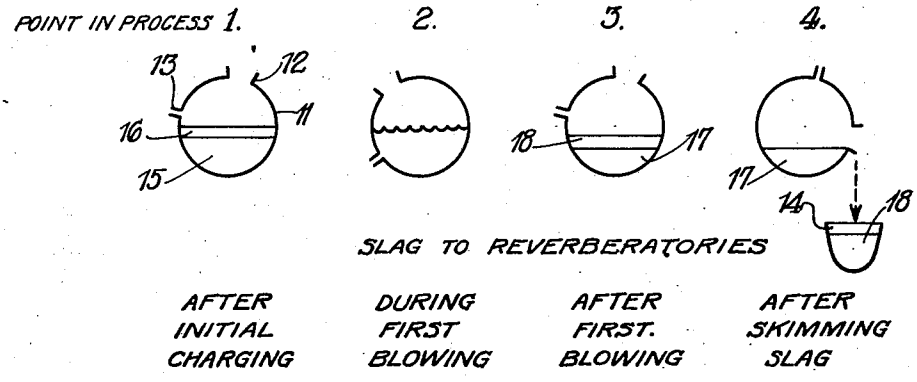
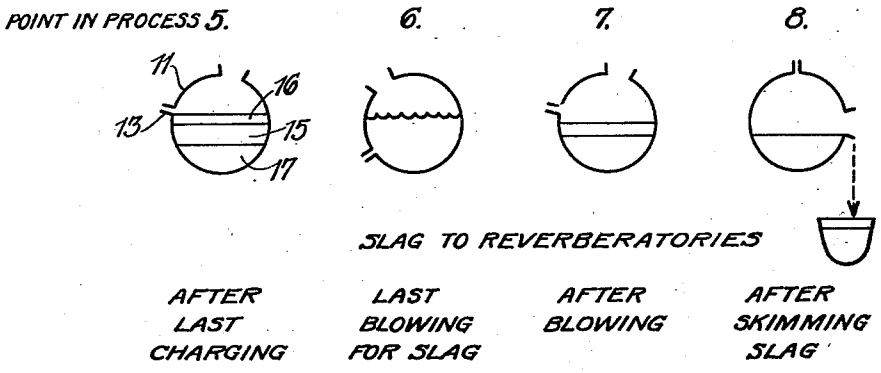
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SELECTIVE CONVERTING OF COPPER MATTE

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Fig. 1.





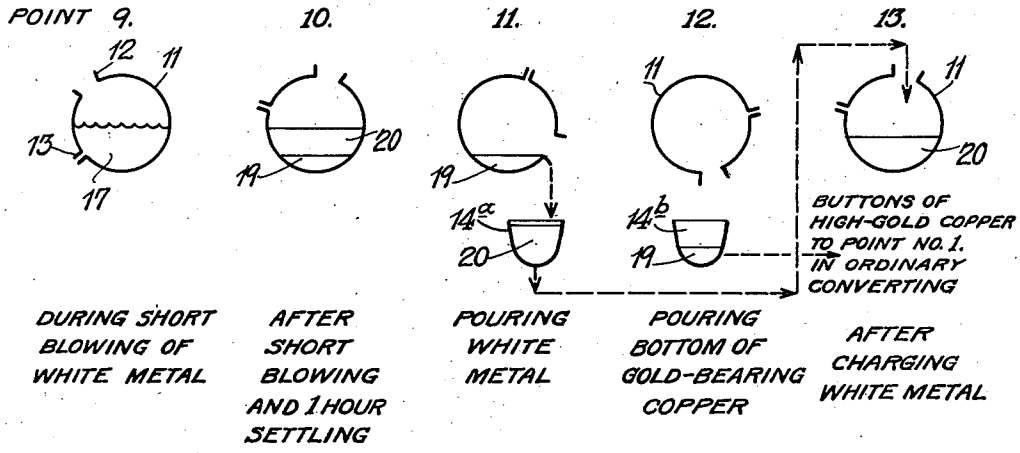
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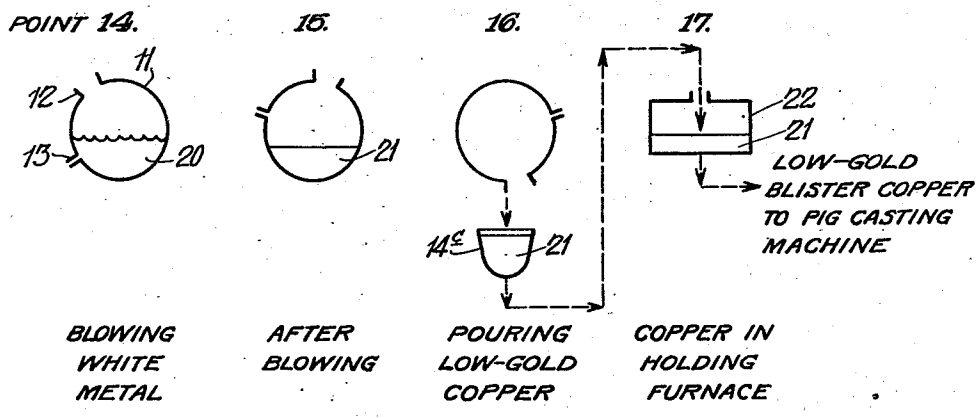
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Fig. 2.





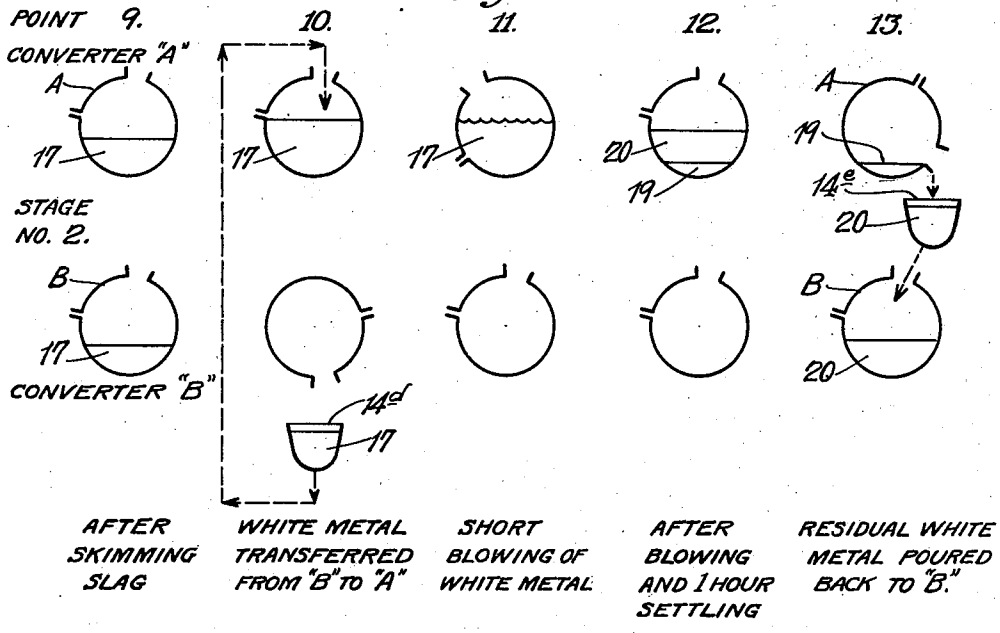
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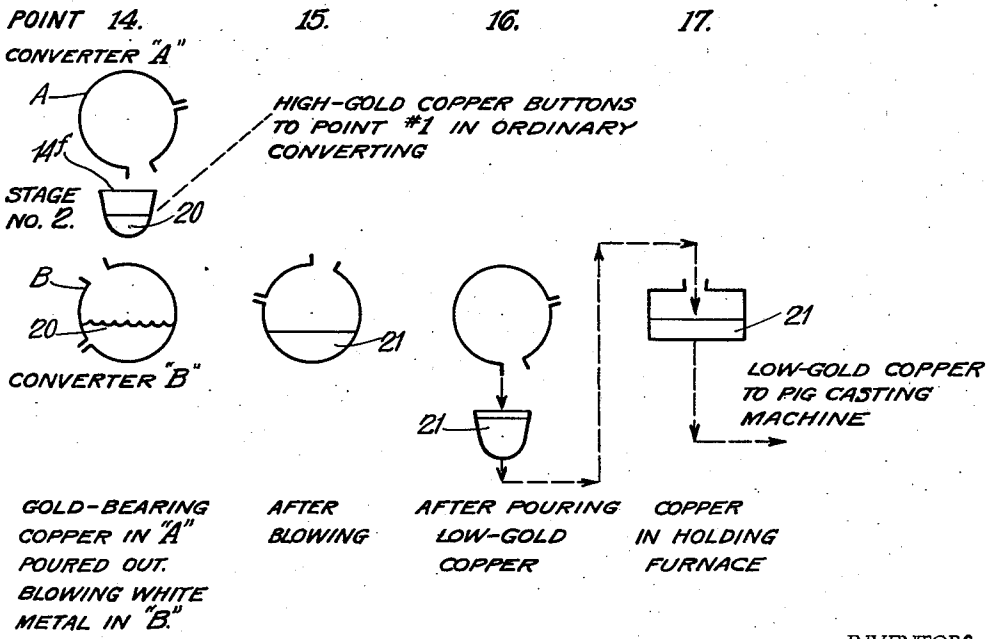
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Fig. 3.





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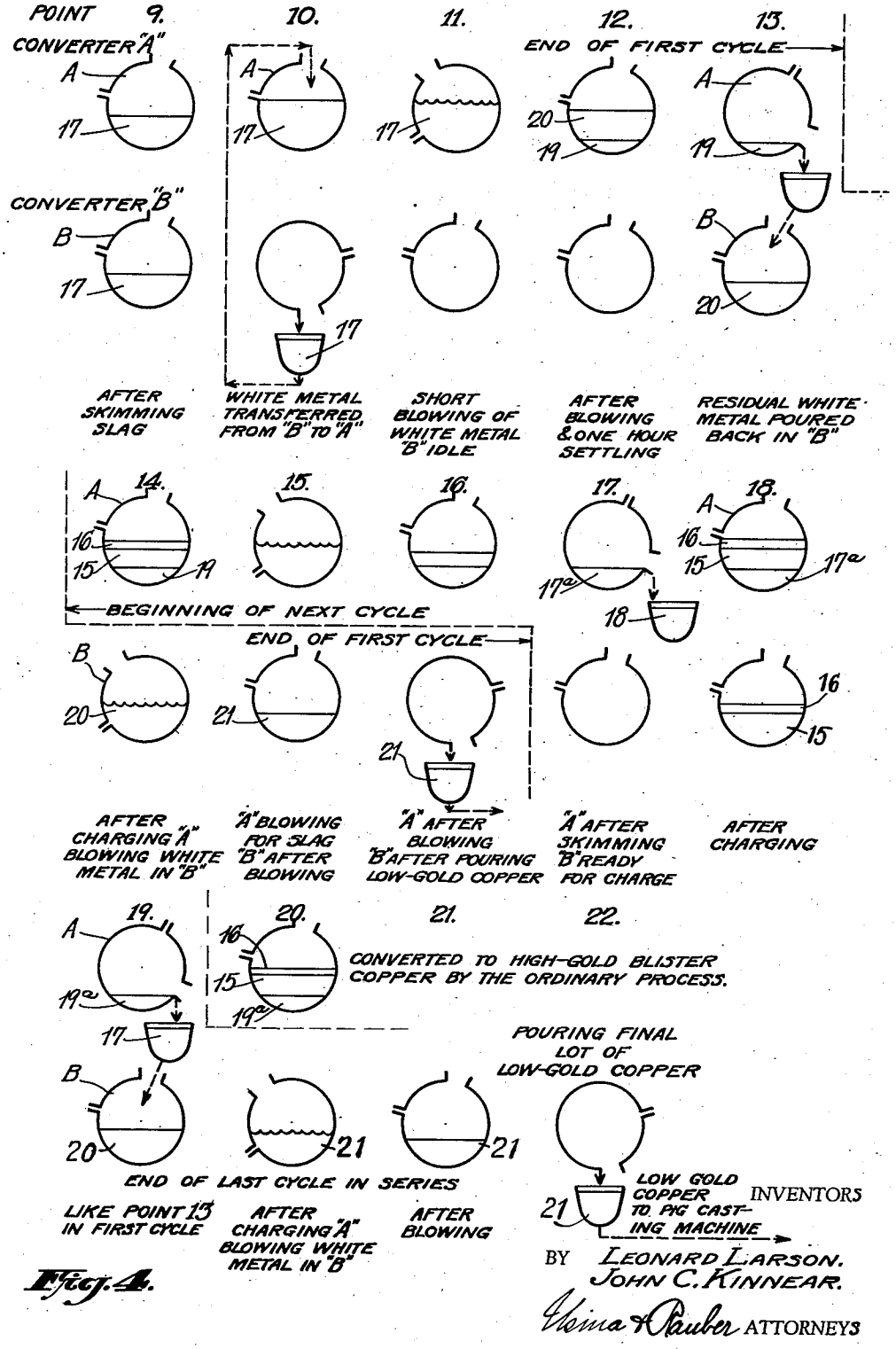


Fig. 4.

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Patented Feb. 22, 1938 2,109,272

UNITED STATES PATENT OFFICE

2,109,272

SELECTIVE CONVERTING OF COPPER MATTE

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Application May 21, 1935, Serial No. 22,572

5 Claims. (Cl. 75—75)

The invention aims to provide certain improvements over the known processes of converting copper matte selectively, so as to produce two products, one comparatively high in gold, silver and other impurities, and the other comparatively pure copper. An example of a matte produced by the smelting of raw concentrate in a reverberatory furnace has the following composition approximately:—

Copper	per cent	34
Iron	do	35
Sulphur	do	25
Gold	ounces per ton	0.3
Silver	do	2.0

Other impurities may be present in unimportant quantities, and the matte may be of any percent copper suitable for converting operation.

In ordinary non-selective converting the molten matte is introduced with a quantity of flux into a vessel similar to a Bessemer converter and air is blown through it. The oxygen in the air blast combines first with the iron and its sulphur. The sulphur burns to sulphur dioxide gas which escapes through the open mouth of the converter, while the iron is oxidized and with the silica in the flux forms a slag. Assuming the oxygen in the blast and the silica in the flux to be provided in proper proportions, a first stage of the process will be complete when the materials in the converter consist of only (1) undecomposed copper sulphide or "white metal" and (2) slag. The slag is skimmed off and the blast restored, without flux because the iron has all been eliminated. The sulphur is oxidized by the blast, burning as before with considerable evolution of heat and formation of sulphur dioxide gas which passes off. The copper is more resistant to oxidation and separates in metallic form. When all the sulphur has been oxidized out, the molten copper remaining is transferred in a ladle to a furnace which holds it molten, from which it is cast into pigs of blister copper.

In some cases the first batch of white metal would yield an inconveniently small lot of copper. To get around that difficulty, more matte is added to the white metal and the process repeated until a sufficiently large batch of white metal is obtained, whereupon the slag is skimmed and the blowing of the white metal alone is inaugurated.

This one final product contains all of the original impurities, principally precious metals which were incapable of being removed either in the slag or with the gases. The final separation from the copper is accomplished by an electrolytic process after the blister copper pigs have been transferred to the refinery.

In the present selective method the white metal is produced in the above described manner, or in any other usual or suitable way, and is blown in such a way as to obtain two products; one a comparatively high gold bearing copper, which brings a price increasing with its gold content, and the other a blister copper comparatively low in gold content.

The white metal is blown only partially. The blast is turned off for a substantial time to allow all the copper formed to settle out of the molten mass. This metal contains practically all of the gold in the charge and a large part of the silver and other impurities. It is removed, after which the remaining white metal is blown and converted into copper which is low in gold or practically free from gold.

The process may be varied in detail, three examples being described below.

Example No. 1 is the simplest. The steps, after providing the required quantity of white metal molten in the converter, are as follows:—

1. Blow the white metal about 90 minutes (as compared with 210 minutes required in the non-selective process). During this short blow about 25 per cent or even less of the total copper originally in the white metal is converted into metallic copper. For example, the original charge of white metal might contain 80 tons of copper, in which case the short blow would convert about 20 tons or even less to metallic copper. In order to collect this, the blast is shut off and the converter is allowed to stand quietly for about an hour, during which the metallic copper settles in the bottom. The principle of the comparatively short blow and the long settling period would involve increasing or diminishing the time intervals stated if the process is carried with a larger quantity of white metal or a smaller quantity respectively, the extent of the departure from this example being within the skill of workers in this art. The white metal is poured off as completely as possible into ladles or pots for temporary storage; and the settled copper or bottom, which contains a large part of the gold and a smaller fraction of the silver, is transferred to storage pots and allowed to solidify into buttons which are remelted later on in ordinary blister copper converting or are otherwise utilized.

2. The molten white metal (minus the high gold copper), which was held in temporary storage is poured back into the converter and finished to blister copper as in ordinary converting. The fraction of the copper so produced is impoverished in gold. Portions of the white metal which freeze during its temporary storage, termed pot skulls, are remelted later in ordinary blister copper converting.

The partial blowing described does not produce any substantial quantity of copper oxide, nor any substantial accumulation of a bottom of completely blown blister copper. It merely pro-

duces a certain quantity of blister copper in particles disseminated throughout the white metal. These particles present a prodigius area of gold-collecting surfaces which are present at the end of the partial blow and which are maintained well into the succeeding settling period. These dispersed particles constitute the principal reliance of the process for the concentration of the gold, though, of course, there is some collection of gold through bulk contact with the bottom as the latter settles out.

In the above process the partial blowing and long settling serve to collect a large percentage of the gold by a simple method and equipment, utilizing a single converter.

Example No. 2 is carried out with a pair of converters. The blister copper produced is practically free from precious metals, all of which are collected in the bottoms. The steps, after producing the required quantities of white metal in two converters designated A and B, are as follows:—

1. Transfer the white metal from converter B to converter A. Or the process may be said to begin with an equivalent quantity of white metal provided in any way in converter A. The white metal is blown for about 90 minutes and the high gold copper allowed to settle out substantially completely in the bottom. The white metal on top is transferred to converter B. The high gold copper remaining in A is poured into pots, solidified into buttons and remelted later in ordinary blister copper converting.

2. The white metal in converter B is blown to low gold blister copper as in ordinary converting.

The chief advantage in this over Example No. 1 is in the maintenance of the low gold white metal molten by transferring it directly from A to B and thus maintaining a practically continuous blow to the end.

Example No. 3 also utilizes two converters A and B. But the procedure is modified so that there is produced a comparatively small quantity with a higher percentage of gold. The process is the same as that of Example No. 2 through the short blowing of the double charge of white metal in converter A, the allowing of the high gold copper to settle out thoroughly and the transferring of the white metal to converter B.

1. Instead of pouring the high gold copper and solidifying it into buttons, it is allowed to remain molten in converter A.

2. The next step is to blow the white metal in B to low gold blister copper, which is disposed of as usual. During this blow in B a second cycle of operations is commenced and carried out as follows.

3. Charge converter A with a new supply of matte and flux on top of the high gold metal therein, blow to white metal and slag and skim off the slag.

4. Charge A again with matte and flux on top of the white metal left from the previous step and at the same time recharge the emptied converter B with matte and flux. Blow both converters to white metal and slag and remove the slag.

5. Transfer the white metal from B to A, blow the double charge a short time, permit settlement, transfer the white metal to B, leaving the high gold copper in A and blowing the white metal in B to completion repeating steps 1 and 2. The various steps (3, 4 and 5) of the first cycle are repeated in order until from two to sixteen cycles or more have been completed. When new matte and flux are added to the converter the residual metallic copper in converter A reacts with the new matte and is changed to copper sulphide which immediately dissolves in the matte. Until the last cycle is reached, the only withdrawn product is low gold copper. The residual metallic copper in converter A is passed on from cycle to cycle, carrying with it the gold which it has extracted in the preceding cycles. When it has become sufficiently enriched in gold, the cyclic operation is brought to an end and the next step follows.

6. A final batch of low gold copper is made from the white metal in B. The enriched bottom remaining in A is supplemented by a charge of new matte and flux and the mixed mass converted into high gold blister copper by the ordinary procedure.

7. The result is a comparatively small quantity of copper in which is collected most of the gold which was carried in a plurality of successive converter charges of matte, from two to sixteen or more double charges in the case described.

For a fuller disclosure of the invention, reference is made to the diagrams illustrated on the accompanying drawings, showing the successive phases of the treatment.

Fig. 1 illustrates stages in the production of white metal from the slag. This is the ordinary process, which is followed by blowing all the white metal to ordinary gold-bearing blister copper; Fig. 2 illustrates Example No. 1 above; Fig. 3 ilustrates Example No. 2 above; Fig. 4 illustrates Example No. 3 above, with certain omissions as hereinafter explained.

Referring now to Fig. 1, 11 illustrates a converter with a spout 12 and tuyères 13; and 14 illustrates a ladle. At point 1, after initial charging, the converter carries matte 15 on which is floating flux 16. At point 2, the converter is tilted and the blast is on. At point 3 the converter is upright, the blast is off and we have a mass of white metal 17 on which floats slag 18. At point 4 the converter is tilted forward to pour the slag 18 into a ladle, holding back the white metal.

In order to increase the quantity under treatment the converter is turned back from point 4 to point 5 and on top of the white metal 17 is applied a further charge of matte 15 and flux 16. At point 6 the blowing is renewed. Points 7 and 8 are practically repetitions of 3 and 4 except for the increased volume of white metal in the converter. The same steps may be repeated to any desired extent, after which the white metal is blown to blister copper which is held molten in a furnace until ready to be conveyed to the pig casting machine and the pigs to the refinery.

In carrying out Example No. 1, the steps are the same as in Fig. 1 until the required quantity of molten white metal is accumulated in the converter; after which they are as illustrated in Fig. 2. The white metal 17 is blown at point 9 for the short period stated. The blast is stopped, point 10, and the converter held upright long enough to permit the comparatively high gold copper 19 to settle out of the comparatively low gold white metal 20. At point 11 the low gold white metal 20 is poured off into a ladle 14a, and at point 12 the converter is further tilted to pour off the high gold copper 19 into a second ladle 14b. This comparatively high gold copper may be transferred to point 1 (Fig. 1) of an ordi-

nary converting process, or may be separately collected and disposed of in other ways.

The white metal 20 from the ladle 14a is transferred back to the converter 11 and is blown as at point 14 until it is finished to comparatively low gold blister copper 21, which is poured into a ladle 14c and thence to a holding furnace 22 (point 17), whence it passes to the pig casting machine.

In carrying out Example No. 2, the process of Fig. 1 is practiced until a sufficient quantity of white metal is accumulated in two converters A and B (Fig. 3). The metal from B is transferred to A (point 10) by way of a ladle 14d. Thence it is blown (point 11) and held (point 12) until there is an accumulation of comparatively high gold bearing copper 19 at the bottom of the low gold bearing white metal 20. At point 13 the white metal 20 is transferred by means of a ladle 14e to a converter B.

At point 14 the high gold copper 19 is poured into a ladle 14f and transferred to point 1 (Fig. 1) of an ordinary converting process, or otherwise utilized. The converter B is tilted and the blast turned on to blow the white metal 20 to blister copper 21, point 15, which is disposed of as in Fig. 2.

Example No. 3 (Fig. 4) also utilizes two converters A and B of white metal 17. At point 10 it transfers the same from B to A, blows briefly, point 11, settles, point 12, and pours off the low gold bearing white metal 20 into converter B while retaining the high gold bearing copper 19 in converter A, point 13.

Then commences a new cycle. While the white metal 20 in converter B is blown to low gold blister copper and finally conveyed to the pig casting machine, as in Fig. 3, the high gold bearing copper 19 in converter A is further enriched. The converter is held upright and matte 15 and flux 16 are added, point 14. The mass is blown, point 15, for a short time and the converter then righted while the matte settles, point 16. The slag 18 is poured off (point 17) into a ladle and taken to reverberatory furnaces, or otherwise disposed of.

This leaves in converter A a small quantity 17a of high gold white metal. To this are added matte 15 and flux 16, while matte and flux are also put into converter B, bringing us to point 18. A number of cycles following are omitted from Fig. 4 for brevity's sake, being shown in other figures. Both converters are blown to white metal and skimmed to remove slag as in points 2, 3 and 4 (Fig. 1); bringing about the condition of point 9 except that the white metal in converter A has acquired a higher gold content than that in B, which is the same as it was originally. The white metal poured off from B is then transferred to A, as in point 10, blown briefly as in point 11, held for settlement as in point 12 and the white metal poured off into B as in point 13, leaving in A a still higher gold content in the bottom.

This concentration process is repeated through from two to sixteen of the described cycles. At point 19 is illustrated the end of the last cycle. The final batch of low gold copper is made from the white metal 20 in B in the usual way. The enriched bottom 19a in A is supplemented by a further charge of matte 15 and flux 16 (point 20) and converted by the ordinary procedure, yielding a high gold blister copper.

Various modifications of the processes above described may be made by those skilled in the art without departing from the invention as defined in the following claims.

What we claim is:

1. In the selective converting of copper matte containing gold, the method which consists in blowing such matte to white metal, subjecting the white metal to a partial blow so short as to convert only a comparatively small percentage of the copper originally in the matte into particles of metallic copper disseminated throughout the mass of white metal, and holding the charge quiet over so long a period as to permit a long settling out of the fraction of copper converted, the particles of copper disseminated throughout the mass during the short blow and long settling period providing a large gold-collecting surface in contact with the matte so that the fraction settled out has a comparatively high gold content, said method being practiced with two converters A and B, by the partial blowing and long settling of the double charge of white metal in A and the collection of a small fraction of high gold copper therein, the pouring of the remaining white metal into B and the blowing of it therein to copper of comparatively low gold content, the removal of such low gold copper from B and the refilling of B with matte and flux, the addition to the molten bottom in A of new matte and flux, the blowing of the charge in the two converters to produce white metal, the transfer of the white metal from B to A and the repetition of the previous steps so as to extract additional gold in a single bottom in converter A until a bottom of the desired enrichment is obtained.

2. In the selective converting of copper matte containing precious metals, the process which consists in blowing a charge of matte in one converter A to form white metal and metallic copper, the metallic copper comprising about 25% of the total amount of copper values in the charge containing the major proportions of the precious metals, transferring the residual white metal to a second converter B and blowing it therein to metallic copper, blowing the metallic copper in converter A with successive charges of white metal to transfer the precious metals from the white metal to the copper metal and successively transferring the residual white metal of said charges after treatment with metallic copper to converter B and converting said residual treated white metal to metallic copper in converter B.

3. The process of claim 2, in which matte is freed from slag in converter B and supplied therefrom to converter A between the conversion of charges of white metal low in precious metals received from converter A.

4. In the selective converting of copper matte containing precious metals, the process in which a charge of copper metal is incorporated in successive charges of copper matte in a converter A, blowing said matte to reconvert said metal enriched with precious metal values and leave a residual white metal impoverished in precious metal values and successively converting said residual impoverished white metal in a second converter B.

5. The process of claim 4, in which the proportions of metallic copper to the copper content of said white metal after which conversion is in the ratio of approximately 1 to 3.

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