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FLUXING MATERIAL FOR METALLURGICAL FURNACES AND METHOD OF OPERATING SAID FURNACES

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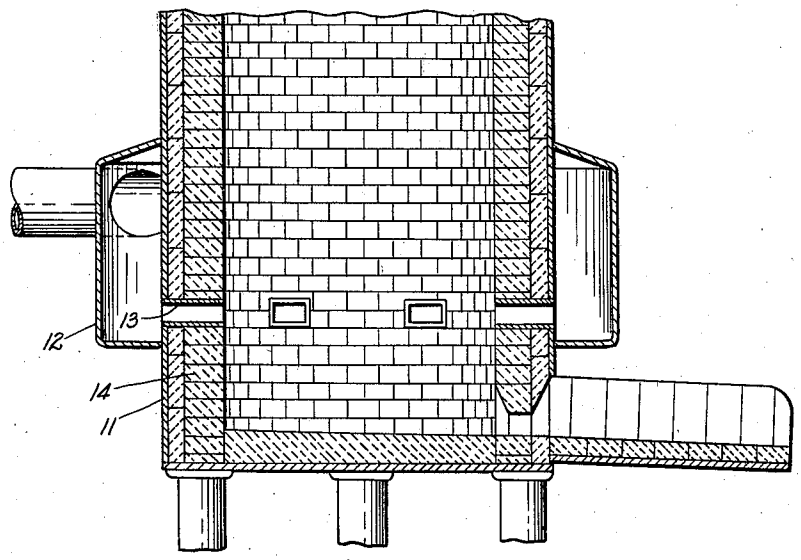


Fig. 1

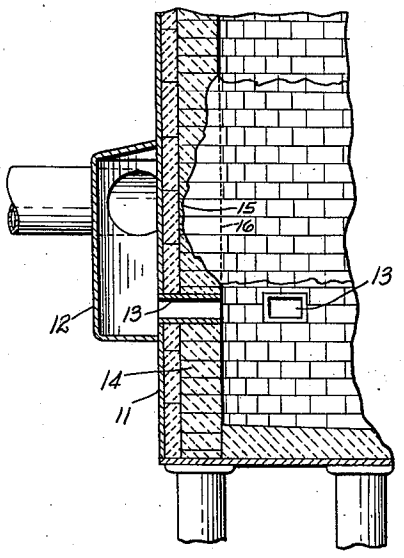


Fig. 2

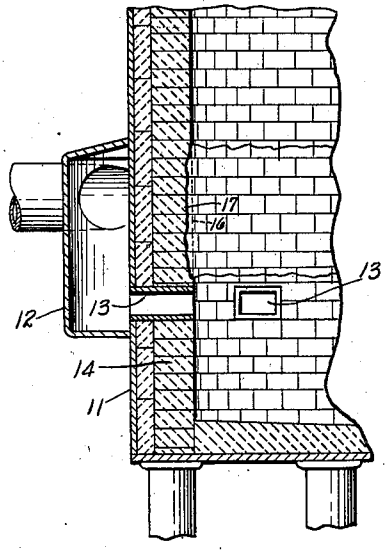


Fig. 3

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FLUXING MATERIAL FOR METALLURGICAL FURNACES AND METHOD OF OPERATING SAID FURNACES

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11 Claims. (Cl. 75—43)

My invention relates to an improved fluxing material for use in cupolas and other metallurgical furnaces having a refractory lining and to an improved method of operating said cupolas and other metallurgical furnaces.

In the operation of cupolas and other metallurgical furnaces the refractory lining is corroded or burned out and eroded by the action of the fluxing agent and charge used in the processing of metal in the cupola or furnace. This refractory is generally of silica brick, of firebrick or other suitable compounds and may vary somewhat in composition but it has been found that most commercially available refractories suitable for cupolas and other metallurgical furnaces are subject to being re-acted upon by the slag formed by the usual fluxing material heretofore used in cupolas and furnaces.

The corrosion and burning out of the refractory lining by action of the slag forms a "burn-out" or recess in the refractory lining. It is necessary, after a relatively short period of time or daily, to repair the refractory lining by patching the burn-out. This periodic and frequent patching or repair necessitates the shutting down and emptying of the cupola or other metallurgical furnace, the re-placing of deteriorated or destroyed bricks, and the addition of daubing of plastic refractory material to otherwise re-build the refractory lining to original contour.

The requirement for this frequent periodic re-building of the refractory lining is undesirable and constitutes a great limitation upon efficient and economical operation of cupolas and other metallurgical furnaces. The cost of the re-building of the refractory lining is considerable and includes: the cost of bricks, daubing and other material used, the cost of labor used in doing the cleaning out of the cupola or other furnace and in re-building the refractory lining, and the loss incurred by reason of the shut-down and suspension from operation of the cupola or other furnace while the refractory lining is being re-built.

It is an object of this invention to avoid or minimize the requirement of frequent periodic re-building of the refractory lining of a cupola or other metallurgical furnace.

Another object is the provision for avoiding or minimizing the burn-out in the refractory lining of the cupola or other metallurgical furnace.

Another object is the provision of an improved fluxing material in the fluxing of a cupola or other metallurgical furnace to avoid or minimize undesirable re-action between the refractory lining and the slag formed by the fluxing material.

Another object is the provision for increasing the useful life of a refractory lining without repair or replacement.

Another object is the provision for conserving the refractory lining of a cupola or other metallurgical furnace without substantially impairing the fluxing capacity of the fluxing material used.

Another object is the provision of an improved method of operating a cupola or other metallurgical furnace at a maximum degree of efficiency and economy.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a sectional view of the lower portion of a cupola, taken lengthwise of the cupola, and illustrates the condition of the cupola at the time that the refractory lining is built and before a burn-out or corrosion has occurred;

Figure 2 is a view of the left-hand side of the cupola shown in Figure 1 (the right-hand side being similar), illustrating the amount of corrosion, erosion or burn-out occurring in the refractory lining for a given period of operation and for a fixed amount of material processed or passing through the cupola when the prior fluxing materials of previous practices have been utilized in the cupola or other metallurgical furnace.

Figure 3 is a view of a cupola somewhat similar to that shown in Figure 2 and illustrates the very small amount of burn-out, erosion or corrosion, as compared with that of Figure 2, in the refractory lining by utilizing my improved fluxing material and improved method of operating the cupola, the cupola of Figure 3 representing its condition after the same given period of time and for the same fixed amount of material processed or passing through the cupola as in the case of the cupola of Figure 2.

The views of the drawing are given to illustrate the greatly improved results provided by the use of my discovery. While a cupola is shown for illustratory purposes, my invention is not necessarily limited to use in this type of metallurgical furnace.

I have discovered that by using a fluxing material comprised of a substantial amount of slag produced from a previous operation of the cupola or other metallurgical furnace radically different and much improved results are obtained. This slag that is utilized has previously attacked the refractory lining of the cupola or furnace and therefore contains the substance or ingredient obtained from the refractory lining in the re-

action therewith. This substance or ingredient removed from the refractory lining and contained by the slag may be in the form of compounds of the silica, alumina or other ingredient of the refractory lining.

My improved fluxing material may be composed of all slag produced by a previous operation of the cupola or furnace but preferably contains some limestone, either calcite limestone or dolomitic limestone. The term "limestone" as used hereafter in the specification and claims is intended to include limestones composed largely of calcium carbonate and also limestones of the dolomite type containing varying percentages of magnesium carbonate. This additional limestone is fresh or virgin limestone in that it has not previously been used in a cupola or furnace. The desired proportions of used slag and of fresh limestone to be incorporated in my improved fluxing material depends upon a number of factors such as the condition of the metal to be processed and the amount of fluxing action required, the physical condition of the used slag, that is, the degree of its saturation with substances from the refractory lining, the degree of its contamination with dirt and other impurities, and the general physical fluxing capacity of the slag. Local conditions and particular instances of operation may modify the proportions found most desirable at another place and time.

I have found in practice that the following proportions have proved to be preferable, the preferred compositions being here given in the order of preference:

(1) Composition of 30% to 90% used slag and 70% to 10% fresh limestone.

(2) Composition of 40% to 90% used slag and 60% to 10% fresh limestone.

(3) Composition of 50% to 90% used slag and 50% to 10% fresh limestone.

(4) Composition of 50% to 75% used slag and 50% to 25% fresh limestone.

(5) Composition of approximately 90% used slag and approximately 10% fresh limestone.

(6) Composition of approximately 75% used slag and approximately 25% fresh limestone.

(7) Composition of approximately ⅔ used slag and approximately ⅓ fresh limestone.

(8) Composition of approximately half used slag and half fresh limestone.

The used slag from a previous melt or operation is crushed or otherwise broken up into pieces. The pieces of used slag and pieces of fresh limestone are mixed together to uniformly distribute the pieces of slag and pieces of limestone relative to each other. The fluxing agent so produced may be diluted, if desired, with conventional diluting agents, such as soda ash, fluorspar, and the like. The mixture is added to the cupola or furnace as a fluxing material in the usual manner.

It has been found that by using a fluxing material embodying used slag that there is a marked decrease in the amount of burn-out or corrosion of the refractory lining. This is graphically demonstrated in the views of the drawing.

Figure 1 shows the unimpaired condition of the refractory lining 14 in the cupola 11 when installed. Figure 2 demonstrates the result of the prior practice in which substantially all limestone is used as a fluxing material, and shows the large and deep burn-out or corroded recess 15 extending back from the inner wall 16 of the lining. This burn-out 15 extends around the circumferential extent of the cupola and is located a short distance above the plane of the plurality of tuyères 13 which extend through the wall of the cupola from the wind box 12. Figure 3 demonstrates the result of utilizing my improved fluxing material and following my discovered method of operation, and shows the relatively small and shallow burn-out or corroded recess 17 produced thereby in operating the cupola for the same period of time and in processing the same amount of material as for the cupola of Figure 2. The composition of the fluxing material used in the cupola of Figure 2 was all limestone and the composition of the fluxing material used in the cupola of Figure 3 was approximately two-thirds used slag and one-third fresh limestone.

The slag used as a component of my fluxing material may have been used once before or a number of times before in contact with a refractory lining which it has attached. There is no precise limit on the number of times that the slag may be used over again. However, if used too many times without addition of fresh limestone it becomes "gummy" and lacks fluidity and further is burdened with an excess of dirt and impurities. By mixing the used slag with a portion of fresh limestone each time that it is used the "life" or fluxing capacity of the combination is maintained and the dirty or impurity filled slag is diluted to a satisfactory degree of purity. When slag is used over but once it becomes necessary to add a smaller percentage of fresh limestone than when it is used more than once.

Without being bound by the correctness of the theory, it is believed that the used slag in my improved fluxing material has already satisfied itself with the substance or ingredient extracted or derived from the refractory lining during a previous operation and therefore the used slag is not inclined to further attack the refractory lining when again charged into the cupola or furnace as a fluxing material. It is also believed that the fresh limestone component of my improved fluxing material is not inclined to substantially attack the refractory lining because the fresh limestone may more easily combine with or acquire the same substance or ingredient from the used slag intermixed with the limestone as it otherwise would obtain from attacking and re-acting with the refractory lining. The fresh limestone therefore appears to satisfy itself by combining or re-acting with the used slag rather than by attacking the refractory lining.

Whether the expounded theory is correct or not, it is known that my discovery of using slag produced by a previous operation as an ingredient in a fluxing material to be charged in a cupola or furnace for a subsequent operation has made it possible to conserve the refractory lining of the cupola or furnace. It is also known that an efficient and satisfactory fluxing action in the cupola or furnace is obtainable with the use of my improved fluxing material containing used slag and such proportion of fresh limestone as may be necessary to maintain the fluxing capability of the fluxing material as affected by the condition of the used slag component.

As an illustration of the efficacy of my improved fluxing material in a cupola there is given the following comparative analyses of resulting slag produced in a cupola having a firebrick lining when a fluxing material of all limestone was used and of resulting slag produced in a similar cupola under the same operating conditions when a fluxing material composed of

two-thirds used slag from such a cupola and one-third fresh limestone was used. In both cases about fifty pounds of fluxing material was charged for twelve-hundred pounds of metal charged.

Resulting slag analyses

Fluxing material composed of all limestone charged into cupola		Fluxing material composed of ⅔ used cupola slag (used once before) and ⅓ fresh limestone charged into cupola
48.40	SiO_2	47.80
19.90	Al_2O_3	19.62
.94	FeO	1.13
2.12	MnO	2.78
24.40	CaO	24.70
3.79	MgO	3.50
.16	S	.17

The above analyses demonstrate that my improved fluxing material gives better results than the previously used fluxing material of all limestone. This improved fluxing action is in addition to the advantage of maintaining the refractory lining of the cupola in comparatively sound and whole condition.

My discovery not only includes the invention of the improved fluxing material itself but also the new principle of operation of cupolas and furnaces whereby slag produced in one operation is used again as a fluxing material in a subsequent operation.

The present disclosure includes the foregoing description and the description contained in the following claims, which claims are made a part of this specification by reference.

Although the present disclosure has been set forth in detail and with considerable particularity, it is to be understood that my invention is not limited to the examples given in the foregoing by way of illustration, the invention being more fully defined in the accompanying claims.

I claim as my invention:

1. An improved fluxing material for a cupola furnace having a refractory lining susceptible to re-action with fluxing material of all fresh limestone, said fluxing material being comprised of used slag containing more than 35% silica produced in a prior operation of said furnace and of fresh limestone, said used slag containing the products of said re-action.

2. An improved fluxing material for a cupola furnace having a refractory lining susceptible to re-action with slag of all limestone not previously used in the furnace, said fluxing material being comprised of a preponderant proportion of used slag containing more than 35% silica produced in a prior operation of said furnace and a lesser proportion of limestone not previously used in the furnace, said used slag containing the products of said re-action.

3. An improved fluxing material for a cupola furnace having a refractory lining of the class including silica brick and firebrick and which is susceptible to corrosion by the action of slag, said fluxing material being comprised of used slag containing more than 35% silica that has re-acted with such refractory lining in a previous operation of such a furnace and of virgin limestone, said used slag containing the product of said re-action with the refractory lining.

4. An improved fluxing material for a cupola furnace having a refractory lining of the class including silica brick and firebrick and which is susceptible to corrosion by the action of slag, said fluxing material being comprised of a preponderant proportion of used slag containing more than 35% silica that has re-acted with such a refractory lining in a previous operation of such a furnace and of a lesser proportion of virgin limestone, said used slag containing the product of said re-action with the refractory lining.

5. An improved fluxing material for a cupola furnace having a refractory lining of the class including silica brick and firebrick and which is susceptible to corrosion by the action of slag, said fluxing material being comprised of a preponderant proportion of used slag containing more than 35% silica that has re-acted with such a refractory lining in a previous operation of such a furnace and containing the products of said re-action, and of a lesser proportion of virgin limestone, said used slag and said limestone being present in the form of small pieces throroughly inter-mixed.

6. A fluxing material adapted to be charged into a cupola furnace having a refractory lining subject to re-action with slag and comprised of a mixture of at least one-half used slag containing more than 35% silica produced in a previous operation of such a furnace and containing the product of said re-action, and the remainder of new limestone.

7. A fluxing material adapted to be charged into a cupola furnace having a refractory lining subject to re-action with slag and comprised of a mixture of nine-tenths to one-half used slag containing more than 35% silica produced in a previous operation of such a furnace and containing the product of said re-action, and the remainder of new limestone.

8. A fluxing material for use in a cupola furnace comprised of approximately two-thirds used slag containing more than 35% silica and all the impurities resulting from prior use and approximately one-third fresh limestone.

9. The improved method of fluxing a cupola furnace having a refractory lining susceptible to re-action with slag which comprises the re-use of slag produced by such a furnace, without purifying the slag of impurities resulting from said re-action, as a fluxing agent in a subsequent operation of the furnace.

10. The improved method of fluxing a cupola furnace having a refractory lining susceptible to re-action with limestone slag by passing slagging material containing limestone through the furnace more than once as a fluxing agent acting on said lining and retaining in the re-currently used limestone the product of re-action with said lining.

11. A fluxing material for a cupola furnace comprising a mixture of crushed slag containing more than 35% silica and substantially as it comes from a previous melt in the same or a similar furnace and virgin limestone.

HERBERT A. REECE.