United States Patent

Foulard et al.

[15] **3,689,048**

[45] **Sept. 5, 1972**

[54] **TREATMENT OF MOLTEN METAL BY INJECTION OF GAS**

[72] Inventors: **Jean Foulard,** Ablon; **Jean Galey,** Saint Maur Des Fosses, both of France

[73] Assignee: **L'Air Liquide, Societe Anonyme Pour L'Etude Et L'Exploitation Des Procedes Georges Claude,**

[22] Filed: **March 5, 1971**

[21] Appl. No.: **121,501**

Related U.S. Application Data

[62] Division of Ser. No. 774,139, Nov. 7, 1968, abandoned.

[52] **U.S. Cl.** .....**266/34 T,** 75/59, 75/93 R, 75/96, 164/66, 164/259, 266/34 PP

[51] **Int. Cl.** **C22b 9/00**

[58] **Field of Search**.....75/76, 93 R, 93 E, 59, 96; 164/66, 67, 259, 335, 337; 266/34 T, 34 PP

[56] **References Cited**

UNITED STATES PATENTS

2,821,472	1/1958	Peterson et al.	75/93
3,490,755	1/1970	Lutgen	266/34 PP
1,690,750	11/1928	Moyer	164/66
3,490,897	1/1970	Dore et al.	75/76
2,060,134	11/1936	Summey	164/259
3,402,757	9/1968	Halliday	164/66
3,467,167	9/1969	Mahin	164/66

FOREIGN PATENTS OR APPLICATIONS

400,259	10/1933	Great Britain	164/259

Primary Examiner—Gerald A. Dost
Attorney—Young & Thompson

[57] **ABSTRACT**

Molten metal is treated by flowing gas through it. The container for the treatment is provided with a fore hearth, with a cover and with means for blowing the gas in fine bubbles into the metal. From the container the treated metal flows into a hopper provided with a cover having means for flushing the hopper with an inert gas.

7 Claims, 2 Drawing Figures

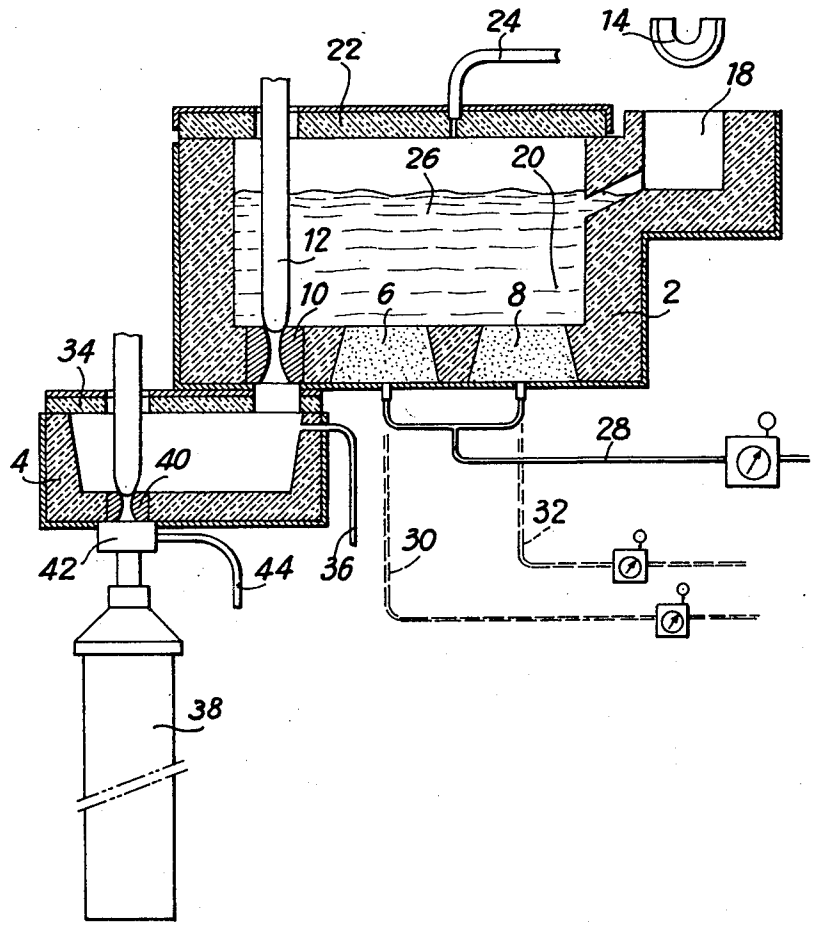


Fig. 1

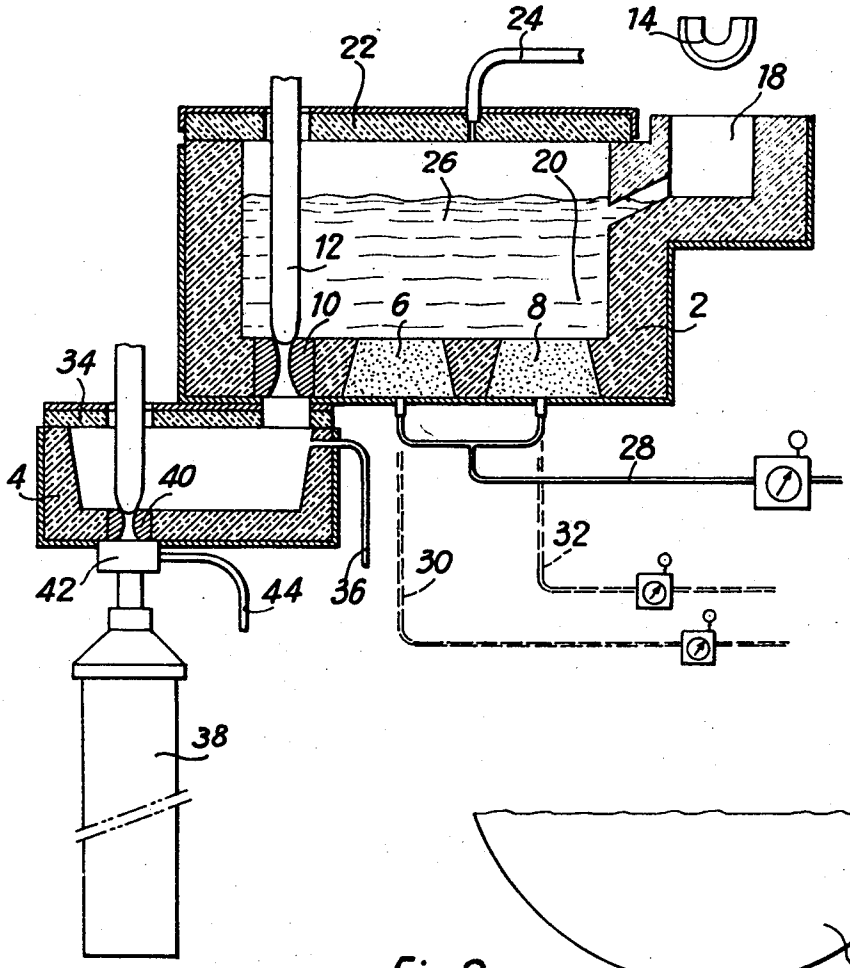
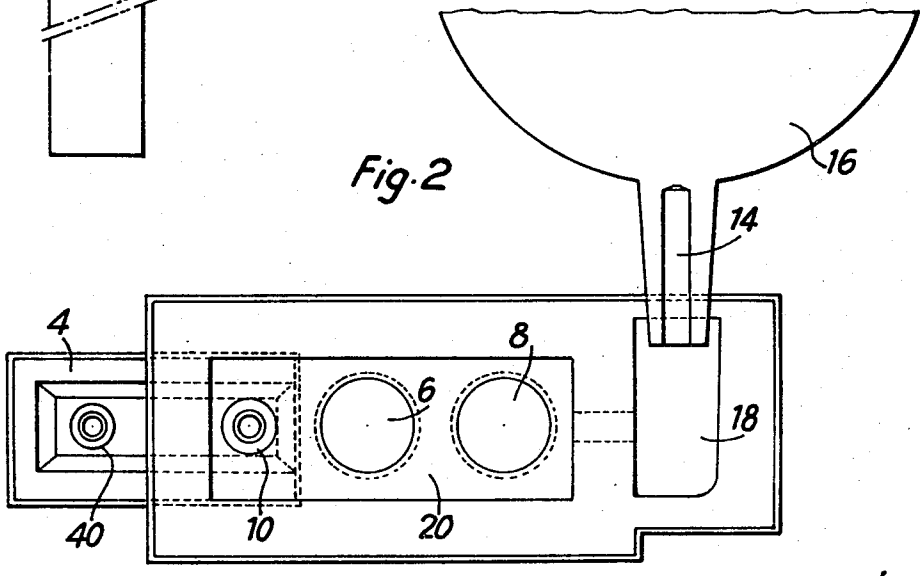


Fig. 2



INVENTORS
JEAN FOULARD
JEAN GALEY
By Young & Thompson
ATTYS

TREATMENT OF MOLTEN METAL BY INJECTION OF GAS

This application is a division of copending application Ser. No. 774,139, filed Nov. 7, 1968 and now abandoned.

The present invention relates to an apparatus for the treatment of molten metal by injection of gas into said metal. This apparatus is sturdy and allows for a continuous, semicontinuous or discontinuous treatment. It allows for an efficient treatment and a very good shielding of the metal from the ambient atmosphere.

The apparatus of the invention is usable for instance for the deoxidation and degasification of copper and its alloys by blowing into the molten metal hydrogen or a hydrogen-containing gas and, simultaneously and/or separately, a gas chemically inert to the molten metal. Using this process and the apparatus of the invention, the final oxygen content in copper may fall below 0.001 percent and even less, and the densities of the copper may reach and even slightly exceed 8.93, which corresponds to a both well-degassed and well-deoxidized copper.

The apparatus of the invention comprises a gas-treatment chamber, a pouring box or fore hearth that communicates with the gas-treatment chamber for feeding molten metal to said chamber, a cover for said chamber, an outlet in the bottom of said chamber, means for closing and opening the outlet, the cover being gas-untight to permit the escape of gas from the gas-treatment chamber, at least one gas-permeable, molten metal impervious member in the bottom of said chamber, and means for supplying gas to said member for introduction into the molten metal in the form of fine bubbles.

Preferably, the apparatus of the invention comprises a hopper with which said outlet communicates to receive molten metal from said chamber, said hopper having a second outlet in its bottom, means for closing and for opening said second outlet, a second cover for said hopper, said second cover being gas-untight for the escape of gas from said hopper.

In the accompanying diagrammatic figures, which are given by way of explanation:

FIG. 1 shows in longitudinal section an embodiment of the device of the invention, and

FIG. 2 shows in plan view the embodiment of FIG. 1 in the absence of molten metal, the covers being assumed to have been removed.

The installation shown comprises essentially a treatment container 2, a fore hearth 18 and a supply hopper 4.

The treatment effected is deoxidation of copper by insufflations of hydrogen and nitrogen.

The base of the container 2 is provided with gas-permeable, molten metal impervious, members 6, 8, in the form of plugs, and with a nozzle 10 which is closed by a stopper 12 during the treatment. The blowing area of the members, their number and their arrangement in the base of the treatment container depend upon the quantity or the rate of flow of the metal to be treated and upon the desired extents of deoxidation and degasification.

The cuprous metal to be treated is poured without any particular precaution through the runner 14 of a furnace 16 into a pouring box or fore hearth 18, whereafter it flows into the main compartment 20 of

the container 2. The said compartment is covered by a lid 22 provided with a nitrogen inlet duct 24 to enable the metal to enter a substantially neutral atmosphere. There may be mixed with the nitrogen a reducing gas such as hydrogen. Before this pouring operation, the container 2 has been flushed by inert or reducing gas.

The treatment described in the foregoing is carried out by blowing the treating gases through the plugs 6, 8. These gases, which are mixed with those produced by the deoxidation and by the degasification, escape through the lid by way of the clearance surrounding the stopper. They have created above the metal bath 26 a protective atmosphere, whereby the admission of nitrogen through the tube 24 during the treatment can be stopped.

There is illustrated in solid lines a simultaneous feeding of the two plugs by a common tube 28. For example, hydrogen is admitted through the said tube, and then nitrogen or a mixture of nitrogen and hydrogen.

There is illustrated in chain lines a separate supply to the two plugs through the two tubes 30, 32. This renders possible not only the same treatments as by the single tube 28, but also the supply of nitrogen to one of the plugs while the other is being supplied with hydrogen, or after the other one has been supplied with hydrogen.

The supply hopper 4, which is fed in molten metal by nozzle 10 when stopper 12 is lifted, is also covered by a lid 34. A lateral nitrogen supply duct 36 is provided to enable the copper to be poured in the absence of air. The copper is run from the hopper into an ingot mold 38, for example, through a nozzle 40.

The deoxidized and degassed metal is protected while being run from the hopper 4 into the ingot mold 38 by a device which insulates the cast stream from the ambient air by surrounding it with a neutral gas atmosphere, for example by the device described in French Pat. No. 1,404,505. A gas box 42 supplied with nitrogen through a tube 44 protects the cast stream in its travel from the nozzle 40 into the ingot mold, and has previously enabled this passage and the ingot mold to be purged of air.

These various admissions of protective gas permit of casting the copper or copper alloy in the absence of air and of receiving it in a cavity which has previously been purged of air.

For example, using the device of the invention and starting with a copper containing 0.030 percent of oxygen, the density of which is of the order of 8.4, blowing-in of hydrogen in a proportion of 500 liters per ton of treated copper, followed by blowing-in of nitrogen in a proportion of 600 liters per ton of treated copper, gave a copper whose oxygen content was less than 0.001 percent and whose density was 8.93.

In some cases, the same result may be obtained by simultaneously carrying out the two deoxidizing and degasifying operations by simply blowing-in a mixture containing, for example, 80 percent of hydrogen and 20 percent of nitrogen. A consumption of 800 liters of mixture, per ton of treated copper, gave the same results as above. These results show that the effectiveness of the treated gases is high, both in the deoxidation and in the degasification. It is therefore unnecessary to employ large volumes of gas.

The installation of FIGS. 1 and 2 may be modified. For example, there may be only one porous member such as 6, 8, or more than two. These members may have various forms, for example they may be in the form of frusto-conical plugs or slabs.

The installation of FIGS. 1 and 2 may be continuously employed, a stream of molten metal continuously running from the furnace 16 to the hopper 4 and even to a continuous molding installation used instead of the ingot mold 38. It may also be discontinuously used.

Installations of another type may be employed, for example a rocking ladle having one or more porous members in its lower parts. The treatment container may comprise two compartments, one for the deoxidation and one for the degasification. The porous members may be supported by lances which are plunged into the liquid metal.

Further modifications may be made without departing from the scope of the present invention.

Having described our invention, we claim:

1. Apparatus for the treatment of molten metal by injection of gas into said metal, comprising means defining a gas-treatment chamber having a bottom wall and side walls, a pouring box the inner volume of which is very substantially smaller than that of said chamber, said pouring box communicating with the gas-treatment chamber for feeding molten metal to said chamber, a cover for said chamber, an outlet in the bottom wall of said chamber, means for closing and opening the outlet, the cover being gas-untight to permit the escape of gas from the gas-treatment chamber, at least one gas-permeable, molten metal impervious, member

in the bottom of said chamber, and means for supplying gas to said member for introduction into the molten metal in the form of fine bubbles.

2. Apparatus as claimed in claim 1, and a hopper with which said outlet communicates to receive molten metal from said chamber, said hopper having a second outlet in its bottom, means for closing and for opening said second outlet, a second cover for said hopper, said second cover being gas-untight for the escape of gas from said hopper.

3. An apparatus as claimed in claim 1, comprising a plurality of gas-permeable members in the bottom wall of the gas-treatment chamber, said gas-permeable members being spaced apart by substantial areas of said bottom wall of the gas-treatment chamber, and means for supplying two chemically different gases respectively to two gas-permeable members.

4. An apparatus as claimed in claim 1, comprising a stopper for removably closing said outlet, said stopper extending up through said cover, the cover having clearance with the stopper for the escape of gas from the gas-treatment chamber.

5. An apparatus as claimed in claim 1, and means for introducing inert gas under said cover.

6. An apparatus as claimed in claim 2, comprising a stopper for removably closing said second outlet, said second cover having an opening therethrough for said second stopper and having clearance with said stopper.

7. An apparatus as claimed in claim 2, and means for introducing inert gas under said second cover.

* * * * *