Oct. 18, 1960 M. ALLARD 2,956,794

METHOD AND MEANS FOR BLOWING GASES CONTAINING POSSIBLY PULVERULENT MATERIAL INTO A BATH OF MOLTEN METAL

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Fig. 1

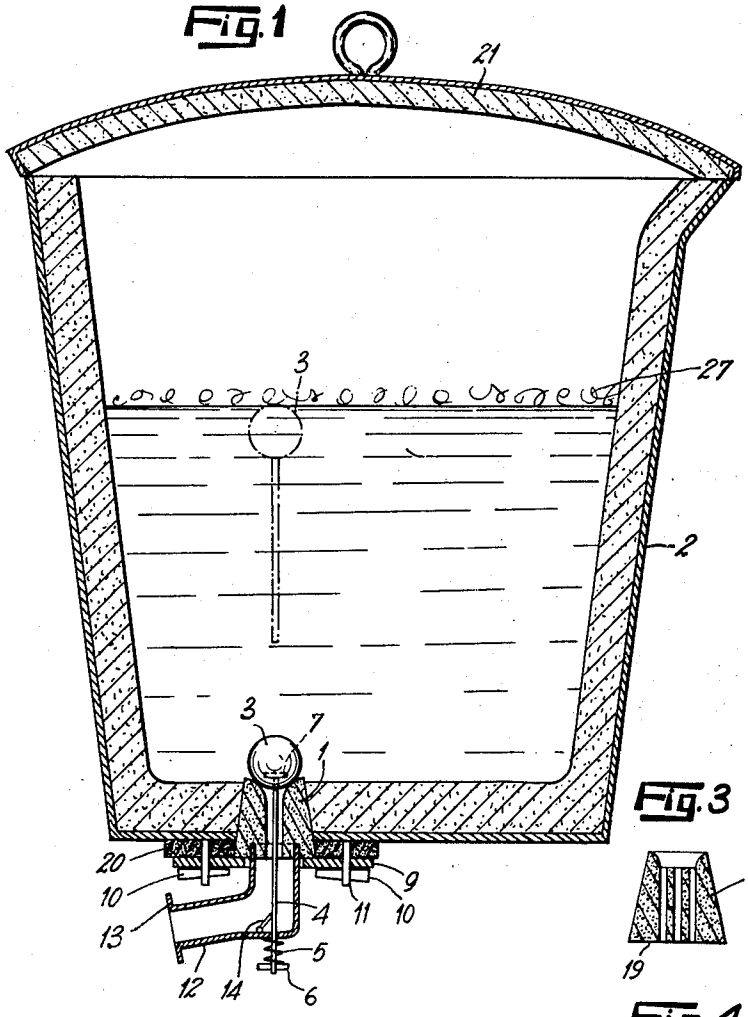


Fig. 3

Fig. 4

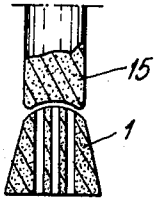
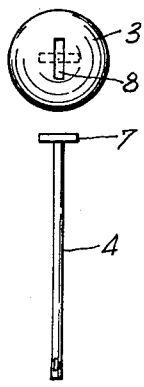


Fig. 2



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Fig. 8

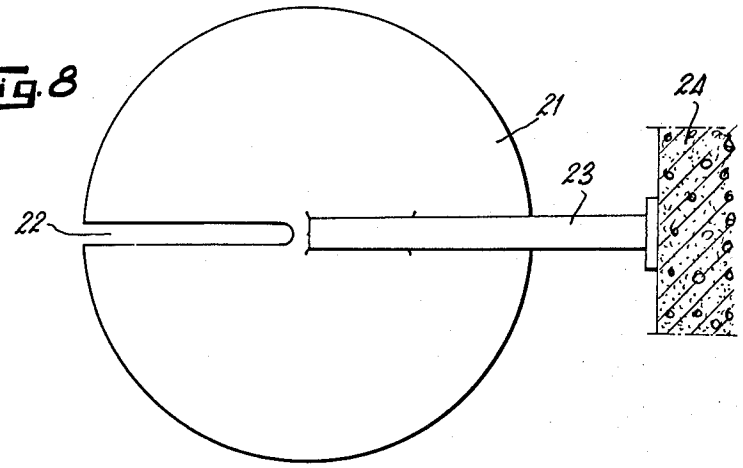


Fig. 5

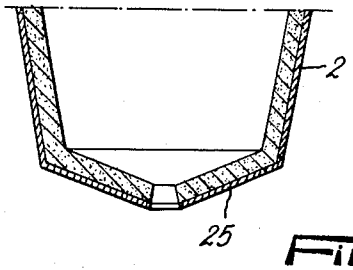


Fig. 6

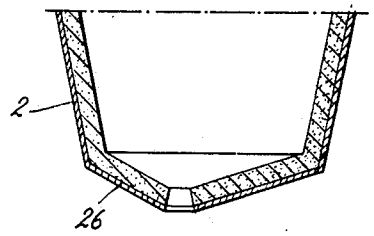
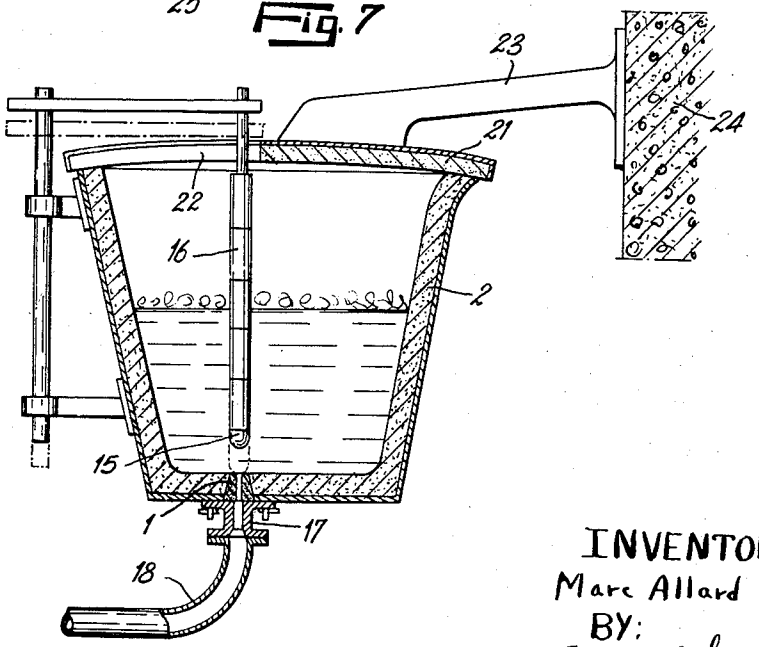


Fig. 7



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METHOD AND MEANS FOR BLOWING GASES CONTAINING POSSIBLY PULVERULENT MATERIAL INTO A BATH OF MOLTEN METAL

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15 Claims. (Cl. 266—34)

According to a well known procedure, it is possible to blow through baths of molten metal gases adapted to react with the metal. The transformation of cast iron into steel by the Bessemer and Thomas methods requires such a blowing of a gasiform fluid.

Another known procedure consists in blowing through a liquid metal neutral gases such as argon so as to remove from the metal other suspended gases or merely stir the molten metal in order to renew the surfaces of contact between the metal and the supernatant slag which may react with the metal.

Lastly, it is also known to inject finely subdivided material into a bath of liquid metal suspended in a gas. Such injections are generally performed in two different manners. It is possible for instance to use nozzles or tuyères rigid with the bottom of an apparatus of the retort type, the rocking of which allows covering the injection ports with a view to preventing the liquid metal from entering said ports when the pressure of the gases no longer provides an equilibrium to the hydrostatic pressure of the metal. It is also possible to use lances or branch pipes, generally of refractory material and sometimes even cooled, which branche pipes are adapted to be introduced into the bath of liquid metal and to be removed therefrom.

However, these operations lead to complicated arrangements and furthermore have various drawbacks. In the first case, they require generally the transfer of liquid metal, which leads to losses of heat and of time. In the second case, the immersion of the lance into the bath being limited as to depth, only a fraction of the height of the liquid metal carried inside the container is subjected to the action of the injected gas which may or may not carry solid material.

Now, my invention has for its object to provide for the easy injection into the liquid metal of a gas by executing said injection directly without any transfer and without the use of any lance, into a ladle filled with the metal, so that it is possible to keep the ladle covered with a removable cover, both for reducing the losses through radiation and for keeping above the bath the desired atmosphere which may be a neutral or a reducing atmosphere. The slag from the ladle which has contained the metal can be removed easily after the end of the injection. The ladle of the present invention does not have a small opening, but is generally open and is slightly flaring towards its top as in the case of all conventional ladles used for carrying molten cast iron or steel.

According to one feature, my invention provides a method of blowing gases, said method consisting mainly in using a casting ladle or the like containing a molten metal and in injecting the gas, carrying pulverulent material or otherwise, through means located at the lower end of the ladle which is adapted to be closed and opened as required.

My invention also provides for an arrangement of

means for closing and opening a casting ladle for the execution of the above defined method, said means including mainly a nozzle made of refractory brick material positioned at the lower end of the ladle and cooperating with a plug also made of refractory material which plug is adapted to engage the end of the nozzle opening into the ladle and to be urged against said nozzle through a carrying and connecting member which may be held fast by securing means on the outside of the ladle, which allows the plug to be released with reference to the nozzle. According to an auxiliary feature of said closing and opening means, the nozzle may be held fluid-tight against the bottom of the ladle and can be connected to a pipe feeding gases which may carry pulverulent material.

According to a further feature of my invention, the carrying and connecting member for the closing plug comprises a rod or a wire extending through the nozzle and secured to the plug, said rod or wire being held fast in position by means operated from the outside of the lower section of the ladle, so that the plug may be selectively held against the nozzle or urged into the metal of the ladle whenever it is desired to free the nozzle.

When the injection is at an end, the closing of the injection ports formed in the nozzle is automatically performed by the solidification of the metal in the corresponding injection channel or channels, provided that, taking into account the temperature of the metal undergoing treatment and the temperature of the injected fluid, the diameter and the length of the channel have been suitably selected and the injection pressure has been reduced to a predetermined value.

According to a modification, the closing plug consists of a pad carried by a stopper rod extending downwardly into the ladle and controlled from the outside, said stopper rod holding the pad selectively in its nozzle closing position or in a position spaced with reference to the nozzle so as to allow the injection to be performed.

My improved ladle may also include one or more of the following optional features:

The frusto-conically shaped nozzle is urged from the outside into the bottom of the ladle, the base of the nozzle being located on the outside of the latter.

The nozzle is provided with a plurality of channels in fan formation.

The nozzle is provided with a plurality of parallel channels.

The nozzle is provided with at least one helically shaped channel.

The periphery of the inner end of the nozzle is in the shape of a tore and the closing pad terminates with a hemispherical cap engaging said tore.

The nozzle is in the shape of the rose of a watering can and the closing pad has its end in the shape of a concave hemisphere or said end is provided with a concave tore-shaped flange engaging said rose.

A connection for the feeding of the gases into the ladle is rigid with the nozzle and is incorporated with the refractory paste forming the latter before said refractory paste has been baked.

A cover is used for covering the ladle.

Said cover is designed for the free passage of the stopper rod mechanism therethrough.

Further features and advantages of my invention will appear furthermore in the reading of the following description of a preferred embodiment of my invention given by way of an example and by no means in a limiting sense, reference being made to the accompanying drawings, wherein:

Fig. 1 is a diagrammatic vertical sectional view, passing through the axis of the nozzle, of a ladle the bottom

of which is provided with closing and opening plugs according to my invention, said ladle being provided furthermore with a suitable cover.

Fig. 2 is a view of the plug seen from underneath and of the rod holding it in position against the nozzle.

Fig. 3 is an axial sectional view of a modification of the nozzle.

Fig. 4 is an axial sectional view of another modification of said nozzle and of its closing plug.

Fig. 5 is a vertical sectional view of a ladle the bottom of which has a special shape, the nozzle being located centrally of and coaxially with the nozzle.

Fig. 6 is a similar view of another ladle wherein the position of the nozzle is an eccentric one in relation to the center of the ladle.

Fig. 7 illustrates diagrammatically in a vertical cross-sectional view passing through the axis of the nozzle a ladle the bottom of which is provided with a closing plug in accordance with a modification of my invention, said ladle being positioned underneath a suitable cover.

Fig. 8 is a plan view of the cover of the ladle shown in Fig. 7.

Turning to Fig. 1, the nozzle **1** made of refractory material is fitted in the bottom of the ladle **2**, also referred to as a body and a vessel, while a closing plug or pad **3** engages, when in its closing position, the upper end of the nozzle **1** over which it is held by a rod **4** urged downwardly by a spring **5** bearing against the key **6** passing through the rod **4**; the head **7** of the rod **4** may engage a flat elongated opening **8** (Fig. 2) formed in the plug. A transverse recess in the inside of the plug allows turning the rod **4** by one quarter of a revolution into a position perpendicular to the direction of said opening **8**, in which the plug can no longer disengage the rod **4** and is reliably held by the latter in contact with the nozzle. Plug **3** may be suddenly released by removing the securing means in the form of a key **6** so as to open as required the communication between the channel or channels extending through the nozzle **1** and the metal bath carried in the ladle, the plug **3** rising then to the upper level of the ladle, as illustrated in dot and dash lines. Plug **3** is made of a material having a specific gravity smaller than that of the molten metal and is also termed a valve member.

The frusto-conical nozzle **1** is fitted in the ladle from the outside thereof, the larger base of the frusto-cone lying naturally on the outer surface of the ladle wall as shown, so as to keep it from being driven inside the ladle **2** under the action of the pressure of the injected gases. In contradistinction, the nozzle is driven by the gas pressure into tight engagement with the frusto-conical opening, having a circular base, which is provided for this purpose inside the refractory bottom of the ladle.

According to conventional technique, nozzle **1** is secured by a plate **9** held in contact with the ladle by a key **10** engaging studs **11** projecting downwardly from and rigid with the bottom of the ladle.

In the embodiment illustrated in Fig. 1, a connection **12** is incorporated in the nozzle **1** and terminates in a flange **13** on which an injection pipe is mounted forming a conduit. A flap valve **14** is adapted to close the small opening provided in the connection **12** for the passage therethrough of a holding member in the form of a rod **4**, said opening being closed as soon as the rod **4** is released and rises with the plug, as described hereinabove.

In Fig. 7, another embodiment is illustrated in association with a closing pad **15** carried by a stopper rod **16**. The connection **17** with the gas blowing pipe **18** is detachably connected to the nozzle instead of being fixed to the latter, as in the preceding case.

The outer surface **19** of the nozzle **1** illustrated in Fig. 3 should be flat as also the surface of the securing plate **9** so as to provide for a good fluidtightness, increased if required through the interposition between said surfaces of a packing **20** as illustrated in Fig. 1; said packing is constructed of a material suitable for the gas to be used. It may be thick pitch in the case of a gas which is not or is only slightly oxidizing or may be some other plastic material resisting the outer temperature of the ladle or an aluminous cement setting at a very high speed and finely ground in the case of highly oxidizing gases.

The actual nozzle illustrated in Fig. 1 with a single central opening may be provided with a plurality of passage-ways arranged either in fan formation or parallel to each other (see Fig. 3), or again along one or more helical paths depending on the desired manner of injecting the material into the metal bath with a view to furthering the reaction through a suitable stirring. The periphery of the inner end of the nozzle is flush with the inner surface of the bottom of the ladle and preferably said end facing the inside of the ladle has a tore-shaped outline so that the closing may be easier in the case of a closing pad in the shape of a sphere or portion of a sphere.

A reversed arrangement may also be resorted to; in other words, the use of a nozzle in the shape of the rose of a watering can may be associated with the use of a pad **15** the operative surface of which is hollowed out in the shape of a hemisphere (Fig. 4).

The above listing of modifications is obviously not of a limiting character and any other closing means may be used such as, for instance, those including a frusto-conical pad.

The refractory materials forming the nozzle and the pad may be different depending on the nature of the gases and injected material. Chamot, highly aluminous refractories and magnesia and possibly chromite, may be used. Graphite may be used also when the injected gases are not of an oxidizing nature. It should also be considered that the tuyères formed in the nozzle may be lined by a metallic tubing, so as to cut out in particular wear of the walls.

The treating ladle thus equipped with a system including a nozzle and its closing means and the injection connection may be fed with the liquid metal to be treated, from an apparatus of any type as long as the undesirable material such as a parasitical slag capable of disturbing the treatment considered is held back and is not poured into the ladle together with the metal.

The treating ladle may, as already disclosed, be provided after filling and before injection, with a cover **21** leaving if required a slot or passageway **22** (Figs. 7 and 8) for the stopper-rod controlling mechanism when the latter is in use without the whole cross-sectional area of the ladle being left open to the atmosphere. Thus, the losses of heat through radiation are reduced and the space free of metal extending between the upper level of the metal and the cover, may be of a composition suitable for the operation to be executed, such as, for instance, of a reducing or neutral type. For the purpose of a higher speed of operation, cover **21** may be held fast on a wall **24** or to a carrier arm **23** fixed to wall **24** and a travelling crane may bring the ladle into position so that the slot or passageway **22** allows the stopper rod mechanism to enter the ladle. The size of the treating ladle should be such as will take into account the bubbling which may be produced through the passage of the gases in the metal bath. It may be of interest, in certain cases and with a view to ensuring a better stirring of the metal in the vicinity of the injection nozzle, to give the bottom of the ladle a conical outline which may be of revolution as shown at **25** (Fig. 5) or eccentric, as shown at **26** (Fig. 6), the openings being always formed at the apex of the conical bottom.

For removing the metal after treatment, after the treating ports are closed, I may resort to any known means. I may for instance pour the liquid out through a mouth or lip on the ladle after a mere rotation of the latter round the axis of its trunnions, the residual material formed by the treatment being retained, if required, in-

side the mouth through any means conventionally resorted to. When using a ladle of the tea-pot ladle type which is provided between the inner and outer wall and along a generating line with a channel with refractory walls the lower end of which opens into the bottom of the ladle and the upper end into the mouth of the ladle, it is also possible to pour through said channel and mouth. This well-known arrangement allows removing the liquid metal without the latter carrying along with it the supernatant slag and residual matter. It is also possible to cast the metal through the bottom of the ladle by means of a second system including a stopper rod and a nozzle of the type generally used for casting liquid metal into a mold. This method also allows tapping off the metal without the latter carrying along with it any slag or residual matter.

I will now disclose by way of example and by no means in a limiting sense the application of my improved method to a method of desulfurizing liquid pig iron by injecting pulverulent lime in a current of nitrogen or the like non-oxidizable gas in accordance with my copending application Ser. No. 567,032, filed on February 21, 1956, and entitled "Method For Desulfurizing Molten Metal and in Particular Liquid Pig Iron," now U.S. Patent No. 2,906,616, issued September 29, 1959. Into a conventional ladle for steel or iron of a theoretical capacity of 30 tons, equipped in the manner illustrated in Fig. 1, I pour 20 tons of liquid pig iron to be desulfurized. After the cover has been removed while the closing member is held in contact with the nozzle, the liquid pig iron is poured out of a pig iron mixer, care being taken to prevent any parasitic slag being carried along with the pig iron.

The ladle is returned by the travelling crane into proximity to the injection mechanism; a few lumps **27** of rich coal releasing when heated hydrogen-containing gases, are thrown onto the surface of the metal and cooperate in speedily obtaining a non-oxidizing atmosphere in the section of the ladle above the metal which is thereafer closed immediately by the cover **21**. The air blowing pipe is thereupon fitted without any delay to the connection opening into the nozzle through the agency of a fluidtight connection of a conventional type.

As soon as the pressure of the gas, of between about 1.5 and 2 kg. pressure, is applied to the nozzle, the pad buoyantly rises in the molten metal, unseals the opening in the bottom of the vessel and is brought into its upper position to allow the injection of the lime dust carried as a suspension in the injected gas. When the required amounts have been introduced, the injection pressure is lowered down to zero and the liquid metal becomes solid inside the injection channels whereby the nozzle is closed. If a stopper rod is used, a gas is allowed to pass for a few seconds without carrying any dust with it, after which the sliding control member is operated so as to set the pad in its lower nozzle closing position. The gas blowing pipe is disconnected, the ladle is removed from the position in which it has been covered and the travelling crane empties it at the desired location after it has been turned over by rotation about its trunnions.

Of course, the embodiment described hereinabove and illustrated in the drawing is given by way of a mere example and by no means in a limiting sense and obviously it is possible to modify in any desired manner the shape, arrangement, nature and manner of mounting of the different parts without widening the scope of the invention as defined in the accompanying claims. In this line, many other manners of mounting the apparatus may be considered for the application of the closing plug onto the nozzle. It is possible, for instance, to carry the plug through a high resistance wire attached through one end to a ring embedded in the plug, said wire passing through the nozzle and having its other end secured outside the ladle to a clamp or the like suitable holding means.

What I claim is:

1. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal adapted to engage in contacting relationship the end of said nozzle facing the inside of said ladle, an elongated metal member extending through said nozzle and connected with said plug, means outside said ladle and outside said nozzle adapted to secure removably said elongated member to the lower end of said ladle, the release of said elongated member allowing it to rise together with said stopper plug inside the metal bath, and a connection opening into said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

2. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom said vessel being adapted to hold molten metal, a nozzle of refractory material fitted in said opening in the bottom of said ladle and having an inner end opening into said ladle, a pad of a material having a specific gravity smaller than that of the molten metal arranged to engage and close the inner end of said nozzle opening into said ladle, a shiftable stopper rod rigid with said pad and extending vertically inside the metal bath and above same, means controlling the position of said stopper rod from the outside of said ladle to selectively engage and disengage said nozzle by said pad, and an opening formed in said nozzle adapted to feed the gasiform fluid through the same into the bath inside said ladle.

3. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom said vessel being adapted to hold molten metal, a frusto-conical nozzle of refractory material fitted inside said opening, the larger base of the frusto-conical nozzle lying on the outside of said ladle and having an inner end opening into said ladle, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal arranged to engage in contacting relationship the end of the nozzle facing the inside of the ladle, means operable from the outside of the ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of the ladle and for releasing said plug from said engagement, and an opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

4. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle and provided with a plurality of channels arranged fanwise, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal arranged to engage in contacting relationship the end of the nozzle facing the inside of the ladle, means operable from the outside of the ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of the ladle and for releasing said plug from said engagement, and a connection opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

5. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a frusto-conical nozzle of refractory material fitted in said opening in the bottom of said ladle and provided with a plurality of channels arranged in parallel formation, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal arranged to engage in contacting relationship the end of said nozzle facing the in-

side of said ladle, means operable from the outside of said ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of said ladle and for releasing said plug from said engagement, and a connection opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

6. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle and provided with at least one helical channel, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal arranged to engage in contacting relationship the end of said nozzle facing the inside of said ladle, means operable from the outside of said ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of said ladle and for releasing said plug from said engagement, and a connection opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

7. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle, the end of said nozzle facing the inside of said ladle being partly tore-shaped, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal, the lower end of which is in the shape of a hemispherical cap arranged to engage in contacting relationship the tore-shaped part of said end of the nozzle facing the inside of the ladle, means operable from the outside of the ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of said ladle and for releasing said plug from said engagement, and a connection opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

8. An arrangement for blowing a stream of gasiform fluid into a bath of molten metal, comprising a ladle provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle, the inner end of said nozzle extending along an axis and being in the shape of a convex sprinkling rose, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal the lower end of which is concave and arranged to engage in contacting relationship the end of said nozzle facing the inside of said ladle along a circular line in a plane perpendicular to said axis of the nozzle, means operable from the outside of said ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of said ladle and for releasing said plug from said engagement, and a connection opening formed in said nozzle and adapted to feed the gasiform fluid through the latter into the metal bath inside said ladle.

9. A ladle for treating a bath of molten metal, comprising a body provided with an opening in its bottom, a nozzle of refractory material fitted in said opening in the bottom of said ladle, a stopper plug of refractory material having a specific gravity smaller than that of the molten metal adapted to engage in contacting relationship the end of the nozzle facing the inside of said ladle, means operable from the outside of the ladle controlling said stopper plug for holding said stopper plug in fluidtight engagement with the bottom of said ladle and for releasing said plug from said engagement, means for blowing the gasiform fluid through the nozzle into the base of the ladle body, and a cover for the ladle body.

10. A ladle for treating a bath of molten metal, comprising a body provided with an opening in its bottom, a nozzle of refractory material fitted in the opening in the bottom of said body, a pad having a specific gravity smaller than that of the molten metal arranged to engage and close the inner end of said nozzle opening into said body, a shiftable stopper rod rigid with said pad and extending vertically inside the metal bath and above same, means controlling the position of said stopper rod from the outside of said body to selectively engage and disengage the pad with reference to said nozzle, means for blowing the gasiform fluid through said nozzle into the base of said body, and a cover for said body, said cover being provided with a slot for the passage therethrough of the means controlling the position of said stopper rod.

11. An arrangement for blowing a stream of gaseous fluid into a bath of molten metal, comprising in combination, a vessel having an opening in the bottom thereof, said vessel being adapted to hold molten metal; a valve member in said vessel and engageable with said opening for releasably sealing the same, said valve member being of a material having a specific gravity smaller than that of said molten metal; a holding member fastened to said valve member and adapted to extend outwardly through said opening in the engaged position of said valve member; securing means accessible from the outside for releasably securing said holding member in such a manner that said valve member is held in sealing engagement with said opening; and a conduit communicating with said opening from the outside for feeding a gaseous fluid into said vessel when said valve member is disengaged, whereby upon release of said securing means said valve member buoyantly rises in said molten metal and unseals said opening.

12. An arrangement for blowing a stream of gaseous fluid into a bath of molten metal, comprising in combination, a vessel having an opening in the bottom thereof, said vessel being adapted to hold molten metal; a valve member in said vessel and engageable with said opening for releasably sealing the same, said valve member being of a material having a specific gravity smaller than that of said molten metal; a holding member fastened to said valve member and adapted to extend outwardly through said opening in the engaged position of said valve member; securing means accessible from the outside for releasably securing said holding member in such a manner that said valve member is held in sealing engagement with said opening; and a conduit communicating with said opening from the outside for feeding a gaseous fluid into said vessel when said valve member is disengaged, said holding member having a portion passing through a wall of said conduit, and said securing means securing said portion of said holding member to the outside of said conduit wall, whereby upon release of said securing means said valve member buoyantly rises in said molten metal and unseals said opening.

13. An arrangement for blowing a stream of gaseous fluid into a bath of molten metal, comprising in combination, a vessel having an opening in the bottom thereof, said vessel being adapted to hold molten metal; a valve member in said vessel and engageable with said opening for releasably sealing the same, said valve member being of a material having a specific gravity smaller than that of said molten metal; a holding member releasably fastened to said valve member and adapted to extend outwardly through said opening in the engaged position of said valve member; securing means accessible from the outside for releasably securing said holding member in such a manner that said valve member is held in sealing engagement with said opening; and a conduit communicating with said opening from the outside for feeding a gaseous fluid into said vessel when said valve member is disengaged, whereby upon release of said securing means said valve member buoyantly rises in said molten metal and unseals said opening.

14. An arrangement for blowing a stream of gaseous fluid into a bath of molten metal, comprising in com-

bination, a vessel having an opening in the bottom thereof, said vessel being adapted to hold molten metal; a valve member in said vessel and engageable with said opening for releasably sealing the same, said valve member being of a material having a specific gravity smaller than that of said molten metal; a holding member fastened to said valve member and adapted to extend outwardly through said opening in the engaged position of said valve member; resilient securing means accessible from the outside for releasably securing said holding member in such a manner that said valve member is held in sealing engagement with said opening; and a conduit communicating with said opening from the outside for feeding a gaseous fluid into said vessel when said valve member is disengaged, said holding member having a portion passing through a wall of said conduit, and said securing means resiliently securing said portion of said holding member to the outside of said conduit wall, whereby upon release of said securing means said valve member buoyantly rises in said molten metal and unseals said opening.

15. An arrangement for blowing a stream of gaseous fluid into a bath of molten metal, comprising in combination, a vessel having an elongated opening in the bottom thereof, said opening having a longitudinal axis extending therethrough, said vessel being adapted to hold molten metal; a valve member in said vessel and engageable with said opening for releasably sealing the same, said valve member being of a material having a specific gravity smaller than that of said molten metal; a holding member fastened to said valve member and adapted to extend outwardly through said opening in the engaged position of said valve member; securing means accessible from the outside for releasably securing said holding member in such a manner that said valve member is held in sealing engagement with said opening; and a conduit communicating with said opening from the outside for feeding a gaseous fluid into said vessel when said valve member is disengaged, said conduit having a first portion extending from said opening in substantially the longitudinal direction thereof, and a second portion contiguous to said first portion and extending transversely therefrom, said holding member having a portion passing through a wall of said second transverse conduit portion, and said securing means securing said portion of said holding member to the outside of said wall, whereby upon release of said securing means said valve member buoyantly rises in said molten metal and unseals said opening.

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