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STAINLESS STEEL OF IMPROVED DUCTILITY

Wesley Kalita, New Kensington, Pa., assignor to Allegheny Ludlum Industries, Inc., Pittsburgh, Pa.

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ABSTRACT OF THE DISCLOSURE

Stainless steel of improved ductility and cold rollability, more particularly, stainless steel which may be cold rolled from hot band directly to final gage without intermediate processing and annealing. In accordance with the invention, there is provided a stainless steel consisting essentially of up to 0.6% carbon, 0.2 to 1.0% manganese, 13 to 14% chromium, 0.2 to 1% silicon, 0.1 to 0.3% aluminum, 0.05 to 0.15% titanium and the balance essentially iron with usual steelmaking residuals.

This application is a division of now abandoned copending application Ser. No. 860,036 filed Sept. 22, 1969.

Many stainless steels of improved corrosion resistance and physical properties which require relatively large amounts of alloying elements such as nickel or chromium are in existence, however, they are relatively expensive and consequently, the usefulness of such materials is limited. There has been considerable effort to develop alloy steels with adequate corrosion resistance having comparatively smaller amounts of expensive alloying elements. These compositions have served very well in many applications. Frequently however, such compositions possess comparatively poor ductility necessitating intermediate processing to produce cold rolled material of usual sheet and strip thickness, that is, less than about 0.02 inch. It has now been discovered that stainless steel containing sufficient chromium to withstand standard salt spray testing may be manufactured with sufficient ductility to permit direct cold reduction from hot band, e.g., 0.8 to 0.9 inch thickness, to desired final gage without intermediate annealing. Compositions fulfilling this requirement in accordance with the invention consist essentially of up to 0.06% carbon, 0.2 to 1.0% manganese, preferably 0.3 to 0.7% manganese, 0.2 to 1% silicon, preferably 0.2 to 0.5% silicon, 13 to 14% chromium, 0.05 to 0.15% titanium, 0.1 to 0.3% aluminum and the balance essentially iron with usual steelmaking residuals. Steels of the invention are useful in a variety of applications where moderate corrosion resistance is desired, such as trim on appliance, functional parts of cars, and indoor structures.

To achieve the desired combination of properties including sufficient ductility to be cold rolled direct to final gage from hot band, it is necessary to critically control the compositional limits. The carbon of this alloy steel is limited to about 0.06% maximum since steels with greater quantities of carbon may be somewhat difficult to weld due to formation of additional martensite. The upper limits of the alloying elements, for example manganese and chromium, are restricted to avoid developing unnecessary hardness and strength which would interfere unduly with formability. However, a chromium content of 13 to 14% is highly desirable to assure the degree

of corrosion resistance required for a number of applications to which the present invention is particularly well suited. Such compositions will successfully withstand standard salt spray tests. The aluminum limits are established to provide adequate weldability which is reduced if too little aluminum is included and to help assure adequate ductility and formability which may be reduced if too much aluminum is present. Titanium is also included to improve formability, but must be restricted to avoid developing undesirable metallurgical structures such as titanium stringers. The presence of titanium stringers also has an undesirable effect on stamping die wear.

As an illustration of the practice of the invention, coils of steel of the composition described in Table I were hot rolled to band gage. One coil (Heat 48805) was cold rolled to 0.077 inch with intermediate annealing and pickling, the other coil (Heat 326911) having a composition in accordance with the invention was cold rolled directly from hot band to 0.028 inch without intermediate annealing. The properties of these steels are shown in Table II. As can be seen, the hardness steels of the invention are substantially less, indicating superior ductility which permits direct reduction to final gage.

TABLE I

Heat No.	C	Mn	Si	Cr	Al	Ti
48805	0.042	0.49	0.57	13.23	0.25	Tr
326911	0.04	0.37	0.34	13.55	0.20	0.10

TABLE II

Heat No.	YS	UTS	El., percent	RB
48805	45,000	69,000	26	77
326911	36,000	65,000	33	67

It is apparent from the foregoing that various changes and modifications may be made without departing from the invention, accordingly, the scope thereof should be limited only by the appended claims wherein what is claimed is:

I claim:

1. A method of manufacturing stainless steel strip, sheet or the like less than 0.02 inch thickness which comprises hot rolling to band gage stainless steel consisting essentially of up to 0.06% carbon, 0.2 to 1.0% manganese, 13 to 14% chromium, 0.2 to 1.0% silicon, 0.1 to 0.3% aluminum, 0.05 to 0.15% titanium and the balance iron with usual steelmaking residuals and thereafter cold rolling said hot rolled band direct to a thickness less than 0.02 inch without intermediate annealing.

2. A method according to claim 1 wherein said steel contains 0.3 to 0.7% manganese.

3. A method according to claim 1 wherein said steel contains 0.2 to 0.5% silicon.

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WAYLAND W. STALLARD, Primary Examiner