

Nov. 29, 1932.

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1,889,426

VESSEL FOR FIRE REFINING

Filed June 26, 1931

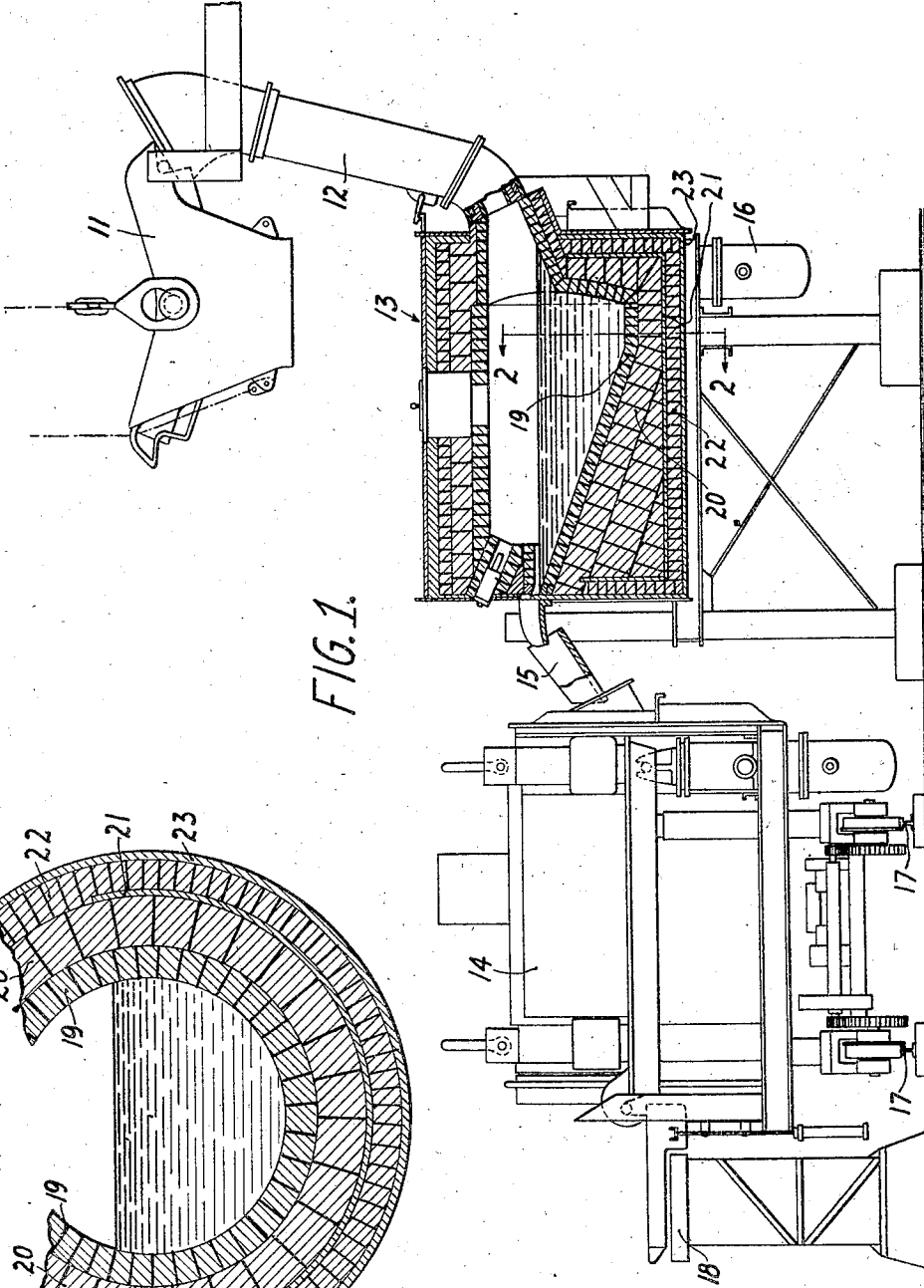


FIG. 1.

FIG. 2.

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REISSUED

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VESSEL FOR FIRE REFINING

Application filed June 26, 1931. Serial No. 547,013.

This invention relates to a vessel for the fire refining of metals.

The present application is a continuation in part of my co-pending application Serial No. 299,666 which has matured into Patent No. 1,817,935 granted August 11, 1931.

In carrying out this object the closed vessel is completely covered with an interior lining of basic material and with an outer layer of heat-insulating material.

In order to protect the heat-insulating material a steel shell may be located in the wall of the vessel between the basic lining and the heat-insulating material.

While a preferred form of the invention has been disclosed herein for purposes of illustration, it should be understood that various changes may be made in the structure without departing from the spirit of the invention as herein set forth and claimed.

In the drawing:

Figure 1 is an elevation partly in section of certain apparatus used in fire refining, including the vessel of the present invention;

Figure 2 is a section on line 2-2 of Figure 1.

In carrying out the process disclosed in my copending application above referred to, molten copper is poured from ladle 11 through launder 12 into the oxidizing vessel 13, where the copper is oxidized. The oxidized copper is then transferred through launder 15 into the reducing vessel 14, this flow being caused by tilting the oxidizing vessel by means of hydraulic cylinder 16. After the reducing step, the copper is poured into molds, indicated at 18.

For the process disclosed in the said copending application it is important that the vessels 13 and 14 be heat-insulated, and the present invention relates to the construction of these vessels whereby it is possible to successfully insulate them against heat under the conditions in which they are used. The vessels must be provided with the openings necessary to conduct the process, and these openings must be capable of being closed relatively tight against the entrance of air into the vessel.

The vessel of the present invention can also

be used for the refining and/or treatment of other metals, such as tin, lead, zinc, nickel, aluminum, steel and wrought iron, and alloys of these and other metals.

It is preferable in treating any molten metal in this vessel to maintain the temperature of the interior reasonably constant. This is due to the fact that a sudden drop of temperature over any considerable range will cause the inner basic lining to crack, and portions of the lining will spall off, thereby causing increase maintenance. For that reason it is preferable to previously melt the metal by any of the processes used in the art. Likewise in making alloys of any metal, it is preferable to previously melt the major component of the alloy and charge that into the vessel, where it can be treated or prepared for the reception of other components. These other components may then be added in the molten state, or if added in the solid state they should be added in such quantities and at such a rate as will not cause a rapid drop in temperature of the contents of the vessel.

The inner lining with which the molten metal comes in contact must be of basic material, such for example as magnesite or chrome refractory material, preferably in the form of brick, which will not substantially combine or slag with the molten metal or with any compound of the molten metal formed during its treatment.

It has been found that if the efficient heat-insulating material, such as sil-o-cel is placed next to the inner basic lining, molten metal penetrates to it and its heat insulating qualities are destroyed. If the basic inner lining is made thick enough to prevent this penetration, the required thickness of basic lining makes the structure so large as to be inoperative. This is due to the fact that the thermal conductivity of the basic material is about 34 times of that of heat-insulating material such as sil-o-cel.

If the insulation of the vessel is attempted solely by placing a layer of neutral or acid refractory material outside of the inner basic lining, the thickness of the acid or neutral refractory material must be so great that the vessel becomes inoperative. This is due

to the fact that the thermal conductivity of acid or refractory material is about 16 times that of insulating material such as sil-o-cel. In other words it would require a thickness of 128 inches of neutral or acid of refractory material to heat insulate a vessel to the same extent as is done with an 8 inch thickness of sil-o-cel, as used in the present invention.

It has been found that if the inner basic lining is surrounded by an acid refractory material, such as high-aluminum-content fire brick, and outside of this is placed a layer of any good insulating material, such as sil-o-cel, the relation of the thickness of the neutral or acid refractory layer to the thickness of the heat-insulating layer could be such that the junction between these layers is maintained below the melting point of the metal, and the molten metal therefore can not penetrate the heat insulating material. In a vessel adapted for treating molten copper the basic lining is 9 inches, the neutral refractory lining is 8 inches, the heat-insulating lining is 8 inches, this latter being held in place by an outer steel shell.

It has also been found that by placing an inner metal shell between the heat-insulating material and the neutral or acid refractory material, the thickness of the latter can be somewhat reduced, thus making the vessel smaller, which reduces the first cost as well as the weight.

The inner lining 19, which is in contact with the molten copper is formed of basic brick; next comes a lining 20 of refractory brick and then a shell 21 preferably formed of chromium steel, or other resistant metal. The lining 20 of refractory brick is of such a thickness that the steel shell 21 never rises above a temperature that it is well able to withstand over long periods of use. The steel shell extends a safe distance above the molten copper level. The next lining 22 of the vessel is composed of a suitable heat-insulating material such as sil-o-cel, magnesia, asbestos, etc., and this lining must be of suitable thickness to retain most of the heat within the vessel and at the same time permit the steel shell 21 to stay below its suitable working temperature. Outside of this heat-insulating material is the outer metal shell 23.

The fuel economy resulting from the use of this vessel in refining copper is shown by the fact that prior art furnaces receiving molten blister from a converter and fire refining it in the prior art furnaces requires from 95 to 120 pounds of fuel oil per ton of refined cast product in the process, while the vessel disclosed uses from 15 to 19 pounds of fuel oil per ton of refined cast product.

The present invention differs from prior art practice also in that prior art requires a much higher capital expenditure per ton of product as the following example will show. To produce 240 tons per day of product, fire

refined from molten blister, requires by prior art apparatus two furnaces of 120 tons each or 240 tons total, from each furnace one charge in 24 hours is cast and the casting period is from 3 to 5 hours long for each charge. With my invention two vessels each approximately 20 tons or a total vessel size of 40 tons, will cast the same amount of copper, a charge is cast every two hours and the casting period for each charge is from 18 to 26 minutes.

The large size furnace units of the prior art require continuous combustion of fuel and therefore need an oxidizing flame during reduction and casting. They consume from 52 to 83 pounds of poles per ton of product. In the present apparatus no fuel is required during reduction and casting, only from 23 to 32 pounds of poles are used per ton of product, and the length of time required for reduction is correspondingly shorter.

I claim:

1. A vessel for treating molten metal comprising an inner basic refractory lining extending over the entire inner walls of the vessel, surrounded by a layer of acid or neutral refractory material, and an outer layer of heat-insulating material, the relation of the thickness of the layers of different materials being such that the temperature at the junction between the layer of neutral or acid refractory material and the layer of heat-insulating material is maintained below the melt point of the metal treated.

2. A vessel as defined in claim 1 having an inner metallic shell inserted between the neutral or acid refractory material and the layer of heat-insulating material in the bottom part of the vessel.

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