United States Patent

[11] 3,608,880

[72] Inventors **Marcel Gombert**
Metz-Queuleu;
Pierre Leroy, St. Germain en Laye; Emile Sprunck, Moyeuvre-Grande, all of France

[21] Appl. No. **5,303**
[22] Filed **Jan. 23, 1970**
[45] Patented **Sept. 28, 1971**
[73] Assignee **Wendel-Sidelor and Compagnie des Ateliers et Forges de la Loire (St-Charmand, Firming, St-Etienne, Jacob Holtzer)**
[32] Priority **Jan. 28, 1969, Nov. 6, 1969**
[33] **France**
[31] **6,901,640 and 6,938,151**

[54] **BLAST FEED DEVICE FOR A STEEL CONVERTER**
14 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **266/34 T,** 266/41
[51] **Int. Cl.** **C21c 7/00**
[50] **Field of Search** ..... 266/41, 35, 36 P, 34 L, 34 T; 122/6.6; 110/182.5

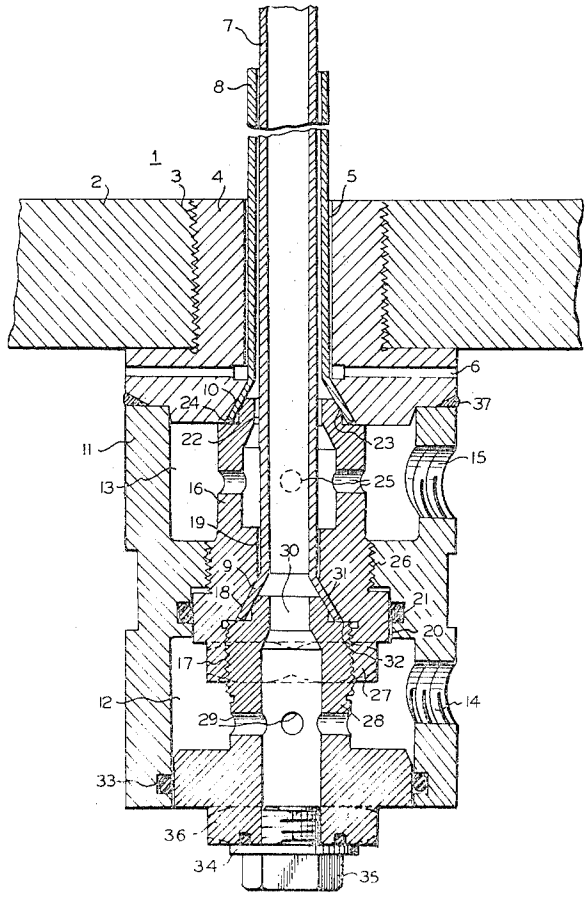
[56] **References Cited**

UNITED STATES PATENTS

2,562,813	7/1951	Ogorzaly et al.	266/35
3,397,878	8/1968	Holmes et al.	266/41

Primary Examiner—Gerald A. Dost
Attorney—Wenderoth, Lind & Ponack

ABSTRACT: This device for supplying wind to be blown through the bottom of a steel converter, adapted to ensure a double yet separate feed to the blast tuyeres and wherein said tuyeres comprise for each blowhole a pair of concentric metal tubes adapted to be supplied with different gaseous substances, such as a combustive agent, for instance pure oxygen, and a cooling gas such as water steam or carbon dioxide gas, said device comprising essentially a body constituting a two-compartment chamber, each compartment being adapted to supply a specific substance annularly to at least one injector having its head engaged in a fluidtight manner against the base of the particular one of the pair of tubes of each tuyeres which it is intended to supply with this gaseous substance.



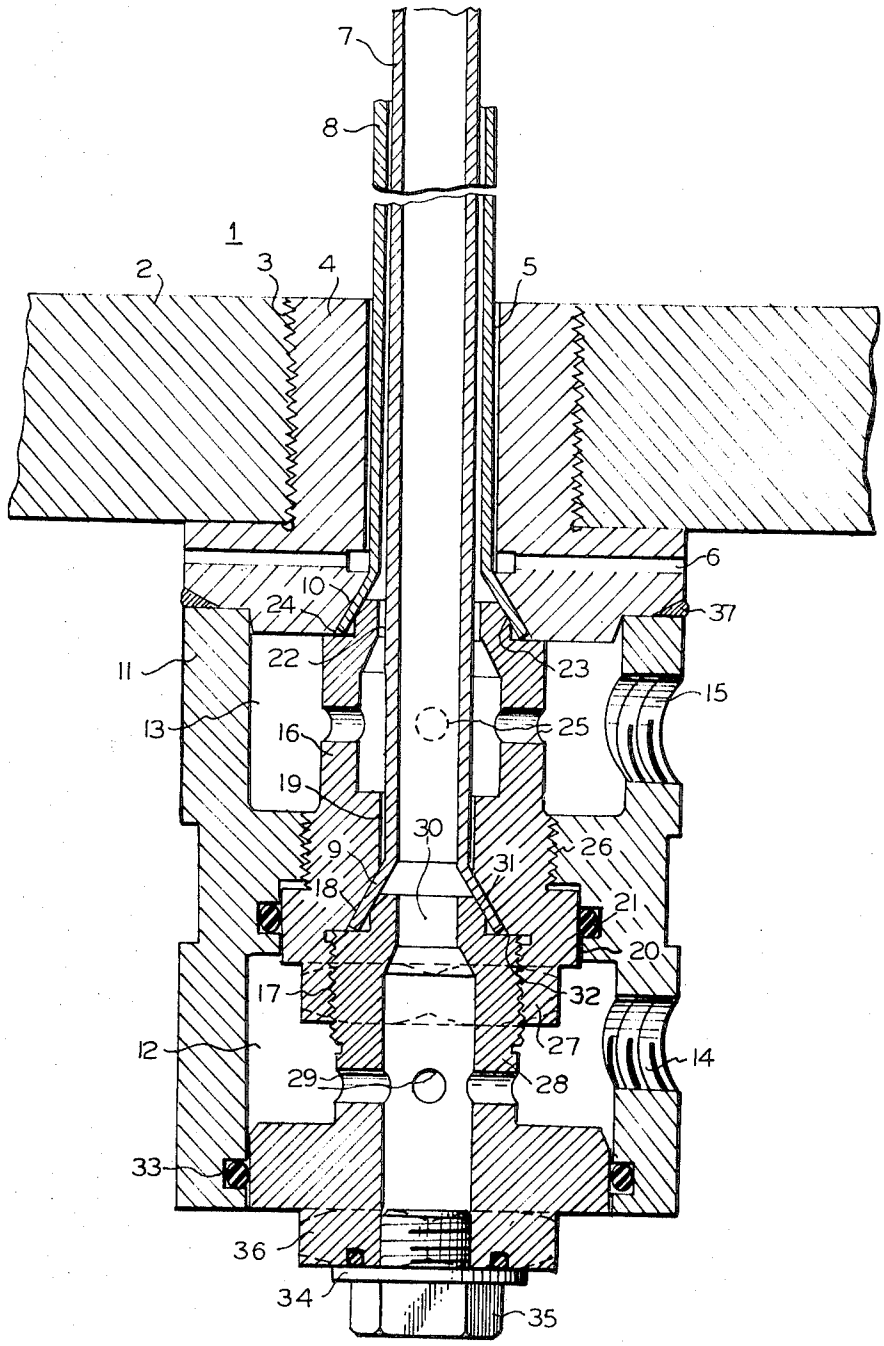


FIG. 1

INVENTORS
MARCEL GOMBERT
PIERRE LEROY
EMILE SPRUNCK

BY Wenderoth, Lind & Ponack

ATTORNEYS

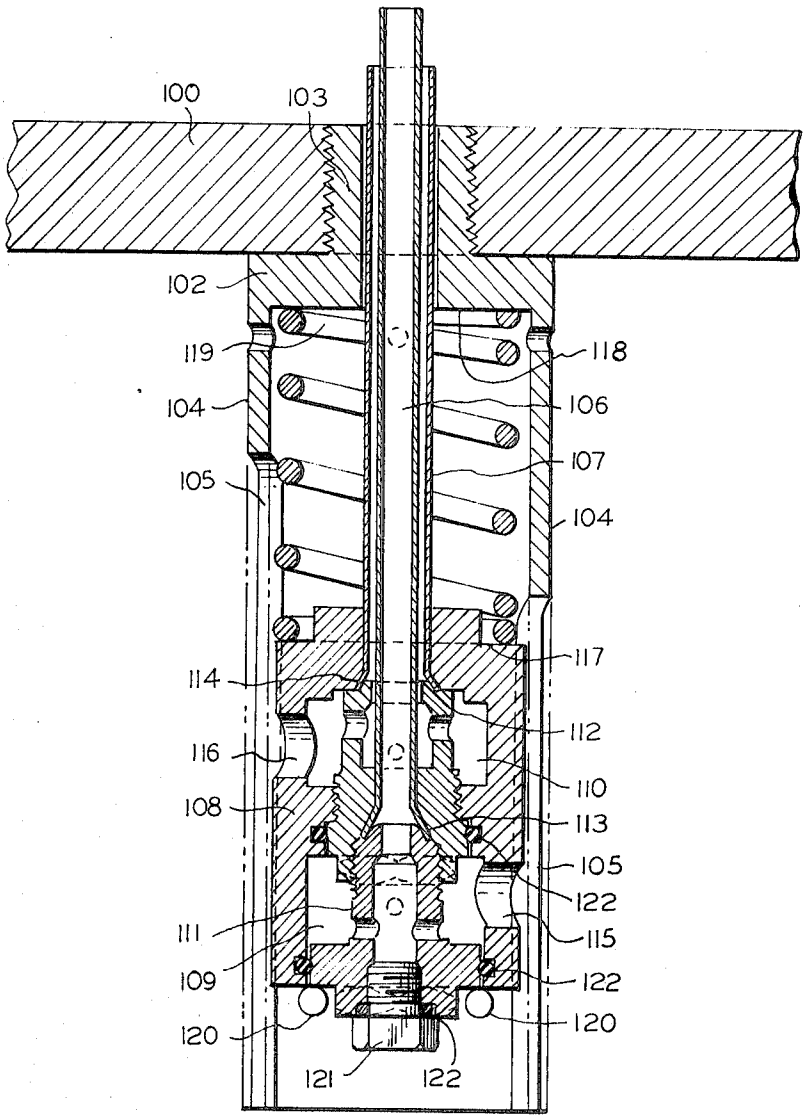


FIG. 2

INVENTORS
MARCEL GOMBERT
PIERRE LEROY
EMILE SPRUNCK

BY Winderoth, Lind & Ponack
ATTORNEYS

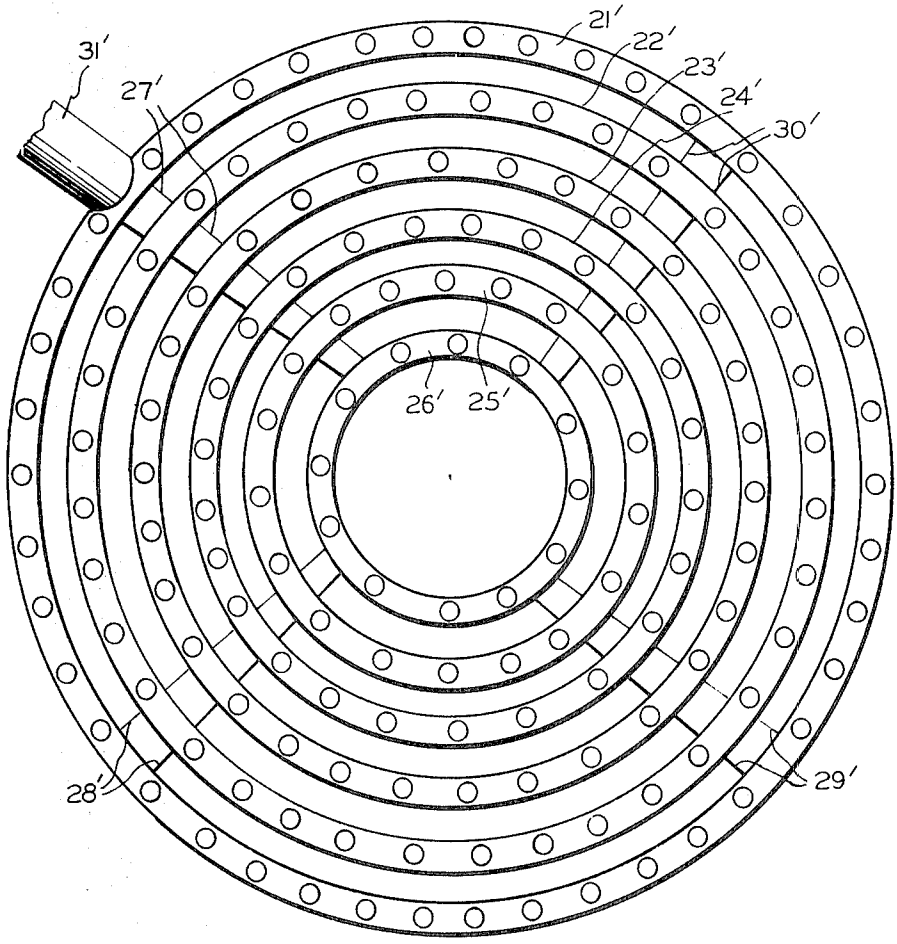


FIG. 6

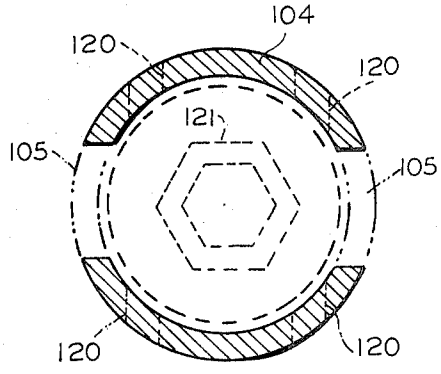


FIG. 3

INVENTORS
MARCEL GOMBERT
PIERRE LEROY
EMILE SPRUNCK

BY Wenderoth, Lind & Ponack
ATTORNEYS

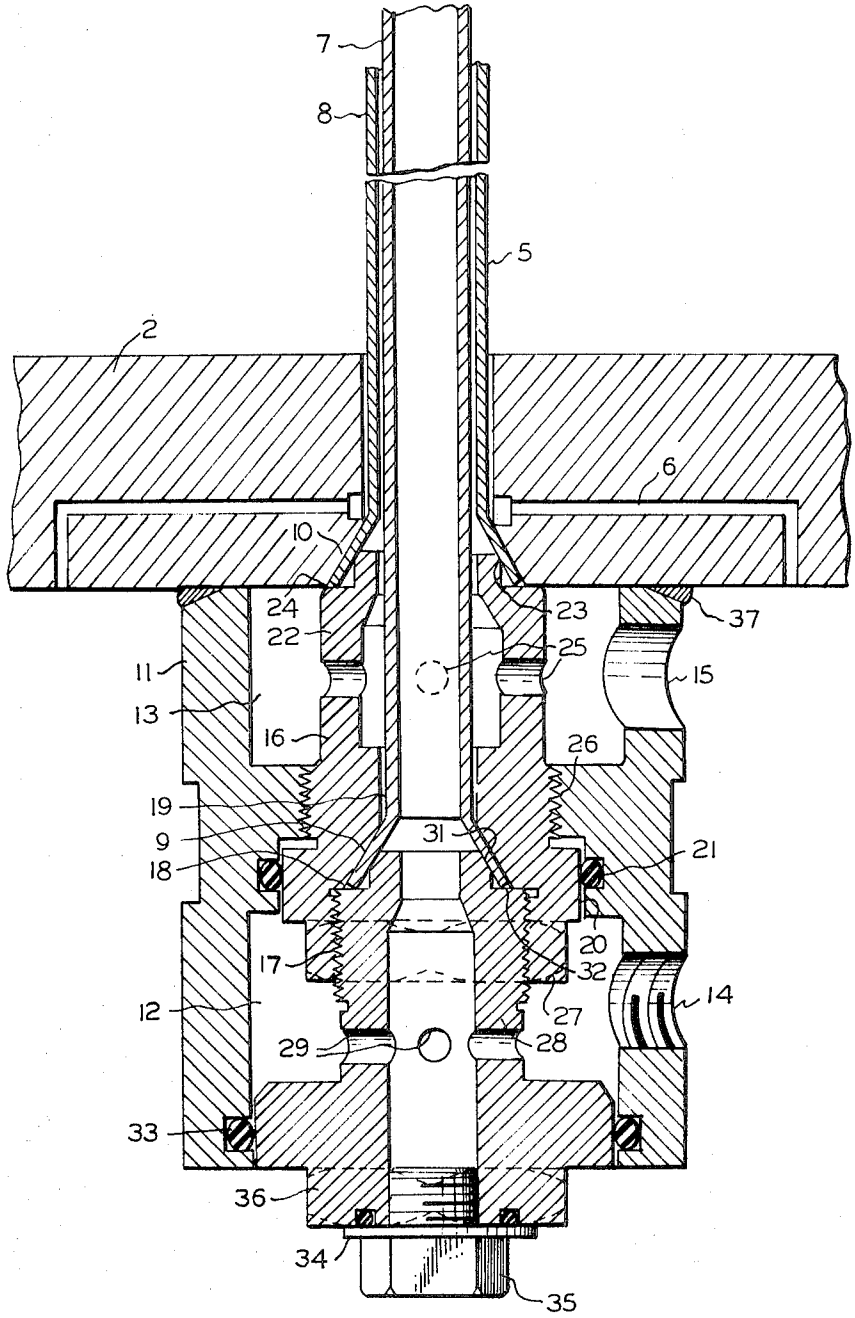


FIG. 4

INVENTORS
MARCEL GOMBERT
PIERRE LEROY
EMILE SPRUNCK

BY Wenderoth, Lind & Ponack
ATTORNEYS

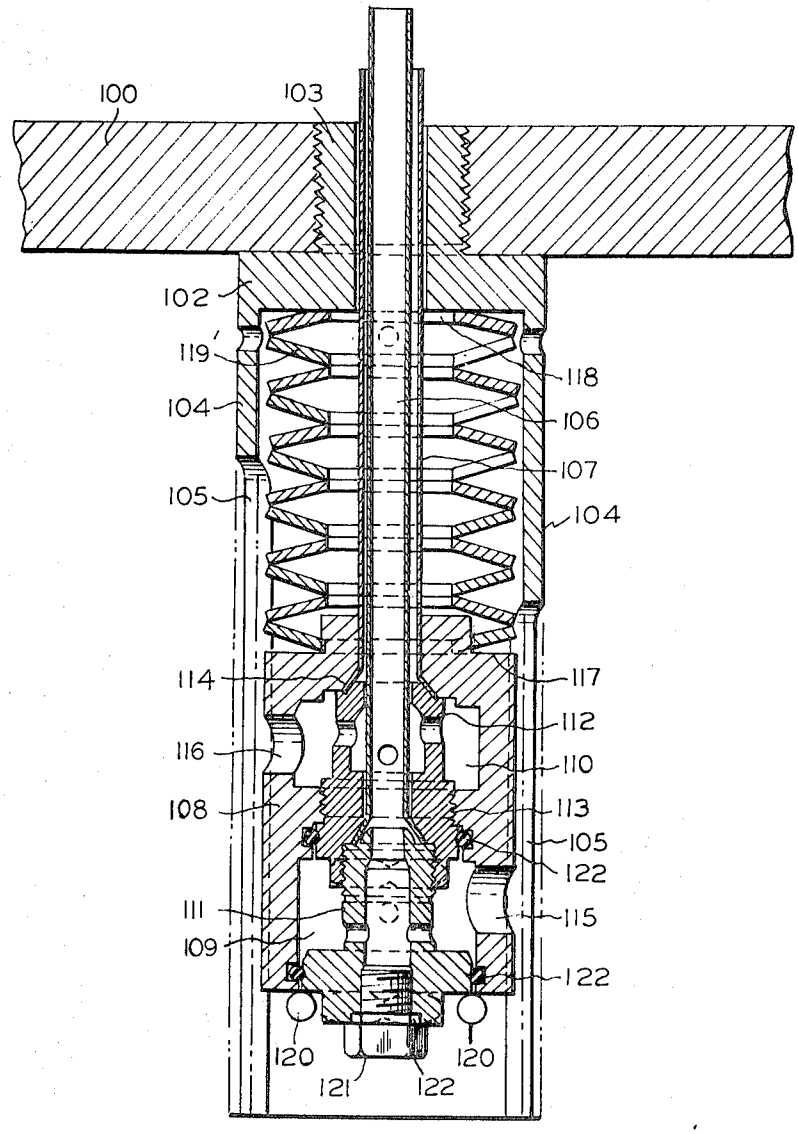


FIG.5

INVENTORS
MARCEL GOMBERT
PIERRE LEROY
EMILE SPRUNCK

BY Wenderoth, Lind & Ponack
ATTORNEYS

BLAST FEED DEVICE FOR A STEEL CONVERTER

In a prior Pat. application Ser. No. 739,553 filed June 24, 1968 by Pierre Leroy, there is described a device for supplying wind to be blown through the bottom of a steel converter, which is particularly advantageous when the blast pressure exceeds 3 bars or 43 p.s.i. This device comprises a plurality of header tubes under pressure having either the shape of concentric tores or any other suitable configuration, each header being adapted to supply blast wind to a number of blast pipe or blowholes disposed in the bottom of the converter.

In aforesaid prior patent application there are provided, for connecting each header to the blasthole proper, either flexible hoses, or small-diameter tubes forming one or more turns in order to impart a certain elasticity thereto, either device being advantageously provided with self-sealing unions.

Each blasthole or pipe consisting of a metal tube is supplied with blast wind through a movable injector engaging in a fluidtight manner, with its head, the frustoconical base of the metal tube, this injector being fed in turn from a blowing box or like chamber under pressure communicating therewith. If desired, this injector may be provided with a movable valve member, the injector axis and the valve axis being both coincident with the axis of the pipe or like means constituting the blowpipe or hole.

In case a relatively great number of such blast pipes are provided, these are relatively close to each other and the devices for connecting them to the above-mentioned headers become cumbersome. Therefore, in said former patent application a device is provided which is characterized in that each header under pressure is mounted directly to the baseplate, against a row of blowholes, and that a movable injector, with or without valve or sealing member, extends therethrough, the injector axis and possibly the axis of the valve or sealing member being coincident with the axis of the metal tube constituting the relevant blowhole.

In the devices described and illustrated in said patent application and of which the essential features are briefly summarized in the foregoing, the bottom of the steel converter is supplied with blow wind consisting of a single gas, either pure or in admixture.

Now it may be necessary for certain processes, to blow simultaneously two different gases through a common tuyere, the latter comprising a double feed system so designed that it is possible to blow on the one hand along the axis of said tuyere pure oxygen or oxygen-enriched air, or any other suitable gaseous combustive agent, and on the other hand, along the outer periphery of said oxygen jet, a cooling gas such as water steam or carbon dioxide gas.

It is the essential object of the present invention to permit a general application of the devices described and illustrated in the aforesaid prior patent application (originally designed for a single-feed system) to a double-feed system, so that two gases not mixed beforehand can be blown simultaneously under pressures in excess of 3 bars (43 p.s.i.) i.e. the value constituting the maximum blowing pressures in Bessemer and Thomas steelmaking processes, so that blowing pressures of the order of 20 bars (290 p.s.i.) or more can be used.

To this end, the present invention is concerned primarily with an arrangement permitting the double and separate feed of blowing tuyeres provided at the bottom of a steel converter with two different gases, wherein said tuyeres comprise in each blowhole a pair of concentric metal tubes, this device being characterized in that it consists of a chamber comprising two separate compartments each adapted to supply in a radial direction at least one injector engaging in a fluidtight manner, with its head, the base of the specific tube of each tuyere to be supplied with this gas.

It is another object of the present invention to provide different forms of embodiment of this device, the first form of embodiment being applicable to a limited number of tuyeres, the second form of embodiment being applicable preferably to a greater number of tuyeres.

In the first form of embodiment, each tuyeres comprises its separate, preferably cylindrical, two-compartment feed chamber, and each compartment is connected to the relevant gas header through a flexible hose or tube of relatively small diameter. Under these conditions, the number of flexible hoses or tubes is twice that of the tuyeres.

In the other form of embodiment, each row of tuyeres comprises a separate two-compartment feed chamber, preferably of toroidal configuration, receiving therethrough, in alignment with each tuyere, a pair of injectors each connected to a separate compartment, each one of the pair of toroidal compartments being fed at one or a plurality of circumferentially spaced points through any suitable means, small-diameter pipe or flexible hose.

In each one of these forms of embodiment the lowermost injector of each tuyere feeding the central tube may be provided with a valve member of the type already described in the aforesaid patent application, and adapted to be used when it is desired to measure the degree of wear of the tuyere in actual service, for example for detecting an abnormally high rate of wear in comparison with the rate of wear of the other tuyeres.

However, it is also possible to dispense with this valve member and in this case the measurement of the rate of wear of a tuyere and the putting of this tuyere out of service are effected by unscrewing a screw plug at the base of the central injector and introducing into the central tube of the tuyere involved a solid rod, or alternately by clogging this tube with a suitable pulverulent product.

After exhaustive tests the applicants found that in actual service, during a refining process consisting in converting cast iron into steel, the outer tube of each tuyere was stressed mainly in the longitudinal direction, this causing movements of the order of several centimeters directed mostly towards the inside of the converter. If the outer tube is secured in a rigid manner, considerable strain may result, which may cause tearing, stripping, torsions, etc. resulting in detrimental and dangerous leakages.

The true reasons of these longitudinal efforts exerted against the external tube of each tuyere have not been clearly identified so far. It appears that they are ascribable to complex reasons including the following phenomena:

inherent distorsions of the refractory bottom, consisting chiefly of tarred dolomites;

development of a protrusion of solidified metal of variable magnitude, at the inner end of the external tube, which is pushed by the wind pressure exerted against this protrusion;

convection movements of the liquid bath around the tuyeres due to the impulse of the gaseous jet issuing therefrom, with due consideration for the aforesaid protrusion of solidified metal.

Whatever the real causes of these longitudinal stresses, the solution for avoiding their detrimental tearing and breaking action on the external tube consists in removing any rigidity from the mounting of the assembly comprising each two-compartment chamber and the corresponding tubes.

Consequently, this invention is also concerned with the provision of a device for supplying blow wind to the bottom of a refining converter, said device being arranged with a view to ensure a double yet separate supply of gaseous substances to blowing tuyeres comprising two concentric tubes, which device consists of a chamber comprising two separate compartments each adapted to feed annularly at least one injector of which the head engages on the one hand, in a fluidtight and rigid manner, the base of the tube of each tuyere which is fed thereby, said device being characterized in that said two-compartment chamber rigid with the two tubes of the tuyere is adapted to slide within a guide sheath rigidly secured to the bottom plate of the converter, the front face of said chamber bearing against a suitable resilient member fitted against and/or into the bottom plate, the rear face of said chamber abutting on the other hand against any suitable locking means, such as one or a pair of transverse pins.

According to a specific feature characterizing this invention said resilient member consists of one or a plurality of springs, or a set of dished spring washers, or the like.

As will be readily understood, this last-mentioned improvement consists in imparting a certain longitudinal flexibility to the assembly comprising the pair of coaxial tubes and their two-compartment feed chamber. Since in most instances the external tube is urged towards the inside of the converter, the resilient member such as a coil compression spring or a set of dished spring washers or other suitable means is disposed between the front face of each chamber and the bottom plate of the converter. On the opposite end, i.e. adjacent the rear face, some resilient means may also be provided, if desired, but in most instances it would prove useless. From this side, for safety reasons, a locking system may be introduced which consists simply of one or a pair of transverse lock pins constituting abutment members in the outward direction, thus preventing the movable system from being accidentally expelled or ejected from its receiving cavity.

Other features and advantages characterizing this invention will appear as the following description proceeds with reference to the attached drawing illustrating diagrammatically be way of example a plurality of forms of embodiment. In the drawing:

FIG. 1 illustrates in axial section a device according to this invention, the section being taken along the axis of a blowing tuyere; however, this section is a meridian section of the cylindrical device in the case of the first form of embodiment broadly set forth hereinabove, and a transverse or cross section of the toroidal device in the case of the other form of embodiment, as will be explained hereinafter;

FIG. 2 illustrates a meridian section of a third form of embodiment;

FIG. 3 is a cross section of this third form of embodiment;

FIG. 4 is a view similar to FIG. 1 illustrating a modified construction;

FIG. 5 is a view similar to FIG. 2 wherein a different type of spring construction is used; and

FIG. 6 is a plan view illustrating a toroidal construction wherein six headers supply the blast air and the communication ducts associated therewith.

Referring ot FIG. 1, the reference numeral 2 designates the bottom plate supporting the bottom 1 of the converter, of refractory material. This bottom plate 2 has formed therethrough an orifice 3 in which a sleeve designated in general by the reference numeral 4 is fitted. This sleeve 4 comprises an axial bore 5 and a plurality of channels such as 6, the function of which will be explained presently.

The concentric metal tubes 7 and 8 constituting the tuyeres proper are positioned in said axial bore 5 of sleeve 4. In the example illustrated, copper tubes are used to this end, the central tube having an inner diameter of 12 mm. (0.47 inch) and an outer diameter of 14 mm. (0.55 inch), and tube 8 has an inner diameter of 20 mm. (0.787 inch) and an outer diameter of 22 mm. (0.865 inch). In the central tube 7 having a length slightly greater than that of tube 8, a suitable gas such as pure oxygen is blown, and the outer tube 8 or more exactly the annular space formed between these tubes 7 and 8 receives a gaseous coolant. Both tubes 7 and 8 are formed with frustoconical outer ends shown at 9 and 10, respectively.

The sleeve 4 has welded to its underface 37 a body designated in general by the reference numeral 11 which constitutes a chamber divided into two compartments 12 and 13 respectively. Compartment 12 is fed with combustive gas (pure oxygen, for instance) through an inlet 14, and compartment 13 is fed with a gaseous coolant (such as water steam) through another inlet 15.

The concentric tubes 7 and 8 are fed through injectors 28 and 16, respectively.

The injector 16 of gaseous coolant has a bottom opening comprising in succession firstly a screw-threaded cylindrical portion 17, then a plain frustoconical portion 18 and finally a plain cylindrical portion 19, this opening being adapted to receive the central tube 7 with its frustoconical base 9 engaging the corresponding portion 18, and also the second injector 28 having its head screwed in the first portion 17.

On its outer lower face the injector 16 comprises a shoulder 20 engaging one or a plurality of rubber seals such as 21 fitted in annular grooves formed in the inner wall of body 11. The head of injector 16 comprises along its axis an aperture 22 having a greater diameter than tube 7 so as to permit the passage of cooling gas between injector 16 and tube 7, and thus introduce this gas into the annular space between the tubes 7 and 8. (In the example illustrated the diameter of opening 22 is 18 mm. (0.7 inch).

The outer face of the head portion of injector 16 comprises a rounded portion 23 bearing against the frustoconical base 10 of tube 8, and also a flat shoulder 24 engaging the sleeve 4.

The injector 16 further comprises a plurality of radial openings such as 25 through which the gaseous coolant delivered to compartment 13 via inlet 15 is introduced into the injector proper and thence between the tubes 7 and 8. This injector 16 is screwed to the body 11 by means of threads 26 when its lower portion 27 is rotated until the shoulder 24 abuts against the sleeve 4; simultaneously, the rounded portion 23 clamps without any excessive tightening force the frustoconical base portion 10 of tube 8 against the sleeve 4.

The injector 28 of gaseous combustion agent comprises a plurality of radial openings such as 29 through which this gaseous agent delivered to compartment 12 via inlet 14 is introduced into this injector and thence through an axial aperture 30 into the central tube 7. This axial aperture 30 has the same diameter as tube 7, i.e. 12 mm. (0.47 inch) in the example illustrated.

The outer face of the head of injector 28 comprises, like the outer face of the head of injector 16, a rounded portion 31 bearing against the frustoconical base portion 9 of tube 7, and a flat shoulder 32 engaging the base of the frustoconical contour 18 of injector 16. The fluid tightness between injector 28 and body 11 is obtained by means of one or a plurality of rubber seals such as 33. The base of injector 28 is normally sealed by a screw plug 34 adapted to be unscrewed in case of need by rotating its hexagonal head 35.

This injector 28 is screwed in the tapped contour 17 of injector 16 when its lower portion 36 is rotated until the shoulder 32 abuts against the base of the frustoconical contour 18 of injector 16, and the rounded portion 31 clamps without any excessive force the frustoconical base portion 9 of the tube 7 against the contour 18 of injector 16.

In a first form of embodiment of the device according to this invention, which comprises a relatively small number of tuyeres, say less than 40, each tuyere incorporates its inherent device providing the double but separate gas supply, in the form of a substantially cylindrical chamber of which the figure shows in this case a meridian section. For each tuyere the inlets 14 and 15 are connected to one or a plurality of oxygen-feed headers and to one or a plurality of cooling-gas feed headers, by means of flexible hoses. The oxygen and cooling-gas headers (not shown in FIG. 1) are secured to the converter and themselves adapted to be supplied at one or several points either through a rigid duct extending through the hollow trunnion of the converter or through a large flexible hose. These two headers may advantageously have a toroidal configuration.

If a greater number of tuyeres is contemplated, the number of flexible hoses would obviously become prohibitive. Therefore, in this case a modified or second form of embodiment may advantageously be used wherein a double but separate feed system consisting of a chamber of toroidal configuration, of which the cross-sectional illustration is shown in FIG. 1, is disposed beneath each row of tuyeres, with the only difference that the sleeve 4 is dispensed with and that the annular body 11 is welded directly to the bottom plate 2, the base 10 of tube 8 being clamped between the rounded head 23 of injector 16 and a frustoconical contour machined in the baseplate 2 (not shown in the FIG.). Under these conditions, the number of annular chambers or bodies 11 corresponds to the number of rows of tuyeres in the converter bottom. Each annular body 11 may thus comprise one or a plurality of pairs of inlets 14,

15 connected through flexible hoses or rigid tubes to the supply ducts delivering on the one hand pure oxygen and on the other hand a gaseous coolant. However, in this second form of embodiment each tuyere is still comprised of a first injector 16 and a second injector 28 both of revolution about the axis of the corresponding tuyere, as in the first form of embodiment. Only the body 11 which was of cylindrical configuration about the tuyere axis in the first form of embodiment is now toroidal about the axis of the converter bottom, in the second form of embodiment.

In either forms of embodiment any leakage of oxygen to the outside is positively prevented by the rubber seal 33. Any communication between compartments 12 and 13 is prevented by the rubber seal or ring 21. Finally, any possible gaseous leak between the base 10 of outer tube 8 and sleeve 4 would be exhausted via the leakage ducts 6 provided in this sleeve 4 and could therefore not seep to the bottom of the converter. In the second form of embodiment, the sleeve 4 is dispensed with as already explained hereinabove and the leakage duct 6 are formed in the bottom plate 2 proper, and open of course to the outside, under the bottom plate, as already explained in the above-mentioned prior patent application.

Now reference will be made to FIGS. 2 and 3 of the drawing which illustrate a third form of embodiment of the present invention. In the bottom plate 100 of the converter a member 102 is secured by screwing; this member 102 comprises on the one hand a socket 103 formed with a cylindrical bore and tightly fitted into the plate 100, and on the other hand a guide portion consisting of a cylindrical skirt 104 formed with expansion slots 105; this skirt 104 is open at its end opposite to the bottom plate 100.

Slidably mounted in this guide skirt 104 is a unit comprised of the pair of tubes 106 and 107, and the member 108 providing a two-compartment chamber 109, 110 enclosing the injectors 111 and 112, these injectors engaging in a fluidtight manner, with their heads, the bases 113, and 114, respectively, of tubes 106 and 107.

The oxydizing gas, for example pure oxygen, is fed through an aperture 115 into the chamber 109 via a flexible hose (not shown). The gaseous coolant, such as water steam, is fed into chamber 110 via an opening 116 and the supply is through another flexible hose (also not shown).

Between the front face 117 of member 108 and the inner bottom 118 of member 102 is a coil compression spring 119 or any other suitable resilient means reacting against the bottom 118.

On the other side of member 108 the ports 120 formed in said guide skirt 104 permit the passage of a pair of transverse lock pins (not sown) extending through the drain plug 121 so as to avoid any interference with the necessary disassembling operations.

Finally, inside the member 108 toroidal seals 122 provide the necessary fluid tightness at the proper locations.

The spring 119 is so calculated and constructed that in the absence of any tractive effort exerted in the upward direction on the outer tube 107, as seen in the FIGURE, the member 108 constituting the two-compartment chamber abuts against the pair of lock pins without exerting any pressure thereon outside the one resulting from its inherent weight, whether the spring is fully expanded in this position and the maximum tractive effort exerted in the upward direction as seen in the FIGURE and to which the tube 107 is normally subjected is inferior to the force necessary for compressing the spring 119 home against the bottom 118.

Thus, the movable assembly has all the desired flexibility for preventing any tearing off or rupture of tube 107.

In the construction of FIG. 4 the sleeve 4 has been eliminated and the annular body 11 is welded directly to the bottom plate 2. The base 10 of the tube 8 is clamped between the rounded head 23 of the injector 16 and a frustoconical contour machined in the baseplate 2.

FIG. 5 is similar to FIG. 2 with the exception that the spring 119 has been changed to the Belleville-type springs 119'.

The form of embodiment of FIG. 6 comprises six headers disposed each beneath one of the six rows of blastholes of the converter bottom.

The communication between the headers and the blastholes is obtained by means of one nozzle or injectors per hole, each nozzle or injector being provided with a valve member.

FIG. 6 illustrates six toroidal headers 21', 22', 23', 24', 25' and 26' corresponding to the six rows of blastholes. The header 21' corresponds to the peripheral row, and is secured to the baseplate 2.

These headers are interconnected by four communication ducts 27', 28', 29' and 30' of which the cross-sectional passage area decreases towards the center, according to a law ensuring a uniform distribution of the blast through the complete set of blastholes.

The blast wind under pressure is supplied to the device through the inlet 31'.

The blast inlet duct 31' is welded both to the plate 2 supporting the bottom of the converter (not shown) and to the peripheral header 21'. The blast penetrates both into the peripheral header 21' and into the communication duct 27'. It penetrates through these two paths into the complete device consisting of the six headers and the four communication ducts.

Of course, it would not constitute a departure from the basic principles of this invention to bring various modifications and detail improvements in the practical embodiment of this invention, and even to contemplate the use of equivalent means.

Besides, this invention is applicable not only to the bottoms of refining converters such as steelwork converters but also to any other apparatus comprising a double yet separate feed, such as reactors, condensers, heat transfer apparatus, burners, etc. wherein a certain flexibility of the tubes is required for reasons specific to the case contemplated.

What is claimed is:

1. A device for supplying wind to be blown through the bottom of a steel converter, adapted to ensure a double yet separate feed to the blast tuyeres and wherein said tuyeres comprise for each blowhole a pair of concentric metal tubes, said device consisting of a body constituting a two-compartment chamber wherein each compartment is adapted to supply a gaseous substance annularly to at least one injector having its head engaged in a fluidtight manner against the base of the particular one of the pair of tubes of each tuyere which it is intended to supply with one gaseous substance.

2. A device as set forth in claim 1, wherein each tuyere comprises a separate feed chamber having two compartments, said chamber being preferably cylindrical, each compartment of said chamber being connected to the corresponding gas header through a flexible hose or a small-diameter tube.

3. A device as set forth in claim 1, wherein each row of tuyeres comprises a separate feed chamber having two compartments, said chamber being preferably of toroidal configuration and receiving therethrough, registering with each tuyere, the pair of injectors each connected to a separate compartment, and each one of said compartments is supplied with gaseous substance at one or a plurality of points of its circumference through any suitable means such as a flexible hose or a small diameter tube.

4. A device as set forth in claim 3, wherein the injector of each tuyere which feeds the central tube is closed at its base by a screw plug adapted to be unscrewed in case of need.

5. A device as set forth in claim 1, wherein the base of the tubes of said tuyeres has a frustoconical portion adapted to coact with a frustoconical portion provided on each one of the corresponding injector heads.

6. A device as set forth in claim 5, characterized in that the base of the tubes of said tuyeres is frustoconical and adapted to coact with a corresponding frustoconical portion provided on each one of the heads of the corresponding injectors for ensuring the necessary fluidtightness.

7. A device as set forth in claim 2, wherein said two-compartment chamber is welded to a sleeve inserted into a hold formed through the bottom plate of the converter.

8. A device as set forth in claim 7, wherein said sleeve comprises one or a plurality of ducts opening into the surrounding atmosphere and acting as leakage ducts.

9. A device as set forth in claim 3, characterized in that said chamber is welded directly to the underface of the bottom plate of the converter which is provided with leakage ducts opening to the outside beneath said bottom plate.

10. A device as set forth in claim 1, wherein said two-compartment chamber rigid with the pair of tubes of the tuyeres is adapted to slide in a guiding cylindrical skirt rigidly secured to the bottom plate of the converter, the front face of said chamber bearing against a resilient member reacting against and/or into said bottom plate, its rear face being adapted to react against a locking system.

11. A device as set forth in claim 10, wherein said resilient member consists of spring means.

12. A device as set forth in claim 10, wherein said resilient member consists of a set of dished spring washers.

13. A device as set forth in claim 10, wherein said locking system consists of one or a plurality of transverse lockpins extending through slots formed in said guide skirt.

14. A device as set forth in claim 10, wherein said resilient member is so arranged that, in the absence of any tractive effort exerted on the external tube in the direction of the bottom of said converter, said two-compartment chamber abuts against said locking system, without any other pressure than that resulting from its inherent weight, said resilient member being expanded completely in said position and the maximum tractive effort exerted in the direction of the bottom of said converter and to which the outer tube is normally subjected is inferior to the effort necessary for compressing home said resilient member against the bottom of the converter.