Patented Aug. 2, 1949

2,477,561

UNITED STATES PATENT OFFICE

2,477,561

METHOD OF HEAT-TREATING METAL PARTS WITH A BRIGHT FINISH

Artemas F. Holden, New Haven, Conn.

No Drawing. Application June 20, 1944, Serial No. 541,281

4 Claims. (Cl. 148—15)

1

The present invention relates to metallurgy and particularly to heat treatment liquid salt baths, more especially for use in heating and quenching work pieces of steel, similar to austempering but with the variation that after the pieces of steel have been heated from 1350° F. to 1700° F. and quenched at a temperature of from 400° F. to 800° F., the work is held at this lower temperature for a substantial period of time, dependent upon the character of the metal and the size of the pieces comprising the work, and the work is then transferred to another bath operating at from 900° F. to 1100° F., and is finally quenched in cold water.

In accordance with the present invention, the first or high temperature No. 1 bath in which the work is submerged, comprises a molten bath of potassium chloride 34% to 50%, sodium chloride 45% to 65% and sodium fluoride ½% to 8%, the preferred percentage being potassium chloride 43%, sodium chloride 55%, and sodium fluoride 2%. This No. 1 liquid bath may be operated from 1350° F. to 1700° F. Since the work pieces are covered with the molten salts of this bath as they are being transferred to the No. 2 bath, the work remains bright at this stage.

The No. 2 bath, or low temperature bath, comprises sodium hydroxide 30% to 70% and potassium hydroxide 30% to 70%; the preferred percentages being sodium hydroxide 50% and potassium hydroxide 50%. This second bath is adapted to be operated from 400° F. to 800° F.

This No. 2 bath is preferably heated in a steel pot, with an electric electrode furnace using substantially pure nickel electrodes, that is, commercial nickel rods. Work pieces coming from this No. 2 bath, when heated as specified, are of a bright finish with no surface oxidation.

It was found that where this No. 2 bath was heated in a steel pot in a gas fired furnace, that the work came from the pot with a blue oxide finish. The reason why the work comes from a gas fired furnace with a blue oxide finish, and comes from the electric electrode furnace with a bright non-oxidized finish, may perhaps be due to electrical decomposition of the salts in the electric furnace, thereby producing a small amount of metallic alkali metals which act to prevent the formation of any oxide on the surface of the work. This suggestion is merely a possible theory and is not put forward as a definite explanation, but the fact remains, however, that the results are as stated.

In the course of the operation of the low temperature hydroxide No. 2 bath, the hydroxides are gradually transformed into carbonates. This may

2

be due to the bath taking up carbon dioxide from the surrounding atmosphere. Also, some of the No. 1 high temperature bath, comprising the chlorides and fluorides specified, is brought over into the No. 2 low temperature bath due to the transfer of work pieces from the No. 1 bath to the No. 2 bath. This contamination of the No. 2 bath by additions from the No. 1 bath and the breakdown of the hydroxides to carbonates results in a thickening of the No. 2 bath which may continue to such extent that the materials of the No. 2 bath become too thick for satisfactory operation at the temperatures specified, at which time a portion or all of this bath is removed by bailing out, and is restarted with the proportions of the materials as previously herein specified.

After the temperature of the work has been reduced to the temperature of the No. 2 bath, it is desirable, in most cases, to again raise the temperature of the work pieces in a No. 3 bath which is operated from 900° F. to 1100° F. and comprises the following chemicals: soda ash 20% to 30%, sodium chloride 5% to 15%, sodium cyanide 8% to 12%, sodium fluoride 10% to 15%, and caustic soda 30% to 50%, the preferred formula being soda ash 24%, sodium chloride 10%, sodium cyanide 10%, sodium fluoride 12%, and caustic soda 44%. The work, when being carried from the No. 2 bath to the No. 3 bath, carries with it a small percentage of the chemicals of the No. 2 bath which adhere to the work pieces, and, therefore, appropriate adjustments should be made from time to time in the No. 3 bath to retain the same at approximately the percentages specified, more especially by the addition of sodium cyanide and sodium fluoride.

The preferred percentages in the baths No. 1, No. 2, and No. 3 are the percentages of the mixtures when the baths are started, and when contamination reaches a point whereby the bath becomes thickened at the temperature at which the bath is supposed to be running, then it becomes necessary to bail out the thickened bath and replace the same with a mixture substantially the same as the proper mixture when the bath is started.

When the work is removed from the No. 3 bath, it is of a bright finish and is immediately submerged in clear cold water for quenching, and the result is a clean bright surface thereby eliminating any major pickling or other treatment. The surface of the work is sufficiently clean, after leaving the No. 3 bath, so that it may be electrolytically plated with any suitable finishing metal, tinned, brazed, or otherwise treated, without requiring any special treatment to remove oxides such as usually form when ferrous parts are heat treated.

The three baths specified are adaptable for treatment of various metals, comprising stainless steels and other steels and non-ferrous metals. An example of use of the specified baths with a particular kind of steel comprises the treatment of SAE 4140 steel. This SAE 4140 steel was heated to 1550° F. in the No. 1 bath, and was quenched to a range between 600° F. and 700° F. in the No. 2 bath, then transferred to the No. 3 bath where it was heated to 900° F. and finally quenched in clear cold water. The physical properties of this SAE 4140 steel after the treatment, in accordance with the present method, was found to be: reduction in cross-sectional area of from 45% to 59%; and elongation of from 13% to 16% under the application of a pull of from 160,000 pounds to 170,000 pounds, on a standard testing machine.

When it is desired to merely anneal the work, the No. 1 and No. 2 baths only need to be used, and the No. 2 bath may be run from 600° F. to 1300° F.

What I claim is:

1. In the method of heat treating steel parts and providing a non-oxide bright finish thereon, wherein the parts are heated in a first molten salt bath operated at a temperature of from 1350° F. to 1700° F., the parts being retained in the bath until heated to the temperature of the bath; the parts then being transferred to a second molten salt bath without substantial loss of temperature to the parts during said transfer, the second bath being operated at a temperature of from 600° F. to 1300° F., the parts being retained in the second bath until they have acquired the temperature of said bath; the parts then being removed from the second bath and quenched in water: the improvement which comprises the first bath being potassium chloride 34% to 50%, sodium chloride 45% to 65% and sodium fluoride ½% to 8% and the second bath being sodium hydroxide 30% to 70% and potassium hydroxide 30% to 70% heated in an electrode type electric furnace.

2. The method of heat treating steel parts with a non-oxide bright finish thereon according to claim 1, and wherein the second bath comprises substantially 50% sodium hydroxide and 50% potassium hydroxide.

3. In the method of heat treating steel parts and providing a non-oxide bright finish thereon, wherein the parts are heated in a first molten salt bath operated at a temperature of from 1350° F. to 1700° F., the parts being retained in the bath until heated to the temperature of the bath; the parts then being transferred to a second molten salt bath without substantial loss of temperature to the parts during said transfer, the second bath being operated at a temperature of from 400° F. to 800° F., the parts being retained in the second bath until they have acquired the temperature of said bath; the parts then being removed from the second bath and transferred to a third bath, the third bath being operated at a temperature of from 900° F. to 1100° F., the parts being retained in the third bath until they have acquired the temperature of said third bath; the parts then being removed from the third bath and quenched in water: the improvement which comprises the first bath being potassium chloride 34% to 50%, sodium chloride 45% to 65% and sodium fluoride ½% to 8%, the second bath being sodium hydroxide 30% to 70%, and potassium hydroxide 30% to 70% heated in an electrode type electric furnace, and the third bath consisting substantially of soda ash 24%, sodium chloride 10%, sodium cyanide 10%, sodium fluoride 12% and sodium hydroxide 44%.

4. The method of heat treating steel parts with a non-oxide bright finish thereon according to claim 3, and wherein the second bath comprises substantially 50% sodium hydroxide and 50% potassium hydroxide.

ARTEMAS F. HOLDEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,237,434	Holden	Apr. 8, 1941
2,309,745	Bergin	Feb. 2, 1943
2,370,959	Holden	Mar. 6, 1945

FOREIGN PATENTS

Number	Country	Date
12,816	Great Britain	June 7, 1905

OTHER REFERENCES

"Fuels and Furnaces," pages 1169, 1173–1174, Sept. 1927.

"Iron Age," page 721 and advertising page 16, Nov. 10, 1932; ibid., pages 62–69, Feb. 10, 1944.