

UNITED STATES PATENT OFFICE.

GEORGE MITCHELL, OF NACO, ARIZONA TERRITORY.

METHOD OF REDUCING COPPER MATTE TO REFINED COPPER.

SPECIFICATION forming part of Letters Patent No. 705,109, dated July 22, 1902.

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To all whom it may concern:

Be it known that I, GEORGE MITCHELL, of Naco, in the county of Cochise and Territory of Arizona, have invented certain new and
5 useful Improvements in Methods of Reducing Copper Matte to Refined Copper; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to
10 which it appertains to make and use the same.

My invention relates to an improved method of reducing copper matte to refined copper. The object of the invention is to facilitate and cheapen the production of refined copper
15 from sulfid ores.

The following is a description of my improved method of reducing copper matte to refined copper. Copper matte produced by the well-known method of smelting sulfuret
20 ores and containing from forty to sixty per cent. copper (more or less) is charged in a molten condition into a copper-converter provided with a silicious lining and the air-blast on being applied is forced into and through
25 the molten matte, with the result that the iron and sulfur contained in the matte are oxidized and maintains the charge at a high temperature, causing the iron to attack the silica lining and convert the iron into silicate of
30 iron or slag, which being lighter than copper floats on the surface of the latter or on the partially-converted charge. After the charge has been blown from fifteen to thirty minutes, (more or less,) the time depending on the
35 character of the matte and other conditions, practically all of the iron contained in the charge will have been converted into slag, and when this stage in the operation has been reached and which is called the "first" or
40 "slag-forming" stage of the process the converter is turned down and the slag raked off, and then the converter is tilted back into its upright condition, and the blowing operation is continued and maintained until the charge
45 has been converted into metallic copper, which is indicated to the skilled operator by the color of the flame and the characteristics of the sparks that issue and are projected from the mouth of the converter. The conversion
50 of matte into metallic copper requires that the molten charge be furnished with a constant supply of air to maintain a sufficiently

high temperature to insure the rapid oxidation of the impurities contained in the charge. Owing to its low specific heat copper will chill
55 and freeze over the inner ends of the twyers during the blowing of a charge, and unless removed such chilled copper will so obstruct the twyers and supply of air as to not only delay the process, but prevent its successful accomplishment. Hence provision is
60 made for removing the chilled copper as it forms over the inner ends of the twyers, and this is effected by providing the wind-belt with openings opposite each one of the twyers
65 and furnishing each one of such openings with a readily-removable plug or stopper or with a valve or gate that may be quickly opened and closed. A converter provided with removable stoppers substantially like
70 the one shown in Letters Patent No. 470,644, granted to Pierre Manhes, March 8, 1892, may be employed, although the well-known Barrel converters now in common use for converting copper may be employed. During the
75 blowing of a charge the operators from time to time insert a drift-bar into the twyers and punch off any chilled copper that may have formed on their inner ends, and thus insure a continuous supply of air to the molten
80 charge. Less punching of the twyers is ordinarily required during the first stage of the operation than in the last, due to the fact that as the operation continues the heat-producing constituents of the charge gradually
85 decrease in amount up to the completion of the operation, when all of the iron and nearly all of the sulfur and other impurities will have been oxidized and eliminated.

The foregoing is a description of the process
90 ordinarily practiced for converting copper matte into metallic copper, and for the purpose of clearly distinguishing my invention and improvement from the present method of reducing metallic copper made by
95 the converter process to refined copper I will first describe the method now commonly and universally practiced and will then describe my improved method.

After copper matte has been reduced to
100 metallic copper by the converter process hereinbefore described the converter is turned down and the copper is poured into molds and cast into pigs or bars. It is the aim of

the operation to pour the contents of the converter the instant it has been converted into metallic copper. In the event the blast should be maintained slightly longer than is necessary to produce metallic copper—an operation which is designated as “overblowing the charge”—the contents will contain more or less oxid of copper, and in order to convert it back to metallic copper a little raw matte and slag and floor-sweepings are added to the charge, which is reblown a short time to put it in proper condition for pouring.

The converted copper pigs or bars are ordinarily refined by the well-known “Swansea” process, which may be briefly described as follows: The pigs or bars of copper are charged into a reverberatory furnace, which is heated by extraneous fuel to melt the pigs or bars and to maintain the charge in a molten condition until its impurities have been oxidized and eliminated. To facilitate the process, the molten charge is agitated so as to bring all its particles in contact with the atmospheric air and promote a quick oxidation of the impurities contained in the charge. After the charge has been treated in the reverberatory furnace a sufficient length of time to oxidize and eliminate its impurities and which requires from twenty-four to forty-eight hours (more or less) a portion of the copper will have been transformed into suboxid of copper, which must be reduced to metallic copper again; otherwise the copper would be brittle and unfit for manufacturing purposes. This reduction is accomplished by the well-known process of “poling,” which consists in first covering the molten charge with charcoal to prevent the access of air thereto and then inserting into the charge a pole of green wood, which operates to evolve a large volume of hydrocarbons and other reducing gases and rapidly eliminates the excess of oxygen, and after the poling process has been completed the refined copper is cast into ingots or bars.

I will now describe my improved process, which results in a great saving in time and expense in the reduction of metallic copper to refined copper.

After the charge in the converter has been reduced to metallic copper the air-blast is continued a sufficient length of time to “overblow” the charge and oxidize and eliminate all or practically all the sulfur or sulfurous-acid gas remaining in the charge and produce suboxid of copper substantially equivalent in amount to that which is produced by the refining process as carried on in a reverberatory furnace. The extra time required to overblow the charge will vary slightly with varying conditions; but at most it will rarely, if ever, exceed five minutes and oftentimes will require not longer than a fraction of a minute. The operator can determine by the color and volume of the flame and sparks escaping from the converter when the charge has been sufficiently overblown to insure the

production of the proper amount of suboxid in the charge, which may vary from one to five per cent. (more or less) without seriously interfering or affecting the subsequent refining operation. When the molten charge of metallic copper has been overblown in the manner and to the extent set forth, it is poured from the converter into a ladle, which is moved by an electric crane and its contents are charged into a reverberatory furnace, when the molten charge is covered by a layer of charcoal to exclude contact of the atmospheric air therewith, and then the molten mass is poled in the manner already described, and refined and ductile copper is produced.

By “overblowing” the molten charge of metallic copper in the converter the same result is obtained in from one to four minutes that requires from twenty-four to forty-eight hours by the ordinary Swansea process and which I have described. In both the object is to eliminate the sulfurous-acid gas and any remaining impurities contained in the metallic copper, and in both this result is attended by the suboxidation of a certain percentage of the mass of metallic copper treated, which excess of oxygen must in each case be eliminated by the process of poling in order to render the product sufficiently ductile for commercial use.

By my process I conserve all or nearly all the heat that is stored in the charge of metallic copper in the converter and utilize the heat in oxidizing and eliminating the impurities, while in the process as now practiced such heat is not availed of.

By my process the time, labor, and expense involved in casting the metallic copper into pigs or bars and remelting them again in a reverberatory furnace is saved, and, again, by my process I save the time, labor, and expense that is involved in maintaining the charge of copper in a molten condition and agitating it for a period of from twenty-four to forty-eight hours, (more or less,) because I attain the same result by overblowing the charge in the converter.

While I may refine but a single converter charge at a time, I prefer to treat two or more converter charges at a single operation for the following reasons: While the overblowing of a charge in the converter may be effected with great certainty and uniformity by a skilled operator, it might and doubtless would happen that under varying conditions arising from careless or unskilled workmen or for other reasons one charge might not be overblown to the required extent to insure the best results, while another charge might be overblown for a longer period than was required or desired, and hence in carrying out my improved process I provide a reverberatory furnace of sufficient capacity to hold several converter charges and preferably of sufficient capacity to hold all the converter charges that may be produced by a night's shift, so that all of the charges produced during

the night may be collected and stored in the reverberatory furnace in readiness for treatment in the morning. It will be found that notwithstanding the fact that some of the charges so stored in the furnace may be slightly underblown and others may have been overblown slightly longer than was necessary or desirable the entire mass will contain such a proportion of suboxid of copper as will insure its complete and satisfactory refining treatment by the poling process. However, in the event the operator should find that the accumulated charge in the furnace contains too little or too much suboxid of copper for rapid and economical poling he may bring the charge into proper condition by regulating the condition of the next succeeding converter charge. If the charge in the furnace contains too little suboxid of copper, the next converter charge will be overblown to such a degree as to produce an abnormally-high percentage of suboxid of copper, so that when it is poured into the furnace it will bring the suboxid of the entire mass up to the desired percentage. On the other hand, if it is found that the contents of the furnace contain too much suboxid of copper the next succeeding converter charge may be underblown to such an extent as to contain little or no suboxid of copper, and such charge when poured into the furnace will reduce the suboxid to the proper percentage for economical treatment.

After the desired number of converter charges have been poured into the reverberatory furnace the molten mass is covered with charcoal and is then subjected to the poling process, after which the refined copper is run into pigs or bars; but the refined metal is preferably cast into anodes of suitable size and shape to be treated by the well-known electrolytic process, as by the elimination of the sulfurous-acid gas and other impurities from the copper. The anodes cast therefrom are homogeneous and firm in texture and when subjected to the electrolytic treatment do not injuriously affect the electrolytic bath.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The method of reducing copper matte to refined copper consisting in charging molten copper matte into a converter and blowing air through the charge until practically all of the iron in the charge has been converted into slag, removing the slag, then reblowing the charge and reducing it to metallic copper and continuing the blowing operation until the charge has been overblown sufficiently to produce a small percentage of suboxid of copper and approximating as nearly as is possible

the amount required to prepare the copper for "poling," then charging the molten contents of the converter into a reverberatory furnace and subjecting it to the poling process, substantially as set forth.

2. The method of reducing copper matte to refined copper consisting in blowing copper matte in a converter until practically all the iron contained in the charge has been transformed into slag, removing the slag, then blowing the remaining charge until it has been reduced to metallic copper and continuing the blowing operation until the metallic copper has been sufficiently overblown to produce a small percentage of suboxid of copper and approximating as nearly as is possible the amount required to prepare the copper for "poling," punching the twyers during the blowing of the charge to maintain a constant and practically uniform distribution of air throughout the charge; then charging the molten contents of the converter into a reverberatory furnace and subjecting it to the "poling" process, and finally casting the product into pigs, bars or anodes, substantially as set forth.

3. The method of reducing copper matte to refined copper consisting in reducing copper matte in a converter to metallic copper containing a small percentage of suboxid of copper and approximating as nearly as is possible the amount required to prepare the copper for "poling;" charging a reverberatory furnace with two or more of such converter charges and subjecting such mixed and accumulated charges to the poling process, substantially as set forth.

4. The method of reducing copper matte to refined copper consisting in blowing the copper matte in a converter and reducing it to metallic copper containing a small percentage of suboxid of copper, charging two or more such converter charges into a reverberatory furnace, and then adding to such accumulated charge, one or more additional converter charges blown to such a predetermined condition that when mixed with the accumulated charges they will cause the mass to contain the desired percentage of suboxid of copper and finally subjecting the entire charge to the poling process, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

GEORGE MITCHELL.

Witnesses:

S. W. FOSTER,
GEO. F. DOWNING.