

UNITED STATES PATENT OFFICE

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METAL SURFACE TREATMENT

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1 Claim. (Cl. 134—15)

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This invention relates to the conditioning of metal surfaces particularly in connection with the removal of oxide films formed, for instance, by strip or sheet rolling operations at elevated temperatures.

The object of the invention is to provide a method of modifying such oxide coatings so that subsequent pickling or other treatments will be rendered more promptly and efficiently effective in removing these coatings.

Other objects of the invention, particularly in the special procedures and apparatus employed in the treatments, will appear from the following specification taken in connection with the accompanying drawing in which:

Fig. 1 is a schematic outline of a surface cleaner system employing the invention;

Fig. 2 is a diagrammatic view of the surface treatment; and

Fig. 3 is an enlarged view of a portion of Fig. 2. In the system outlined in Fig. 1 a metal strip 5 having an oxide surface layer 6 is passed through the primary surface treatment stage A and on to the secondary surface treatment B preferably by drawing means C. Stage A involves the application to the strip of physical forces in a manner concentrating this effect on the surface and in particular disrupting the continuity of the oxide films so as to condition them for ready response to subsequent removal treatment indicated at B. Treatment A may be at room temperature or any temperature substantially below that at which such oxide films are formed.

As diagrammed in Fig. 2, the primary surface treatment at A impresses the metal strip by rollers 7 under adjustable pressure at 8 so that the forces applied to the strip surfaces 6 may be adjusted and regulated. Preferably the rollers 7 are idlers, the strip 5 being drawn through this stage in any desired manner. The pressure applied by rollers 7 compresses the strip 5 thinning it somewhat and so causing an angle bend 9 and rippling 10 of the metal surface in advance of the roll contact as illustrated, for instance, in Fig. 3. The pressures involved and surface distortions are not sufficient to clear the oxides from the surface and substantially no oxide is removed here.

I have found that a much improved over-all removal and descaling is attained by disintegrating the surface oxide layers in situ under the action of this bending and rippling effect and completing the actual removal at the later stage B. Such preliminary modifications of the physical nature of the surface may be attained at no loss

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of time and while the strip is en route to the removal stage B. Here, at stage B, the time of treatment is greatly reduced by the modified structure of the surface films and this permits a higher rate of feed, or conversely shorter length of the removal stage B. Such shorter timing at stage B, usually a chemical cleaning, also reduces the action on the metal itself and minimizes the losses involved.

To attain the desired condition of the surface the compression effect is regulated to limit it to a disintegrating of the scale without removing it, thus retaining the surface oxides while developing within them multitudinous microscopic fractures honeycombing the entire film and reacting right down to the metal itself. Any concomitant permanent thinning of the strip from thickness a to thickness b (Fig. 3) is at most a small percentage, 2% to 4% being characteristic, and in some cases the reduction is imperceptible, the elastic limit of the material not having been substantially exceeded. Apparently the invisible network of microscopic fractures, left in tightly closed position by passage between the rolls, serves as a maze of latent paths of attack and entry for the usual pickling solutions and it has been found that wetting agents are not necessarily added.

In attaining this modification of the surface oxide film, the bend 9 and the radius of the crest of the metal ripple or wave 10 at the surface of the metal entering the rolls are functions of roll diameter and are of an entirely different degree of magnitude in comparison with the radii achievable by bending the entire shape over a pulley, for instance. The smaller the diameter of the roll 7 the less the pressure as determined by the percentage reduction in thickness will have to be. This is of practical significance for two reasons. By the use of very small diameter "work rolls" bearing upon heavier "back-up" rolls, the amount of cold working to which the body of the metal section must be submitted may be held to a minimum and, in some cases, the portion of the cross section in which the elastic limit is exceeded may be confined to the immediate metal surface. Secondly, the amount of work which must be done on the metal becomes so small that it is often possible to pull material such as a rod or strip through the rolls by use of the existing traversing equipment without the necessity of driving the rolls.

It has been found advantageous to employ the rolls 7 having diameters in the range between 5 and 50 times the thickness of the material being