# United States Patent

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[54] **DEVICE FOR STIRRING MOLTEN METAL**
**2 Claims, 1 Drawing Fig.**


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(PP), 34 (T), 34.1, 34.2, 34 (V)



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,033,550 | 5/1962 | Harders | 266/34 |
| 3,053,525 | 9/1962 | Leroy et al | 266/34 |
| 3,380,727 | 4/1968 | Ruettiger et al | 266/34 |

FOREIGN PATENTS

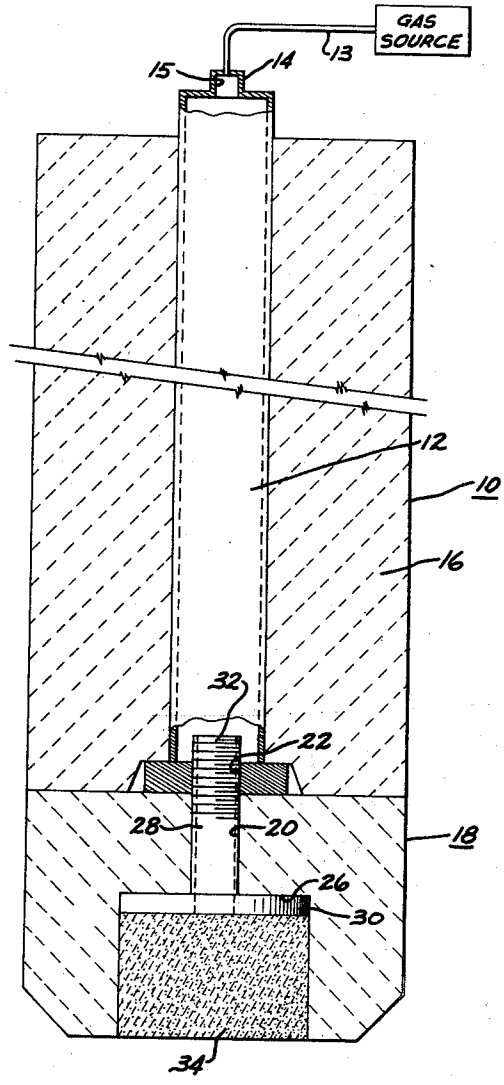
| | | | |
|---|---|---|---|
| 1,014,255 | 12/1965 | Great Britain | 266/34(PP) |



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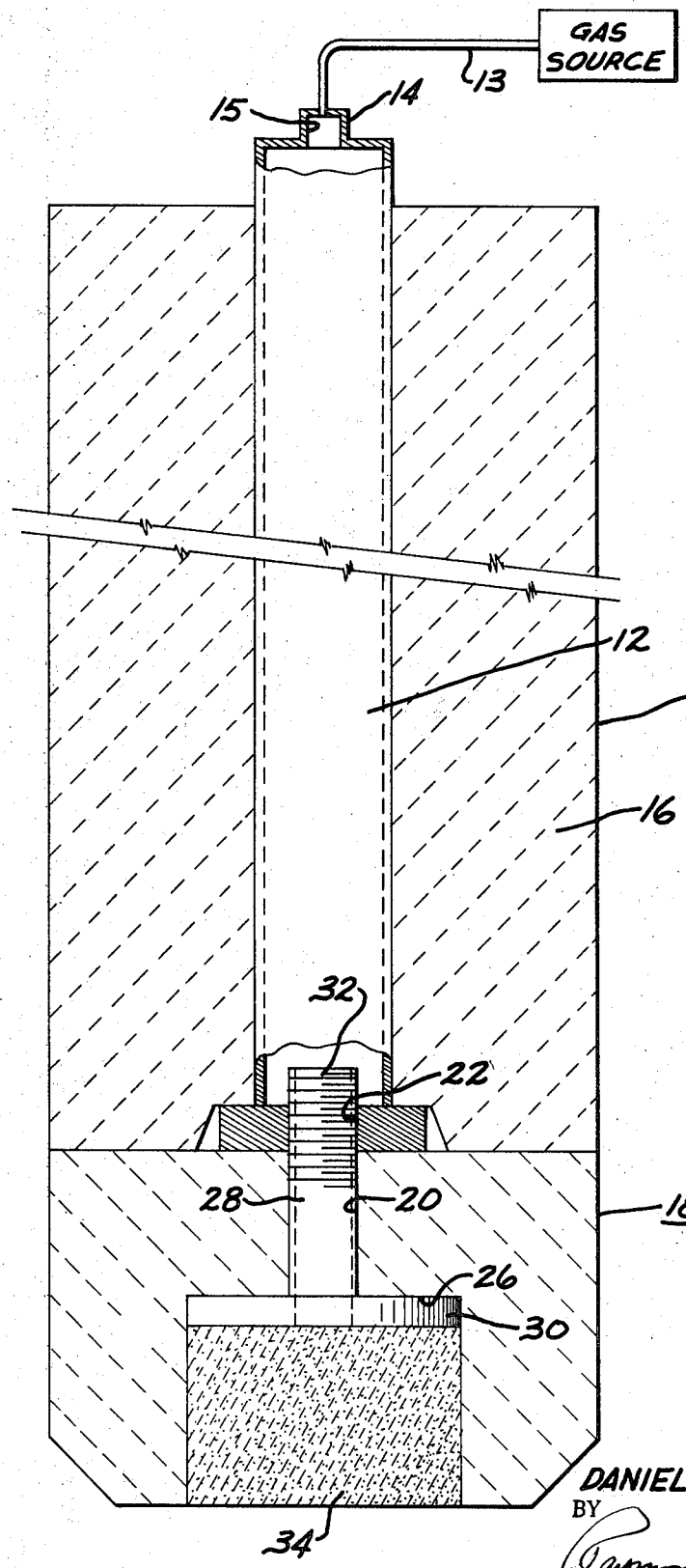


**ABSTRACT:** A device, similar to a stopper-rod and stopper head assembly, for immersion in molten metal to provide gaseous agitation thereof.

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3,565,412




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# DEVICE FOR STIRRING MOLTEN METAL

There have been many attempts to inject gas into masses of molten metal in such as holding ladles, tundishes and the like. This has been accomplished by many different devices in the past. One such method, a lance, having temporary resistance to molten metal and slag was rapidly thrust into the top surface of the metal to quickly inject the gas and then removed. Another method has been constructing a large part of a wall of a vessel of a porous material or the use of a tuyere construction. It has also been accomplished by permanently attaching a porous plug in an aperture in the base of a vessel.

The method having the most contemporary prominence is the one using a porous plug. However, this has the disadvantage that the vessel has to be modified extensively to attach the plug, and, attachment and detachment is difficult since the plug is part of a more or less permanent structure on the vessel. In addition, it has been found that when gas is passed through a porous plug into a ladle, a portion of the gas passes through the porous plug sidewalls and into the refractory lining the ladle bottom. This has caused a great deal of distress to steel producers.

Accordingly, an object of the present invention is to provide a gas injecting device which is inert to and impervious to molten metals and which has pores therein through which gases will pass, which is not a part of the molten metal containing vessel, which will not tend to spall due to thermal shock upon introduction into the molten metal and which will not react with the slag formed during treatment of the molten metal.

Another object of the invention is to provide for the stirring of a molten metal mass with an apparatus that is simpler and less expensive to operate than existing devices, such as, rotating furnaces, electromagnetic stirring, porous plugs for insertion into ladle bottoms, while achieving comparable or even better efficiency.

Other objects of the invention will, in part, become apparent hereinafter.

Briefly, the device of the invention consists of an elongated tubular conduit for conveying a gas, such as, argon or helium. A gas source is attached to the upper end of the conduit and a gas insufflating head is attached to the bottom end of the conduit. The head consists of an outer, cylindrical, gas impermeable, refractory shell. Within the shell is disposed a porous refractory plug which is in communication with the tubular conduit to receive the gas.

The invention has thus been generally described and now will be referred to in more detail by reference to the accompanying drawings, the single FIG. of which is an elevation view, partly in section, of an immersion device according to the invention.

Referring to the drawing, there is shown the immersion device **10**. The numeral **12** designates the tubular conduit which is generally composed of a metal, such as, steel. Attached to the upper end of the conduit is a gas source which supplies the required gaseous material to the conduit by means of a hose **13**, or the like. The gas source may be attached to the conduit by any means known to those skilled in the art. The drawing shows the connecting means as being a cap **14** fitting over a projecting lug **15** at the top of the conduit. The lower end of the conduit is flanged so as to support protective refractory sleeves **16**. Their necessity is quite obvious. In order to properly stir and remove the desired impurities from the molten metal, the device must be immersed therein for the required period of time. The metal conduit would melt under these conditions. The use of a conduit composed of a refractory has been considered; however, such conduits are quite difficult to manufacture and are not economical. The sleeves are composed of a heat resistant material, such as, fireclay or high alumina and this serves to adequately protect the conduit from contact with molten metal for as long as necessary.



The gas insufflating head **18** is attached to the lower flanged end of the tubular conduit. The head contains a relatively small, centrally disposed aperture **20** coaxially aligned with the aperture **22** in the tubular conduit, The aperture **20** opens into a larger aperture **24** toward the lower end of the shell. Communication between the two apertures is defined by upper flat surface **26**. The shell is connected to the conduit by means of a pipe **28** having a lower, outer peripheral flange **30**. The pipe passes through the small aperture **20** and is secured to the conduit by means, such as, a threaded portion **32**. Of course, other means known to those skilled in the art for securing the pipe to the conduit are readily available. The flange **30** on the pipe is disposed in contact with the surface **26** joining the small aperture **20** to the larger aperture **24**. This in effect brings the refractory shell into close abutment with the flange **30** of tubular conduit **12** and secures it thereto. The porous plug **34** is disposed in the larger aperture with one end being in contact with the flanged pipe, the sidewalls being in contact with the walls of the larger aperture and the other end being free to allow the gaseous material to pass therefrom.

The device of the invention may be fabricated in a variety of ways; however, it is preferred to construct it in the following manner: The refractory shell is formed by vibration coasting a refractory batch in a mold conforming to the contours of the shell. The shell is preferably composed of a high alumina refractory material analyzing at least about 85 percent $Al_2 0_3$, on an oxide basis. The refractory grains are bonded with from about 2 to 15 percent $P_2 0_5$ provided by orthophosphoric acid. After the shell has been cured by drying, the flanged pipe is passed up through the relatively small aperture so that the flange **30** is in abutment with the surface **26**. After the flanged pipe is in place, the shell and flanged pipe act as a mold for the porous plug. The porous plug thus is formed in situ by casting a refractory batch in the larger aperture. Preferably, the batch is composed of calcined South American bauxite with about 2 percent by weight, of bentonite. The batch similarly is bonded with $P_2O_5$ in amounts of up to 15 percent. After complete fabrication, the assembly is then dried at a temperature of about 500° F. The grind of the batch for the refractory porous plug is such that after drying, the plug will have a porosity of about 25 percent. After curing by drying, the threaded end of the flanged pipe is then secured to the threaded female socket of the tubular conduit until the shell fits securely against the conduit.

In operation, after the vessel, such as a steel ladle, is filled with molten metal, the stirring device is immersed therein. The gas supply is then activated and gas is fed through the hose to the tubular conduit. The gas passes through the conduit and then through the pipe and diffused down through the porous plug and into the molten metal in small bubbles which rise up through the molten mass to carry out the desired metallurgical effect.

I claim:

**1**. A device for immersion in molten metal to provide gaseous agitation thereof consisting of an elongated tubular conduit for conveying a gaseous substance, a gas source attached to one end and a gas insufflating head attached to the other end, the head consisting of a outer, cylindrical gas impermeable refractory shell, said shell containing a relatively small, centrally disposed aperture coaxially aligned with the aperture in the tubular conduit, which aperture opens into a larger aperture toward the lower end of the shell, the shell being connected to the conduit by means of a pipe having a lower outer peripheral flange, said pipe passing through the small aperture and being secured to the conduit, the flange being in contact with the surface joining the small aperture to the larger aperture and an inner, porous refractory plug disposed in the larger aperture adjacent the peripheral flange.

**2**. The device of claim **1** in which the tubular conduit contains refractory material on the outer surfaces thereof.