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ALLOY STRUCTURE.

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The present invention relates to processes of producing alloy structures or articles formed of alloys and in the preferred embodiment which has been chosen for the purpose of description relates specifically to the production of porous alloy articles or structures particularly useful as bearing materials.

The invention has among its objects increasing the facility of alloying of metals without reducing the alloy constituents to a molten condition.

Another object is the toughening and the rendering more ductile of alloys produced in certain processes more fully indicated hereinafter.

Further objects will be clearly seen as the description proceeds.

In earlier applications filed by us there have been disclosed porous metallic bodies suitable for use in bearings and the like which are composed mainly of an alloy of cellular structure with or without a filling material such as graphite in the interstices. This material will absorb a large proportion of its weight of oil and thereafter is to a great extent self-lubricating.

Bodies of the kind described may be made by intimately mixing in suitable proportion finely divided metal particles, a substance, preferably organic, which will volatilize when the bodies are heated without chemically reacting with the metallic particles or otherwise injuring the mass. In some cases finely divided graphite or the like may be mixed with the metallic particles. The addition of the graphite or its omission depends upon the characteristics desired in the bearing or other article to be made.

After these materials have been thoroughly mixed, the mixture is placed in a suitable die and compressed to the desired form under very high pressure. The formed articles are then packed in suitable containers with carbonaceous material and heated to cause alloying of the metals.

After the containers and contents have cooled, the articles are removed and subjected to suitable finishing operations, including impregnation with oil or other lubricant.

The present application is based on improvements in the process just described whereby a superior product is obtained, the product of the present process being stronger and much more ductile than that of the prior process.

In the process of this application, the procedure is quite similar to that described with respect to the earlier applications but with certain substantial differences, one difference being the addition to the mix of a volatile flux which very greatly aids the alloying of the metal constituents.

In carrying out the present process, as applied to making bearing material a typical mixture is made as follows: The parts being by weight:

	Parts.
Copper	90.
Tin	10.
Graphite	6.
Ammonium chloride	.53

These materials in finely divided condition, preferably fine enough to pass a 120 mesh screen, are thoroughly mixed and compressed in a die of the desired form under a very high pressure, for example, 80,000 lbs. per sq. in. The formed article is then heated in a suitable non-oxidizing atmosphere, for example by packing in carbonaceous material in a container, for a period sufficient to cause alloying of the tin and copper. The time and temperature of heating may be varied to some extent and, as a rule, the time is shortened as the temperature is increased and vice versa. A satisfactory temperature for the heating has been found to be around 730° C. and the time of heating at such a temperature should be from 3 to 6 hours although a longer time will not be found objectionable.

As another example, the following proportions of materials may be given:

	Parts.
Copper	90.
Tin	10.
Salicylic acid	6.
Ammonium chloride	.53

the treatment being the same as above given.

The ammonium chloride mentioned in these formulæ is an example of a volatile flux that has been found satisfactory and may be used in the mix with advantage in amounts up to 1% thereof, although .5% or thereabout has been found sufficient and preferable.

The action of the ammonium chloride or similar material seems to be chiefly one of

fluxing although when used in the mix its volatility tends to increase porosity of the product as well. On account of its fluxing function and its property of being volatile it is not confined in its use to being mixed with the materials before the heating but it is satisfactory to have the heating take place in an atmosphere of the vapor. For example, excellent articles of the character described have been made by omitting the flux from the mix and placing some of the material in the bottom of the heating vessel, with or without, preferably without, a carbonaceous packing material for the articles, so that it will volatilize and permeate the formed articles under treatment. This may be done by putting some of the flux under a perforated false bottom in the heating vessel and packing the articles on top of this perforated bottom. During the heating the flux will volatilize and envelop and permeate the articles and fulfil its function of fluxing. In this operation, using ammonium chloride, an amount up to about 1% of the weight of the articles is advisable.

It has been found that finely powdered mica or other inert non-reducing unctuous material may be used in the place of graphite for substantially all purposes and accomplish substantially as good results. While mica is preferable, other non-abrasive materials may be used, e. g., talc.

These other materials mica, talc, etc., may be used in substantially the same proportions as the graphite for which they are substituted and the same porosity of product produced without otherwise modifying the process of production. Bearings produced with mica or talc instead of graphite have been made with a porosity sufficient to permit absorption of four or five percent of their weight of oil and such bearings have given excellent results even when run at a high rate of speed upon soft steel shafts.

The alloy materials or structures produced according to the present process are sufficiently ductile to permit die shaping and sizing without surface breaks and are also sufficiently strong to withstand considerable stress without permanent deformation.

While the forms of embodiment of the invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What we claim is as follows:

1. A process comprising intimately mixing finely divided alloyable metals, and finely divided material that volatilizes under heat, compressing the mixture into a desired form, and heating in the presence of a volatile flux to a temperature sufficient to cause alloyage of the metals.

2. A process comprising intimately mixing finely divided alloyable metals, finely divided material that volatilizes under heat, and finely divided volatile flux, compressing the mixture into a desired form, and heating to a temperature sufficient to cause alloyage of the metals.

3. A process comprising intimately mixing finely divided alloyable metals, and finely divided salicylic acid, and finely divided volatile flux, compressing the mixture into a desired form, and heating to a temperature sufficient to cause alloyage of the metals.

4. A process comprising intimately mixing finely divided alloyable metals, finely divided material that volatilizes under heat, and finely divided ammonium chloride, compressing the mixture into a desired form, and heating to a temperature sufficient to cause alloyage of the metals.

5. A process comprising intimately mixing finely divided alloyable metals, finely divided salicylic acid, and finely divided ammonium chloride, compressing the mixture into a desired form, and heating to a temperature sufficient to cause alloyage of the metals.

In testimony whereof we hereto affix our signatures.

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