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COMPOSITION FOR CASE HARDENING

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The present invention relates to a fused case hardening bath which is applied in the form of a hot liquid in which metals to be case hardened are submerged. The present invention also comprises materials which are combined in such manner that a relatively small amount of fuming occurs when the materials are raised to the proper temperature to be used for case hardening purposes. This is particularly desirable, because the less fuming that occurs, the less amount of material is lost as gases.

Another feature of the present invention is that when the articles are removed from the case hardening bath and are quenched in oil, the residual material on the surface of the articles being case hardened is of such composition as to be relatively easily soluble in water. Therefore, this material may be readily removed from the case hardened articles by washing the same in water.

The materials forming the bath of the present invention are of such nature that during use, the bath need not be renewed as to specific materials composing the bath, but requires renewal only to replace the case hardening material which is removed mechanically from the bath by the case hardening material sticking to the surface of the articles which are taken from the bath.

The composition herewith disclosed, comprising the preferred embodiment of the present invention, is of such nature that it becomes thoroughly liquid when heated to proper temperatures and its use is within the range of temperatures of 1650° F. for a maximum, and as low as 1200° F. for a minimum. Preferably, the working temperature for most materials is in the neighborhood of 1450° F. to 1600° F. The composition, therefore, is entirely workable at temperatures below the critical temperatures of mild steel which begin at about 1550°.

The composition of the present invention gives a deep case in a relatively short time. For example, a piece of mild steel submerged in this bath for a period of three hours at a temperature range of substantially 1550° takes a case hardening having a penetration of .025 inch to .032 inch. A similar piece of mild steel submerged in this fused bath at a temperature of approximately 1600° takes the same depth of penetration of the case hardening in approximately one and one-half hours.

The composition has a melting point at approximately 1100° F., and preferably when the material is being fused for the first time, it is held at this temperature for about one-half hour in order to permit chemical changes to occur at a temperature at which substantially no fuming takes place. Then, as the temperature is raised, after these chemicals have recombined, there is very little fuming at the increased temperatures.

The preferred constituents of the composition comprising the present invention are sodium cyanide, or any other alkali earth cyanide; barium chloride, or any other alkaline earth metal chloride; sodium fluoride, or any other alkali metal fluoride; and calcium fluoride, or any other earth metal fluoride.

The preferred composition and the preferred percentages are as follows:

	Per cent
Sodium cyanide	45.9
Barium chloride	31.1
Sodium fluoride	12.4
Calcium fluoride	7.3

It is to be understood that these are the preferred proportions. However, these proportions are not absolutely critical and may be varied slightly without substantially impairing the effectiveness of the composition. For the conditions where a lesser degree of case hardening penetration is desired, the sodium cyanide content may be decreased while the barium chloride and sodium fluoride content is increased, and preferably, the calcium fluoride content is maintained substantially constant between seven and eight percent of the total mass.

The effects of the various components of the composition are believed to be as follows: that the carbon penetration producing the case hardening is derived largely from the sodium cyanide; that the barium chloride in conjunction with the sodium cyanide tends to increase the nascent carbon which is effective for penetration; that the sodium fluoride increases the solubility of the residual compound in water and thereby increases the washing characteristics of the residual material that is left upon articles removed from the bath. The calcium fluoride seems to have a catalytic action which in some manner increases the rate of penetration of the case hardening into the articles being treated. The calcium fluoride also appears to tend to control the balance of effective carbon for case hardening purposes due to the action of the calcium fluoride with the sodium cyanide and barium chloride. Where the calcium fluoride is omitted or is substantially less than the preferred proportion, the bath tends to give excess carbon up to 1.512%. This is undesirable and produces

a case hardened layer that tends to flake off or spawl from the metal that has been treated, whereas with the proper balance of calcium fluoride, the composition produces a case hardening having carbon of .95% to .1%. This amount of carbon will penetrate the articles being treated without causing spawling, chipping or flaking, and this condition is better suited to metallurgical requirements. These percentages referred to are the carbon content in the case hardening and the articles being treated, and not the carbon content of the bath.

In view of the high carbon content of the case hardening produced, it is desirable to control the nitrogen content of the case hardening and the calcium fluoride also seems to act with the other ingredients to provide a proper balance so that an undue amount of nitrogen in the case hardening is not present. Experiments and practical use of this composition show that where mild steel is case hardened with the bath at a temperature of 1600° F., the carbon content of the case hardening is .95% to .1% and the nitrogen content is .179%. The result is that the present composition produces a high carbon, low nitrogen case hardening, which results in less embrittlement than would be the situation if a higher nitrogen content occurred.

A piece of mild steel of S. A. E. test 1020, one inch round was submerged in the bath for one hour at a temperature which ranged between 1600° to 1620° F. This piece was then turned and the turnings analyzed. It was found that the first 4/1000 of an inch showed .95 to .1 carbon hypereutectoid; and that the second 4/1000 showed .85 to .90 carbon eutectoid.

The present composition has been in commercial use and the examples given herewith are based upon actual commercial tests.

The temperatures herein referred to are measured on the Fahrenheit scale and the proportions of the preferred amounts of the materials are by weight.

What I claim is:

1. A fused salt bath for case hardening consisting of the fusion of the following ingredients in substantially the following percentages by weight: sodium cyanide 45.9%; barium chloride 31.1%; sodium fluoride 12.4%; calcium fluoride 7.3%.

2. A fused salt bath for case hardening consisting of the fusion of a mixture of an alkali metal cyanide in an amount sufficient to impart case hardening characteristics to the bath, an alkaline earth metal chloride, an alkali metal fluoride, and an alkaline earth metal fluoride; the bath being liquid above a temperature of substantially 1100° F.

3. A fused salt bath for case hardening consisting of the fusion of a mixture of an alkali metal cyanide in an amount less than one-half by weight of the total mass and sufficient to impart case hardening characteristics to the bath, an alkaline earth metal chloride, an alkali metal fluoride, and an alkaline earth metal fluoride of an amount comprising approximately one-twelfth by weight of the total mass, the bath being liquid at a temperature above 1100° F.

4. A fused salt bath for case hardening consisting of the fusion of a mixture of an alkali metal cyanide in an amount sufficient to impart case hardening characteristics to the bath, an alkaline earth metal chloride, an alkali metal fluoride, and an alkaline earth metal fluoride; the earth metal fluoride comprising slightly less than eight percent by weight.

5. A fused salt bath for case hardening consisting of the fusion of an alkali metal cyanide substantially 45% by weight, an alkaline earth metal chloride, an alkaline metal fluoride, and an alkali earth metal fluoride; the proportions of the ingredients being such that the combined amounts of the alkaline earth metal chloride and the alkali metal fluoride is slightly less than the amount of alkali metal cyanide, and the alkaline earth metal fluoride is slightly less than eight percent by weight of the total mass.

6. A fused salt bath for case hardening consisting of the fusion of sodium cyanide substantially 45% by weight, barium chloride, sodium fluoride, and calcium fluoride; the proportions of the ingredients being such that the combined amounts of the barium chloride and the sodium fluoride are approximately equal by weight to the amount of sodium cyanide, and the calcium fluoride is slightly less than eight per cent by weight of the total mass.

7. A fused salt bath for case hardening comprising a mixture in substantially the following proportions by weight, sodium cyanide forty-five parts, barium chloride thirty-one parts, sodium fluoride twelve parts, and calcium fluoride seven parts.

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