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# UNITED STATES PATENT OFFICE

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## PICKLING SOLUTION

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13 Claims. (Cl. 148—8)

This invention relates to pickling solutions, and has especial reference to such solutions for use in the pickling of chromium-containing alloy steels as for example, chrome steels and chromium-nickel steel alloys.

An object of the invention is to provide a pickling solution which will remove scales from chromium-containing alloy steels as for example, chrome steels and chromium-nickel alloy steels, without corroding or pitting the metallic surface of the alloy, and which will effectively clean the metal within a permissible period of time.

The scale which forms on the chromium-containing alloy steels as for example, chrome steels and chromium-nickel alloy steels adheres closely to the surface of the metal, and even after the regular annealing process, considerable difficulty is encountered in removing the same in reasonable periods of time without damaging the surface of the alloy. The pickling solutions in general use either do not remove all of the scale, or if exceptionally strong solutions are used, the alloy surface is frequently corroded and pitted.

I have found that suitably annealed chromium-containing alloy steels as for example, chrome steels and chromium-nickel alloy steels, and especially such alloys which contain from ten to thirty percent of chromium, and from five to twenty-five percent of nickel, with or without additions such as tungsten, molybdenum, copper, etc. etc., and which acquire highly refractory scales, may, after proper annealing, be successfully pickled in a solution containing from five percent to twenty-five percent of commercial nitric acid, and up to five percent of commercial (48%) hydrofluoric acid, the percentages used being by volume. The composition of a particular solution may be selected for a special case. Desirable solutions contain from twenty percent to twenty-five percent of commercial nitric acid, and from one percent to three percent of hydrofluoric acid (48%), by volume. With an annealed alloy steel containing about eighteen percent of chromium, and about eight percent of nickel, a preferred pickling solution would contain about twenty-five percent by volume of commercial nitric acid, and about two percent by volume of hydrofluoric acid, (48%), preferably heated. Such a mixed solution has been found to be highly effective in removing scale from this class of alloy steels, and does not corrode the exposed surface of the alloy.

Exhausted pickling solutions may be treated chemically or electrochemically for the recovery of their values.

I claim:

1. For use with annealed 18% chromium 8% nickel alloy steel having a difficultly removable, closely adherent, highly refractory scale, a heated pickling solution containing by volume about 25% of commercial nitric acid and about 2% of hydrofluoric acid (48%), which will not attack the alloy surface.

2. A pickling solution of mixed character adapted for removing scale of highly refractory, closely adherent nature, such as that acquired by chromium-containing alloy steels, e. g., chrome steels and chromium-nickel steels, and comprising about 20–25% by volume of commercial nitric acid intermixed with about 1–3% of hydrofluoric acid (48%) by volume, the composite pickling solution effectively removing such scale and the cleaned alloy surface being unattacked thereby.

3. A pickling solution of mixed character adapted for removing highly refractory, closely adherent scales such as those acquired by chrome and chrome-nickel steels, particularly after annealing thereof, comprising commercial nitric acid to an amount over 5% and up to 25% by volume and an appreciable amount of hydrofluoric acid (48%) up to about but less than 4% by volume.

4. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing nitric acid and hydrofluoric acid, the amount of nitric acid being greater than any other acid.

5. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing nitric acid as its predominant active constituent, and also containing from .05 to 5% hydrofluoric acid.

6. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing from 3 to 25% nitric acid and from .05 to 5.0% of hydrofluoric acid, the amount of nitric acid being greater than any other acid.

7. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing from 3 to 25% nitric acid and an effective amount of hydrofluoric acid, the amount of nitric acid being greater than any other acid.

8. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing from 7 to 25% of nitric acid and an

effective amount of hydrofluoric acid, the nitric acid constituting the predominant element of the bath.

9. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing from 7 to 25% of nitric acid and .5 to 1% hydrofluoric acid, the nitric acid constituting the predominant element of the bath.

10. The method of treating alloys of chromium and iron to remove surface stains and scale, comprising immersing the alloy in an aqueous bath containing about 25% nitric acid and about 1% hydrofluoric acid.

11. An aqueous pickling bath for chromium-iron alloys containing from 3 to 25% nitric acid and from .05 to 5.0% hydrofluoric acid the amount of nitric acid being greater than any other acid.

12. An aqueous pickling bath for chromium-iron alloys containing from 7 to 25% nitric acid and from .5 to 1.0% hydrofluoric acid.

13. An aqueous pickling bath for chromium-iron alloys containing about 25% nitric acid and about 1% hydrofluoric acid.

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See Cr-Mn Steels by Becket.
Am Fe & St Inst
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No Fe mentioned
for HF