United States Patent

Müeller

[15] **3,635,768**

[45] **Jan. 18, 1972**

[54] MOLTEN SALT CARBURIZING PROCESS AND REPLENISHING SALT FOR SAME

[72] Inventor: **Johannes Müeller,** Frankfurt am Main, Germany

[73] Assignee: **Deutsche Gold-und Silber-Scheidean-stalt vormals Roessler,** Frankfurt am Main, Germany

[22] Filed: **Apr. 29, 1969**

[21] Appl. No.: **820,337**

[52] **U.S. Cl.**.....**148/15.5,** 148/15, 148/20

[51] **Int. Cl.**.....**C23c 9/12**

[58] **Field of Search**.....148/15, 15.5, 20, 27, 28, 30

[56] **References Cited**

UNITED STATES PATENTS

1,970,852	8/1934	Harding et al.	148/15.5
2,819,992	1/1958	Albrecht	148/30 X
3,117,038	1/1964	Hewson et al.	148/15.5

OTHER PUBLICATIONS

Metals Handbook, 1948 Ed. pages 692–696

" Molten Salt Baths for Heat Treatment and Case Hardening of Steel," published by E. I. du Pont de Nemours & Co. May 7, 1943, pgs. 6–8, 25, 26, 31 & 33.

Primary Examiner—Charles N. Lovell

Attorney—Cullen, Sloman & Cantor

[57] **ABSTRACT**

Carburizing of metals is effected by using molten cyanide baths containing activators. In the operation of such baths, due to consumption of the cyanide, it is necessary to add replenishing materials. The replenishing material is a mixture of activator and cyanide salt only, wherein the activator cyanide salt proportion is identical to that of the starting salt.

1 Claims, No Drawings

MOLTEN SALT CARBURIZING PROCESS AND REPLENISHING SALT FOR SAME

BRIEF DESCRIPTION OF THE INVENTION

This invention relates to the process of carburizing metals by means of molten cyanide baths containing activators. The invention relates more specifically to novel replenishing salts and novel replenishing steps in the process as a whole.

THE BACKGROUND OF THE ART

It is known to carburize metal workpieces by the use of molten cyanide baths containing activators. Known activators are alkali earth metal chlorides and chlorides known for such purposes are chlorides of barium and strontium.

It is also known to design a bath specification according to the desired carbon potential which is the point on the carbon content curve where the carbon content in relation to the depth of the carbon content from the surface is at a maximum.

It is also known that if a higher carbon potential is desired, a greater proportion of activator salt in the bath should be maintained.

During the operation of a bath, not only does the liquid level of the bath decrease due to drag out losses and other losses but also the cyanide proportion decreases as the cyanide breaks down in the carburizing process. Hence, it becomes necessary for the workmen practicing the process to add replenishing materials.

The present practice prior to the invention is for the workmen to add to the bath a desired quantity of cyanide salt from a stock of same, and add also a desired or specified quantity of the activator, also from a stock of the same. Great possibilities for variation have been observed and have plagued the industry and particularly the segment of the industry which was anxious to provide an exact control of the carbon potential and for this purpose to provide an exact control of the bath and particularly its replenishing steps.

Besides the method of replenishing two different types of salt, there are also known baths that are replenished with just one salt. The salt for the latter baths contains both cyanide and activator, but also contains diluents such as alkaline chlorides or carbonates. The activator content of this premixed salt is not equal to the activator content to be maintained in the bath, so that with such baths it is not possible to produce and maintain over long periods, an exact predetermined surface carbon content.

Therefore, this invention aims in the direction of providing a more exact control of the bath and particularly of the replenishing step and materials, with the view of eliminating mistakes and errors as much as possible and to make the replenishing operation as exact and foolproof as possible.

THE INVENTION

First, in the investigation of the operation of the bath with a view to providing a better control for same came the discovery that the carbon potential of the bath is exclusively dependent on the amount of activator contained in the bath. The activator is not subject to decomposition during the operation of the bath. It is essential for this discovery that the activator content be controlled within extremely close limits to produce and consistently maintain over long periods a specified carbon potential.

Therefore, an effort was made to design a practical method of replenishing.

The first aspect of the improved replenishing method and material is that the replenishing salt is supplied by a single stock of material so that it was not necessary for the workmen to obtain replenishing materials from two stocks and to mix them. Hence, the first aspect of the novel replenishing salt is that it is a premix of the cyanide salt and the activator in predetermined proportions from which the workman merely draws as much as needed for replenishing.

The single replenishing premix includes both the activator and the cyanide salt.

The second aspect is based upon the knowledge that it is only the cyanide salt that is consumed by decomposition during carburizing. We are not speaking here of reduction of liquid level due to drag out losses but rather a change in the proportions of cyanide salt and activator that occurs during the use of the process. The replenishing salt of the invention is made up of the activator and cyanide salt but the novel aspect is that the percentage of activator with respect to the cyanide salt is exactly the same as the percentages of these two ingredients at the start of the carburizing operation and before decomposition of the cyanide salt.

It is known that in carburizing, the cyanide breaks down and there is formed within the bath a quantity of carbonate. The activator does not break down and remains constant. The novel replenishing salt includes only cyanide salt and activator and these are in the proportions of the same two ingredients at the start of the operation. This novel salt then for replenishing, maintains the bath in such a state that it returns the bath into the state desired to establish the desired carbon potential.

For example, let us consider a bath which at a specific period of its operation, and long after a previous period of operation is of the content of 10 percent cyanide salt, 20 percent activator salt, and 70 percent carbonate. This bath is considered to have been designed as providing a carbon potential of 0.5 and for this purpose was set up as a bath of 20 percent activator and 80 percent cyanide. During the long period of operation and just prior to the specific period of operation, the bath has changed to, as stated, 10 percent cyanide, 20 percent activator, and 70 percent carbonate.

At the end of the specific period of operation, let us say one day, the bath is found to have its cyanide content reduced to 7 percent and the carbonate content increased to 73 percent but the activator content is the same 20 percent.

Accordingly, for replenishing, I propose by this invention to use a replenishing salt of 20 parts activator and 80 percent cyanide and this returns the bath to its original condition but at all times maintains the bath at a not over 20 percent activator content.

While it is known that the constancy of carbon potential of a bath can be predetermined and maintained by insuring a constant prefixed level of the activator, I consider as new the disclosure that despite the need for replenishing, the constancy of the activator can be maintained by using as a replenishing salt, a premix containing cyanide but whose activator content is exactly the same as the activator content originally desired for the bath.

REPLENISHING FOR CHEMICAL DETERIORATION

If the cyanide content has dropped, I use as a replenishing mix a mixture of activator and cyanide salt only, with the activator percentage being the same as that of the starting salt.

REPLENISHING FOR VOLUME LOSS

Considering a bath whose original content is such that the activator level was predetermined according to the desired carbon potential with the rest of the bath being cyanide and carbonate, when the liquid level of the bath has dropped below the desired level, replenishing is done here by a premix whose percentages and content are the same as that of the starting salt, namely activator plus cyanide plus carbonate. Thus, in the example given, replenishing for volume loss would be done by a premix of 20 percent activator, 10 percent cyanide salt, and 70 percent carbonate.

Contrast the foregoing with the replenishing salt which is used to offset chemical deterioration. This replenishing salt would be without carbonate and would be 20 percent activator and 80 percent cyanide salt in the example given.

FURTHER EXAMPLES

1. In carburizing chains made up of links, I have used as a starting salt a mixture of 20 percent barium chloride plus 10 percent cyanide salt and 70 percent carbonate to insure a car-

bon potential of 0.5. The salt I use for replenishing then is a premix of 20 percent barium chloride and 80 percent cyanide.

2. In carburizing certain front wheel automobile drive components, such as drive shafts and universal joints, I have operated to insure a carbon potential of 0.8. The starting mixture at the specific period of operation was set up as 35 parts barium chloride plus 10 parts sodium cyanide and 55 parts sodium carbonate. The replenishing salt for chemical deterioration is a premix of 35 parts barium chloride and 65 parts sodium cyanide.

ADVANTAGES

A. Salt consumption was reduced over a long time by the use of a premix formula. There was no tendency to add excess salt either by error or inexperience or guesswork and personal variations and human errors did not affect the replenishing operation and consequently there was no tendency to use more salt than was actually required for replenishing.

B. This replenishing program provided a highly satisfactory control for the level of retained Austenite. By using a controlled carbon potential, I enable the control of the amount of retained Austenite. Hence, using the process hereof it did not become necessary to harden by repeated quenching and heating as was formerly the case to insure a predetermined level of Austenite retention. Previously, because of uncertainties of the Austenite level, it was the practice to carburize and quench and thereafter to harden by reheating and quenching again. Because of the certainty provided by my invention, it is necessary now only to carburize and quench and there is no need for the additional steps of hardening by reheating and quenching.

CONCLUSION

Having described and stated all that I know of the process and salts hereof at the present time, I wish it understood that all of the foregoing is to be interpreted as illustrative only rather than limited and accordingly, I refer to the claims which follow for a determination of the scope of the invention.

I claim:

1. In a molten cyanide salt carburizing process employing a bath of the molten cyanide salt and an activator of the group consisting of barium chloride and strontium chloride; and wherein the bath at starting of a first period of operation, has a predetermined ratio of activator to cyanide salt; and,

wherein the bath, at the end of that first period of operation, has the same amount of activator, plus a reduced but satisfactory amount of cyanide and an amount of carbonate formed by decomposition of the cyanide; and,

wherein the bath, at the end of a second period of operation has the same amount of activator, plus a further reduced and now unsatisfactory amount of cyanide and an increased amount of carbonate; and requires restoration to make up for the loss of cyanide in such second period of operation;

the step of restoring the bath after the second period of operation by adding a restoration salt premix of the cyanide salt and the activator, wherein the activator-cyanide salt proportion is identical to that at the start of the first period of operation; and without carbonate.

* * * * *