United States Patent

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[54] **OXYGEN STEEL CONVERTER**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **266/34**
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[50] **Field of Search** ..... 266/34, 34 (T), 34 (PT), 35; 98/155

[56] **References Cited**
UNITED STATES PATENTS

3,205,810	9/1965	Rosenak	266/35X
3,380,728	4/1968	Baillie	266/35

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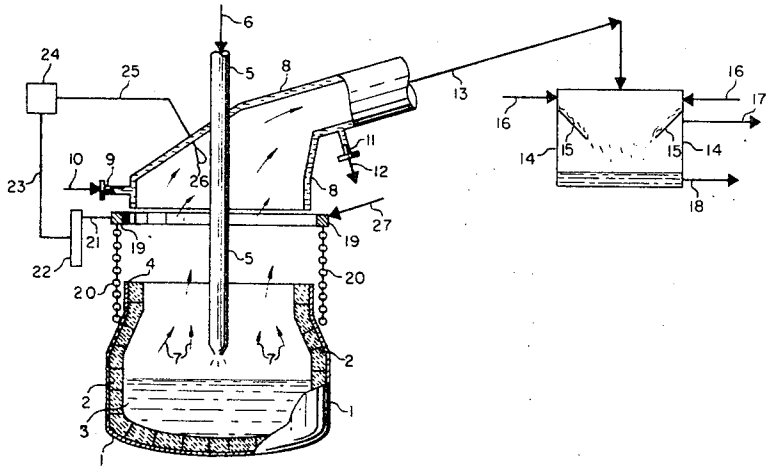
ABSTRACT: A chain curtain is disposed in the annular opening between the mouth of an oxygen steel converter and the lower end of an off-gas removal hood, to modulate air flow into the hood to control combustion air ratio and to prevent egress of the off-gas into the surrounding atmosphere as the off-gas debouches from the oxygen steel converter to the hood during the oxygen blow period of the furnace-operating cycle.



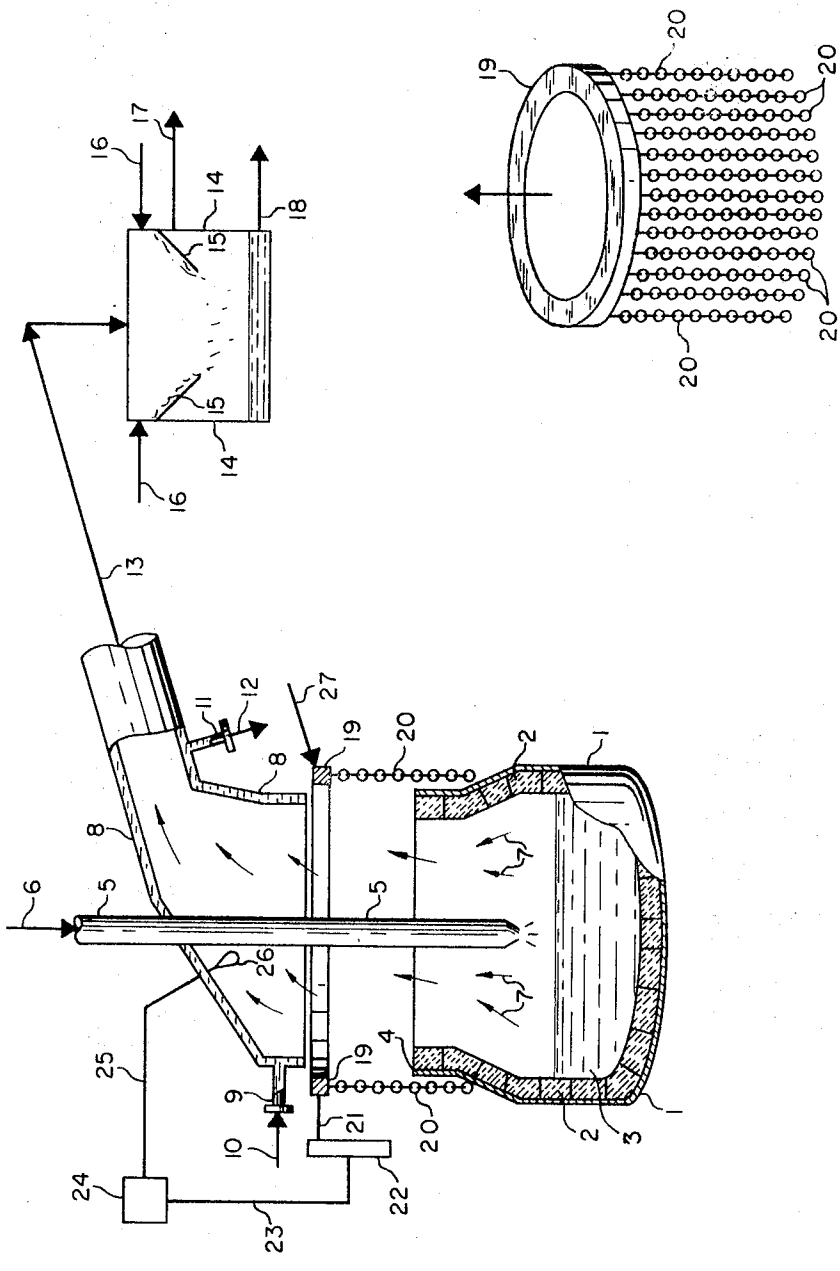


FIG. 1

FIG. 2

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OXYGEN STEEL CONVERTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to oxygen steel converters, in which a charge of molten ferrous metal is refined and/or converted to steel by the blowing of oxygen gas from an oxygen lance onto the molten metal charge. The invention particularly relates to oxygen steel converters in which the off-gas removal hood is spaced above the mouth of the hood, to permit air entry into the hood and partial or total combustion of the off-gas in the hood.

2. Description of the Prior Art

In the conventional oxygen converter design, there is an appreciable space between the lip or mouth of the vessel and the intake area of the upper hood. This spacing may be from 30 to 75 centimeters in length. This area must be swept by inspired air with sufficient velocity to prevent an outflow of gas and fume into the shop. This causes an air-gas ratio highly in excess of the stoichiometric quantity for combustion. This often overloads the gas-cleaning equipment and, with any irregularity in the converter operation, the flow of fume and gas outward into the shop cannot be controlled by the gas-cleaning system fans. Movable heat shields for oxygen steel converters are shown in U.S. Pat. Nos. 3,380,728; 3,347,539 and 3,205,810; while chain-type screens for furnaces are shown in U.S. Pat. Nos. 1,128,206 and 1,972,710. A means for sealing the charging and discharging apertures of continuous or intermittent furnaces is shown in U.S. Pat. No. 2,200,619. One type of hood for oxygen steel converters is disclosed in U.S. Pat. 3,372,917, and U.S. Pat. No. 3,215,523 describes the use of a steam curtain for sealing the spacing or aperture between the hood and an oxygen steel converter.

SUMMARY OF THE INVENTION

In the present invention, an improved oxygen steel converter apparatus is provided, in which a series of chains or chain curtain is mounted, either integrally with the hood, or independently disposed, contiguous with the spacing or gap between the hood and the converter mouth. The chains are freely suspended vertically from an upper attachment or mounting, and are preferably very closely spaced in the form of a dense curtain of chains, to partially block this area. The chain curtain would then act as a heat shield or heat curtain, as well as restricting gas flow.

If the chain curtain is independently mounted, the portion of the area over which it extends may be automatically varied by any means, such as manually by the operator or automatically by response to some signal such as negative pressure in the hood.

The chain curtain would not interfere with rotary or tilting motion of the vessel for charging and tapping. With the vessel in the charging or tapping position, any slag accumulation from spitting or the like could be removed by fracture caused by shock cooling with a small jet of water.

The principal advantage of the present invention is that the chain curtain effectively modulates the flow of air into the hood of an oxygen steel converter, and prevents the flow of noxious and potentially explosive off-gas from the oxygen steel converter into the surrounding atmosphere of the steelmaking facility or shop. Another advantage is that the chain curtain acts as a heat shield and prevents the exposure of operating personnel to highly elevated temperatures or radiant heat. A further advantage is that the oxygen steel converter may be tilted or rotated with the chain curtain in place, and that the chain curtain does not have to be moved or removed during various phases of the furnace-operating cycle.

It is an object of the present invention to provide an improved oxygen steel converter apparatus.

Another object is to provide an improved apparatus for selective closure of the opening between the mouth of an oxygen steel converter and the intake area of an associated overhead hood.

A further object is to provide an apparatus for controlling air entry and preventing off-gas discharge, between the mouth of an oxygen steel converter and its associated off-gas removal hood.

An additional object is to provide an improvement in oxygen steel converters provided with spaced hoods which allow for air entry into the hood through the spacing between the hood intake and the lower converter mouth.

Still another object is to provide apparatus for modulating gas flow between an oxygen steel converter and its hood.

Still a further object is to provide an improved heat shield apparatus for oxygen steel converters.

These and other objects and advantages of the present invention will become evident from the description which follows.

DESCRIPTION OF THE DRAWINGS AND PREFERRED EMBODIMENTS

Referring now to the drawings,

FIG. 1 is a sectional elevation view of a preferred embodiment of the invention, and

FIG. 2 illustrates the chain curtain and associated support collar or bracket in detail.

Referring now to FIG. 1, oxygen steel converter 1 is disposed in a generally upright or substantially vertically oriented position, and unit 1 is usually provided with an internal refractory lining 2. A molten metal pool 3 consisting of a charge of molten ferrous metal is disposed within converter 1, with charge metal 3 being admitted via upper mouth 4 during intermittent nonblow periods of the operating cycle. An oxygen lance 5 extends downwards into converter 1 through mouth 4, and an oxygen-rich gas stream 6, which usually consists of substantially pure oxygen, is discharged into vessel 1 via lance 5 and impinges on molten ferrous metal charge 3. The resultant reaction of the oxygen with the hot molten ferrous metal results in the evolution of a hot gas stream 7 which is rich in carbon monoxide, and which rises and debouches from the mouth 4 of converter 1. Gas stream 7 may react with a small proportion of inducted air immediately above and adjacent to the mouth 4, and in any case the hot gas stream flows upwards into hood 8, which is disposed above converter 1 and spaced from the mouth 4 of converter 1. The hood 8 is preferably water cooled by the circulation of cooling water through an external jacket or lining. Typically nozzle 9 is provided for entry of cooling water via stream 10, with warmed cooling water being removed from the hood jacket via nozzle 11 as stream 12.

The off-gas stream now leaves hood 8 via stream 13, which may now be quench cooled and scrubbed for entrained solids removal in any suitable manner. Stream 13 is preferably quenched and scrubbed in a venturi-type scrubber 14. The hot gas stream 13 flows downwards through unit 14 and is accelerated to a high velocity by the converging inverted frustoconical baffle 15. Scrubbing liquid streams 16, which usually consist of water, are passed into unit 14 above baffle 15, and the liquid flows downwards on the upper surface of baffle 15 and is projected into the high-velocity gas stream at the lower end of baffle 15, producing a dispersion of liquid droplets in the gas stream and attaining a rapid quench-scrubbing effect, whereby the gas stream is simultaneously cooled and scrubbed free of entrained solid particles. The resulting scrubbed and cooled gas phase is removed from unit 14 via stream 17, which may be flared to atmosphere, employed in chemical manufacture or as a fuel gas, or otherwise utilized. The solids-laden liquid phase is removed from unit 14 as stream 18, which may be discharged to waste or filtered or centrifuged for solids removal with recycle of the filtrate or clear liquor via stream 16.

In accordance with the present invention, a circular collar or bracket 19 is mounted or otherwise disposed adjacent to the annular opening between the lower perimeter of hood 8 and mouth 4, and bracket 19 is usually oriented in a position

contiguous with the lower perimeter of hood 8 during the blow period. A plurality of chains 20 are attached to collar 19, and the chains 20 are juxtaposed and freely suspended vertically from the collar 19, with the chains 20 depending downwards and terminating at or adjacent to the mouth 4 of the converter 1. The chains 20 are preferably closely spaced in practice, so as to permit only minimal inflow of air into the space between hood 8 and converter mouth 4, with the inducted air reacting with stream 7 adjacent to chains 20 and at the entrance to hood 8. The chains 20 are therefore generally composed of a suitable heat-resistant metallic alloy, such as stainless steel or other suitable refractory metallic alloy, since the reaction of inducted air with stream 7 at points or regions contiguous to chains 20 is a highly exothermic reaction consisting of the burning of carbon monoxide, which produces a further elevation in the temperature of the gas stream.

The upper collar 19 may be permanently mounted, however collar 19 may be vertically adjusted in practice by the provision of a suitable adjustable support. Typically, a support rod 21 supports collar 19, and rod 21 is adjusted in vertical elevation by controller 22, which receives a pneumatic or electrical signal via line 23, which extends from measuring device 24. Unit 24 may be any suitable device for measuring changes in negative pressure within the hood 8, with pressure level being transmitted via line 25 from sensor 26 disposed within hood 8. The variations in hood negative pressure will result in adjustment of the position or vertical elevation of collar 19 and chains 20.

FIG. 2 is an isometric view showing the circular collar 19 and the plurality of depending chains 20 in vertical alignment. In practice of the invention, the chains 20 are contiguous and may even be closely aligned with point contact between links of adjacent chains, to severely restrict the inward flow of air.

Numerous alternatives within the scope of the present invention will occur to those skilled in the art. The chains 20 may be permanently mounted and depend downwards from an upper suspension or mounting attached to the lower perimeter or periphery of hood 8. The chains 20 may even be directly mounted on or suspended from the hood 8 in some cases. In this event, or whenever the chains 20 are in a permanent emplacement, unit 22 and support number 21 and their functions may be omitted. Numerous types of gas-quenching and -scrubbing devices may be provided in practice, instead of or in addition to unit 14, or in some cases stream 13 may be processed for solids removal by cooling and electrostatic precipitation or other means known to the art. Means may also be provided in the apparatus of the present invention for using cooling water in conjunction with the chains 19, by weeping or spraying cooling water on the chains 19. For example, the collar 20 could be hollow and provided with lower perforations. A cooling water stream passed into the hollow collar 20 via optional stream 27 would flow downwards through the perforations and onto the chains 19. The cooling water flow would serve to cool the chains 19, and also to replace air in the interstices of the chains, with steam. Any generated steam will dissociate in the hood endothermally, thus providing a cooling effect.

We claim:

1. An apparatus for treating molten ferrous metal with oxygen gas which comprises a refractory-lined vertically oriented converter, said converter having an upper mouth and being provided with an internal charge of molten ferrous metal, an oxygen lance, said lance extending downwards into said converter and serving to discharge a gas stream rich in free oxygen above said charge of molten ferrous metal, whereby an off-gas stream rich in carbon monoxide is discharged from the mouth of said converter, an off-gas removal hood, said hood being disposed above said converter and spaced from the mouth of said converter, whereby said off-gas stream flows into said hood from said converter, and a chain curtain, said curtain extending downwards in the annular spacing between said hood and said converter mouth and being composed of a plurality of juxtaposed chains, each of said chains being freely suspended vertically and depending from an upper support mounting.

2. The apparatus of claim 1, in which said chains are vertically suspended from an upper support mounting which is attached to said hood.

3. The apparatus of claim 1, in which said chains depend downwards to a lower contact with said converter.

4. The apparatus of claim 1, in which said hood is water cooled by the circulation of a cooling water stream on the outer surface of said hood.

5. The apparatus of claim 1, in which said hood extends to means for gas quenching and scrubbing, said means including a venturi scrubber.

6. The apparatus of claim 1, in which the upper support mounting of said chain curtain is independently spaced from said hood.

7. The apparatus of claim 6, in which the position of said upper support mounting is varied in response to change in the negative pressure in said hood, whereby the inward flow of excess air into said hood is modulated and the outward flow of off-gas external to said converter and hood through the annular spacing between said converter and said hood is prevented during the entire operating cycle of said converter.