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[54] LANCE FOR BLOWING OXYGEN INTO A KALDO FURNACE

6 Claims, 2 Drawing Figs.

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[51] Int. Cl. F22b 37/00
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[56] References Cited

UNITED STATES PATENTS

3,169,161	2/1965	Kurzinski	266/34
3,112,194	11/1963	DeVries	266/34
3,321,139	5/1967	Martin	266/34

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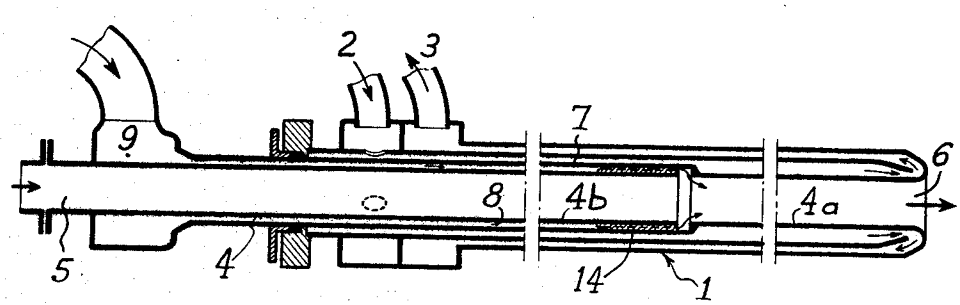
ABSTRACT: A lance for blowing oxygen into a Kaldo furnace for refining iron into steel which comprises a main oxygen duct, auxiliary oxygen duct means and cooling circuit. The auxiliary duct means debouch substantially tangentially into the main oxygen duct at a point spaced from the outlet orifice of the lance by a distance which is at least four times the mean diameter of the portion of the main duct between the outlet orifice and the auxiliary oxygen duct means.



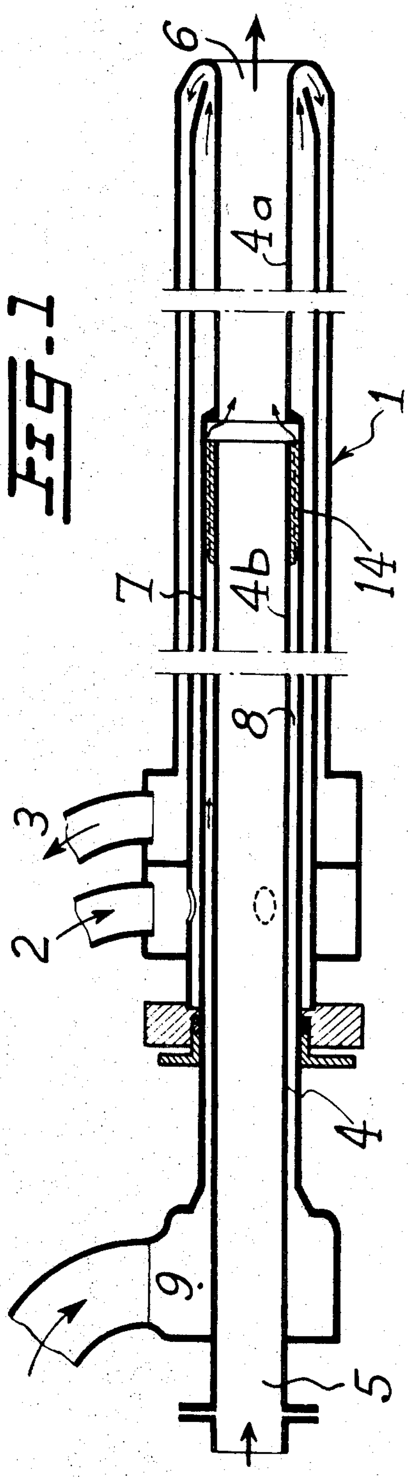


FIG. 1

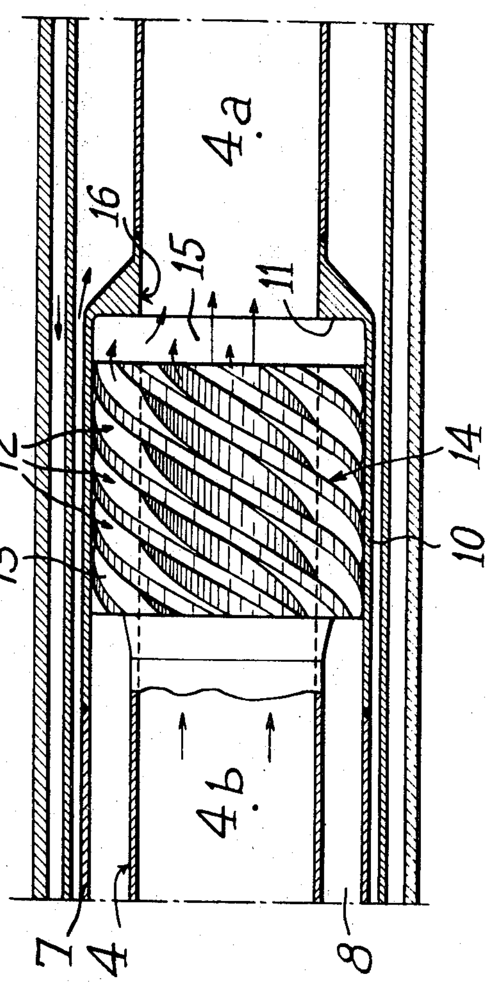


FIG. 2

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LANCE FOR BLOWING OXYGEN INTO A KALDO FURNACE

BACKGROUND OF THE INVENTION

This invention relates to a lance for blowing oxygen into a furnace for refining iron into steel by the Kaldo process.

In the Kaldo process, molten iron is contained in a furnace which is rapidly rotated about its longitudinal axis and which is inclined at an angle, generally about 16°—20°, to the horizontal. The furnace has an opening at one end through which a lance directs oxygen on to the slag-metal surface. The lance is inclined at an angle, generally about 20° to about 30°, to the horizontal. Frequently, the lance is provided with a separate motor to enable it to be given a sweeping or oscillating motion in relation to the slag-metal surface when desired. The oxygen is delivered by the lance at a linear flow rate such that one portion of the oxygen penetrates into the slag-metal bath and serves, more particularly, for the combustion of carbon to form carbon monoxide, and another portion of the oxygen remains in the free space of the furnace and is used in the combustion of the carbon monoxide issuing from the bath into carbon dioxide. The combustion of the carbon monoxide, which takes place in the furnace itself, improves the thermal economy of the refining operation and permits the melting of a considerable quantity of iron. With a lance of a given outlet orifice diameter the volume flow rate of oxygen determines the linear flow rate of this gas on impact with the slag-metal bath. At the same time, the desirability of obtaining an optimum combustion coefficient for the conversion of carbon monoxide into carbon dioxide determines the distribution coefficient which is required between the portion of oxygen penetrating the slag-metal bath and the portion of oxygen remaining in the free space of the furnace and, therefore, determines the specific linear flow rate of the oxygen on impact with the slag-metal surface, which in turn fixes the volume flow rate of oxygen. One method which has been used in the Kaldo process in order to permit an increase in the volume flow rate of oxygen whilst maintaining the combustion coefficient unchanged, involves reducing the angle of inclination of the lance with respect to the surface of the slag-metal bath and reducing the penetration of the lance into the furnace, and in this way it has been possible to multiply the optimum volume flow rate of oxygen threefold. However, there is a limit to the increase in the volume flow rate of oxygen which can be obtained in this way since, for an angle of inclination of the lance of less than 21° and a penetration of the lance into the furnace of 0.40 m, there are oxygen losses and excessively rapid wear of the internal wall of the furnace. Indeed, for the aforesaid values, the optimum volume flow rate of oxygen was 320 m3/mn in a Kaldo furnace having a specific capacity of 135 metric tons.

It is an object of the present invention to provide a lance which can be used for blowing oxygen into a furnace of the Kaldo-type and which enables there to be used an increased volume flow rate of oxygen whilst obviating the introduction of too large a quantity of oxygen into the slag-metal bath and premature wear on the end of the lance.

SUMMARY OF THE INVENTION

According to the present invention there is provided a lance for blowing oxygen into a furnace of the Kaldo-type and comprising a main duct, a plurality of auxiliary duct means and a cooling circuit, wherein the main duct comprises a rearward section which is connectable to a source of oxygen, a forward section which has an outlet orifice and is of a length which is at least 4 times its mean diameter, and a mixing chamber which is disposed between and interconnects said rearward and forward sections; wherein the plurality of auxiliary duct means are disposed externally of the rearward section of said main duct and debouch substantially tangentially into the mixing chamber; and wherein the cooling circuit encases the forward section and mixing chamber of said main duct and the plurality of auxiliary duct means.

Advantageously, the plurality of auxiliary duct means comprise a plurality of ducts arranged in the form of a helix about the rearward section of the main duct. With such an arrangement it is preferred for the mixing chamber of the main duct to have an axial length which is at least equal to the radial width of the helical ducts.

In one embodiment a lance according to the invention comprises a central tube, which has a rearward section, a mixing chamber and a forward section, defining the main oxygen duct, and a coaxial tube constituting with the external wall of the rearward section of the central tube an auxiliary oxygen duct of annular form which debouches, through a plurality of helical ducts into the mixing chamber. These tubes are placed in a cylindrical double-wall casing, which constitutes with the coaxial tube and the forward section of the main tube the cooling circuit. In accordance with the invention the forward section of the main tube has a length equal to at least 4 times its mean diameter. The forward section is made fast at its rear end with the coaxial tube by means of a cylindrical connecting sleeve forming part of the coaxial tube. The plurality of helical ducts extend over the entire cross section of the annular space defined between the coaxial tube and the rearward section of the central tube and debouch tangentially into the mixing chamber and thence into the forward section of the central tube, the mixing chamber having a diameter which is equal to that of the coaxial tube and an axial length which is at least equal to the radial width of said helical ducts.

By means of the present invention, all the oxygen entering through the rearward section of the main duct into the mixing chamber is rotated by the tangential jets of oxygen issuing from the auxiliary ducts, and the total quantity of oxygen issuing from the mixing chamber undergoes, in the forward section of the main duct, a sufficient pressure loss so that at the outlet orifice of the lance the jet of oxygen in its entirety flares rapidly in the form of a cone substantially without any central stabbing dart portion remaining.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing in which:

FIG. 1 shows a diagrammatic axial section of a lance according to the invention; and

FIG. 2 is a diagrammatic axial section of an enlarged scale of part of the lance shown in FIG. 1.

As can be seen from the accompanying drawing, more particularly FIG. 1, the lance comprises a double-walled outer casing **1**, a central tube **4** and a tube **7** disposed between and coaxial with the outer casing **1** and the central tube **4**. The double-walled outer casing **1** constitutes a cooling circuit connectable at **2** to a source of cooling fluid and at **3** to a recovery tank therefor, these not being shown. The central tube **4** constitutes the main oxygen duct which is connectable at its rear end **5** to a source of oxygen under pressure and which debouches into the free atmosphere at its fore end **6**. The coaxial tube **7** and an extension sleeve **10** (FIG. 2) define with the external wall of the central tube **4** an annular passageway **8** which forms an auxiliary oxygen duct and which is connectable at its rear end **9** to a source of oxygen under pressure and which debouches at its fore end into the central tube **4**. As can be seen in more detail in FIG. 2 the central tube **4** can be considered to consist of two sections **4*a*** and **4*b*** separated by a mixing chamber **15**. The forward section **4*a*** extends from the point at which the annular passageway **8** debouches into the central tube **4** to the outlet of the central tube **4**. The forward section **4*a*** has a length which is substantially greater than its diameter, being equal to at least 4 and preferably from 5 to 10 times its diameter. The forward section **4*a*** of the tube **4** is fixed to the main portion of the tube **7** by means of the extension sleeve **10** which includes an annular shoulder **11** whose internal diameter is equal to that of the forward section **4*a*** of the tube **4** and whose external diameter is equal to that of the main portion of the tube **7**. The rearward section **4b** of the tube **4** extends from the point at which the annular passageway **8** debouches into the central tube **4** rearwardly to the point at which the tube **4** can be connected to the source of oxygen under pressure. The rearward section **4b** of the tube **4** is provided on the outside thereof with helical ducts **12** which are defined by grooves **13** of a screw-threaded sleeve **14** and by the internal wall of the connecting sleeve **10**. The helical ducts **12** extend substantially over the entire cross section of the annular passageway **8** between the connecting sleeve **10** and the external wall of the rearward section **4b** of the tube **4**. At one end, the helical ducts **12** communicate with the annular passageway **8**, that is to say with the secondary oxygen duct and, at the other end, the helical ducts **12** debouch into the mixing chamber **15**, which is bounded by the shoulder **11**, a portion of the connecting sleeve **10** and the frontal wall of the screw-threaded sleeve **14**, and thence into the forward section **4a** of the tube **4**. The chamber **15** communicates, on the one hand, with the rearward section **4b** of the central tube **4** and, on the other hand, with the forward section **4a** through an aperture **16** bounded by the inside of the shoulder **11**. The mixing chamber **15** has a diameter equal to the internal diameter of the tube **7** and of the connecting sleeve **10** and has an axial length at least equal to the radial width of the helical ducts **12**.

In one specific embodiment of the lance described above the tube **4** had a diameter of 162 mm. and the mixing chamber **15** was situated at 1,300 mm. from the outlet orifice of the lance. With this lance it was possible to achieve a volume flow rate of oxygen of 560 Nm.^{3}/mn. In the Table below there are set out the linear flow rates of oxygen on impact, V_i, for given theoretical distances, D_t, between the outlet orifice of the lance and the surface of the bath of molten metal and for angles of inclination, α_L, of the lance relative to the horizontal employing a volume flow rate of oxygen of 560 Nm.^{3}/mn.

TABLE

V_i in metres/second	D_t in metres	α_L in degrees
53.0	[1] 0.2	24
39.7	1.2	24
39.8	0.4–0.5	19
31.5	1.4	19

[1] Approximately.

Thus, it can be seen that with a lance according to the invention it is not only possible to increase considerably the volume flow rate of oxygen, and consequently to reduce the duration of the refining process, but also to improve the ratio between the quantity of oxygen entering the bath of molten metal and the quantity remaining in the free space of the Kaldo furnace, which quantity serves for the combustion of the CO issuing from the bath, so that there is substantially no CO escaping through the chimney.

With the lance of the present invention the jet of oxygen issuing from the lance is more or less flared in conical form depending on the magnitude of the oxygen delivery coming from the auxiliary oxygen ducts and mixing with the quantity of oxygen of the main oxygen duct.

It is particularly important that the length of the forward section of the main duct is at least equal to 4 times the mean diameter of said duct, since it is in this section that a considerable pressure loss occurs on the part of the oxygen flow whose flow turbulence has just been substantially increased in the mixing chamber by the tangential jets issuing from the auxiliary ducts. Thus, despite a very high oxygen delivery, the pressure of the jet on issuing from the lance is relatively low.

It has been found that very satisfactory results can be obtained as regards the behavior of the lance, more particularly an increase in the volume flow rate of oxygen, the production of a conical oxygen jet, a reduction of the linear flow rate of the oxygen jet on impact, an effective cooling of the helical ducts etc. when the length of the forward section of the main duct is between 5 and 10 times the diameter of the said main duct. With a lance whose mixing chamber is situated at a distance from the mouth of the lance equal to 8 times the diameter of the forward section of the main duct it has been possible to develop more than 4,500 steel batches without the lance showing traces of wear.

It will be understood that the subject of the present invention can have a number of modifications made thereto without thereby departing from said invention.

I claim:

1. A lance for blowing oxygen into a furnace of the Kaldo-type ad comprising a main oxygen duct, a plurality of auxiliary oxygen duct means and a cooling circuit, wherein the main duct comprises a rearward section which is connectable to a source of oxygen, a forward section which has the same diameter as the rearward section and an outlet orifice, and is of a length which is at least 4 times its mean diameter, and a mixing chamber which is disposed between and interconnects said rearward and forward sections and flushes on the one side with the forward end of the rearward section and on the other side with the rearward end of the forward section; wherein the plurality of auxiliary duct means are disposed externally of the rearward section of said main duct and debouch substantially tangentially into the mixing chamber; and wherein the cooling circuit encases the forward section and mixing chamber of said main duct and the plurality of auxiliary duct means.

2. A lance as claimed in claim 1, wherein the forward section of said main duct is of a length which is from 5 to 10 times the mean diameter of the forward section of said main duct.

3. A lance for blowing oxygen into a furnace of the Kaldo-type and comprising a main duct, a plurality of auxiliary duct means and a cooling circuit, wherein the main duct comprises a rearward section which is connectable to a source of oxygen, a forward section which has an outlet orifice and is of a length which is at least 4 times its mean diameter, and a mixing chamber which is disposed between and interconnects said rearward and forward sections and which has an axial length which is at least equal to the radial width of the auxiliary duct means; wherein the plurality of auxiliary duct means comprises a plurality of ducts arranged helically about the rearward section of the main duct and debouch substantially tangentially into the mixing chamber; and wherein the cooling circuit encases the forward section and mixing chamber of said main duct and the plurality of auxiliary duct means.

4. A lance as claimed in claim 3, wherein the forward section of said main duct is of a length which is from 5 to 10 times the mean diameter of the forward section of said main duct.

5. A lance as claimed in claim 3, wherein the plurality of auxiliary ducts are defined by a duct which is coaxial with said main duct and forms with said main duct an annular passageway which debouches into said mixing chamber and by a screw-threaded sleeve disposed in said passageway.

6. A lance as claimed in claim 3, wherein the plurality of auxiliary ducts are disposed in an annular passageway which is defined by said main duct and a duct which is coaxial with said main duct, and wherein the mixing chamber has a diameter equal to that of said duct coaxial with said main duct.