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CONVERTING MATTES.

SPECIFICATION forming part of Letters Patent No. 755,557, dated March 22, 1904.

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To all whom it may concern:

Be it known that I, ROBERT H. AIKEN, a citizen of the United States, residing at Jerome, in the county of Yavapai and Territory of Arizona, have invented certain new and useful Improvements in Converting Mattes; 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 which it appertains to make and use the same.

My invention relates to converting mattes, and especially metallic sulfid mattes, which commonly contain copper, nickel, and similar metals and often carry appreciable amounts of gold and silver.

At present a common practice is to place the molten sulfids in a modified Bessemer converter and reduce them to crude metals or higher-grade sulfids by blowing air through the molten mass and fluxing the oxids thus formed, and thereby roughly separating the valuable from the waste constituents of the mass. It is common to supply the fluxing material by tamping it into the converter as a lining, whereby it serves the double purpose of protecting the steel shell and fluxing the oxids, (usually of iron.) Using up the lining for this last-mentioned end has very serious disadvantages in that it is often consumed in treating three or four charges, when the expense of relining must be incurred, the delay for cooling and drying the lining being a virtual added expense, since the effective capacity of a given plant is thereby greatly reduced. Attempts have been made to avoid these evils by supplying the fluxing material (usually SiO_2) through the mouth of the converter during the blowing process; but it has been found that the material so supplied remained unfused or uncombined and collected in a mass, obstructing the converter, while at the same time destruction of the lining went on as before, its flux-forming constituents continuing to form slag.

I have found that if suitable fluxing material—*e. g.*, silica or quartz—be first brought to a very high temperature and be then introduced into the converter during the process of blowing it will unite with the products of oxidation and form liquid slags even more readily than will the like material arranged as a lining and that if instead of forming the lining of such material a refractory non-silicious lining be used the converter can be kept in continuous use for far longer time than under the ordinary conditions and that the process is generally improved, as will presently appear.

It is well known that every slag and matte has its "freezing" temperature and its forming temperature, or temperature to which its constituents must be raised before they can form slag, and, further, that the formation temperature of the slags common to the converter process in question is higher than the freezing temperature of the mattes. It follows that the mattes may be poured into the converter while at a temperature considerably below that of the slag formation, and it is at present common practice to charge the converter while both matte and lining are below the temperature of slag formation and then to begin the blowing. As the flux must come from the lining, the latter must be heated at the expense of the matte during the blowing until a temperature at which slags will form is reached, and it is important to note that the specific heat of the slag material far exceeds that of the matte. During this heating slag is not formed, but overoxidation takes place—iron, for instance, oxidizes partly to Fe_2O_3, which is not as desirable for slag forming as a lower oxid. Still further, as the fluxing material serves also as a lining it must be present in excess, and proper control of its amount is impossible.

In my process I have used a converter-shell of the size and form of those commonly employed, giving it a comparatively thin lining—for example, a brick's length in thickness—of refractory material, preferably of basic brick made from chromite or magnesite mixtures or other material which does not yield silica in any material quantity. A silicious lining may be employed, however, especially if means—*e. g.*, a water-jacket—be employed to keep the lining below the temperature at which slag is readily formed. Such cooling is advantageous whatever the lining; but when the lining is silicious it is particularly desirable, because it retards the destruction of the lining by the combination of the silica with other

material to form a slag. The converter thus constructed is raised to a high temperature, usually by fuel burned therein, and the matte is then poured in and blowing is begun. Near the mouth of the converter when in position for blowing is located a suitable furnace, reverberatory or blast, but preferably a hearth-furnace with regenerative chambers attached. Flux material, commonly silica crushed to the size ordinarily used in lining converters, is heated in this furnace preferably at least to the temperature of formation of slags to be produced in the converter in the particular case, or in the process above discussed to about 1,200° centigrade, although the temperature may be varied within somewhat wide limits, according to the size of the converter, the initial or charging temperature of matte and converter, and the kinds of slag to be formed. Often when blowing and oxidation begin the matte is below slag-forming temperature, yet if the added flux be above that temperature slag actually forms and overoxidation is avoided. When the matte becomes more highly heated, the temperature of the added flux may be greatly reduced without arresting the formation of slag. Thus at the outset the temperature of the added flux material may be 1,600° centigrade perhaps, while later its temperature may fall to 500° centigrade possibly. This heated material is preferably supplied in small quantities through the mouth of the converter during blowing, the amount added being proportioned as nearly as may be to the amount of slag-forming oxid produced. It is quite possible, however, to carry out the process with tolerable success if all the heated flux material be added at one time. Whether or not a particular temperature renders a particular fluxing material plastic or liquid is immaterial, the essential point being that the highly-heated material, solid or otherwise, should be suitable flux-forming material as distinguished from molten slag, such as is often poured into converters, which take the real flux from their linings. It is, however, evident that material readily fused at the temperature of my preliminary heating must carry a considerable percentage of bases, which with their acids must greatly increase the total bulk to be handled by the converter, and hence that commercial reasons would make such a liquid flux hardly a practical success. As has been suggested above, the flux may and should vary with the requirements of a particular case, other materials—lime, for example—being added if necessary to the attainment of any desired mechanical or chemical result.

Practically I have found that great economy results from having perfect control of the amount and kind of flux employed, it being quite common to produce in the converter chemically-differing slags. For illustration, it may be said that in adding a proper percentage of lime in certain cases I produce a slag whose formation temperature is fully 150° centigrade lower than that of the slag—nearly pure silicate of iron—ordinarily produced.

Slags thus under control may be made such as to resist solution of the mattes, whereby they carry less value, and be more readily cleaned for wasting than in ordinary processes. It is also true that with this process a thinner lining is made possible, and any given converter or any plant has much greater productive capacity, with consequent saving in investment of capital and cost of operation; that the lining may be made such as to resist abrasion and rough usage; that the converter can be kept in continuous use not less than five times as long as with other processes; that there is a saving of most of the cost of relining and a saving of fuel for reheating after relining, and that there is little chance of having the converter underheated when the charge is poured in.

What I claim is—

1. The process of converting matte which consists in placing molten matte in a converter having non-fluxing walls, introducing suitable non-molten fluxing material at a high temperature, and subjecting the whole to an oxidizing-blast.

2. The process which consists in holding mattes in molten condition in a converter, raising suitable flux material to a high temperature and adding it, in a non-molten state, to the matte in the converter, and subjecting the whole to the usual blowing.

3. The process of converting mattes which consists in adding to molten matte in a converter suitable non-molten flux material at a high temperature, subjecting the contents of the converter to an oxidizing-blast, and maintaining the converter-walls at a temperature below that at which slag readily forms.

4. The process of converting mattes which consists in subjecting a charge of molten matte in a converter to an oxidizing-blast and meantime adding to the charge, at a rate approximately corresponding to the rate of formation of oxid, material, proper for fluxing such charge, at a temperature approximately that at which slag forms from the products of the particular matte and fluxing materials.

5. The process of converting mattes which consists in highly heating material suitable for fluxing the particular matte and progressively or gradually introducing it, during the process of blowing, into a converter containing molten matte at approximately the rate of its consumption.

6. The process of converting mattes which consists in subjecting molten matte in a converter to an oxidizing-blast, highly heating flux material outside the converter, and, during the process of blowing, adding such heated material to the mass in the converter at a rate

approximately that of its combining to form a flux.

7. The process of converting mattes which consists in introducing into a converter containing molten matte non-molten flux material at a high temperature and subjecting the whole to an oxidizing-blast.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERT H. AIKEN.

Witnesses:
JUSTIN FRASER,
FRED BRAUNS.