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SELF-AGITATING METALLURGICAL
SALT BATH

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1

The present invention relates to molten salt baths for heat treatment of metals, for cleaning of metallic surfaces, and more especially to a self-agitating quenching bath.

A quenching bath operates at a temperature below the lower critical temperature for steel. Work is heated in a high temperature salt bath or in a furnace to a temperature above the upper critical point for the steel comprising the work. Then the work is transferred to the quenching bath at a temperature below the lower critical for the steel comprising the work. The quenching bath not only lowers the temperature of the work, but it holds the work at this temperature until the desired characteristics have developed in the work.

One of the problems in the operation of a quenching bath is the agitation of the bath around the work. Unless the bath is agitated the salt adjacent the work becomes locally heated and the desired rapid cooling is not attained. This local heating is usually uneven around the work and this sets up uneven stresses in the work which is very undesirable and may also result in distortion of the work.

Mechanical agitators are commonly used in salt bath pots to circulate the salt in the pot. This tends to keep the salt moving throughout the pot and produces a more even temperature to the mass of melted salt. It does not, however, entirely solve the problem of salt flow adjacent the surfaces of the work.

It has been discovered that certain salt baths will retain water in the bath at temperatures far above the boiling point of water. The addition of water to such a bath produces several desirable effects, among which is self-agitation.

The amount of water the molten salt bath will retain is inverse to the temperature of the bath and it follows that where the bath is supersaturated with water at a lower temperature of, for example, 400° F., a portion of this water will be released as steam if the temperature of the bath is raised to a higher temperature of, for example, 700° F. or higher.

Where this quenching bath is operating at 400° F. to 420° F. and work heated to 900° F. to 1950° F. in a high temperature bath or in a furnace, is dropped into the quenching bath a strong agitation of the quenching bath occurs over the area of the submerged work. This agitation appears to be due to the hot work causing the bath adjacent the work to throw out the water as steam, thus causing this portion of the bath to boil. The rising steam passing upwardly through to

2

cooler portion of the bath is condensed and re-absorbed in the bath. Where large amounts of high temperature work are submerged in the quenching bath, some water will be lost from the bath as steam and thus in commercial operation it may be desirable to continuously introduce enough water into the bath as is necessary to compensate for the loss.

This self-agitation of the bath is very important since the bath adjacent every surface of the work is thus kept in motion by the boiling action.

Another important action of this water-impregnated bath is its cleansing action, both on ferrous and non-ferrous metals heated to 300° F. or higher; copper, brass or bronze metals are quickly cleaned of all discoloration and oxide, and the work leaves the bath bright and clean. The water in the bath appears to activate the operation of the bath.

A bath which will absorb and retain water above the boiling point of water comprises: zinc chloride 60% to 80%; potassium chloride 8% to 18%; sodium chloride 10% to 18%; and sodium fluoride ¼% to 4%; the preferred formula being zinc chloride 73½%; potassium chloride 12%; sodium chloride 14%; and sodium fluoride ½%.

The material which contributes most to the water-retaining qualities of this bath, appears to be the zinc chloride. Ferric chloride (6H₂O) and potassium acetate may be used in the place of zinc chloride, but these replacements do not behave as satisfactorily as the zinc chloride.

Using the preferred formula set forth above and lowering the temperature of the bath from 700° F. while adding water, the amounts of water retained in the hot bath before the bath will boil are as follows: 700° F. a small fraction of 1%; 650° F. about ½%; 600° F. about 1%; 550° F. about 1½%; 500° F. about 2½%; 450° F. about 4%; 400° F. about 6%; 350° F. over 11%; 300° F. about 20%; and 250° F. over 30%; percentages being by weight. These percentages are based upon many tests and are an approximation of the results obtained. Barometric pressure was not taken into consideration since the tests were for information for use in the commercial field where this bath is in use, usually at temperatures from 400° F. to 420° F.

While either external or internal heating of the salt bath may be used, preferably the heating is by alternating electrical current through chrome-iron or nickel electrodes immersed in the bath which preferably is in a metal pot, If

3

encased immersed resistance electric heaters are used, a nickel sheath or case is preferred.

What I claim is:

1. A metallurgical salt bath consisting essentially of zinc chloride 60% to 80% of the salts of the bath, potassium chloride, sodium chloride, sodium fluoride, and water, with the water retained in the salt bath while the bath is operating at temperature ranges between 650° F. and 250° F., the retained water at 650° F. being substantially $\frac{1}{2}$ % and at 250° F. being substantially 30%, said percentages being by weight.

2. A metallurgical salt bath consisting essentially of zinc chloride 60% to 80%, potassium chloride 8% to 18%, sodium chloride 10% to 18%, sodium fluoride $\frac{1}{4}$ % to 4%, and water, with the water retained in the bath when the bath is operated below the temperature of 700° F., the amount of retained water being substantially 30% at 250° F., 20% at 300° F., 11% at 350° F., 6% at 400° F., 4% at 450° F., $2\frac{1}{2}$ % at 500° F., $1\frac{1}{2}$ % at 550° F., 1% at 600° F., $\frac{1}{2}$ % at 650° F., said percentages being by weight.

3. A metallurgical salt bath consisting essentially of zinc chloride 60% to 80% of the salts of the bath together with alkali metal chloride, alkali metal fluoride, and sufficient water to cause ebullition when an object hotter than the bath is placed therein, said bath being operable between temperature ranges of 250° F. to 650° F., the amount of water retainable in the bath at 250° F. being substantially 30%, and at 650° F. being substantially $\frac{1}{2}$ %, said percentages being by weight.

4. The process of quenching metal parts heated to an elevated temperature comprising immersing heated metal parts in a salt bath consisting

4

principally of zinc chloride, together with small percentages of alkali metal chloride and alkali metal fluoride and water, and operated at a temperature between 250° F. and 650° F. within which temperature range said bath retains a substantial amount of water, said metal parts to be quenched being hotter than the bath and the water being volatilizable about the surface of the metal parts so as to agitate the bath and improve the quenching and cleansing action thereof.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
384,935	Schneider	June 19, 1888
1,140,568	Brown	May 25, 1915
1,532,663	Shimer	Apr. 7, 1925
1,984,369	Gensch	Dec. 18, 1934
2,172,933	Daesen et al.	Sept. 12, 1939
2,263,489	Day	Nov. 18, 1941
2,328,932	Streicher	Sept. 7, 1943
2,400,511	Holden	May 21, 1946

FOREIGN PATENTS

Number	Country	Date
2,664 of 1861	Great Britain	Oct. 21, 1862

OTHER REFERENCES

35 The Metals Handbook, 1939 edition, pages 317-322.