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FERRITIC STAINLESS STEEL

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4 Claims. (Cl. 75—124)

This invention relates to 9 to 11% chromium stainless steels and more particularly to stainless steels of this grade that are ferritic at all temperatures below 1200° C. and have a coefficient of expansion closely approximating the coefficient of expansion of glass whereby glass can be fused and sealed thereto.

In sealing glass to metal, the temperature of the glass is raised to fusion point of glass, i. e., about 1200° C. to effect the seal. If the seal is to remain intact without shattering or placing undue strain on the glass, the coefficients of expansion of the glass and the metal must be closely matched on cooling, particularly throughout the range of temperature of 530° to 30° C. Moreover, for many purposes such as cones for television tubes and the like, it is necessary to form the metal articles in a spinning operation. Due to their ready formability, chromium stainless steels of the 28–30% straight chromium type and modified 17% grades of such steel have heretofore been used for such purpose. While such steels are quite satisfactory, they are quite expensive and it is therefore desirable to use cheaper grades of steel. I have discovered that the 9 to 11% grade of chromium stainless can be used for such purpose if modified as hereinafter set forth.

It is accordingly an object of the present invention to provide chromium stainless steels suitable for forming by spinning and for sealing to glass containing less chromium than steels heretofore usable.

It is a further object of the present invention to provide a stainless steel of the 9 to 11% chromium type suitable for sealing to glass.

The foregoing and further objects of this invention will be apparent from the following invention which is directed generally to chromium stainless steels containing 9 to 11% chromium.

Steels of this type are readily formable by spinning and are sufficiently oxidation resistant to make them desirable for use in application requiring that glass be sealed thereto. Moreover, they are considerably cheaper than steels heretofore used. They, however, form austenite upon heating to high temperatures which partially transforms to martensite upon cooling. The accompanying changes in volume, causing an unfavorable coefficient of expansion render them unsuitable for sealing to glass. To be suitable for sealing to glass the steel should have a coefficient of expansion over the temperature range of 530° to 30° C. of less than 12.5×10^{-6} in./in./° C., preferably being within the range of about 11.5 to 12.5×10^{-6} in./in./° C.

I have discovered that chromium steels within the range of 9 to 11% chromium are completely ferritic after heating to 1200° C. if the carbon is maintained below .03% along with titanium in the amount of at least 10 times the carbon content and preferably at least .35%, aluminum within the range of .02 to .30%, silicon .10 to 1.00% and manganese .10 to 1.00%. Titanium should be maintained below 1% because of its unfavorable effect on cleanliness or homogeneity when present in excess amounts. Phosphorus and sulphur should be maintained as low as possible. Molybdenum may be added if desired. Small quantities of nickel, boron, vanadium and tungsten are not desirable,

but may be tolerated. The balance of the alloy is substantially iron. Moreover, such steels have a coefficient of expansion within the temperature range of 530° to 30° C. of 11.5 to 12.5×10^{-6} in./in./° C.

Specific examples of steels typical of this invention are set forth in the following table:

Table I

	C	Cr	Mn	P	S	Si	Ni	Ti	Al	Mo	B
A	.03	11.0	.63	.010	.012	.17	.37	.56	.12	-----	-----
B	.028	10.72	.64	.009	.012	.16	.39	.54	.12	.84	-----

Both steels were completely ferritic on heating to 1200° C. and the coefficients of expansion on cooling from 530° to 30° C. were within the desired range that of steel A being 12.0 and steel B being 11.9×10^{-6} in./in./° C.

On the other hand, the following steels of Table II outside the composition range were transformed at least partially to martensite on heating to 1200° C. and accordingly are not satisfactory. Steel C for instance had a coefficient of expansion on cooling from 530° to 30° C. of 7.1×10^{-6} in./in./° C.

Table II

	C	Cr	Mn	P	S	Si	Ni	Ti	Al	Mo	B
C	.062	9.67	.60	.009	.011	.16	.42	.48	.09	-----	-----
D	.04	9.00	.53	.010	.011	.16	.40	.50	.09	.92	-----
E	.06	9.99	.43	.009	.010	.23	.39	.47	.29	-----	.0079

However, when these steels were decarburized to a .03% maximum carbon content, they were observed by microscopic examination to be fully ferritic.

This application is a continuation-in-part of my copending application Serial No. 316,327, filed October 22, 1952, now abandoned.

While I have shown and described several specific embodiments of my invention, it will be understood that these embodiments are merely for the purpose of illustration and description and that various other forms may be devised within the scope of my invention, as defined in the appended claims.

I claim:

1. A ferritic stainless steel containing 9 to 11% chromium, .03% maximum carbon, titanium at least 10 times carbon but not over 1%, .02 to .30% aluminum and .10 to 1.00% manganese, balance iron except for residual impurities and elements in amounts that do not adversely affect the properties.

2. A ferritic stainless steel containing 9 to 11% chromium, .03% maximum carbon, at least .35% but not over 1% titanium, .02 to .30% aluminum and .10 to 1.00% manganese, balance iron except for residual impurities and elements in amounts that do not adversely affect the properties.

3. A ferritic stainless steel consisting essentially of 9 to 11% chromium, .03% maximum carbon, .35% minimum but not over 1% titanium, .02 to .30% aluminum, .10 to 1.00% manganese, balance iron except for impurities and minor amounts of nickel, boron, vanadium, tungsten or molybdenum.

4. A ferritic stainless steel consisting of about 9 to 11% chromium, .03% maximum carbon, titanium at least 10 times carbon but not over 1%, .02 to .30% aluminum, .10 to 1.00% manganese, balance iron except for impurities and minor amounts of nickel, boron, vanadium, tungsten or molybdenum.

No references cited.