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ZINC BASE ALLOYS

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My invention, which relates to zinc base alloys and has among its objects the provision of a zinc base alloy of improved characteristics, will be best understood from the following description, while the scope of the invention will be more particularly pointed out in the appended claims.

Alloys according to the invention contain 0.1 to 5.5% copper, 0.05 to 0.3% silver, and 0.02 to 0.8% metal of the group consisting of tellurium and selenium.

Applicant has found that the tensile strength of zinc can be markedly increased by adding small amounts of copper to it without any marked decrease in the ductility unless the amount of copper exceeds about 2.7%. He has also found that the tensile strength of zinc can be further increased by adding with the copper small amounts of metal of the group consisting of tellurium and selenium. However, in this latter case the increased tensile strength can be secured only at marked expense of the ductility over that secured by increasing the tensile strength by adding copper alone. Further, he has found that if a small amount of silver is added with the copper and metal of the group mentioned, although roughly the same tensile strength is secured as in the absence of silver, the silver nevertheless corrects the decrease in ductility caused by the addition of metal of the group. For example, zinc in the hot rolled condition has a tensile strength of about 17,000 pounds per square inch and a ductility corresponding to 45% elongation in 2 inches, and adding 1% copper to the zinc will raise its tensile strength in the hot rolled condition to about 29,000 pounds per square inch, the ductility approximately remaining the same. Adding 0.2% metal of the group mentioned with this amount of copper will increase the tensile strength of the zinc in the hot rolled condition to 34,000 pounds per square inch, but will decrease the ductility to a value corresponding to 35% elongation in 2 inches, but by adding 0.1% silver with the copper and metal of the group there will be secured a tensile strength in the hot rolled condition of 36,000 pounds per square inch, that is to say, about the same tensile strength as when the silver is omitted, and the ductility will be raised to a value corresponding to 50% elongation in 2 inches, in other words, a better ductility than that of the original zinc.

In general throughout the ranges of constituents of the improved alloy the silver will correct the decrease in ductility tended to be caused by the addition of metal of the group mentioned and secure a ductility superior to that of the

original zinc. At the same time the combination of silver and metal of the group in conjunction with the copper has a marked effect in increasing the tensile strength as compared to the binary zinc-copper alloy, and secures a somewhat better tensile strength than the ternary alloy consisting of zinc, copper and metal of the group. Also the stability of the alloy in respect to maintaining its tensile strength and ductility with age is much improved as compared to the binary zinc-copper alloy or the same with metal of the group added thereto. The silver also secures the very valuable effect of markedly increasing the toughness of the alloy measured by its resistance to shock or impact loading, such toughness being maintained as the alloy ages.

In general the improved alloys are characterized by high tensile strength and unusual ductility in the hot rolled and annealed conditions, making the alloys useful in situations where subjected to moderately high temperatures, say up to 300° F. They are also stable in respect to maintaining their linear dimensions with age, and are not subject to intergranular corrosion. The stability of the improved alloys is satisfactory in respect to all their physical properties, and in fact the toughness and high resistance to shock or impact loading tend to increase rather than diminish with age.

For example, by varying the proportions of copper, silver and metal of the group within the ranges of 1 to 5% copper, 0.05 to 0.3% silver, and 0.02 to 0.8% metal of the group it is possible to obtain alloys having in the hot rolled condition tensile strengths of from about 35,000 to 52,000 pounds per square inch with ductilities corresponding to from about 50 to 55% elongation in 2 inches and a toughness measured by impact resistances of about 300 to 700 foot pounds per square inch. When subjected to moist steam at 95° C. for 10 days, which is the standard accepted test for determining the effect of age on zinc and its alloys, the improved alloys will have tensile strengths of from about 30,000 to 43,000 pounds per square inch and elongations in 2 inches of from about 38 to 42%, and the same or somewhat greater toughness.

The improved alloy throughout its ranges of constituents can be hot and cold worked by commercial mill processes, having sufficient hot and cold plasticity to be readily hot or cold rolled into sheets. The most satisfactory alloys in respect to properties imparted by cold working contain about 1.5 to 3.5% copper, 0.07 to 0.15% silver, and 0.05 to 0.5% metal of the group men-

tioned. The alloys do not self anneal during cold working when the amount of copper is 1.5% or more. Whether the alloys are to be hot or cold worked best results in regard to securing desired properties will be secured with about 0.07 to 0.15% silver.

The excellent properties of the improved alloys in the hot rolled and annealed conditions are exhibited by the following table:

Per- cent Cu	Per- cent Te	Per- cent Ag	Tensile strength hot rolled p. s. i.	Percent elonga- tion in 2 inches hot rolled	Tensile strength annealed at 600° F. for 1 hr. p. s. i.	Percent elongation in 2 inches annealed at 600° F. for 1 hr.
0	0	0	17,000	45	6,000	4
1	0.05	0.1	20,000	50	21,000	28
1	0.75	0.1	27,000	55	22,000	42
5	0.05	0.1	40,000	50	40,000	40
5	0.75	0.1	48,000	50	41,000	40

It will be understood that, within the scope of the appended claims, other elements may be added to the improved alloy for modifying its properties or securing additional properties, so long as the characteristics imparted by the copper, silver and metal of the group mentioned are not destroyed.

I claim:

1. Hot and cold workable alloys, characterized 30

by superior tensile strength, ductility and toughness in the annealed condition as compared to zinc, having, approximately, 0.1 to 5.5% copper, 0.05 to 0.3% silver, 0.02 to 0.8% metal of the group consisting of tellurium and selenium, the balance constituting approximately 93.4 to 99.8% of the alloy being substantially zinc.

2. Zinc base alloys according to claim 1 having about 0.07 to 0.15% silver, the balance constituting approximately 93.6 to 99.8% of the alloy.

3. Hot and cold workable alloys, characterized by superior tensile strength, ductility and toughness in the annealed condition as compared to zinc, having 1 to 5% copper, about 0.1% silver, and 0.05 to 0.75% metal of the group consisting of tellurium and selenium, the balance constituting approximately 94.2 to 98.9% of the alloy being substantially zinc.

4. Hot and cold workable alloys, characterized by superior tensile strength, ductility and toughness in the annealed condition as compared to zinc and by resistance to self annealing when cold worked, having, approximately, 1.5 to 3.5% copper, 0.07 to 0.15% silver, and 0.05 to 0.5% metal of the group consisting of tellurium and selenium, the balance constituting approximately 95.9 to 98.4% of the alloy being substantially zinc.

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