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PROCESS OF CHARGING FINE MATERIALS

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Fig. 1

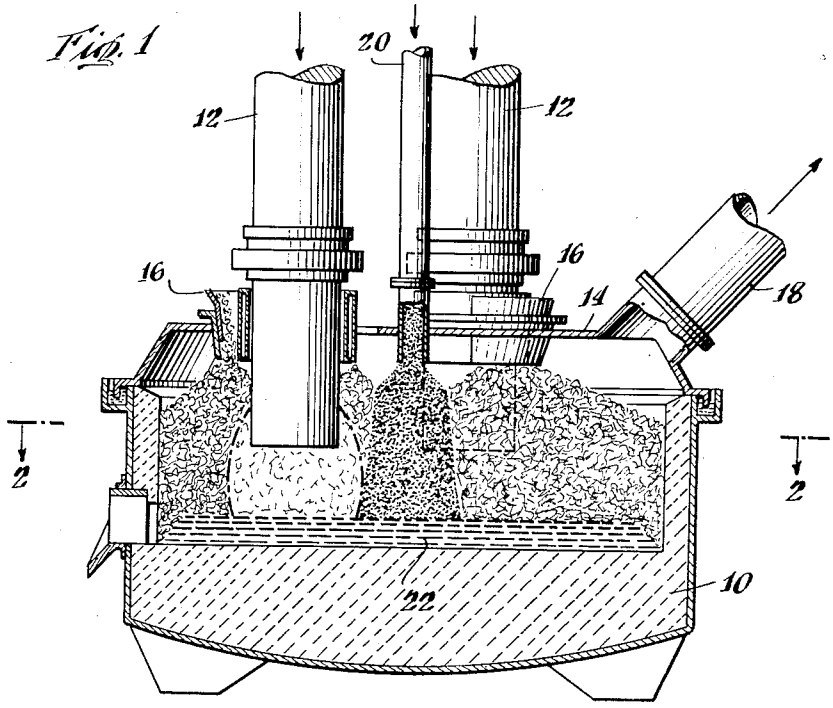
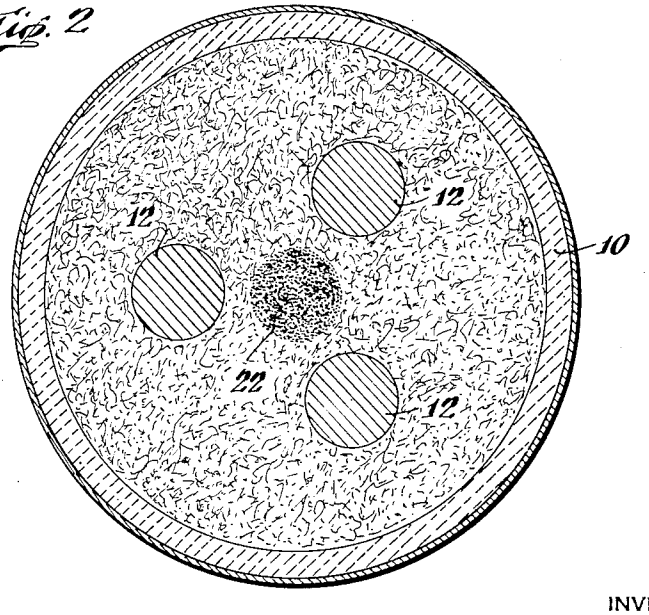


Fig. 2



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PROCESS OF CHARGING FINE MATERIALS

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2 Claims. (Cl. 75—10)

This invention relates to the process of electric smelting of fine materials which are too fine to be charged around the electrodes of an electric smelting furnace.

The latest years have brought great improvements in the electric smelting of carbide, ferro-alloys, pig iron etc. Formerly open furnaces were used for such smelting, and the valuable gas which was developed during the reduction process and consisted of CO, respectively a mixture of CO and CO_2, was lost. The gas also carried off great amounts of dust partly due to mechanical action, but also due to evaporation in the crater of the electric smelting furnace. This dust formed a very disagreeable smoke making the smelting plants detrimental to the surroundings.

In most countries strict rules have been introduced to prevent the contamination of the air by letting out such smoke. This has forced the smelters to change over to closed smelting furnaces where the gas is collected in concentrated form so that it may be cleaned and utilized.

In order to operate a closed furnace satisfactorily, it is a condition that the smelting may proceed with sufficient regularity without boiling and eruptions in the charge. It has been found that it is possible to employ such closed furnaces in most reduction processes. It is, however, a condition that the charge is sufficiently porous to permit the gases to escape without forming high pressure collections which would cause violent eruptions.

The electric smelting furnaces have been built in various ways for the different smelting processes. In some cases only half-way measures have been taken by making semi-closed furnaces. In other cases the furnaces have been fully closed. Generally the furnaces are of the three-phase type provided with three electrodes in triangle. A series of furnaces are designed in such a way that each electrode is surrounded by one or more low shafts through which the charge is introduced into the smelting furnace. The reduction gases must then pass through the charge column surrounding each electrode before being collected under the furnace roof. To achieve this it is often necessary to sift out the finer grains in the charge whereby a very porous charge is obtained. This procedure is for example today used in carbide smelting in closed furnaces. Usually between 5% and 25% of the charge must be sifted out as unsuitable for direct use in the furnace charge. In some cases this fine-grained charge may be smelted in open carbide furnaces. If no such furnaces are available, the fine materials must be disposed of in other ways. Thus, some carbide smelters sell the fines as a fertilizer. It is also possible to briquet or sinter such fines. All this, however, causes expenses and the fine-grained materials therefore usually represent a problem in such plants.

In the so-called Elkem furnaces it has been tried to facilitate the escape of gas from the charge by introducing the charge at some distance from the electrodes, thus leaving a gas chamber between the electrode and the charge below the roof. This undoubtedly means a considerable improvement in the escape of the gas, but in

practice there will still be certain limits to the quantity of fine materials which may be contained in the mass without causing eruptions. It is therefore advantageous also in these furnaces to sift out a part of the fine-grained materials. Generally between 5% and 15% of the fines in the charge are removed.

Applicant has taken up the question of introducing the fine-grained constituents of the charge into the smelting furnace in such a way that no eruptions will occur. It has been found that this may advantageously be achieved if the fine-grained materials in a suitable mixture are introduced in, or in the vicinity of the central part of the furnace. If the electrodes are arranged in triangle and the charge is filled in around the electrodes, a cavity will be formed in the central part of the furnace. This cavity may advantageously be charged through a separated charging tube. Such central cavity does not comprise the melting craters surrounding each electrode, but the temperature is all the same so high that the charge will melt in a satisfactory way, although comparatively slowly. The rate of melting may be adjusted by a suitable choice of distance between the electrodes.

It is evident that a fine-grained charge must be heated slowly if eruptions shall be avoided and the evolution of gas must be in relation to the porosity of the charge. Applicant has now found that the rate of melting in the central parts of the furnace usually suits well with the porosity of the fine-grained charge. It has been found that the 5–15% of charge which is sifted out may be charged into the central part of the furnace without disturbing the smelting in any way. On the contrary, the central part of the furnace will be better utilized for smelting by such introduction of the fine charge and thus the smelting capacity and effectivity of the furnace will be improved.

The fine-grained charge will vary in grain size in the different processes. In carbide smelting, for example, one may sift out a smaller or greater part of all materials smaller than about four millimeters as for example by passing the material through a ¼-inch screen. These materials which pass through the screen are then charged separately into the central part of the furnace, as above described.

It is evident that instead of filling in fines sifted out from the charge, fines from other sources may, for example flue dust, from the smelting furnace gas, to be used with the same result.

Such returning of the flue dust to the central part of the furnace is very advantageous. By production of for instance carbide, the yields of lime and coke are considerably increased.

In some plants the flue dust is precipitated from the gases, and briquetted with coke breeze before being returned to the smelting furnace. This is, however, a very expensive process.

If a cyclone-plant is placed on a sufficiently high floor level in relation to the furnace, it will be possible to transport the flue dust directly and continuously from the dust-settling chamber to a central charging place on the furnace roof. The dust may for instance be transported by means of a worm gear. If a central gas outlet is used, the outlet will act as a dust chamber.

This invention may be readily understood by reference to the accompanying drawings in which Fig. 1 is a sectional view through a furnace constructed for the operation of my process, and Fig. 2 is a section on line 2—2 of Fig. 1.

In these drawings **10** is the furnace pot and **12** are the electrodes which are shown as arranged in a triangle. The electrodes **12** pass through the cover **14**. Charging shafts **16** are provided which bring the charge in around the electrodes **12**. The gas developed in the smelting furnace

is drawn off through the outlet **18**. Arranged centrally of the electrodes **12** is a charging pipe **20** through which fine material indicated at **22** will be introduced to the furnace. It will be noted that this material does not enter the furnace directly over any of the smelting zones of the three electrodes but nevertheless as it passes down into the furnace it will gradually be heated hot enough to melt. At the same time, it will not interfere with the escape of gas from around the three electrodes **12**.

If desired, the gas coming from the pipe **18** may be taken to a cyclone separator (not shown) to remove the flue dust which will be even finer than the material screened out of the charge and this can be re-introduced into the furnace through the pipe **20** with the finer portion of the charge.

What I claim is:

1. The method of operating a closed electric smelting furnace for smelting materials of the type illustrated by carbide, ferro-alloys, pig iron and the like, said furnace being of the type in which the electrodes are arranged in a triangle, which comprises screening material to be treated to remove material having a diameter smaller than about 4 mm., charging the material from which such finer material has been removed continuously around the electrodes and charging such finer material into the central zone of the triangle defined by the electrodes so that it is introduced relatively far from the electrodes but spaced from the cooling action of the side walls and melting such finer material relatively slowly in such zone whereby gases are caused to evolve relatively slowly from such finer material to reduce the tendency of such gases to cause eruptions.

2. A method as specified in claim 1 which includes the further steps of precipitating dust from flue gases of the furnace and returning such dust to the central zone of said triangle together with the material having a diameter smaller than 4 mm. which was sifted from the charge.

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