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ALLOY

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This invention relates to a fusible metal particularly adapted for use in temperature-responsive devices. More particularly, the invention relates to an alloy comprising a eutectic and a small addition of mercury.

In temperature-responsive apparatus, and particularly in fire extinguishing and detecting apparatus, the use of fusible metals has been found satisfactory to control the temperature of operation. Such devices are commonly used for controlling sprinkler systems, gaseous fire extinguishing systems, fire doors, fire alarms, and various other devices which serve to extinguish, control, or give warning of a fire or overheating condition which might lead to fire. In all of these uses, certain qualities are of essential importance. In the first place, the device must be sure of operation,—that is, the metal must always soften or fuse at a given temperature. In the second place, the response should be reasonably rapid, since delay in the operation may result in increased damage and loss. Furthermore, it is important that the device should never operate except under the conditions to which it is intended to respond. If, through deterioration, the device should operate when there is no overheated condition, the result would be unnecessary damage and loss in the case of sprinkler and gas systems, and unnecessary alarm in some cases, with lessened significance to the alarm where fire has actually started.

It is an object of my invention, therefore, to provide a fusible metal which will soften or melt sharply at a given temperature required for the fire prevention and alarm devices, which will be satisfactorily fluid at the fusion temperature so as to permit instantaneous operation of devices in which the operation depends upon flow of the fused metal, and which will make satisfactory electrical contact when flowing between metal terminals in a fused or softened condition, but which will not deteriorate so as to allow operation of the device in which it is used, except at the conditions under which operation is intended.

With these objects especially in view, my invention contemplates an alloy comprising a eutectic of lead, tin, cadmium and bismuth, in which has been incorporated a small amount of mercury.

I am aware that alloys including this same combination of metals have been used before for similar purposes. In practical service, however, none of these have been entirely satisfactory. I have now discovered that it is possible to produce a metal which exceeds in quality, particularly for use in temperature-responsive devices, any which has been known before, if the alloy consists of the above specified eutectic and mercury, substantially to the exclusion of all other metals, particularly where the proportions of the eutectic and the mercury vary from 95% and 5%, to 90% and 10%. I have found, furthermore, that to obtain the optimum qualities for use in temperature-responsive devices the grain structure of the metal must be carefully controlled, preferably by controlled cooling and cold working.

In order to give a more thorough understanding of the invention, I shall give below a preferred example of my invention. It is to be understood that this is only one of various ways in which the invention may be practiced.

92.5% of the eutectic, consisting of:

	Parts by weight
Bismuth	50
Lead	26.7
Cadmium	10
Tin	13.3

is fused together with 7.5% of mercury. All of these metals should, for best results, be substantially chemically pure. The resulting alloy fuses at 150° to 152° F.

The fused metal is then cast in deep ingot molds. When the molds have been filled and while they are held in a vertical position, the metal is progressively, but quickly, chilled, beginning at the bottom. The rapid cooling which is thus effected causes the metal to crystallize with a fine grained structure, while the depth of the molds and the progressive chilling allow the unsolidified metal above to close in and fill in the voids and blow holes which might otherwise be formed in the metal because of the rapid cooling.

When the metal is entirely solidified, the molds may be opened and the ingots withdrawn and subjected to cold working. For example, the ingots may be repeatedly passed through cold rolls until the thickness is brought down to about 15/1000 of an inch—very gradually, since too rapid reduction in thickness will tend to crack and weaken the metal. If desired, the alloy may first be extruded through a cold die and thereafter rolled. In either case, the cold working leaves the metal with a close grain, and gives a more uniform alloy with a sharp and certain melting or softening point.

In tests, both laboratory and practical, on this alloy, it has been demonstrated that it fuses or softens sharply and quickly at the given temperature for which it is designed, and that the tem-

perature responsive devices in which it has been used will operate perfectly and well within the minimum time limit specified for such apparatus.

As already stated, the proportion of mercury may be varied from 5 to 10 per cent of the composition. Above 10 per cent, the desired fine, close-grained crystal structure and ductility cannot be attained, no matter how carefully the material is cold worked. If more than slight variations from the chemically pure eutectic of bismuth, lead, cadmium and tin are allowed, whether by inaccuracies of the proportions of these metals, or by impurities in the metals used to form the eutectic, or if the mercury is impure, the resulting metal may not have the advantageous combination of perfect physical qualities combined with low melting point.

In casting the metal, I have found that it is important to keep the mold surfaces perfectly clean, since oil or dirt upon these surfaces may result in the failure of the metal to wet the mold surfaces, and consequent formation of imperfect ingots.

What I claim is:

1. A fusible metal consisting of 10% to 5% of mercury and 90% to 95% of the eutectic consisting of lead, tin, cadmium and bismuth in substantially the following proportions:

	Per cent
Bismuth	50
Lead	26.7
Cadmium	10
Tin	13.3

2. A fusible thermostatic metal which consists of 10% to 5% of mercury and 90% to 95% of the eutectic consisting of lead, tin, cadmium and bismuth, in substantially the following proportions:

	Per cent
Bismuth	50
Lead	26.7
Cadmium	10
Tin	13.3

which has been given a fine uniform grain structure and ductility by solidifying in deep ingot molds strongly cooled progressively from bottom to top and by repeated cold working of the metal thus solidified.

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