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ALLOY AND METHOD OF MANUFACTURE THEREOF

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This invention relates to a new alloy and method of manufacture thereof. The present application is a continuation in part of application 220,134, now abandoned.

It is an object of the invention to provide an alloy having a composition such as to be adapted for use in sanitary food handling machinery and having a corrosion-resistance comparable to that of stainless steel but, unlike stainless steel, having non-galling characteristics adapting it for use wherever the part made of our improved alloy must be movable in metal to metal contact with stainless steel.

Essentially, our alloy comprises approximately 40–80% nickel with about 1–6 bismuth, it being our discovery that the addition of bismuth prevents galling. In its preferred embodiment, the alloy desirably uses 2–6% tin to assist in incorporating and dispersing the bismuth. It desirably also contains 10–25% chromium and other metals commonly used in nickel base alloys. 1–4 molybdenum improves resistance to corrosion. Silicon 0–1% and manganese 0–2% facilitate casting and improve mechanical properties. If there is any balance required, we use iron.

The foregoing figures are regarded on the basis of present information, as representing about the maximum appropriate range. The preferred range is as follows:

	Per cent
Nickel	50–70
Chrome	10–15
Molybdenum	2–3
Tin	2.5–5.0
Bismuth	2–4
Silicon	.25–.75
Manganese	.50–1.50
Balance	Iron

It is believed that the bismuth cannot advantageously be used in the desired proportions in any alloy that does not contain very substantial quantities of nickel. We prefer that nickel be present to the extent of at least 40% to 50%, the exact minimum depending somewhat on the proportions of other metals which are used.

In its method aspects, the invention involves the melting of all of the other ingredients except the bismuth and, in some instances, the tin. All slag must then be removed and the alloy must be in readiness to pour before the bismuth is added. In actual practice, we prefer to incorporate the bismuth in the tin as a master alloy and then add this master alloy just as the rest of the melt, previously skimmed of slag, is tapped from the furnace. By so doing, we prevent the bismuth from being vaporized at the high temperature required to melt the other ingredients. The tin seems to act as a dispersing agent to facilitate the uniform distribution of the bismuth throughout the alloy.

Nickel, chromium, bismuth, tin and molybdenum are relatively expensive and selection of the particular formula may be influenced by the desirability of keeping the cost of the materials as low as in consistent with the desired properties. The precise composition of the alloy preferred for our particular sanitary pump purposes is as follows:

	Per cent
Nickel	60
Chromuim	12
Molybdenum	3
Tin	4
Bismuth	2½
Manganese	1
Silicon	½
Balance	Iron

In practice, the proportions may be varied and some of the ingredients omitted. For example, the use of molybdenum is entirely optional. While tin plays an important part in the preferred alloy and the preferred method of manufacture, even this element may be omitted for certain purposes. To the extent that non-essential ingredients are omitted or reduced in percentage, these may be replaced with additional iron or nickel, or both.

As already indicated, the essential ingredients of the alloy are nickel to a preferred minimum of 50% of the total, and bismuth, which should be at least 1% of the total and desirably 2% or more, in order that the alloy may have the desired non-galling characteristics. A commercially known alloy which as a composition of 78% of nickel and 14% of chromium, plus minor percentages of manganese and silicon and iron is very satisfactory from the standpoint of corrosion resistance, but it galls badly. That alloy becomes completely non-galling when bismuth is added in the indicated proportions of 1% or 2% or more. If the bismuth were added in quantities exceeding 4.5% there would be danger of segregation of this element, particularly if tin were absent or present only in nominal proportions.

The method of preparation which we prefer to use is as follows:

The requisite amount of bismuth and the requisite amount of tin are first melted together. It is immaterial whether the master alloy be used in its liquid or solidified form.

The other ingredients are melted. We have found that they do not melt below 2500° F. and in practice we heat them to about 2800° F. before pouring. At these temperatures, bismuth will vaporize in whole or in part. Accordingly, the nickel, along with the chromium, molybdenum, manganese, silicon, etc. is not only melted, but carefully skimmed to remove all slag before the bismuth is added. As aforesaid, the tin may be melted with the other ingredients, although the preferred practice involves the preparation of a master tin and bismuth alloy which is not added until just before pouring. The importance of removing the slag lies in the fact that a portion of the bismuth enters the slag layer if the bath is not skimmed. This reduces the percentage of bismuth remaining in the completed alloy.

In the preferred practice of the invention, we add the bismuth, or the bismuth tin alloy to the general molten mixture substantially coincidentally with the tapping of the furnace.

The resulting alloy, while not quite as strong as stainless steel nor quite as ductile, is amply strong for the manufacture of bearings or pump parts or the like, its

precise strength and ductility depending on the precise composition. An alloy of the preferred formula as above set forth has a tensile strength of 50,000 pounds plus; a yield point of 40,000 pounds plus; and an elongation of 2% to 3%.

We claim:

1. A non-galling, corrosion-resisting alloy consisting essentially of a nickel-chromium base in combination with bismuth, nickel being present in the approximate range of 40–80% of the whole alloy, chromium being present in the approximate range of 10–25% to make the alloy corrosion-resistant, and bismuth being present in the approximate range of 1–6% to render the alloy non-galling, any required balance being selected from the group consisting of nickel and iron.

2. The alloy of claim 1 in which silicon is present in the approximate proportion of 0–1% of the total.

3. The alloy set forth in claim 1 in which tin is present in the approximate proportion of 2–6% of the total.

4. The alloy set forth in claim 1 in which molybdenum is present in the approximate proportion of 1–4% of the total.

5. The alloy of claim 1 in which manganese is present in the approximate proportion of 0–2% of the total.

6. A non-galling, corrosion-resistant alloy comprising the following ingredients in the approximate range of percentages indicated as follows:

	Per cent
Nickel	50–70
Chromium	10–15
Molybdenum	2–3
Tin	2.5–5.0
Bismuth	2–4
Silicon	.25–.75
Manganese	.50–1.50
Balance	Iron

7. A non-galling, corrosion-resisting alloy for use in sanitary food handling machinery and comprising the following ingredients in the approximate percentages indicated:

	Per cent
Nickel	60
Chromium	12
Molybdenum	3
Tin	4
Bismuth	2½
Manganese	1
Silicon	½
Balance	Iron

8. The method of preparing a non-galling, corrosion-resisting alloy of nickel, chromium and bismuth which comprises the steps of melting the nickel and chromium at one temperature, separately melting the bismuth at a lower temperature, dispersing the molten bismuth in the molten nickel and chromium and immediately cooling the resultant alloy before any substantial part of the bismuth has been lost through vaporization.

9. The method of claim 8 plus the intermediate step of skimming the slag from the molten nickel and chromium prior to adding the bismuth to preclude loss of any substantial amount of bismuth through reaction thereof with the slag.

10. The method of preparing a non-galling, corrosion-resisting alloy of nickel, chromium, tin and bismuth which comprises the steps of melting the nickel and chromium at one temperature, separately melting the tin and bismuth at a lower temperature, and adding the tin and bismuth to the molten nickel and chromium in a step in which the tin constitutes a dispersing agent for the bismuth in said molten nickel and chromium.

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