United States Patent

[11] 3,610,183

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[45] Patented **Oct. 5, 1971**
[73] Assignee **United States Steel Corporation**

[54] **DIRECTIONAL DEVICE FOR AN ORIFICE MEMBER**
16 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **110/182.5,** 122/6.6, 266/41
[51] **Int. Cl.** **F23j 5/00**
[50] **Field of Search** 266/41; 110/182.5; 122/6.6

[56] **References Cited**

UNITED STATES PATENTS

3,350,084	10/1967	Lucarell	266/41
3,371,917	3/1968	Mylting	266/41 X

FOREIGN PATENTS

837,781	6/1960	Great Britain	266/41

Primary Examiner—Kenneth W. Sprague
Attorney—Robert J. Leek, Jr.

ABSTRACT: A directional device for an orifice member having a minimum orifice diameter and an orifice outlet end is disclosed. The orifice member conducts the fluid in an outward direction through the orifice outlet end. The directional device directs the fluid in a predetermined direction toward a work area and has a longitudinal member provided with an outlet end and an inlet end. The inlet end of the longitudinal member has an inlet end diameter equal to or less than the minimum orifice diameter. Packing means are disposed between the inlet end and the orifice outlet end. The packing means has a bonding strength sufficient to secure the inlet end of the longitudinal member to the orifice member during the transmission of the fluid through the directional device but insufficient to prevent the removal of the directional device from the orifice member into the work area without damage to or movement of the orifice member. A directional member is connected to the outlet end of the longitudinal member for directing the fluid in the predetermined direction into the work area.

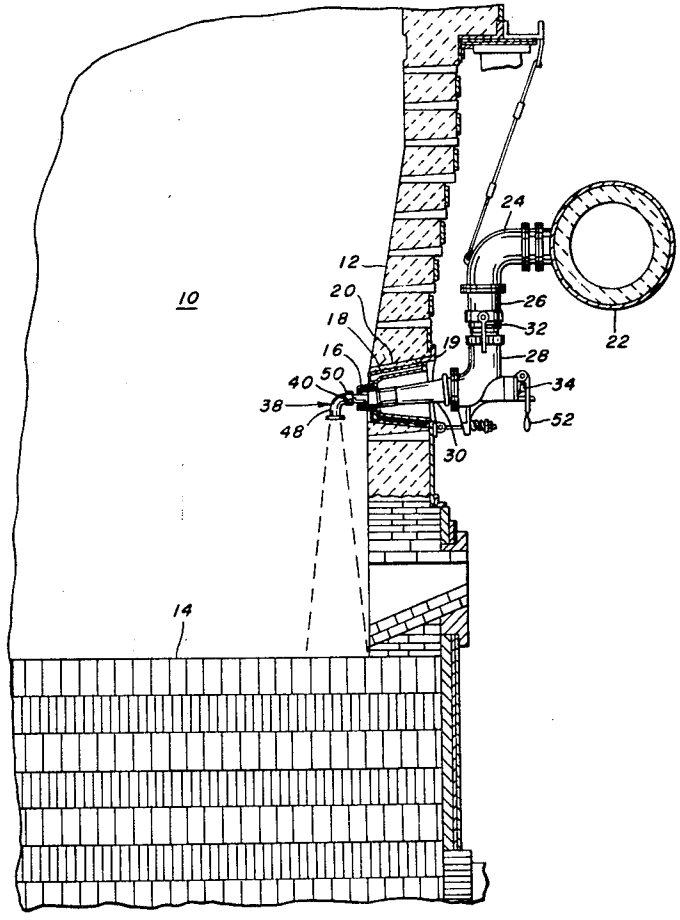
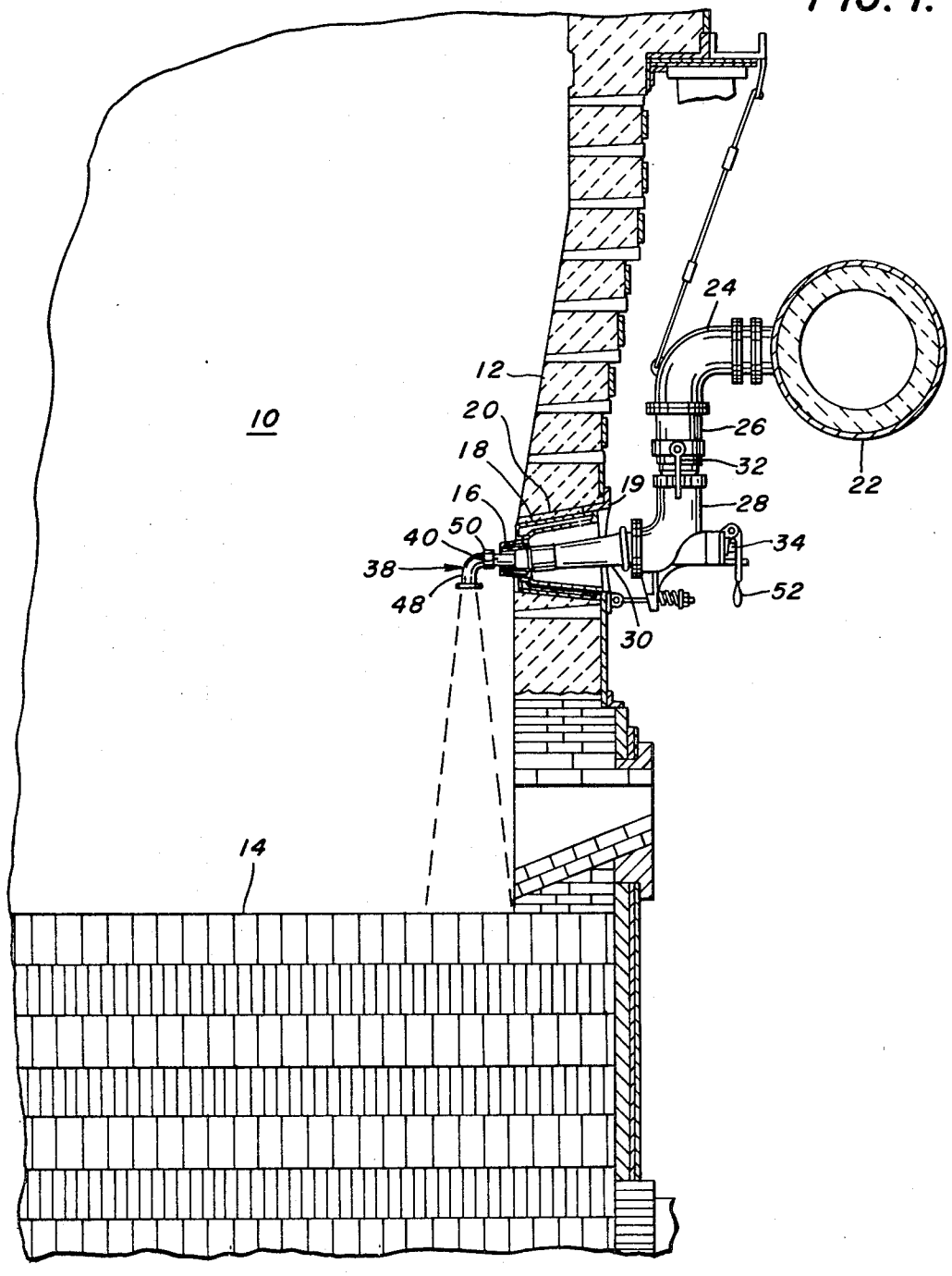


FIG. 1.



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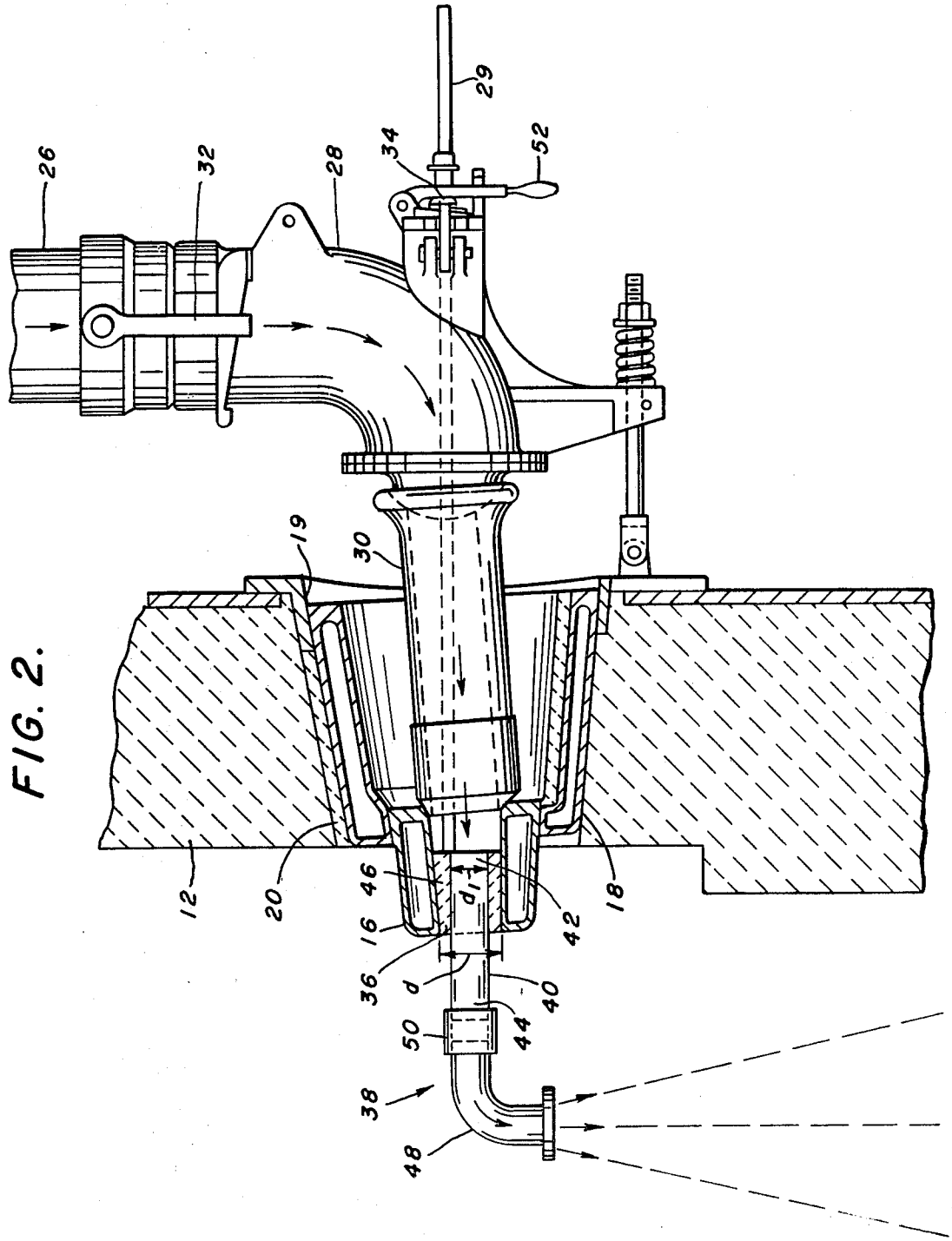


FIG. 2.

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FIG. 3.

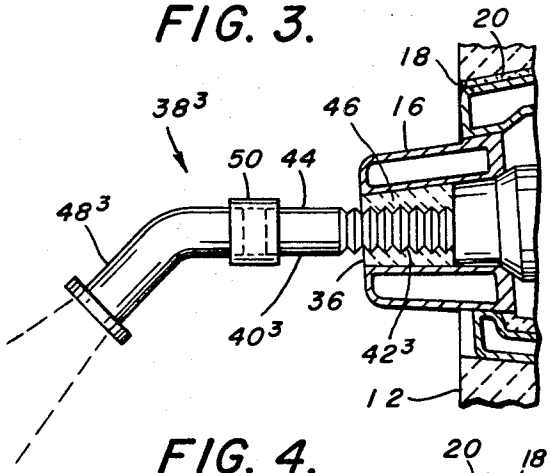


FIG. 4.

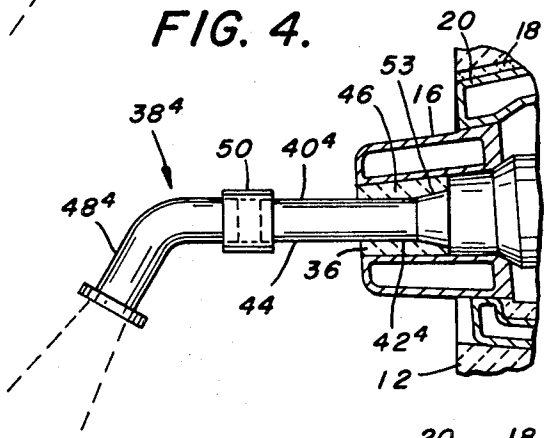


FIG. 5.

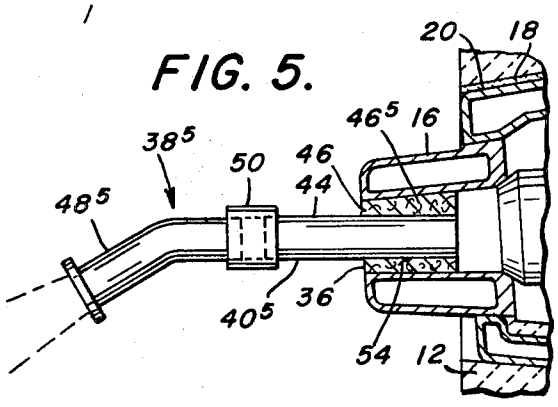


FIG. 6.

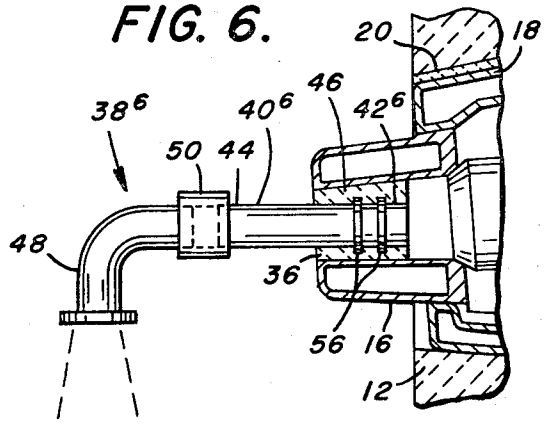


FIG. 7.

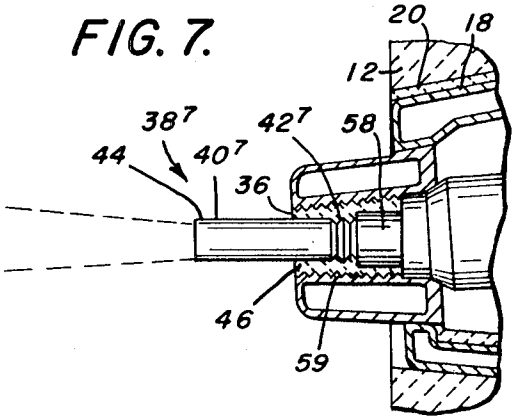


FIG. 8.

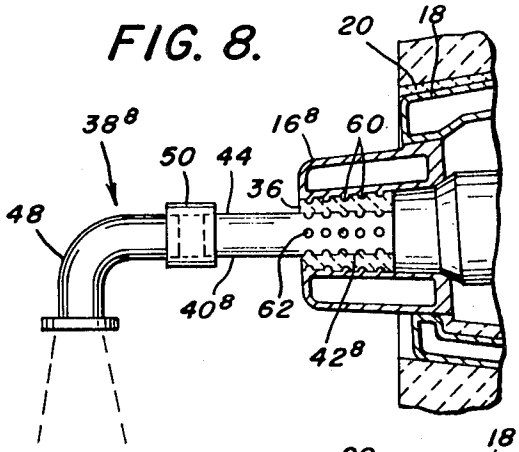
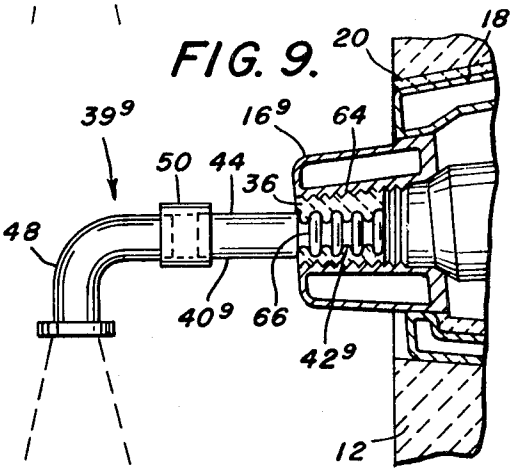


FIG. 9.



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DIRECTIONAL DEVICE FOR AN ORIFICE MEMBER

BACKGROUND OF THE INVENTION

Heretofore, newly lined refractory hearths and walls of blast furnaces have been dried by blowing hot air or the like through the tuyeres and into the furnace. One of the disadvantages of this method was the fact that the hot air would blow directly across the furnace where it would strike the hot air from other tuyeres, thereby causing most of the hot air to flow upwardly with attendant limited flow of hot air to the hearth bottom where it was needed to dry the newly lined hearth. As a result, longer periods of time were required to dry the newly lined hearth bottom long after the sidewalls adjacent the tuyeres were dried, thereby increasing down production time of the blast furnace due to the excessive drying time required to sufficiently dry the hearth bottom of the blast furnace.

In an effort to reduce the drying time required for the newly lined hearth bottom of the blast furnace, peripheral ring was secured as by welding or the like to a longitudinal pipe and affixed in a tight fit in the taper of the tuyere to prevent the longitudinal pipe from falling into the furnace below. An elbow connected to the longitudinal pipe on the furnace end of the pipe was directed downwardly to direct the hot airflow toward the hearth bottom. Resulting airflow was satisfactory and reduced the drying time required for the hearth bottom, but it was necessary to remove the tuyere associated with the longitudinal pipe in order to remove the longitudinal pipe from the tuyere, thereby disturbing the newly dried tuyere cooler packing and inducing breakout of the furnace during the blowing-in period of the blast furnace. In addition, many hours of furnace labor were required to remove the tuyeres and the directional devices.

OBJECTS OF THE INVENTION

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practice by the provision of an improved directional device for an orifice member, which directional device:

a. is secured to the orifice member by a packing material having sufficient bonding strength to secure the inlet end of the directional device to the orifice member during transmission of the fluid through the directional device;

b. has an inlet end of the directional device secured to the orifice member by a packing material having bonding strength which is insufficient to prevent the removal of the directional device from the orifice member into the work area without damage to or movement of the orifice member;

c. which reduces the drying period or fluid transmission period required to accomplish the work in the work area; and

d. which is readily removed from the orifice member within a minimum period of time.

BRIEF SUMMARY OF THE INVENTION

The aforesaid objects of this invention and other objects which will become apparent as the description proceeds are achieved by providing a directional device for an orifice member having a minimum orifice diameter and an orifice outlet end. The orifice member conducts the fluid in an outward direction through the orifice outlet end. The directional device directs the fluid in a predetermined direction toward a work area and has a longitudinal member provided with an outlet end and an inlet end. The inlet end of the longitudinal member has an inlet end diameter equal to or less than the minimum orifice diameter. Packing means are disposed between the inlet end and the orifice outlet end. The packing means has a bonding strength sufficient to secure the inlet end of the longitudinal member to the orifice member during the transmission of the fluid through the directional device but insufficient to prevent the removal of the directional device from the orifice member into the work area without damage to or movement of the orifice member. A directional member is connected to the outlet end of the longitudinal member for directing the fluid in the predetermined direction into the work area.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

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

FIG. 1 is a fragmentary side elevational view of the hearth section, slag notch section, and tuyere section of a blast furnace and showing an improved directional device of the present invention connected to one of the tuyeres of the blast furnace;

FIG. 2 is an enlarged fragmentary sectional view of the tuyere portion of the blast furnace and showing the details of the tuyere and the associated directional device;

FIG. 3 is a fragmentary view similar to FIG. 2 showing the longitudinal member of the directional device with a threaded inlet end and the directional member disposed at an angle of about 45° with the longitudinal member;

FIG. 4 is a view similar to FIGS. 3 and 4 of an alternative embodiment of the invention showing the longitudinal member of the directional device with a tapered head on its inlet end and the directional member disposed at an angle of about 60° with respect to the longitudinal member;

FIG. 5 is a view similar to FIGS. 2–4 of a further alternative embodiment of the invention showing the packing means containing nonmetallic or metallic fibers and the directional device disposed with respect to the longitudinal member at an angle of about 30°;

FIG. 6 is a view similar to FIGS. 2–5 of another alternative embodiment wherein the longitudinal member of the directional device is provided with a plurality of rings on its inlet end;

FIG. 7 is a view similar to FIGS. 2–6 of another alternative embodiment showing a coupling on the threaded inlet end of the longitudinal member and the directional member and its associated coupling omitted;

FIG. 8 is a view similar to FIGS. 2–7 of yet another alternative embodiment showing dimples on the inlet end of the longitudinal member and protuberances on tuyere; and

FIG. 9 is a view similar to FIGS. 2–8 of a further embodiment showing serrations on the tuyere and corrugations on the inlet end of the longitudinal member.

Although the principles of this invention are broadly applicable to an improved directional device for an orifice member having a minimum orifice diameter and an orifice outlet end and adapted to conduct a fluid in an outward direction through the orifice outlet end, this invention is particularly adapted for use in conjunction with a tuyere of a blast furnace and is adapted to conduct a heating fluid towards a work area, such as a hearth bottom or the like of the blast furnace, and hence it has been so illustrated and will be so described.

DETAILED DESCRIPTION

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

The blast furnace 10, being of conventional design, has a blast furnace wall 12 (FIGS. 1,2) formed of refractory brick of the Cone 23 Super Duty type made by Kaiser Refractory Company, Oakland, California or the like and a hearth bottom 14 formed of layers of high-duty-type refractory brick made by Kaiser Refractory Company, Oakland, California, Cone 23 super Duty or the like refractory brick. In the middle portions of FIG. 1 is disposed an orifice member, such as a tuyere 16 or the like. This tuyere 16 (FIGS. 1–7), suitably copper or the like, projects from the tuyere cooler 18 (FIGS. 1–9), suitably copper or the like. The tuyere 16 is secured to the tuyere

cooler **18** by means of machine taper fit or the like. The tuyere cooler **18** is secured to the brick wall **12** by means of a tuyere cooler seat **19** (FIGS. **1,2**), suitably steel or the like, by means of a machine taper fit with the copper tuyere cooler **18** and to the brick wall **12** by grouting and packing **20** (FIGS. **1–9**) of Ram 80 type made by Combustion Engineering Company, New York, N.Y. or the like. A heated fluid, such as heated air or the like at a temperature in the range of about 300° to about 1,000° F is conducted for a period of about 100 to 300 hours from a bustle pipe **22** (FIG. **1**) through a gooseneck **24**, a nipple **26**, a tuyere stock **28**, and blowpipe **30** into the tuyere **16** for the purpose, as shown in FIGS. **1,3**, of drying the newly lined hearth bottom **14** (FIG. **1**). A manual shutoff valve **32** (FIGS. **1,2**) is disposed between the nipple **26** and the tuyere stock **28**. The tuyere stock **28** is provided with a peep sight opening **34** through which the interior of the furnace **10** may be viewed during blast furnace operation and used in the instant case for the insertion of a rod or bar **29** (FIG. **2**) as will hereinafter be explained.

TUYERE 16

The tuyere **16** has a minumum orifice diameter *d*, (FIG. **2**) and an orifice outlet end **36** (FIGS. **2–9**). The tuyere **16**, in the particular case being illustrated in FIGS. **1,2**, is adapted to conduct a fluid such as heated air or the like, in an outward direction shown by the arrows in FIG. **2** through the orifice outlet end **36**.

DIRECTIONAL DEVICE 38

A directional device **38** for directing the heated air in a predetermined direction toward the work area, in this case the hearth bottom **14** of the blast furnace **10**, has a longitudinal member, suitably a straight piece of steel, ceramic or fire clay ceramic pipe **40** (FIGS. **1,2**) or the like, having an inlet end **42** (FIG. **2**) and an outlet end **44** (FIGS. **2–9**). The inlet end **42** of the longitudinal pipe **40** has an inlet end diameter d_1(FIG. **2**) which is equal to or less than the minimum orifice diameter *d* (FIG. **2**).

Packing means **46** (FIGS. **2–4, 6–9**) is disposed between the inlet end **42** of the longitudinal pipe **40** and the orifice outlet end **36**. For packing **46** the gannister-type packing or the like made by United States Steel Corporation, Pittsburgh, Pennsylvania may be used. This gannister-type mix has the following approximate composition:

about 12 percent pitch;
about 20 percent quartz of the crystalline type, ⅛ inch diameter; and
balance Goose Lake, Illinois natural clay.

The packing **46** has a bonding strength sufficient to secure the inlet end **42** of the longitudinal pipe **40** to the tuyere **16** during transmission of the heated fluid through the directional device **38** but insufficient to prevent the removal of the directional device **38** from the tuyere **16** into the work area or interior of the blast furnace **10** without damage to or movement of the tuyere **16** from the packing **20** between the tuyere **16** and the tuyere cooler **18** or from the tuyere cooler **18** itself.

A directional member, such as an elbow **48** (FIGS. **1,2**) or the like, is connected by means of a coupling **50** (FIGS. **1,2**) to the outlet end **44** of the longitudinal pipe **40** and directs the heated air in the predetermined direction of the arrows in FIGS. **1,2** into the work area adjacent the newly lined hearth bottom **14** of the blast furnace **10**.

In order to remove the directional device **38** (FIGS. **1, 2**) from the tuyere **16**, peepsight cover **52** (FIGS. **1,2**) is pivoted away from the peepsight hole **34** and the bar **29** (FIG. **2**) is inserted into the peepsight hole **34** (FIG. **2**) to loosen the packing **46** around the longitudinal pipe **40** and finally to push the directional device **38** (FIG. **2**) into the blast furnace **10** (FIG. **1**).

ALTERNATIVE EMBODIMENTS

It will be understood by those skilled in the art that alternatively the packing means **46** may be formed of the following materials shown in Table I below:

TABLE I

Plastic Refractory Manufacturer	
Ramite	C&E Refractories Division of Combustion Engineering Inc. Evergreen Park, Illinois
	inches
Ram 85	inches
Carbon Patch	Chicago Wellaville Company Chicago, Illinois
Heldspot	Kaiser Refractories Company Oakland, California
Tap Hole Mix	A. P. Green Refractories Company Subsidiary of U. S. Gypsum Co. Lansing, Illinois

In addition the following taphole mixes may be employed:

a. about 12 percent pitch;
about 10–12 percent quartz chips; and
balance ground fire clay made by Illinois Valley Mineral Corp., Ottawa, Illinois; and
b. such ground fire clay packed with an asbestos fire wicking As shown in FIG. **3**, the directional device **38**^{3}has a threaded inlet end **42**^{3}and the elbow **48**^{3}is disposed at an angle of about 45° with respect to the longitudinal pipe **40**^{3}.

In FIG. **4**, directional device **38**^{4}has its inlet end **42**^{4}provided with a tapered inner head **53** and the elbow **48**^{4} is disposed at an angle of about 60° with respect to the longitudinal pipe **40**^{4}.

In FIG. **5**, the packing means **46**^{5}is combined with nonmetallic or metallic fibers or filaments **54** and the elbow **48**^{5}is disposed at an angle of about 30° with respect to the longitudinal pipe **40**^{5}.

These fibers **54** may be formed of fiber glass, nylon, titanium, tungsten, copper, lead, steel, and the like and may be of round or nonround cross section. The nonround fibers may have a width dimension in the range of about 0.005 to about 0.15 inches, a thickness dimension in the range of about 0.001 to about 0.03 inches a length of about ¼ to about 3 inches and a percentage of the fibers **54** in a unit volume of the packing **46** in the range of about 0.33 to about 10.0 percent.

The filaments **54** are bonded to the packing means **46** and have an ultimate tensile strength at least equal to the average tensile stress developed in the filaments **54** at bond failure. In addition, the fibers **54** have a width-to-thickness ratio of not greater than about 5.

In FIG. **6**, the longitudinal pipe **40**^{6} has one or more rings **56** secured, as by welding or the like, to the inlet end **42**^{6}.

In FIG. **7** the inlet end **42**^{7} of the pipe **40**^{7}is threaded and has a coupling **58** threaded onto the inlet end **42**^{7}. The coupling **50** and elbow **48** are omitted in the embodiment. The inner portion of the tuyere **16** may be threaded at **59**.

FIG. **8** shows protuberances **60** on the tuyere **16**^{8} and dimples **62** on the inlet end **42**^{8} of the pipe **40**^{8}.

FIG. **9** uses serrations **64** on the tuyere **16**^{9} and corrugations **66** on the inlet end **42**^{9} of the pipe **40**^{9}.

It will be understood by those skilled in the art that any of the anchoring means shown in FIGS. **3** through **9** may be used on either the tuyere **16** or the inlet end **42** of the pipe **40** or on both.

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 improved directional devices **38** (FIGS. 1,2), **38³** (FIG. 3), **38⁴** (FIG. 4), **38⁵** (FIG. 5), **38⁶** (FIG. 6), **38⁷** (FIG. 7), **38⁸** (FIG. 8) and **38⁹** (FIG. 9) for an orifice member, such as a tuyere **16** or the like, which directional devices are secured to the orifice member **16** by a packing material **46** (FIGS. 1–4, 6–9) and **46⁵** (FIG. 5) having sufficient bonding strength to secure the inlet end **42** of the directional devices **38**, etc. to the orifice member **16** during transmisson of the fluid through the directional devices **38** etc. but having a bonding strength which is insufficient to prevent the removal of the directional devices **38**, etc. from the orifice member **16** into the work area without damage to or movement of the orifice member **16**; reduce the drying period of fluid transmission required to accomplish the work in the work area; and are readily removed from the orifice member **16** within a minimum period of time.

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

We claim:

1. In combination:

a. an orifice member having a minimum orifice diameter and an orifice outlet end and adapted to conduct a fluid in an outward direction through said orifice outlet end;

b. a directional device for directing said fluid in a predetermined direction toward a work area and having:

1. a longitudinal member having an inlet end and an outlet end,

a. said inlet end of said longitudinal member having an inlet end diameter equal to or less than said minumum orifice diameter,

2. packing means disposed between said inlet end of said longitudinal member and said orifice outlet end and having a bonding strength sufficient to secure said inlet end of said longitudinal member to said orifice member during transmission of said fluid through said directional device but insufficient to prevent the removal of said directional movement device from said orifice member into said work area without damage to or mont of said orifice member, and

3. a directional member connected to said outlet end of said longitudinal member for directing said fluid in said predetermined direction into said work area.

2. For an orifice member having a minimum orifice diameter and an orifice outlet end and adapted to conduct a fluid in an outward direction through said orifice outlet end, a directional device for directing said fluid in a predetermined direction toward a work area, said directional device having:

a. a longitudinal member having an inlet end and an outlet end;

1. said inlet end of said longitudinal member having an inlet end diameter equal to or less than said minumum orifice diameter,

b. packing means disposed between said inlet end of said longitudinal member and said orifice outlet end and having a bonding strength sufficient to secure said inlet end of said longitudinal member to said orifice member during transmission of said fluid through said directional device from said orifice member into said work area without damage to or movement of said orifice member, and

c. a directional member connected to said outlet end of said longitudinal member for directing said fluid in said predetermined direction into said work area.

3. The directional device recited in claim **2** wherein said longitudinal member is formed of a ceramic material.

4. The directional device recited in claim **2** wherein said packing means is a refractory material.

5. The directional device recited in claim **2** wherein said packing means is a plastic refractory material.

6. The directional device recited in claim **2** wherein said packing means has fibers disposed therein.

7. The directional device recited in claim **2** wherein said directional member is disposed at an angle with respect to said longitudinal member.

8. The directional device recited in claim **2** wherein one of said orifice member and said inlet end is threaded.

9. The directional device recited in claim **2** wherein one of said orifice member and said inlet end is headed.

10. The directional device recited in claim **2** wherein one of said orifice member and said inlet end has a ring secured thereto.

11. For an orifice member having a minimum orifice diameter and an orifice outlet end and adapted to conduct a fluid in an outward direction through said orifice outlet end, a directional device for directing said fluid in a predetermined direction toward a work area, said directional device having:

a. a longitudinal member having an inlet end and an outlet end;

1. said inlet end of said longitudinal member having an inlet end diameter equal to or less than said minimum orifice diameter, and

b. packing means disposed between said inlet end of said longitudinal member and said orifice outlet end and having a bonding strength sufficient to secure said inlet end of said longitudinal member to said orifice member during transmission of said fluid through said directional device from said orifice member into said work area without damage to or movement of said orifice member.

12. The directional device recited in claim **2** and having a coupling member on one of said orifice member and said inlet end.

13. The directional device recited in claim **2** and having protuberances on one of said orifice member and said inlet end.

14. The directional device recited in claim **2** and having dimples on one of said orifice member and said inlet end.

15. The directional device recited in claim **2** and having corrugations on one of said orifice member and said inlet end.

16. The directional device recited in claim **2** and having serrations on one of said orifice member and said inlet end.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,610,183 Dated October 5, 1971

Inventor(s) Lambert J. Kilboy, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet [72], "Lambert J. Kolboy" should read -- Lambert J. Kilboy -- . Column 4, under TABLE I, lines 10-19, should read as follows:

-- Plastic Refractory	Manufacturer
Ramtite	C&E Refractories Division of Combustion Engineering Inc. Evergreen Park, Illinois
Ram 85	"
Carbon Patch	Chicago Wellaville Company Chicago, Illinois --

line 41, "40f" should read -- 40^4 -- . Column 5, line 44, cancel "movement"; line 46, "mont" should read -- movement -- .

Signed and sealed this 14th day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O--366-334.