

- [54] **METHOD OF MAINTAINING
CONSTANT WATER VOLUME IN A
MOLTEN SALT SOLUTION**
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part interest
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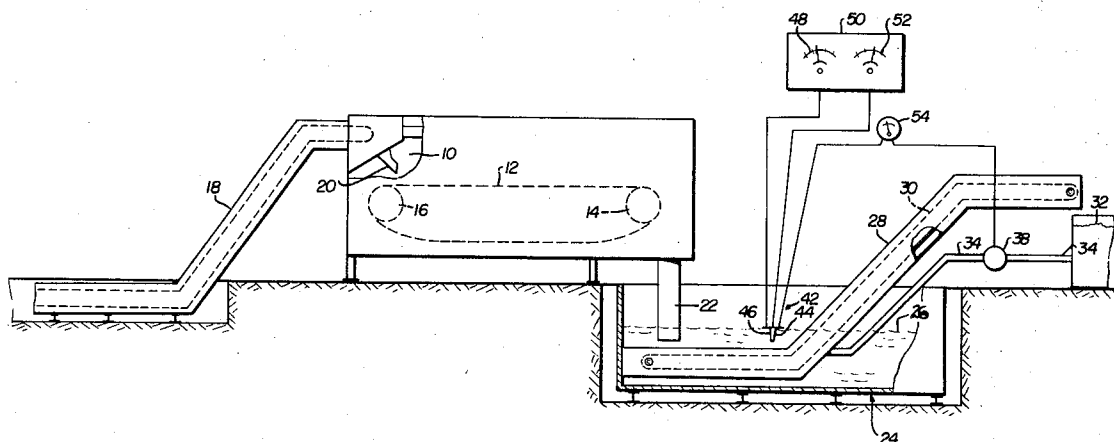
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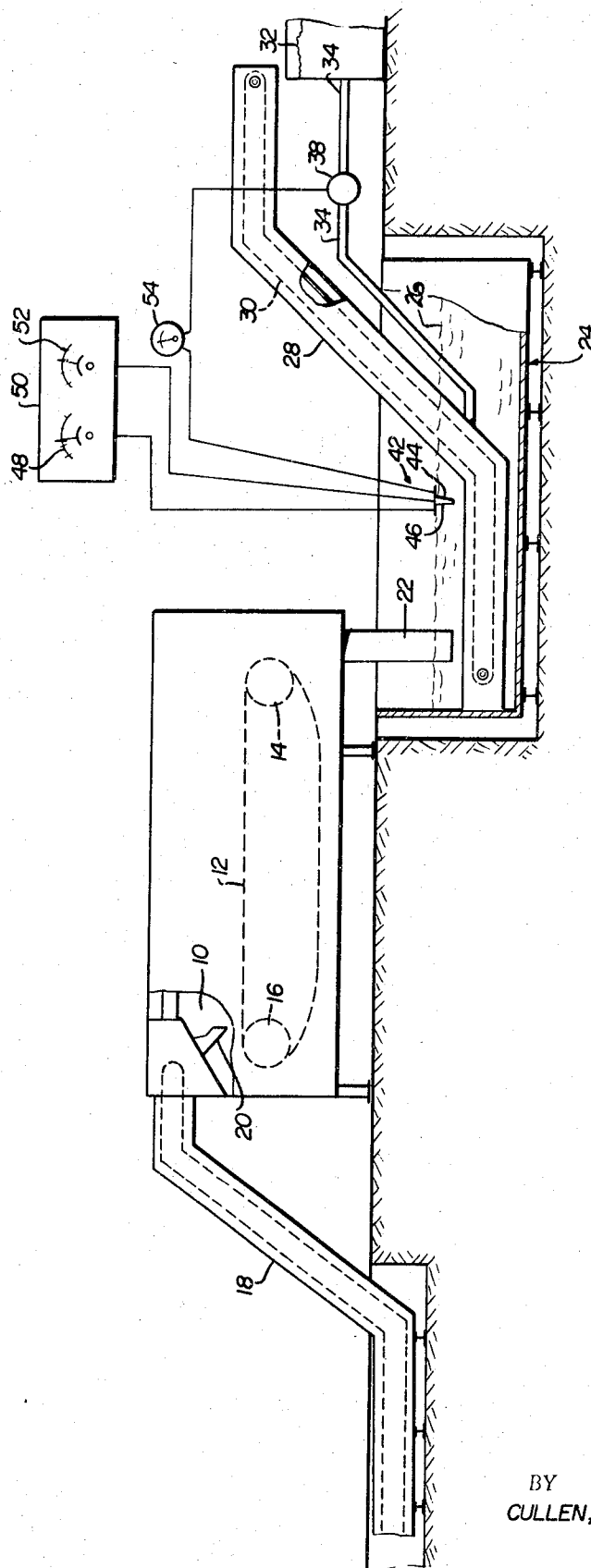
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[57] **ABSTRACT**

A method of maintaining the percentage of water in a molten salt solution substantially constant. The method includes the step adding water to a body of molten salt in response to a rise in the electrical resistivity of the solution beyond a certain predetermined value, and continuing the addition until the electrical resistivity falls back to the predetermined value.

2 Claims, 1 Drawing Figure





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METHOD OF MAINTAINING CONSTANT WATER VOLUME IN A MOLTEN SALT SOLUTION

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a method of automatically maintaining the percentage of the water in a molten salt solution at a constant predetermined level.

Water is sometimes added to a molten salt quench bath used in heat treatment of metal objects in order to make the bath more fluid and thus less likely to cling to the objects of the conveyor carrying objects out of the bath, and to increase the quench severity of the bath. The greater the quench severity, the harder the metal objects being treated will be at the end of the treatment, all other factors being even. It is therefore desirable to control the water content of the bath within a relatively short range to maintain a constant quench severity. When water is added to the bath, however, most of it vaporizes off immediately because of the high temperature of the bath (375°-700° F.). Only by continuously adding water to the bath over a period of time can significant quantities be built up in the bath. It is extremely difficult to maintain the quantity of water in the bath constant because it is continually being vaporized out. Therefore, the quench severity of the bath fluctuates.

A method of maintaining the water content of a molten salt quench bath constant has now been discovered which enables the water content of the bath to be automatically controlled.

The method is based on the discovery that the electrical resistance of a molten salt quench bath varies as a function of the temperature and the amount of water in the bath.

As the temperature and/or the amount of water increases, the resistance decreases.

It is an object of this invention to provide a method of automatically maintaining the percent of water in a molten salt quench bath at a predetermined level.

It is another object of this invention to provide a method of maintaining the quench severity of a molten salt quench bath containing water, constant.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate the corresponding parts in the several views.

ON THE DRAWINGS

The FIGURE is a side elevation view, partly in section, and somewhat schematic, of a heat treatment furnace and associated apparatus used in the method of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The method of this invention is conventionally carried out in connection with a heat-treating furnace and associated apparatus.

Referring first to the FIGURE there is shown a heat treatment furnace of more or less conventional construction which takes the form of a thermally insulated tunnel designated generally 10, through which articles to be heated are conveyed on the upper run of an endless conveyor belt 12. Belt 12 is trained around a drive roller 14 and an opposite end roller 16 and is driven by a motor (not shown) in a direction such that the upper run of the belt 12 moves from left to right as viewed in the FIGURE.

Articles to be conveyed through the furnace are fed onto the upper run of belt 12 from an infeed conveyor 18 to a chute 20 which passes through an inlet opening into the interior of tunnel 10. As the articles are conveyed by belt 12 through tunnel 10, they are exposed to the high temperature maintained in the interior of tunnel 10 by a suitable number of burners (not shown). The temperature within tunnel 10 and the speed of movement of the articles through the tunnel 10 are cooperatively adjusted to achieve the desired heat exposure of the articles during its transit through tunnel 10.

When the articles reach the right-hand end of the conveyor, as viewed in the FIGURE, they drop freely from the belt downwardly through an outlet opening in the bottom of tunnel 10 and into an open-ended tube 22 which extends downwardly into an open tank designated generally 24. The tank 24 contains a bath of molten salt 26.

A belt conveyor designated generally 28 is suitably mounted to extend longitudinally of the tank 24. Conveyor 28 takes the form of an endless belt 30 and is driven by suitable means, not shown, so that its upper run is driven from left to right to carry articles dropped through tube 22 onto the belt 30 through the bath of molten salt 26 contained in tank 24, and to discharge the parts or articles to a wash water tank 32.

A conduit 34 leads from the wash water tank 32 to a valve 38. Beyond the valve 38, the conduit extends to the underside of the belt 30 of the conveyor 28 at a level below the salt level 26 in the quench bath 26. Makeup water is supplied to the wash water tank 32 through an inlet (not shown) to compensate for the water which is removed from the tank 32 through the conduit 34.

The feeding back of wash water from tank 32 to the salt bath 26 in tank 24 accomplishes multiple purposes. First, the addition of water to the salt bath 26 increases the quenching rate of the salt bath 26. Without moisture, the quenching salt 26 has a quenching rate roughly equivalent to a standard slow quench oil. With water additions, such a salt becomes comparable to a fast quench oil because its quenching rate has been increased substantially by the addition of water. The melting point of a nitrate-nitrite mixture is lowered up to 35° F. by the addition of 2 percent of water.

Secondly, some salt from the water bath is fed back with the water to thereby reduce the concentration of salt in the water bath. This, in turn, keeps the carryover of salt from the water bath in subsequent baths such as a soluble oil bath at a minimum. It is desirable to wash all of the salt off the objects in the water bath so that the soluble oil bath will not become contaminated with salt. Any salt on the objects as they finally emerge from the oil bath would tend to produce rusting of the objects. Further, any salt dragged out by the objects being quenched is recovered, thus substantially reducing salt losses and lowering the heat treat cost.

Finally, the addition of water to the salt bath from the water bath decreases the viscosity of the salt bath, thereby reducing the amount of carryover of salt from the salt bath to the water bath. The conveyor 28 and the objects carried by it tend to drag some salt out of the salt bath and carry it over into the water bath in tank 32. The more viscous the salt is, the more salt will be dragged out. Consequently, the reduction in the viscosity of the salt bath resulting from the addition of water to the salt bath is an important factor in reducing the amount of salt carried over from the salt bath to the water bath.

The quench bath 26 has a probe 42 inserted in it containing a thermocouple 44 to measure the temperature and, closely adjacent thereto, a potentiometer 46 or other device to measure the resistance.

Since the resistance of the bath varies as a function of a temperature, it is important that the thermocouple and the resistance-measuring device or potentiometer be as closely together as possible in order to avoid false readings which might be incurred as a result of hotspots developing in the quench bath. That is, if the thermocouple were immersed in a hotspot which was not representative of the temperature of the bath as a whole, then a false reading would be the result.

The thermocouple 44 is electrically connected to a temperature recorder 48 enclosed in a cabinet 50, and the potentiometer 46 is electrically connected to a recorder 52 for the resistance, also enclosed in the cabinet 50.

The potentiometer is also electrically connected to an ohmmeter switch 54 which in turn actuates the valve 38 in the conduit 34. The switch 54 can be set to actuate the valve 38 when the resistance of the quench bath 26 rises above any predetermined value. When the resistance rises above the predetermined value, the switch 54 actuates the valve 38 and water

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flows into the quench bath 26. When the resistance falls below the predetermined value the switch 54 deactivates the valve 38 and the flow of water is interrupted. Thus, the percentage of water in the quench bath 26 can be automatically maintained.

A specific example is as follows:

A molten salt quench bath comprising approximately equal parts potassium nitrate, sodium nitrate and sodium nitrite was prepared. The bath had a melting point of 375° F. The resistance of the bath at 600° F. was 1,900 ohms, and the resistance at 430° F. was 10,000 ohms. One percent by volume water was then added to the bath, and the resistance of the bath at 430° F. was found to be 2,300 ohms.

A resistance and temperature measuring device was placed in the bath. The resistance-measuring device was electrically connected to a switch which was in turn connected to a valve in a water line leading to the bath. The switch was set to actuate the valve and add water whenever the resistance of the bath rose above about 2,300 ohms. When that happened, water was added until the resistance of the bath fell back to about 2,300 ohms. Thus, the water content of the bath was maintained at 430° F. at a substantially constant 1 percent. Because the water content was maintained at a constant level, the quench severity of the bath was also made constant.

Inasmuch as the resistance of the salt bath decreases with an increase in temperature, as well as increase in water content, it is necessary to hold the temperature of the bath substantially constant when regulating the water content in accordance

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with changes in the resistance. The water content of the molten salt bath at any given temperature can be determined. Once it is determined, the resistance switch can be set to maintain the water content at that level, or at any other desired level.

What is claimed is:

1. In the method of heat treating objects, wherein the heated objects are quenched by immersion in a conventional molten salt quench bath containing a relatively small volume of water relative to the salt content and are immediately thereafter conveyed to a wash tank containing primarily water wherein the objects are rinsed, leaving a salt residue in the wash tank, the improvement of maintaining the water content of the quench bath at a predetermined constant level by adding water from the wash tank to the quench bath when the electrical resistance of the quench bath rises above a predetermined value at the temperature of the bath, thereby returning salt to the quench bath from the water tank while maintaining the water content of the bath, the water added to the quench bath from the wash tank being automatically stopped when the electrical resistance of the quench bath decreases below a predetermined value, at a substantially constant bath temperature.

2. The method defined in claim 1, wherein the salt composition of the quench bath is a nitrate-nitrite mixture containing a relatively small volume of water.

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