ABSTRACT: A blowpipe for a blast furnace comprises a ceramic inner conduit that is surrounded by a metallic outer conduit. The ends of the outer conduit seals against the tuyere and the tuyere stock elbow, and the hot blast air pressure and temperature act on both sides of the ceramic inner conduit.
BLOWPIPE FOR BLAST FURNACE

CROSS REFERENCE TO RELATED DISCLOSURE

The subject matter of this application is related to my copending U.S. Patent application Ser. No. 683,326, filed Nov. 15, 1967, now U.S. Pat. No. 3,520,525 for "Apparatus for Delivering Air to a Blast Furnace."

BACKGROUND OF THE INVENTION

In a blast furnace, heated air or blast air is carried in a baffle pipe that surrounds the bosh section of the furnace, and the blast air is conveyed into the furnace through a plurality of conduit assemblies which comprise, generally, a gooseneck tuyere stock, a blowpipe, and a tuyere.

The tuyere itself is mounted in a cooler casting, set into the furnace wall, and the blowpipe is removably mounted between the tuyere stock elbow.

Because of the higher pressures used in blast furnaces at the present time, it has been difficult, heretofore, to obtain a tight seal at the ends of the blowpipe that cooperates with the tuyere stock elbow and the tuyere. Another of the problems created by the use of high-blast temperatures and pressures is the design of a blowpipe that can withstand temperatures in excess of 1,400°F. to 1,800°F. While there are numerous designs of blowpipes in the prior art, none is completely satisfactory for carrying hot blast air at the pressures and temperatures used in blast furnaces at the present time.

SUMMARY OF THE INVENTION

The blowpipe of the invention comprises an inner frustoconical conduit having one end adapted to coact and form a seal with the tuyere while the other end is spaced apart from the tuyere stock elbow. An outer metallic tubular member is sealed to the coactive end of the inner conduit and abuts the tuyere stock elbow at the other end in a sealing manner. Means is provided to maintain the inner and outer tubular conduits in spaced apart relation. Hot blast air, in the space between the inner and outer conduits, acts as an insulator for the outer tubular conduit.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a schematic longitudinal sectional view of a blowpipe in accordance with the invention;

FIG. 2 is a detail, at an enlarged scale, of a seal at one end of the blowpipe of FIG. 1; and

FIG. 3 is a sectional view along line III--III of FIG. 1.

DETAILED DESCRIPTION

FIG. 1 illustrates a blowpipe 11, in accordance with the invention that is disposed between a tuyere 13, in a tuyere cooler 15, and a tuyere stock elbow 17.

The blowpipe 11 is comprised of a frustoconical inner tubular member or conduit 19, which is made preferably of a suitable ceramic material; the tubular member 19 having an integrally formed, circumferentially extending flange 21 on the external wall of the tubular member, at a location about where shown in FIG. 1. The smaller end of the frustoconical tubular member 19 is provided with an end shaped to form a reasonably tight seal with the metallic end 32 that is integral with metallic tube 27 and whose outer surface matches the spherical surface on the tuyere 13. The opposite larger end 25 of the frustoconical tubular member 19 is plain; that is to say, the larger end 25 is cut off perpendicularly to the longitudinal axis of the blowpipe, and this end is spaced apart from a ceramic lining 18 of the tuyere stock elbow 17, as shown in FIG. 1, so as to form a circumferential passage 20.

Surrounding the frustoconical tubular member 19, in spaced apart relation thereto, is a hollow tubular member 27 that is made, preferably, of steel. One end of the tubular member 27 is tapered and attached to, as by welding or in any other suitable manner, the metallic end 23 of the frustoconical member 19. The tubular member 27 also has a rounded other end 29 (FIGS. 1 and 2), that extends past the end 25 of the inner tubular member 19, and that forms a gastight seal against a formed depression 31 in a tuyere stock flange 33, as shown in FIG. 1.

FIG. 2 illustrates another form of gastight seal comprising an annular, soft metallic gasket 35 that is placed between the end 29 of the outer steel tubular member and the tuyere stock flange 33.

Within the metallic tubular member 27, there are a plurality of support stools 37 that cooperate with the positioning flange 12, and, thereby, locate the inner frustoconical tubular member 19 with respect to the outer metallic tubular member 27. In addition, there are a plurality of radially disposed, longitudinally extending, tube positioning members 39, secured to, or integrally formed with, the outer metallic tubular member 27, that also aid in positioning the member 19 with respect to the tubular member 27.

The external surface of the metallic tubular member 27 is fitted with a plurality of radially and longitudinally extending fins 41. At least two of these fins 41a are wider radially (FIG. 3), than the other fins 41 so that the fins 41a rest on and cooperate with the inner surface of the tuyere cooler 15 at the bottom thereof. In this manner the blowpipe 11 is held and maintained in axial alignment with the tuyere 13, the tuyere cooler 15, and the tuyere stock elbow 17.

The blowpipe 11, is, as shown in FIG. 1, disposed between the tuyere 13 and the flange portion 33 of the tuyere stock elbow 17. In my copending application, mentioned hereinafter, I show an arrangement of three bridge rods that apply equal pressure upon the ends of the blowpipe, thereby providing a much improved gastight seal at the ends of the blowpipes. Those skilled in the art will recognize that such an arrangement of bridge bolts can be adapted to the blowpipe-tuyere stock installation shown in FIG. 1, to provide a uniform pressure and a much improved gas seal at both ends of the blowpipe 11.

In operation of a blast furnace, the blowpipe is positioned where shown in FIG. 1 and most of the hot blast air passes through the inner, frustoconical ceramic tubular member 19; but a portion of the hot blast air, passing through the passage 20, fills the space between the inner tubular member 19 and the outer tubular member 27. Thus, both sides of the ceramic, inner, frustoconical, tubular member 19 are subjected to the same hot blast air pressure and temperature. However, the hot blast air in the space between the inner and outer tubular member 19, 27, becomes stagnant and thereby acts as an insulating layer between the heated inner ceramic tube 19 and the outer metallic tube 27.

The plurality of bridge bolts mentioned hereinbefore exert a uniform pressure around the circle of contact between the shaped end 29 of the outer steel tubular member and the arcuate depression 31 in the tuyere stock flange 33, or with the soft gasket 35 therebetween.

A feature of the present invention is that the ceramic, inner, tubular member 19 is supported only at spot locations and needs only to support itself. This means that the inner ceramic tubular member is not subjected to any great appreciable thermal stresses in operation since one end is free and is not connected to other structure. Further, the inner ceramic tubular liner is subjected to the same pressure on the inside and the outside.

A feature of the invention is that the outer metallic tubular member 27 is subjected to axial thrusting forces provided by the bridge bolts, whereas, the inner tubular conduit is not subjected to any axial thrusting forces whatsoever.

A feature of the present invention is the dead airspace between the inner tubular conduit and the outer tubular conduit, whereby the outer metallic tubular conduit is subjected to a lower temperature than the temperature to which the inner tubular member is subjected.

A feature of the invention is that the outer metallic tubular conduit has a plurality of radial, longitudinal, radiating fins to...
dissipate heat to the atmosphere, with at least two of these fins serving as locating and positioning members, whereby the outer tubular member is axially aligned with the tuyere, the tuyere cooler, and the tuyere stock elbow.

A feature of the invention is that the blowpipe of the invention can be made as short as practicable to reduce its weight, to bring the tuyere stock flange close to the outside of the tuyere cooler to act as a shield, and to make it possible to use a plurality of spring tensioned bridle bolts of convenient length equally spaced around the flange to compress the blowpipe against the tuyere and the tuyere stock flange with substantially uniform pressure around the circumference of the tuyere stock blowpipe.

A feature of the invention is that the ceramic liner can be replaced without disturbing the tuyere-blowpipe arrangement with a minimum of physical effort.

A feature of the invention is that the whole blowpipe assembly can be dismounted-remounted in two separate units, reducing the physical effort involved in a tuyere change.

A feature of the invention is that impact forces transmitted as is conventional through the blowpipe to seat the tuyere firmly can be performed without the naturally impact-sensitive refractory tube in place, eliminating possibility of damage to the refractory before it actually goes into service.

Those skilled in the art will recognize that in some installations, that the ceramic inner tubular member may be provided with an outside and external insulating coating or a thin metallic liner. Further, in some installations such a ceramic inner tubular member may include a metallic mesh core in its manufacture which will provide additional strength whenever necessary.

Although the invention has been described herein with a certain degree of particularity, it is understood that the present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

1. A blowpipe for insertion between a tuyere set in a tuyere cooler and tuyere stock elbow of a blast furnace comprising:
   a. an inner frustoconical open ended flow-through tubular conduit having one end adapted to coact with said tuyere and form a seal;
   b. an outer tubular member, surrounding said inner conduit in spaced apart relation, with one end of said outer member being sealingly joined to said one end of said inner conduit, said outer member abutting said tuyere stock elbow and forming a seal therewith; and with
   c. the other end of said inner conduit being spaced apart circumferentially from said tuyere stock elbow whereby a circumferential fluid passage is created between said inner conduit and said tuyere stock elbow; and
   d. means to support and maintain said inner conduit in spaced apart relation to said outer tubular member.

2. The invention of claim 1 including a plurality of radial fins arranged longitudinally on the exterior surface of said outer tubular member, with at least two of said fins coacting with said tuyere cooler to support and maintain said blowpipe in axial alignment with said tuyere.

3. The invention of claim 1 including:
   a. a metallic end portion fitted to the end of said outer conduit that abuts and forms a seal with said tuyere; and including,
   b. means for sealingly securing said inner tubular member to said metallic end portion.

4. The invention of claim 2 including:
   a. a protrusion arranged circumferentially around the outer surface of said inner tubular conduit; and
   b. means on said outer tubular member engaging said protrusion for locating said inner member axially with respect to said outer tubular member.

5. The invention of claim 4 including a plurality of protrusions on said inner conduit arranged in spaced apart relation and coacting with said outer tubular member for supporting and maintaining said inner and outer members in coaxial relation.

6. The invention of claim 1 wherein: said other end of said outer tubular member is shaped to coact with a formed depression in said tuyere stock elbow and thereby make a seal.

7. The invention of claim 6 including: an annular gasket disposed between said formed end of said outer member and said tuyere stock elbow to form a seal.