United States Patent

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[54] **FERRITIC STAINLESS STEEL**
5 Claims, No Drawings

[52] **U.S. Cl.** ..... **75/124,** 75/126 D
[51] **Int. Cl.** **C22c 37/10,** C22c 39/14
[50] **Field of Search** ..... 75/124, 126, 126 D

[56] **References Cited**

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ABSTRACT: A ferritic-type stainless steel suitable for manufacture into sheet and strip form that can be used for production operations involving stamping, punching, piercing, blanking and drawing by high-speed press production.

FERRITIC STAINLESS STEEL

A number of existing ferritic stainless steels, while possessing adequate corrosion resistance in mildly corrosive media, suffer from relatively poor fabrication characteristics due to surface and subsurface titanium stringers. Typical of these alloys which contain titanium are AISI type 409, type 499, and the commercial stainless steel known as MF-1 produced and developed by Allegheny Ludlum Steel Corporation. The titanium stringers which may occur in these alloys are a source of breakage during forming and may be responsible for excessive die wear due to their abrasiveness.

The present invention provides a ferritic stainless steel of relatively low cost and adequate corrosion resistance but which is relatively free of harmful titanium stringers and particles. Alloys in accordance with the invention are particularly useful for replacement of brass, copper, aluminum and carbon steel fabricated articles in applications where moderate corrosion resistance is required and where fabrication includes a processing by high-speed punching presses which typically involve stamping, punching, piercing, blanking and drawing. Illustrative of the potential uses of alloys in accordance with the invention are in the manufacture of shotgun cases and automotive water pump seals. An additional advantage of steels in accordance with the invention is their ability to be bright annealed and produce pickled finishes with good solid surface capable of withstanding the aforementioned fabricating operations. Compositions of the invention possess tensile properties as follows:

Tensile	60–70,000 p.s.i.
Yield	30–40,000 p.s.i.
Elongation	23–35%
Rockwell "B"	70–75

In accordance with the invention there is provided a ferritic stainless steel consisting essentially of about up to 0.06 percent carbon, 0.2 to 1.0 percent manganese, 10 to 11.5 percent chromium, preferably 10.7 to 11.3 percent chromium, 0.2 to 1 percent silicon, preferably 0.2 to 0.5 percent silicon, 0.15 to 0.3 percent aluminum, 0.01 to 0.1 percent titanium, preferably 0.05 to 0.1 percent titanium, and the balance essentially iron with usual steelmaking residuals. The carbon content is limited because additional amounts beyond about 0.06 percent may result in a steel which is somewhat difficult to weld due to the formation of more martensite. The upper limits of the alloy contents of manganese and chromium are restricted to avoid developing unnecessary hardness and strength which would interfere with formability. At least about 10 percent chromium is, however, necessary for adequate corrosion resistance. The manganese and aluminum contents must be controlled to facilitate hot rolling. The aluminum limits of 0.15 to 0.3 percent are established to provide adequate weldability which is reduced if less than about 0.15 percent aluminum is included and to assure adequate ductility and formability which may be reduced if too much aluminum, e.g. more than 0.3 percent aluminum, is present. Titanium is included in amounts of at least 0.1 percent to improve formability, however, amounts of titanium greater than 0.1 percent are avoided to minimize stringer formation which, as mentioned previously, has an undesirable effect on stamping die wear.

As an illustration of the practice of the invention, three hot-rolled coils of the composition described in table I were produced for processing into cold-rolled strip.

The coils were boxed annealed, wheelabrated and edge trimmed and thereafter cold rolled to 0.023 inch, 0.020 inch and 0.015 inch thicknesses respectively. Following cold rolling one-half of each coil was bright annealed and one-half annealed and pickled. The coils were then slit to width as required.

Table I below summarizes the transverse mechanical properties of the material produced. In addition, micrographic analysis of the material in the fully annealed condition confirmed the absence of large titanium stringer-type inclusions which would be detrimental to die wear.

TABLE I

	Broad Range	Nominal Chemistry	(Strip) Check Analysis
Carbon	up to 0.06%	0.06 max.	0.056
Manganese	0.2 to 1.0%	0.30/0.50	0.38
Phosphorous		0.03 max.	0.024
Sulfur		0.03 max.	0.011
Silicon	0.2 to 1%	0.25/0.50	0.27
Chromium	10 to 11.5%	10.7/11.3	10.93
Nickel		0.30 max.	0.20
Aluminum	0.15 to 0.3%	0.15/0.30	0.26
Titanium	0.01 to 0.1%	0.05/0.10	0.10
			Residuals
		Mol	0.065
		Cu	0.12
		N_2	0.025

TRANSVERSE MECHANICAL PROPERTIES

	Mechanical properties of cold rolled material	
	Typical mechanical properties	After furnace annealing at 1,550° F. for five (5) minutes
Yield, p.s.i.	30/40,000	33,000
Tensile, p.s.i.	60/70,000	64,000
Elongation in 2", percent	25/35	30.5
Rockwell "B"	70/75	[1] "30T" 53

[1] Converted "B" 55.

While several embodiments of my invention have been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the appended claims.

I claim:

1. A ferritic stainless steel consisting essentially of about up to 0.06 percent carbon, 0.02 to 1.0 percent manganese, 10 to 11.5 percent chromium, 0.2 to 1 percent silicon, 0.15 to 0.3 percent aluminum, 0.01 to 0.1 percent titanium, and the balance essentially iron with usual steelmaking residuals.

2. A ferritic stainless steel according to claim 1 having 10.7 to 11.3 percent chromium.

3. A ferritic stainless steel according to claim 1 having 0.2 to 0.5 percent silicon.

4. A ferritic stainless steel according to claim 1 having 0.05 to 0.1 percent titanium.

5. A ferritic stainless steel according to claim 1 having 0.3 to 0.5 percent manganese.