

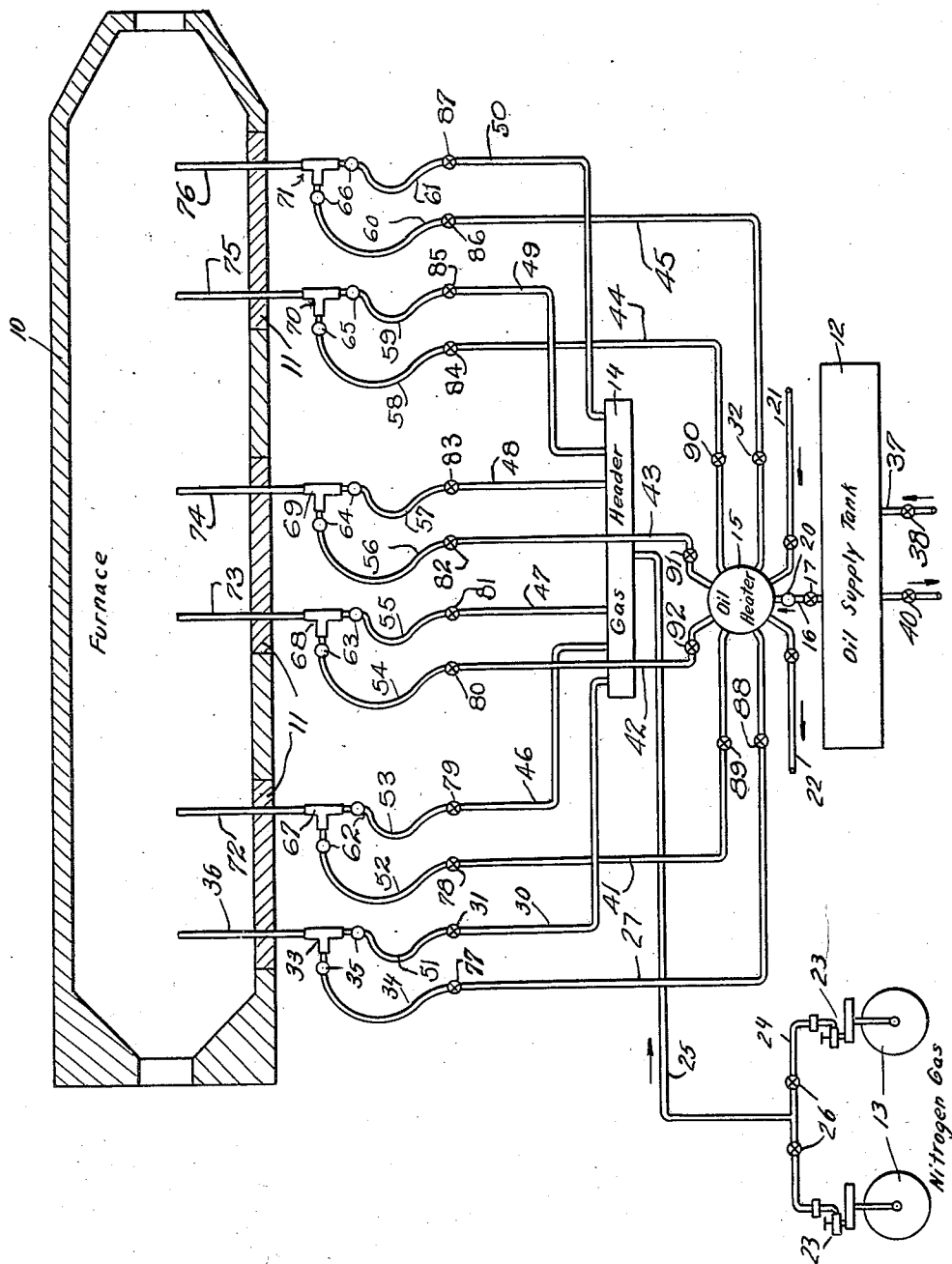
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PROCESS FOR REFINING COPPER

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PROCESS FOR REFINING COPPER

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6 Claims. (Cl. 75—62)

This invention relates to metallurgy and has for an object the provision of an improved process for refining copper.

In the fire refining of copper, compressed air is blown into a molten bath of the metal to oxidize impurities contained therein. The blowing operation is continued until the bath is substantially saturated with cuprous oxide, at which time the impurities will have been substantially completely oxidized and the oxidation products will have been vaporized or will have risen to the surface of the bath from where they are removed by skimming.

In order to produce metallic copper of commercial grade, it is necessary to reduce the major portion of the cuprous oxide formed during the air-blowing operation. It has been customary, heretofore, to effect the reduction of the cuprous oxide by forcing the ends of wood poles under the surface of the molten bath of cuprous oxide-bearing metal. The carbon and hydrocarbons of the wood reduce the cuprous oxide, forming metallic copper which is retained in the bath and oxides of carbon and hydrogen which pass out of the bath. The reducing or poling operation is continued until the set surface of a test ingot indicates that the copper is to pitch, or, in other words, contains the right amount of oxygen to form a product of good commercial quality.

In some localities in which extensive copper refining operations are carried out, it is difficult to obtain poles suitable for use in the reduction of the cuprous oxide and such poles are consequently very expensive. It is, therefore, desirable to eliminate the necessity for employing wood poles and employ more readily available and less expensive agents capable of being utilized to accomplish reduction of the cuprous oxide. Hydrocarbons, such for example, as those contained in fuel oils possess satisfactory reducing capacities, and they are usually easily obtainable and relatively inexpensive.

In order to utilize the reducing capacities of hydrocarbons, it is necessary to bring them into intimate contact with the materials of the molten metal baths. It has been proposed, heretofore, to effect the desired intimate contact by injecting the hydrocarbon agent into the molten metal bath. Thus, for example, it has been proposed to force an agent such as fuel oil into the molten bath by means of air or steam under pressure.

Reducing operations involving the injection of an agent such as fuel oil by means of steam and air are inefficient and frequently result in the production of inferior copper products.

When air is employed, the oxygen contained therein will tend to oxidize the copper and thus neutralize the reducing effect of the oil. The time required to complete the reducing operation will, therefore, be increased. Furthermore, at the temperature of the reducing operation, the oxygen of the air will react with the hydrocarbons of the oil, and it will be necessary, therefore, to employ sufficient oil to react with all of the oxygen of the air in addition to the amount required for reduction of the cuprous oxide.

Steam at the temperature of and in contact with molten copper has a tendency to decompose into its elements, oxygen and hydrogen. Free oxygen thus produced will tend to increase the time required and, also, the amount of hydrocarbon required for deoxidation of the copper. Free hydrogen is substantially insoluble in solid copper at ordinary atmospheric temperatures, but it is readily absorbed by molten copper. Therefore, hydrogen resulting from the decomposition of steam will be absorbed by the molten copper and will be expelled as the copper cools to the solidifying point. If solidification takes place rapidly, as it does in the chill casting of copper shapes, some of the hydrogen will be trapped in the casting and form blow holes.

We propose to modify the heretofore customary deoxidizing procedures by introducing a finely divided or atomized reducing agent into the molten copper. We prefer to employ a hydrocarbon reducing agent such, for example, as fuel oil and to employ, as an atomizing and injecting agent, a gas which is inert toward the components of the bath. We have found that a gas such as nitrogen is admirably suited for use as an atomizing and injecting agent. Nitrogen is substantially completely inert insofar as combining or oxidizing powers are concerned, and it is not absorbed in any detectable quantity in molten copper.

In carrying out a complete fire refining process in accordance with our invention, the copper to be refined is subjected, in molten condition, to the action of an oxidizing agent such as air to effect the elimination of oxidizable impurities. The oxidizing treatment is preferably continued until the bath is substantially saturated with cuprous oxide. The cuprous oxide-bearing bath is then subjected to the action of a suitable reducing agent. The reducing agent is preferably injected in finely divided or atomized condition into the bath at a point below the surface. We prefer to employ fuel oil as the reducing agent and to atomize it and inject it into the bath by

means of nitrogen gas under pressure. The oil and nitrogen gas are conducted from suitable sources of supply by means of suitable conduits to one or more atomizing devices of standard or ordinary design. Any suitable type of atomizer may be employed. The nitrogen gas containing, in suspension, the finely divided or atomized fuel oil is conducted to one or more injecting conduits disposed at suitable points to communicate with the interior of a refining furnace at one or more points below the normal bath level.

The accompanying drawing illustrates an arrangement of apparatus which may be employed in carrying out a process of the invention.

The drawing shows a refining furnace 10 provided with charging doors 11 in a side wall. A main oil supply tank 12 and pressure tubes or tanks 13 for nitrogen gas are disposed at convenient points. The oil and nitrogen gas supply tanks are preferably disposed outside the furnace building to permit easy access thereto for filling or substitution. A gas header 14 and an oil heater 15 are disposed within the building at some distance from the furnace. The oil heater is connected to the oil supply tank by means of a conduit 16 provided with a control valve 17 and a check valve 20. Oil introduced into the heater is heated through contact with a steam coil (not shown) provided with inlet and outlet conduits 21 and 22, respectively.

The gas header is connected to the gas pressure tanks by means of suitable flow regulating devices 23 and conduits 24 and 25. Valves 26 are provided for controlling the flow of gas from the tanks to the header.

Rigid pipes 27, 41, 42, 43, 44 and 45 are provided for conducting the oil to points adjacent the charging side of the furnace, and similar pipes 30, 46, 47, 48, 49 and 50 are provided for supplying the gas. The oil supply pipes are provided at their ends adjacent the furnace with needle valves 77, 78, 80, 82, 84 and 86 which are so placed as to be within easy reach of the furnace operator. Needle valves 31, 79, 81, 83, 85 and 87 are similarly placed in the gas supply lines. The oil supply pipes are also provided with control valves 32, 88, 89, 90, 91 and 92 between the needle valves and the heater.

Atomizing devices 33, 67, 68, 69, 70 and 71 are connected to the needle valves in the oil supply lines by means of flexible tubes or hoses 34, 52, 54, 56, 58 and 60 and to the needle valves in the gas supply lines by flexible tubes or hoses 51, 53, 55, 57, 59 and 61. Check valves 35, 62, 63, 64, 65 and 66 are provided in the flexible hoses between the needle valves and the atomizers. Rigid injector pipes 36, 72, 73, 74, 75 and 76 are attached to the atomizing devices. The atomizers may be of any suitable construction. The atomizers shown in the drawing comprise chambers provided with inlets through which streams of oil and currents of gas may be introduced at right angles. The high velocity gas current is directed against the stream of oil and functions to subdivide the oil into minute particles.

In employing apparatus of the type illustrated for carrying out the process of the invention, a supply of nitrogen gas under pressure is provided. The pressure employed may vary within wide limits. The gas should be under sufficient pressure to atomize the oil and introduce into a molten bath of copper in the furnace, against the hydrostatic pressure of the molten copper, the atomized oil at a rate sufficient to effect deoxidation within a reasonable time. The oil may be main-

tained under pressure in the main oil supply tank to insure a steady or constant flow by means of air under pressure introduced into the tank above the oil body therein through an air supply pipe 37 provided with a regulating valve 38. A pipe 40 having a suitable valve therein is provided for exhausting the air from the tank.

The injector pipes are inserted into the furnace through the charging doors with their discharge ends extending to points below the surface of the molten copper bath. Control of the introduction of oil and gas into the atomizers and injector pipes is accomplished through manipulation of the needle valves in the supply lines. The flexible hoses connecting the atomizers with the needle valves permit easy adjustment of the injector pipes to insure the introduction of the oil-gas mixture at proper points beneath the surface of the molten copper bath.

We claim:

1. A process for refining copper which comprises injecting an oxidizing gas into a molten bath of a copper product to be refined to oxidize impurities contained therein, and subsequently injecting into the molten bath a stream of inert gas having a reducing agent in finely divided form suspended therein to reduce one or more undesirable oxides produced during the oxidizing treatment.

2. A process for refining copper which comprises injecting an oxidizing gas into a molten bath of a copper product to be refined to oxidize impurities contained therein, and subsequently injecting into the molten bath an atomized hydrocarbon by means of an inert gas to reduce one or more undesirable oxides produced during the oxidizing treatment.

3. In a process for refining copper, the improvement which comprises subjecting a liquid hydrocarbon to the action of a current of nitrogen gas to atomize the hydrocarbon, and injecting the resulting oil-gas mixture into a molten bath of copper to reduce one or more undesirable compounds contained therein.

4. A process for refining copper which comprises injecting an oxidizing gas into a molten bath of a copper product to be refined to oxidize impurities contained therein and produce a bath substantially saturated with cuprous oxide, subjecting a liquid hydrocarbon to the action of a current of nitrogen gas to atomize the hydrocarbon, and injecting the resulting oil-gas mixture into the cuprous oxide-bearing bath to reduce cuprous oxide contained therein.

5. A process for refining copper which comprises injecting an oxidizing gas into a molten bath of a copper product to be refined to oxidize impurities contained therein, and subsequently introducing into the molten bath a stream of nitrogen having a reducing agent in finely divided form suspended therein to reduce one or more undesirable oxides produced during the oxidizing treatment.

6. A process for refining copper which comprises injecting an oxidizing gas into a molten bath of a copper product to be refined to oxidize impurities contained therein, and subsequently introducing into the molten bath a stream of nitrogen having a hydrocarbon in finely divided form suspended therein to reduce one or more undesirable oxides produced during the oxidizing treatment.

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