 to about 20 weight percent arsenic, and at least one member selected from the group consisting of manganese and zinc, the balance being about 40 to about 65 weight percent copper. When said zinc is used alone, the zinc composition ranges from about 15 to about 50 percent. When said manganese is used alone, the manganese composition ranges from about 15 to about 45 percent. When said zinc and manganese are used together, the total amount of zinc and manganese ranges from about 15 to about 55 percent.

high concentration of arsenic in the alloy will be used. When manganese is employed with zinc, however, lower amounts of arsenic may be present in the alloy. For example, when the alloy contains from about 30 to 40 percent of manganese or from about 30 to 45 percent zinc, from about 8 to 15 percent of arsenic is used, whereas when the alloy contains from about 20 to 25 percent manganese and from about 15 to 25 percent zinc, from about 5 to 7 percent arsenic may be used.

In preparing the alloys of the present invention, conventional alloying and melting techniques, as practiced by those skilled in the art, may be employed. The alloying constituents may contain those amounts and types of impurities normally found therein.

The following examples are representative of the novel copper base die casting alloys of the present invention but are not intended to be construed as limiting the invention thereto.

Various copper base alloys were prepared in accordance with the present invention by melting the constituents in an induction unit under a cover of a flux composition consisting by weight of 50% $MgCl_2$, 25% KCl, 20% $BaCl_2$, and 5% CaF_2 to prevent oxidation. All the additions were made in elemental form, except zinc, which was alloyed as Muntz Metal (60% Cu + 40% Zn). The resulting melt in each case was cast into a ¾-inch-diameter cylinder in a graphite mold. A 1-inch-long sample was prepared from each cylinder and was tested for compressive yield strength (CYS), ultimate compressive strength (CS), and percent compression (% C) which is a valid indication of the ductility and therefore the utility of the alloys prepared. In addition, the liquidus temperature in degrees Fahrenheit was ascertained for each alloy prepared. The particular composition of each alloy made, its melting characteristics, % C, CYS and CS, are presented in the following table.

Comparative alloys, not illustrative of the present invention, were also prepared to show the high melting point properties of conventional copper base alloys as compared to the melting points of the present inventive alloys.

TABLE

	Nominal composition,[1] percent			Liquidus temp., ° F.	In 1000's p.s.i.		
	Mn	Zn plus As			Percent C	CYS	CS
Example No.:							
Comparative—A	3	0	3	1,900	Ductile		
Comparative—B	6.6	0	1.6	1,840	Ductile		
Comparative—C	1.2	30	1.8	1,670	Ductile		
1	31.8		9	1,450	29	54	130
2	32.8		6	1,520	29	50	106
3	9	25.5	6	1,480	26	35	121
4		45.1	9.75	1,350	Not tested		
5	6	36	4	1,560	40	39	124
6	23.8	19	5	1,500	35	45	106
7	20.6	22.1	6.5	1,480	48	49	153
8	25.6	16.6	6.5	1,470	12	27	44
9	23.1	19.4	6.5	1,480	14	22	36
10	23.5	18.8	6	1,480	19	22	45
11		45	12	1,380	23	50	119
12	6	26.1	7	1,550	28	32	117
13		30	10	1,480	32	32	135
14		40	10	1,420	24	54	124
15		43	13	1,480	12	45	100

[1] Balance being copper.

Preferably the alloy of the present invention will contain from about 5 to about 15 percent arsenic, from about 15 to about 30 percent of manganese, or from about 15 to about 45 weight percent of zinc, or a combination of manganese and zinc from about 25 to about 45 weight percent.

Particularly advantageous alloys in accordance with the present invention contain from about 20 to about 30 weight percent manganese, from about 4 to about 8 weight percent arsenic, from about 15 to about 25 weight percent of zinc.

Although the present invention is characterized as a copper base alloy, it is recognized that in some cases due to the ranges of alloy substitutents copper may not be present in a predominant amount.

While the alloy composition of the present invention may be formulated to obtain the desired combination of a particular low melting point and ductility, generally when high concentrations of manganese or zinc are employed, a moderate to

It can be readily seen from the data in the table that the present alloys (example 1–15) are ductile and are characterized by significantly lower liquidus temperatures than the comparative alloys (examples A–C), thus very suitable for use in die casting operations.

The present invention may be modified or changed without departing from the spirit or scope thereof and it is understood that the invention is only limited as defined in the appended claims.

What is claimed is:

1. A low melting, ductile alloy consisting essentially by weight of from about 2 to about 20 percent arsenic, and at least one metal selected from the group consisting of zinc and manganese, the amount of said zinc when used alone being within a range of from about 15 to about 50 percent, the amount of said manganese when used alone being within a range of from about 15 to about 45 percent, the total amount

of said zinc and manganese when used together being within a range of from about 15 to about 55 percent, the balance being copper in an amount from about 40 to 65 percent.

2. The alloy of claim 1 wherein the metal present is manganese in an amount of from about 15 to about 30 percent, and the arsenic is present in an amount from about 5 to about 15 percent.

3. The alloy of claim 1 wherein the arsenic is present therein in an amount of from about 5 to about 15 percent, and the metal selected is zinc in an amount of from about 15 to about 45 percent.

4. The alloy of claim 1 wherein the arsenic is present therein in an amount of from about 5 to about 15 percent, and the metals selected are zinc and manganese in a total amount of from about 25 to about 45 percent.

5. The alloy of claim 1 wherein the manganese is present therein in an amount of from about 20 to about 30 percent, the zinc in an amount of from about 15 to about 25 percent, and arsenic in an amount from about 4 to about 8 percent.

6. The alloy of claim 1 further characterized as having a liquidus temperature below about 1,600° F.

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