

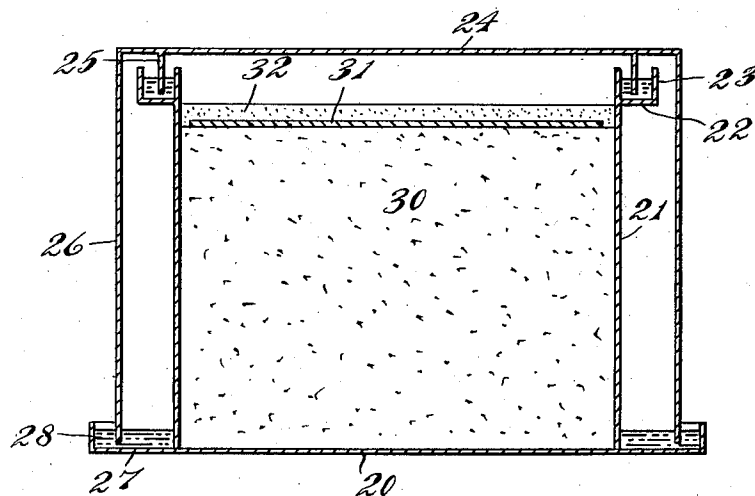
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CHROMIZING METHOD AND COMPOSITION

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CHROMIZING METHOD AND COMPOSITION

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3 Claims. (Cl. 117—22)

The present invention relates to the chromizing of ferrous metal such as iron and steel, including low, medium and high carbon steel and alloy steel.

The present application is a continuation in part of my copending application Serial No. 454,396, filed September 7, 1954, for Chromizing, Coating and Method.

A purpose of the invention is to obtain a smooth chromized surface, free from orange peel.

A further purpose is to obtain a so-called wet finish on a chromized surface.

A further purpose is to avoid pickling and etching effects during chromizing.

Further purposes appear in the specification and in the claims.

In the drawings I illustrate one form of apparatus useful in performing the method.

The drawing is a central vertical section, largely diagrammatic, of a chromizing box.

In the prior art, chromizing is usually performed by packing iron or steel parts to be chromized in a box containing a chromizing powder. The parts are completely surrounded by the powder.

The powder ordinarily contains ferrochromium, an inert bodying agent such as alumina, and a carrier, which usually is ammonium chloride or ammonium iodide.

Difficulty has been encountered due to the fact that the chromizing finish is pebbly in appearance, producing a surface known as "orange peel." This orange peel surface is particularly undesirable on high tolerance machined surfaces where a very fine surface finish is desired.

From my investigation of the chromizing process, I find that in the prior practice the ammonium chloride or ammonium iodide breaks down as it is heated into hydrogen, nitrogen and halogen gas. The halogen gas attacks the ferrochromium, but it also attacks the steel or other work. Thus the work is pickled and etched, causing a change in dimensions, and also causing the pebbly effect since the etching proceeds more rapidly at the grain boundaries.

I have discovered that this difficulty can be avoided without destroying the advantageous effects of the carrier gas in sweeping out and excluding air, and permitting the chromizing reaction.

In accordance with the invention, instead of using an ordinary ammonium halide, I use ammonium bifluoride and react it with chromium before it comes in contact with the metal parts to be chromized. The result appears to be the formation of a complex chromium fluoride which breaks down in chromizing to liberate nitrogen and hydrogen, but does not have a tendency to etch the work, and does not pickle the work or form orange peel.

The following proportions may be used in the initial reactions:

	Parts
Ammonium bifluoride	200
Water	250
Chromium metal powder	100

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The ammonium bifluoride is dissolved in the water and the solution is heated to boiling. Then the chromium metal powder is added to the boiling solution, taking precautions against personal injury due to an explosion, and preferably using remote control. A violent reaction occurs with generation of steam and the heat of the reaction reduces the resulting green powder almost to dryness. Heating is continued until the powder is dry and then immediately stopped.

The final chromizing powder for use in the chromizing box may have the following compositions:

	Parts
Ferrochromium (65% chromium, 7% silicon, low carbon, balance iron)	70
Calcined kaolin	30
Reaction product as above of ammonium bifluoride and chromium	0.055

The metallic chromizing box as shown in the drawing comprises a bottom 20 connected to sides 21 and having at the top a sealing trough 22 which contains a sealing material 23 molten at the chromizing temperature, preferably glass. The cover 24 of the box has a sealing rim 25 which extends down into the trough 22 below the surface of the sealing material and also has sides 26 which extend down into a bottom sealing trough 27 provided with a sealing material 28, suitably glass, molten at the chromizing temperature. The interior of the box contains a chromizing pack 30, consisting of chromizing powder surrounding objects to be chromized. A metallic cover 31 is preferably placed on the pack and on top of this a layer of chromizing compound 32 is placed to filter out air.

Using the above composition and a low carbon steel of an analysis typical of SAE 1010, after chromizing for 12 hours at 1750 degrees F. the chromium case depth was 0.002 inch.

With the same chromizing composition, operating for 12 hours at 1950 degrees F. the case depth on the same steel composition was 0.009 inch.

Excess of the reaction product of ammonium bifluoride and chromium in the box does no harm and the proportions of the reaction product may be increased or reduced 10 fold with increase or reduction in the speed of reaction.

Very smooth chromized surfaces were obtained free from dimensional change and free from orange peel. The finish is unusual in that it is unusually smooth, and is of a character known in the trade as a "wet" finish.

The work may be a medium carbon or high carbon steel, though of course the penetration will be reduced. The temperature range for chromizing in accordance with the invention will ordinarily be in the range from 1650 to 2300 degrees F., and will ordinarily be between 1700 and 1850 degrees F. The time should exceed three hours and will most desirably be in the range from 8 to 24 hours, preferably about 12 hours. Lower temperatures are preferable to avoid harmful effects on the steel.

The quantity of ferrochromium or chromium in the final powder may vary between 20 and 80 percent and the quantity of inert bodying powder such as calcined kaolin or aluminum may vary between 10 and 50 percent by weight. The quantity of the reaction product of ammonium bifluoride and chromium may vary widely, between 0.005 percent and 10 percent.

In making up the reaction product, the proportions of chromium powder to ammonium bifluoride may vary widely, and excess of chromium does no harm. There should not, however, be sufficient excess of ammonium bifluoride above the ratio for chromium fluoride to per-

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mit substantial amounts of free halogen which would etch the work.

In operation, as the box heats, the complex chromium fluoride breaks down liberating nitrogen and halogen and this sweeps out the air and maintains an inert protective atmosphere during the chromizing. The molten glass seals prevent improper introduction of air.

Prior to the arrival at chromizing temperature, no appreciable free halogen is present and therefore pickling of the work and etching effects do not occur.

By the time the box reaches chromizing temperature, chromium fluoride is available to promote the chromizing reaction suitably with some residual decomposition gases from the complex fluoride, and chromium atoms exchange for iron atoms in the surface of the work.

Providing the work has fine machine surfaces, the resultant surfaces after chromizing are likewise fine machine surfaces.

In successive chromizing operations, the spent chromizing powder above referred to is desirably mixed with 10 or 15 percent of fresh chromizing powder and the mixture is used again. This procedure can be followed indefinitely on successive chromizing operations.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the method and composition shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of chromizing ferrous metal parts, which comprises first prereacting together ammonium

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bifluoride and chromium to form a complex compound of ammonium, chromium and fluorine, drying the complex compound and then placing said dry compound, chromium and ferrous metal parts in a closed retort, with the said compound and the said chromium in contact with the ferrous metal parts and maintaining the contents of the retort at a temperature between 1650 and 2300 degrees F.

2. The method of claim 1, which comprises placing in the retort an inert bodying material.

3. A chromizing powder for use in contact with ferrous metal parts in a chromizing retort essentially composed of a dry compound of ammonium, chromium and fluorine, and chromium in metallic form.

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