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F. A. EUSTIS

PROCESS OF SINTERING AND APPARATUS THEREFOR

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Fig. 1.

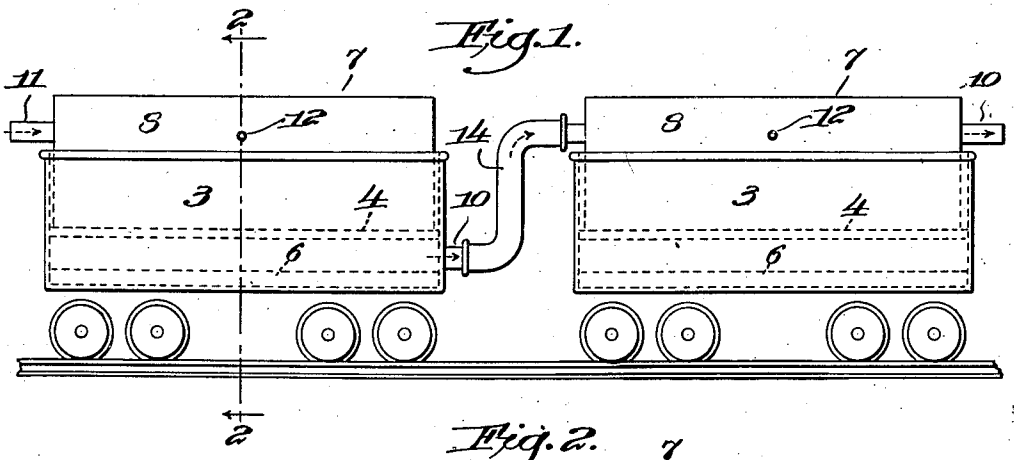
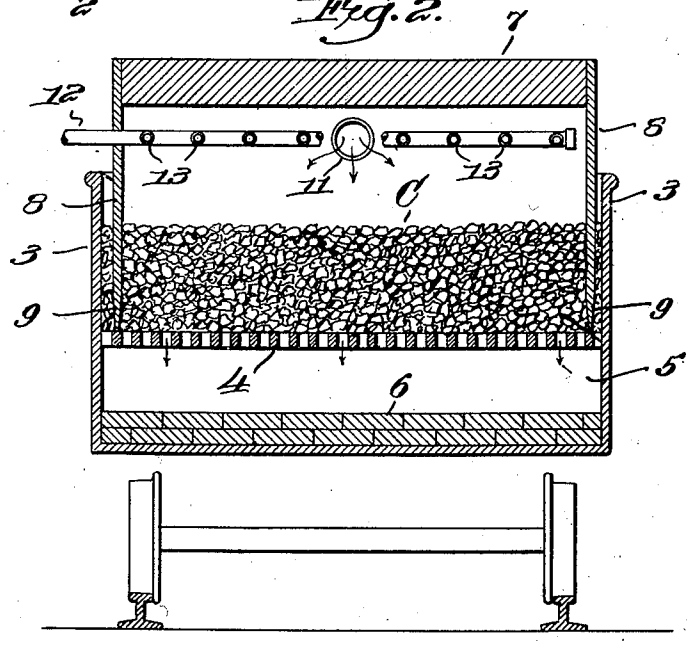


Fig. 2.



Inventor,
Frederick A. Eustis,
by Pierce Pierce & Cushman
his Attys.

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UNITED STATES PATENT OFFICE.

FREDERIC A. EUSTIS, OF MILTON, MASSACHUSETTS.

PROCESS OF SINTERING AND APPARATUS THEREFOR.

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To all whom it may concern:

Be it known that I, FREDERIC A. EUSTIS, a citizen of the United States of America, and resident of Milton, in the county of Norfolk and State of Massachusetts, have invented new and useful Improvements in Processes of Sintering and Apparatus Therefor, of which the following is a specification.

This invention relates to a process of sintering fine ores or other fine materials, and to apparatus therefor. Sintering, generally speaking, consists in subjecting the fine ore or other material, mixed with a suitable proportion of fine fuel, to a burning or roasting treatment, by which the small particles are fused and agglomerated into a solidified, porous mass. The process is usually performed in a sintering pan in which a bed or charge of the material is supported on a suitable grate while the combustion of the fuel mixed with the material takes place, aided by a draft of air.

The object of the present invention is to increase the efficiency of sintering as heretofore practiced, to effect economies of fuel and time, and otherwise to improve and simplify the process of sintering and apparatus therefor, as hereinafter more fully described.

The process, stated in brief general terms, consists in passing air through a charge which has just been sintered, into a fresh charge to be sintered, whereby the air is heated by the first charge and the latter is cooled, and the air is delivered hot to the cold fresh charge at the time it is being ignited, when it most needs a hot blast to aid in starting the combustion.

The process is carried out by connecting the outlet flue of a sintering pan or furnace in which the sintering has just been completed, or substantially completed, and in which the charge is still very hot, to the inlet flue of a second sintering pan or furnace containing the fresh charge, and causing the air to pass through the first sintering furnace and the hot charge therein and thence into the second furnace. When the charge in the second furnace has been completely burned, or substantially so, its outlet flue is in turn connected to the inlet flue of a third furnace containing another fresh charge, and so on. The cool air passing through each furnace and charge previously sintered is not only heated so as to deliver a hot blast of air into the next succeeding fresh charge, but also cools the already sintered charge and makes it possible to dump it or otherwise handle it without damage to apparatus or danger to the operatives.

The process will now be described more in detail in connection with apparatus for performing it.

In the accompanying drawings which illustrate apparatus in somewhat diagrammatic form, suitable for practicing the process,—

Figure 1 is a side elevation of two sintering furnaces connected in series; and

Figure 2 is an enlarged section on line 2—2 of Fig. 1.

As illustrated in the drawings, the furnaces are mounted on cars or wheel trucks, preferably running on rails, so that furnaces containing finished charges may readily be disconnected and removed, and fresh ones added, as the process progresses.

Each furnace comprises a pan 3, in which a suitable grate 4 is supported above the bottom, leaving a space or empty chamber 5, which may be provided with a floor 6 of suitable refractory material such as brick. C represents the charge of sinter resting on the grate 4.

A weighted hood 7 made with depending side and end walls 8 is lowered into the pan 3 and on top of the charge. The walls 8 are forced down into the charge by the weight of the hood, aided if necessary by additional force. The penetration of the walls 8 into the ore may be facilitated by beveling or sharpening their edges as shown at 9. The walls 8 will be preferably pushed down substantially to the grate 4, or at any rate far enough to insure the passage of the air and gases through the charge and the grate without escaping in undue amounts upward around the outside of the walls 8. The space 5 below the grate is provided with an outlet flue 10, preferably at one end of the pan 3 for convenient connection to the inlet flue of the next furnace.

The hood 7 is provided with an air intake flue 11, communicating with the space within the hood above the charge, and preferably disposed at the end of the furnace opposite the outlet flue 10. The hood 7 also has a fuel inlet pipe 12 with suitably ar-

ranged branches 13 for delivering jets of oil or gas to the interior of the hood for the purpose of igniting the charge.

In operation, air is forced by pressure into the intake flue 11, or is drawn in by suction at the delivery end, and passes into the top of hood 7, downward through the charge C and grate 4 into the space 5, and thence passes out with the products of combustion through outlet flue 10. The sintering action is as usual. The weight of the hood may be made sufficient to overbalance the air pressure, when the air is supplied under pressure, in which case no locking devices will be necessary.

When the sintering is completed or substantially completed in one furnace, for example in furnace A (Fig. 1) the outlet flue 10 of furnace A is connected by any suitable means, such as the conduit 14, to the intake flue 11 of furnace B which contains a fresh charge of ore. The air supplied to furnace B will therefore pass through the hot porous charge in furnace A and will be delivered hot to furnace B. The heat of the hot blast supplied from furnace A will aid in igniting the charge in furnace B, and will save fuel and reduce the time of operation.

At the same time the cool air entering the intake flue 11 of furnace A, cools that furnace and its charge so that by the time it has performed its function of heating the charge in furnace B the furnace A may be disconnected from furnace B and discharged without danger to apparatus or operatives from excessive heat. As soon as the charge in furnace B is burned, the outlet flue of furnace B may be connected as before to the inlet flue of another furnace containing a fresh charge, and so on indefinitely, each finished charge furnishing the hot blast for the next succeeding fresh charge, and being cooled off in the process.

The successive treatment of two or more individual charges in series, and the utilization of the heat stored up in a previously sintered charge to heat the succeeding charge, in accordance with the present invention, possesses two major advantages. First, it effects a substantial saving in fuel; and second, it makes it possible without sacrificing fuel economy to avoid excessive drying of the charge, or any part thereof.

It will be apparent, and I have demonstrated in practice, that the sintering of a number of charges successively, and the heating of each successive charge by the heat stored up in the previously sintered charge, will substantially reduce the amount of fuel consumed as compared with existing methods of sintering in which each charge is ignited while cold, and the stored heat in the finished charge is wasted.

It may be suggested that the fuel economy of the present invention might be achieved to a measurable degree, although not fully, by sintering a very thick bed of material in a single furnace, in which case the burning at the inlet side of the bed first to be ignited, that is, the top of the charge in the arrangement shown in the drawings, would to some extent at least pre-heat the material at the outlet side of the bed, that is, the bottom of the charge as shown in the drawings, and so effect some saving of fuel. If, however, an unduly thick charge is used excessive drying the the material occurs at the outlet side of the bed owing to the length of time during which that part of the charge is subjected to the drying action of the hot gases produced by combustion. Excessive drying of the charge, or any part of it, is a thing distinctly to be avoided, since drying destroys the porous nature of the charge and reduces it to powder, which packs and interferes with the draft; moreover, the fine dried material will fall through the grate. It is therefore desirable to use a comparatively thin charge of material, in which the combustion will work through the bed, and the sintering will take place, quickly enough to avoid undue drying of any part of the charge. Moreover, even from the standpoint of fuel economy the treatment of a thick bed by present methods only partially accomplishes the result because each new charge is ignited cold, without provision for the hot blast of air which is especially advantageous at the initial stage.

It will thus be seen that with sintering methods heretofore used, two objects greatly to be desired, namely, maximum fuel efficiency and avoidance of undue drying, appear to be irreconcilable. If the bed of material is thick enough to give a substantial saving of fuel by pre-heating one side of the bed by burning which starts on the other side, excessive drying takes place. And if a comparatively thin bed of material is used in order to avoid the drying difficulty, a maximum amount of fuel is required.

These conflicting conditions are wholly reconciled by the present invention, which makes it possible to use a comparatively thin bed or charge of material, thus completely eliminating the drying trouble, and at the same time to use the minimum amount of fuel by utilizing the heat generated in a previously sintered charge to promote combustion in the next succeeding fresh charge.

A further advantage of the present invention is that it tends to equalize the heat during the sintering operation, and supplies heat to the furnace proportionally to its needs. Thus at the time of ignition and during the initial stages of the sintering, when heat is most needed, the air blast comes hottest from the finished charge to the fresh

charge, and as the combustion in the latter progresses and the charge heats up the heat of the air blast gradually diminishes.

I claim:

1. A method of sintering which comprises severally and successively sintering a plurality of charges of fine material, and utilizing the heat generated by the sintering of the several charges and retained by them after sintering for heating the charges succeeding them respectively, the sintering of each charge being substantially completed before the utilization of its heat for heating the succeeding charge.

2. A method of sintering which comprises successively sintering a plurality of charges of fine material, and passing the air for supporting the combustion of each successive sintering operation through a previously sintered charge while the latter is still hot, whereby the charge to be sintered will be supplied with a hot air blast, and the charge already sintered will be cooled.

3. Sintering apparatus comprising a plurality of independent enclosed sintering furnaces adapted to be operated successively, each having a grate adapted to support the charge and an air inlet at one side of the grate and an outlet at the other side of the grate, and a separable connection between the outlet of one furnace and the inlet of another furnace connecting the furnaces in series, whereby the air for supporting combustion in the latter furnace will be caused to pass through the heated charge of the former furnace.

4. Sintering apparatus comprising a plurality of independent enclosed sintering furnaaces adapted to be operated successively, each having a grate adapted to support the charge and an air inlet above the grate and an outlet below the grate, and a separable connection between the outlet of one furnace and the inlet of another furnace connecting the furnaces in series, whereby the air for supporting combustion in the latter furnace will be caused to pass downward through the heated charge of the former furnace.

5. Sintering apparatus comprising a plurality of independent sintering furnaces adapted to be operated successively, each having a grate adapted to support the charge and an air inlet at one side of the grate and an outlet at the other side of the grate, said furnaces being independently mounted on wheels and consequently movable relatively one to another, and a separable connection between the outlet of one furnace and the inlet of another furnace connecting the furnaces in series, whereby the air for supporting combustion in the latter furnace will be caused to pass through the heated charge of the former furnace.

6. A sintering furnace comprising a pan having a grate adapted to support a charge of ore, and a hood having depending walls adapted to be forced down into the charge inside of the walls of the pan.

7. A sintering furnace comprising a pan having a grate adapted to support a charge of ore, and a weighted hood having depending walls adapted to be forced down by its own weight into the charge inside of the walls of the pan.

Signed by me at Boston, Massachusetts, this fifth day of November, 1920.

FREDERIC A. EUSTIS.