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CYANIDE SALT BATH

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The present invention relates to a novel salt bath for the case-hardening of iron, steel, and the like.

One object of the present invention is to provide a salt bath containing an alkali metal cyanide, as the active carburizing ingredient, which bath also contains a chemical that prevents the decomposition of the cyanide and hence obviates the fuming and flaming of the bath normally encountered when relatively high temperatures are employed in the treatment of iron, steel, and the like.

Another object of the present invention is to provide a salt bath which may be used efficiently in the cementation and hardening of objects made from iron, iron alloys, refined steel, special alloy steels, and the like, and which is also effective in the cementation and nitriding of high speed alloy tool steel such as is used in cutters, taps, etc.

Still another object is to furnish a cyanide bath which may be used at temperatures from 900° F. to 1550° F., depending upon the metal being treated and the type of case desired, and which is characterized by its great fluidity at the case-hardening temperature.

A further object is to furnish a salt bath which does not form a carbon crust on the treated object, and which contains salts, easily soluble in water, so that the salts adhering to the object may be easily removed therefrom by immersion in hot water after an oil quench.

Other objects, including the method of maintaining and/or of regulating the efficiency of cyanide-salt baths, will be apparent from a consideration of the specification and claims.

The present invention contemplates the presence in or the addition to a salt bath containing an alkali metal cyanide of an alkali metal fluoride. The fluoride and cyanide are exemplified by the sodium salts and the potassium salts, but since the former are more economical, they will generally be selected for use. The bath also, advantageously, contains an inert salt, or mixture of inert salts, which is fluid at the temperature used in the case-hardening or carburizing process. The inert salts are generally the chlorides or carbonates of sodium, potassium or barium, and the particular one, or ones, selected and the relative proportions thereof, if a mixture is used, as well as the proportion of the inert salt to the cyanide, will be determined by the conditions of the case-hardening process and the results desired, all in accordance with standard practice. The present invention is characterized by the incorporation of an alkali metal fluoride in any of the cyanide-salt baths of the art. Particularly advantageous results, however, are obtained when the alkali metal fluoride is included in a salt bath containing an alkaline earth chloride or carbonate, with one or more alkali metal chlorides, and/or alkali metal carbonates, as well as sodium cyanide.

The percentage of alkali metal fluoride added to the bath is generally from 2% to 10%, depending to some extent upon the amount of alkali metal cyanide in the bath. Thus, in a bath containing about 32% sodium cyanide, an addition of about 5% of sodium fluoride has been found to be effective in maintaining and/or in regulating the efficiency of the bath and in overcoming the tendency of the bath to fume or flame at relatively high temperatures. If the cyanide content of the bath is relatively low, the percentage of fluoride may be decreased below 2% and an improvement of the properties of the bath will be noted. The upper limit is not critical and percentages appreciably higher than 10% may be employed, but in salt baths where the cyanide content is not greatly in excess of 32%, the use of sodium fluoride above 5% is not recommended for economical reasons. In most salt baths used in the art, the alkali metal cyanide content is between 5% and 50%.

As is known, there is a tendency for the alkali metal cyanide of case-hardening baths to decompose during use, which tendency increases as the temperature is raised. Thus, not only is there loss through decomposition, but the health of the operators of the baths is endangered. At temperatures in the neighborhood of 1500°–1550° F., the decomposition of the cyanide is rapid, and excessive fuming and flaming is encountered. The presence of an alkali metal fluoride in the bath counteracts these objectionable tendencies, and even at the elevated temperature mentioned, the fuming and flaming of the baths are avoided. Thus, the presence of the alkali metal fluoride in the bath, or its addition thereto, affords a method of maintaining, and/or regulating the efficiency of cyanide case-hardening baths. The alkali metal fluoride is readily soluble in water, and, therefore, any of the salt bath adhering to the object treated is easily removed with hot water after an oil quench. There is no formation of a black carbon crust which is oftentimes encountered, and the treated objects are, therefore, relatively clean. Depending on the nature of the inert salts, the bath may be used at temperatures as low as 900° F., and the presence of the

alkali metal fluoride tends to increase the fluidity of the baths to which it is added. The bath of the present invention may be used for the cementation and carburization of objects made from iron, iron alloys, refined steel or special alloy steels, and the like. It is also applicable for the cementation and nitriding of high speed alloy tool steel such as used for cutters, taps, etc.

In a typical case, a bath of the following chemical composition has been found to be especially efficient and not to require further additions of the alkali metal fluoride:

	Per cent
NaCN	32.00
$BaCl_2$	17.00
K_2CO_3	8.00
Na_2CO_3	38.00
NaF	5.00

A bath of the above composition but without the sodium fluoride fumed and flamed violently could not be used successfully at temperatures in the neighborhood of 1550° F. The casing depths were only .007 inch when an article was heated therein at 1500° F. for .5 hour, and only .012 inch when the heating was continued for an hour. The presence of the sodium fluoride (5%) prevented flaming and fuming and increased the case depths to .009 inch when the article was heated in the bath at 1550° F. for .5 hour, and to .014 inch when the heating was continued for an hour. The bath is also satisfactory for the nitriding or cementing of high speed steels at temperatures of 900° F. to 1100° F., after said steels have been hardened and drawn. The bath has a specific heat of .403 at 1550° F. and a specific gravity of 1.42 at the same temperature.

In a bath containing sodium cyanide and barium carbonate, the salts may, for example, vary as follows:—sodium cyanide 5% to 50%; barium carbonate 10% to 35%; potassium carbonate 5% to 15%; sodium or potassium chloride 5% to 30%; sodium fluoride 2% to 10%; and sodium carbonate 20% to 45%; a typical bath having the following compositions:—

	Per cent
NaCN	22
$BaCO_3$	14
K_2CO_3	8
NaCl	9
NaF	5
Na_2CO_3	42

Another example of a bath of the present invention is:—

	Per cent
NaCN	45
$BaCO_3$	32
NaCl	18
NaF	5

Considerable modification is possible in the composition of the case-hardening bath, as well as in the proportions of alkali metal fluoride employed, without departing from the essential features of my invention.

I claim:

1. A case-hardening bath for iron, steel, and the like comprising sodium cyanide approximately 32%, barium chloride approximately 17%; potassium carbonate approximately 8%; sodium carbonate approximately 38%; to which has been added approximately 5% of sodium fluoride, the entire fluoride addition to the bath being characterized by water solubility.

2. A case-hardening bath for iron, steel and the like comprising sodium cyanide 5% to 50%; barium carbonate 10% to 35%; potassium carbonate 5% to 15%; an alkali metal chloride 5% to 30%; sodium carbonate 20% to 45%; to which has been added sodium fluoride, the entire fluoride addition to the bath being characterized by water solubility and being present in amounts from about 2% to about 10% of the total weight of the bath.

3. A case-hardening bath for iron, steel and the like comprising sodium cyanide approximately 22%; barium carbonate approximately 14%; potassium carbonate approximately 8%; sodium chloride approximately 9%; and sodium carbonate approximately 42%; to which has been added approximately 5% of sodium fluoride, the entire fluoride addition to the bath being characterized by water solubility.

4. A case-hardening bath for iron, steel, and the like comprising sodium cyanide approximately 45%; barium carbonate approximately 32%; sodium chloride approximately 18%; to which has been added approximately 5% sodium fluoride, the entire fluoride addition to the bath being characterized by water solubility.

5. A case hardening bath for iron and steel comprising alkali metal cyanide from 5% to 50%, and an inert salt molten at case hardening temperatures, to which has been added an alkali metal fluoride, the entire fluoride addition to the bath being characterized by water solubility and being present in amounts from about 2% to about 10% of the total weight of the bath, the said inert salt and alkali metal cyanide making up the balance of the bath.

6. The case hardening bath of claim 5 wherein the alkali metal cyanide is sodium cyanide and the alkali metal fluoride is sodium fluoride.

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