OXIDATION RESISTANT SULPHUR BEARING STEEL CONTAINING CHROMIUM AND ALUMINUM

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Roland B. Snow, Mount Lebanon Township, Allegheny County, Pa., assignor to United States Steel Corporation, a corporation of Delaware
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3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to an improved oxidation resistant sulphur bearing steel and, more particularly, to wear plates for the stockline zone of a blast furnace and formed of such an improved steel which is resistant to oxidation, carbon deposition, heat distortion and abrasion. The steels contain 11.5 to 14.5% chromium and small amounts of aluminium.

Background of the invention

Heretofore, in the stockline region or throat of a blast furnace, a stockline armor section was utilized to protect the throat from the abrasive charging of the burden (including coke ore, sinter, flux and the like) falling from the charging bell. This stockline armor section is usually composed of L-shaped or Z-shaped wear plates set within the refractory brickwork and, for example, concrete. During a normal blast furnace campaign, lasting about six years, it is essential for the continued maximum production of iron from the blast furnace that the wear plates continuously perform their protective function despite their exposure to temperatures in the range of 700° F. to 1800° F., and in the case of side channeling of the exhaust gases even to temperatures of about 2000° F.

Conventional wear plates are subject during operation to oxidation, carbon deposition, abrasion and heat distortion. When the temperature in the throat exceeds about 1000° F., water vapor (carried by the natural gas injected into the blast furnace at the tuyeres or introduced into the blast furnace with the burden) causes oxidation or scaling of the wear plates with resultant reduction in the cross-section of the wear plates and attendant weakening of such wear plates. Throat temperatures in the range of about 700° F. to 1300° F. cause the carbon monoxide in the combustion gases to be catalyzed (by the iron in the wear plates and in the refractory brick) and to break down into carbon dioxide and carbon, which carbon is deposited on the wear plates and refractory brick with resultant distortion of the wear plates. Increased amounts of water vapor and hydrogen, increased deposition of zinc and sulphur, such as zinc oxide and potassium carbonate impurities from the combustion gases on the wear plates caused by high top temperature and increased gas flow encourage carbon deposition.

Objects of the invention

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of an improved steel product which is resistant to oxidation, carbon deposition, heat distortion and abrasion.

Brief summary of the invention

The aforesaid objects of the present invention, and other objects which will become apparent as the description proceeds, are achieved by providing an improved steel product having resistance to oxidation at high temperatures, substantial resistance to carbon deposition from the combustion products of a blast furnace, and improved resistance to abrasion and heat distortion, and containing approximately 0.07% to 0.30% sulphur, 0.50% to 1.50% silicon, 11.5% to 14.5% chromium, 0.10% to 0.30% aluminium and the remainder substantially carbon, manganese, phosphorus and iron.

Brief description of the several views of the drawing

For a better understanding of the present invention reference should be had to the accompanying drawing, wherein like numerals of reference indicate similar parts throughout the several views and wherein:

FIGURE 1 is a fragmentary vertical sectional view of the stockline region of a blast furnace showing one form of the improved wear plates;

FIGURE 2 is an enlarged fragmentary vertical sectional view of the improved wear plate and its associated refractory brickwork; and

FIGURE 3 is a view similar to FIGURE 2 of an alternative form of the wear plates.

Although the principles of the present invention are broadly applicable to oxidation resistant sulphur bearing steel products, the present invention is particularly adapted for use in conjunction with wear plates for a blast furnace and hence it has been so illustrated and will be so described.

With specific reference to the form of the present invention illustrated in the drawings, and referring particularly to FIGURE 1, a throat of a blast furnace is indicated generally by the reference numeral 10.

This throat 10 has a cone-like plate 12 connecting a bell mouth 14 to a shell 16. Disposed within the shell 16 are castable slag wool packing 18, refractory brick 20 and concrete 22 of the Lummite type. Mounted in the refractory brick 20 and embedded by their end portions in the concrete 22 are L-shaped wear plates 24 (FIGURES 1, 2). The L-shaped wear plates 24 have resistance to oxidation at high temperatures, substantial resistance to carbon deposition from the combustion products of a blast furnace, and improved resistance to abrasion and heat distortion. Such wear plates 24 contain approximately 0.07% to 0.30% sulphur (preferably 0.20% to 0.30%), 0.50% to 1.50% silicon, 11.5% to 14.5% chromium, 0.10% to 0.30% aluminium, carbon not exceeding 0.15%, 0.80% to 1.25% manganese, phosphorus not exceeding 0.06% and the remainder substantially all iron.

A sulphur content of 0.07% to 0.20% suppresses carbon deposition on the wear plates 24, while a sulphur content of 0.20% to 0.30% substantially eliminates carbon deposition thereon. The above-mentioned silicon and aluminium contents resist oxidation at high temperatures and the chromium provides improved resistance to burden abrasion.

Alternative embodiments

It will be understood by those skilled in the art that alternatively, as shown in FIGURE 3, the improved steel product also includes the Z-shaped wear plates 24'.

Summary of the achievements of the objects of the invention

It will be recognized by those skilled in the art that the objects of this invention have been achieved by providing an improved steel product 24, 24' having resistance to oxidation at high temperatures, substantial resistance to carbon deposition from the combustion products of a blast furnace, and improved resistance to abrasion and heat distortion.

While in accordance with the patent statutes preferred and alternative embodiments of the present invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.
I claim:

1. An improved steel product having resistance to oxidation at high temperatures, substantial resistance to carbon deposition from the combustion products of a blast furnace, and improved resistance to abrasion and heat distortion, and consisting essentially, by weight percent, of approximately:
   (a) 0.07%–0.30% sulphur,
   (b) 0.50%–1.50% silicon,
   (c) 11.5%–14.5% chromium,
   (d) 0.10%–0.30% aluminum,
   (e) carbon not exceeding 0.15%,
   (f) 0.80%–1.25% manganese,
   (g) phosphorus not exceeding 0.06%, and
   (h) the remainder except for incidental impurities substantially iron.

2. An improved steel product having resistance to oxidation at high temperatures, substantial resistance to carbon deposition from the combustion products of a blast furnace, and improved resistance to abrasion and heat distortion, and consisting essentially, by weight percent, of approximately:
   (a) 0.20%–0.30% sulphur,
   (b) 0.50%–1.50% silicon,
   (c) 11.5%–14.5% chromium,
   (d) 0.10%–0.30% aluminum,
   (e) carbon not exceeding 0.15%,
   (f) 0.80%–1.25% manganese,
   (g) phosphorus not exceeding 0.06%, and
   (h) the remainder except for incidental impurities substantially iron.

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HYLAND BIZOT, Primary Examiner

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