July 14, 1970 R. E. ZIMMERMANN 3,520,525

APPARATUS FOR DELIVERING AIR TO A BLAST FURNACE

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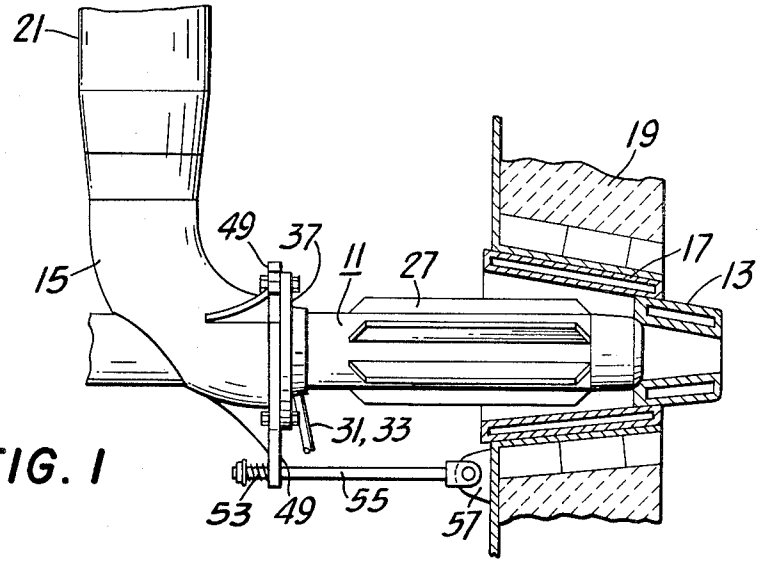


FIG. 1

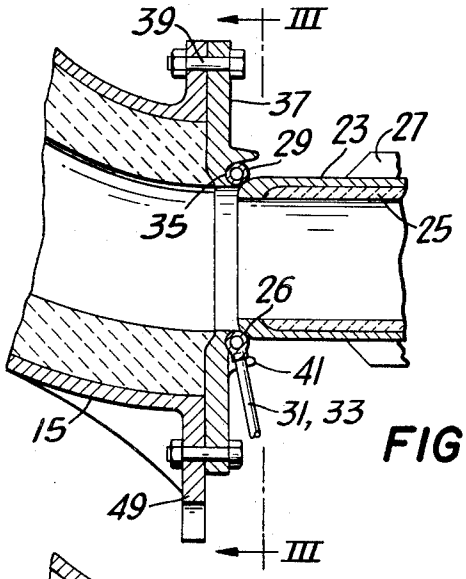


FIG. 2

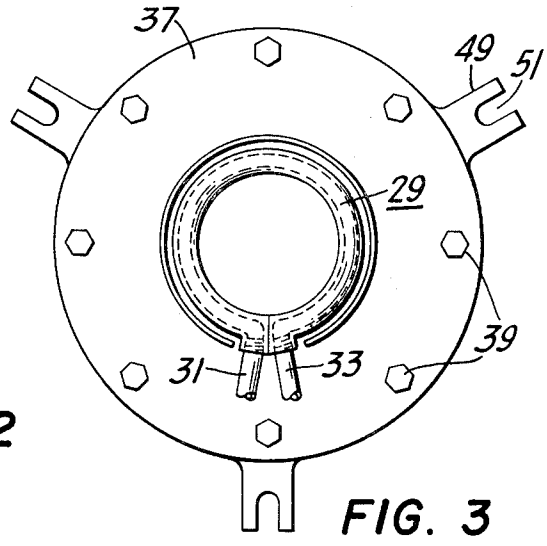


FIG. 3

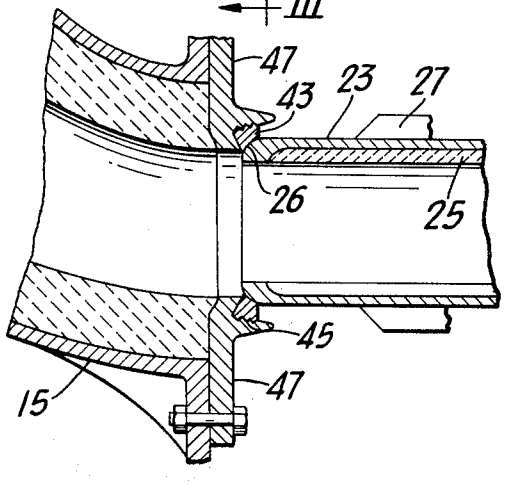


FIG. 4

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APPARATUS FOR DELIVERING AIR TO A BLAST FURNACE

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ABSTRACT OF THE DISCLOSURE

Apparatus for delivering air from a bustle pipe to the tuyeres of a blast furnace comprises an elbow that has an end with a plurality of arms that cooperate with a bridle assembly and a face plate to which is mounted a sealing ring of material that is conformable to the rounded end of a blowpipe extending between, and cooperating with, the sealing ring and the tuyere. A plurality of spring biased bridles exert a force on the blowpipe to frictionally hold it in position. The blowpipe has a refractory lining and a plurality of longitudinally extending external fins that dissipate heat.

BACKGROUND OF THE INVENTION

In the blast furnace process, heated or blast air is carried in a bustle 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 a gooseneck tuyerestock, a blowpipe and a tuyere. The blowpipe comprises a length of refractory lined tubing that abuts the tuyerestock at one end and the tuyere at the other end.

Heretofore, it has been difficult to obtain a tight seal at each end of the blowpipe, and particularly at the end where the blowpipe cooperates with the tuyerestock. In some applications, the blowpipe has been spherically machined to fit a corresponding end of the tuyere and the tuyerestock. But, reliance upon a machined joint to obtain a gastight fit and seal has not been entirely satisfactory. In many instances, the tuyerestock ends become damaged during handling or while the blowpipe is in storage, and they do not make a proper seal with the tuyerestock.

However, the present invention discloses apparatus for delivering air to a blast furnace that overcomes the disadvantages in the prior art.

SUMMARY OF THE INVENTION

The invention comprises a tuyerestock elbow connected to a bustle pipe and a face plate mounted to the tuyerestock elbow which supports a sealing ring that is conformable to the rounded end of a blowpipe extending between the face plate and a tuyere in the wall of the furnace. The sealing ring is hollow and fluid cooled, or is solid material. The blowpipe has external longitudinal fins that provide additional radiating surface to maintain the blowpipe cool.

For a further understanding of the invention and for advantages and features thereof, reference may be made to the following description in conjunction with the accompanying drawing which shows for the purpose of exemplification embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a schematic elevational view of apparatus for delivering air to a blast furnace in accordance with the invention;

FIG. 2 is a sectional view showing details of one end of the blowpipe and tuyerestock elbow of FIG. 1;

FIG. 3 is a view along line III—III of FIG. 2, showing a seal ring in accordance with one embodiment of the invention; and

FIG. 4 is a sectional view similar to FIG. 2 showing a seal ring in accordance with another embodiment of the invention.

DETAILED DESCRIPTION

FIG. 1 illustrates apparatus for delivering air to a blast furnace in accordance with the invention that comprises a blowpipe **11** situated between a furnace tuyere **13** and a tuyerestock elbow **15**. Each of the furnace tuyeres **13** occupies a position at the inner end (the end nearest the furnace centerline) of a cooler casting **17** set into the furnace wall **19**. The tuyerestock **15** is connected in a conventional manner to conduit **21** communicating with a bustle pipe (not shown) that surrounds the furnace and in which heated air flows.

The blowpipe **11** is comprised of a generally cylindrical envelope or shell **23** that is lined with a suitable refractory material **25**. The steel tube or envelope **23** has a plurality of longitudinally extending and outwardly projecting fins **27** that provide additional radiating surface on the envelope to dissipate heat to the ambient air.

The end of the blowpipe **11** that is adjacent the tuyerestock **15** is rounded, as shown at **26** in FIG. 2, and abuts a hollow, generally circular seal ring **29**, shown in FIG. 3. Preferably, both ends of the blowpipe **11** are alike; that is, both ends are rounded as at **26** so that either end may abut and cooperate with the sealing ring **29**. The seal ring **29** may be comprised of a suitable metal, such as Monel, bronze, copper, wrought iron, or the hollow seal ring may be a metal tube covered on the outside with hard asbestos, or stainless steel wire inserted in hard asbestos. The seal ring **29** is provided with an inlet conduit **31** and an outlet conduit **33**, whereby cooling fluid can enter, flow through the tubular seal ring, and flow therefrom.

The seal ring **29** fits into a groove **35** provided in a face plate **37** which is suitably fastened, as by bolts **39**, to the tuyerestock **15**. A notch **41** is provided in the periphery of the face plate at a convenient location around the periphery of the face plate to accommodate the bossing portion of the seal ring, where the inlet **31** and the outlet **33** conduits are connected to the seal ring **29**. Preferably, the groove **35** is so made that the seal ring is deformed slightly, or is pinched as it were, so that the seal ring **29** is held frictionally in position in the groove **35**.

The embodiment of the invention illustrated in FIG. 4 differs only slightly from the embodiment of the invention of FIG. 2. In FIG. 4, the blowpipe **11** abuts a solid metal seal ring **43** which may be made of soft copper or any other suitable metal, and the seal ring **43** has threads **45** that cooperate with threads on the face plate **47** to hold and secure the seal ring **43** in position. Preferably, the seal ring **43** has a tapered surface that is readily deformable and conformable to the rounded end **26** of the blowpipe **11**.

Instead of using a conventional tuyerestock, having a single bridle at the bottom and a safety hook at the top, the invention provides a tuyerestock with three each equiangularly spaced, outwardly extending arms **49**, that have a U-shaped slot therein. The arms **49** cooperate with springs **53**, biasing bridle bolts **59** that are pivotally connected to clips **57** welded to the steel portion of the furnace wall **19**. Thus, the pressure exerted by the spring-biased bridles of the invention on the face plate and ultimately on the blowpipe **11** is more uniformly distributed than the single bridle arrangement of the prior art. The pressure on the seal ring **29** is not exerted only at the bottom of the face plate, as in the prior art apparatus.

When assembling the blowpipe **11** in a blast furnace, the blowpipe is placed between the tuyere **13** and the tuyerestock face plate so that the rounded end of the blowpipe abuts and seals against one of the seal rings. The blowpipe is maintained in position by the frictional force resulting from the pressure exerted by the bridles on the face plate.

A feature of the invention is that the blowpipe has rounded ends that are adapted to cooperate with a deformable seal supported by the tuyere face plate. By being double ended, the blowpipe effectively seals against the tuyere and against the seal ring with equal effectiveness.

A feature of the invention is the tuyerestock elbow with its three equi-angularly spaced arms that cooperate each with a bridle. The three bridles exert a more uniform pressure on the tuyerestock face plate which in turn exerts more uniform sealing pressure on the seal ring and the cooperating end of the blowpipe.

A feature of the invention is that the sealing ring is hollow and that a fluid circulating therein cools the seal ring and the adjacent unprotected metal parts of the face plate **37** and envelope **23**.

A feature of the invention is that the face plate has a groove which is adapted to coperate with the seal ring and frictionally engage the same, whereby the seal ring is held in position even when no pressure is applied against it.

A feature of the invention is the longitudinally extending outwardly projecting fins on the external surface of the blowpipe that provide more radiating surface whereby the blowpipe is cooler and is not subjected to heat and mechanical distortion. Further, the blowpipe is less likely to suffer rupture by cracking.

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.

What is claimed is:

1. In apparatus for delivering air from a bustle pipe conduit to the tuyeres of a blast furnace, the improvement comprising:

(a) a tuyerestock elbow connecting to said conduit and terminating in an end spaced apart from said tuyere;

(b) a face plate having a groove therein mounted to the end of said elbow;

(c) a tubular blowpipe having rounded ends and a plurality of outwardly projecting longitudinally extending fins on the external surface thereof disposed between and cooperating with said tuyere and said face plate;

(d) a sealing member supported in the groove of said face plate between an end of said blowpipe and said face plate that is conformable to the end of said blowpipe to seal against leakage of air from said elbow and blowpipe;

(e) at least three arms equi-angularly spaced around and projecting outwardly from the periphery of said tuyerestock elbow;

(f) a resiliently biased member connecting each said arm and said blast furnace, urging said sealing member into intimate sealing contact with the end of said blowpipe; and

(g) means for maintaining said blowpipe in position.

2. The invention of claim **1** wherein:

(a) said sealing member is hollow and fluid conductive.

3. In apparatus for delivering air from a bustle pipe to the tuyeres of a blast furnace, the improvement comprising:

(a) a tuyerestock elbow connecting to said conduit and terminating in an end spaced apart from said tuyere;

(b) at least three arms equi-angularly spaced around and projecting outwardly from the periphery of said tuyerestock elbow;

(c) a face plate mounted to the end of said elbow, said face plate having a groove in the face thereof;

(d) a blowpipe connecting said tuyere and said face plate, said blowpipe including

(i) a tubular envelope having partially rounded ends,

(ii) a refractory lining within said envelope, and

(iii) a plurality of fins projecting outwardly from and extending longitudinally of said envelope,

(e) a sealing member supported in the groove of said face plate and cooperating with an end of said blowpipe, said sealing member being conformable to the end of said blowpipe to seal against leakage of air from said elbow and blowpipe; and

(f) a resiliently biased member connecting each said arm and said blast furnace urging said sealing member into intimate sealing contact with the end of said blowpipe.

4. The invention of claim **3** wherein:

(a) said sealing member is hollow and fluid conductive.

5. In apparatus for delivering air from a bustle pipe conduit to the tuyeres of a blast furnace, the improvement comprising:

(a) A tuyerestock elbow connecting to said conduit and terminating in an end spaced apart from said tuyere;

(b) A face plate mounted to the end of said elbow;

(c) a tubular blowpipe having rounded ends and a plurality of outwardly projecting longitudinally extending fins on the external surface thereof disposed between and cooperating with said tuyere and said face plate;

(d) a sealing member threadedly engaging said face plate and disposed between an end of said blowpipe and said face plate, said sealing member being readily deformable metal that is conformable to the end of said blowpipe to seal against leakage of air from said elbow and blowpipe;

(e) at least three arms equi-angularly spaced around and projecting outwardly from the periphery of said tuyerestock elbow;

(f) a resiliently biased member connecting each said arm and said blast furnace, urging said sealing member into intimate sealing contact with the end of said blowpipe; and

(g) means for maintaining said blowpipe in position.

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