June 29, 1937. G. ANDERSEN 2,085,625

FURNACE FOR ORE REDUCTION

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Fig. 1.

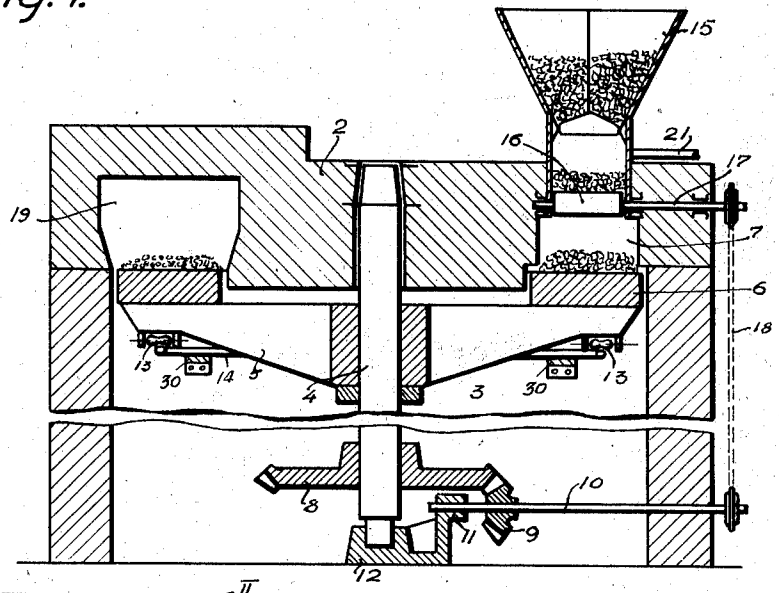
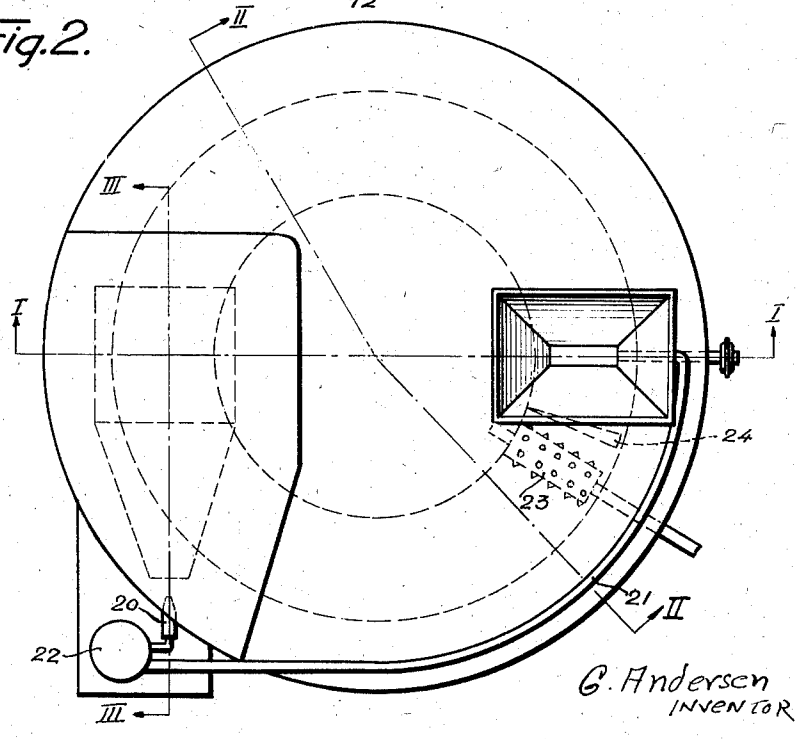


Fig. 2.



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Fig. 3.

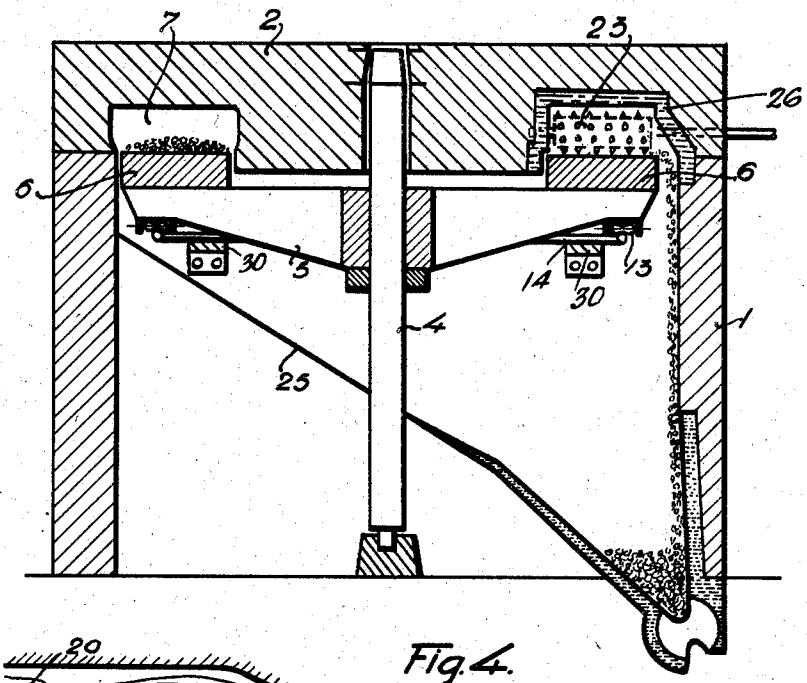


Fig. 4.

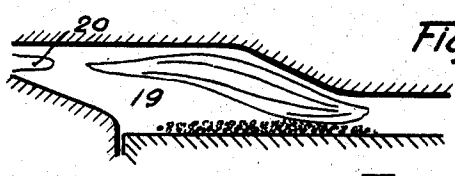


Fig. 5.

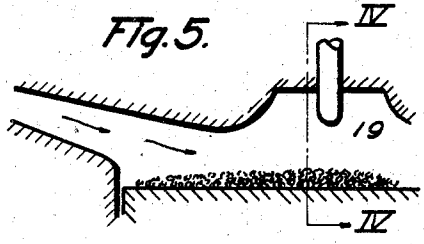


Fig. 6.

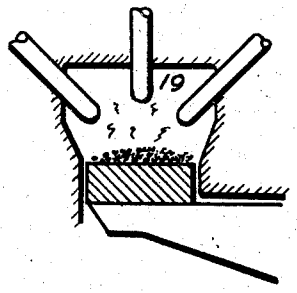
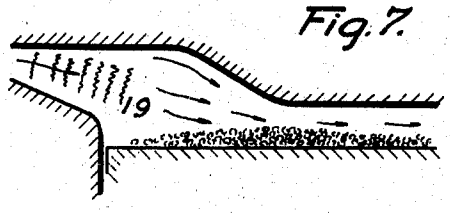


Fig. 7.



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FURNACE FOR ORE REDUCTION

Gustav Andersen, Copenhagen, Denmark

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In Norway December 29, 1932

2 Claims. (Cl. 263—28)

The present invention relates to reduction of ores by solid as well as gaseous reducing means, and the invention has for its object to provide a process giving a high yield, at the same time as the reduction is effected continuously and without any risk of sintering or agglomeration.

According to the invention, this result is attained by performing the reduction with the ore, with or without reducing means, resting in a layer, preferably a thin layer, on a conveyor running continuously in a closed system and passing first a zone with hot gases such as reducing gases flowing preferably in counter-stream, and then through a cooling zone in which the ore is cooled without being exposed to fresh or cooling air, before the reduced ore is removed from the conveyor. According to the process the ore is consequently cooled before coming into contact with the open air, and while being still spread in a relatively thin layer. For this reason, the oxidation of the reduced ore will be insignificant, and further any sintering together of the material, or sintering of the same to the supporting surface etc., will be prevented. By the cooling and the resulting contraction the layer will crack into smaller pieces, and can easily be scraped away and disintegrated in this state.

The invention relates also to a furnace for carrying out the process. This furnace consists of a closed annular chamber fitted with a table adapted to rotate within the said chamber, a feeding device for supplying a layer of ore with or without reducing means to the table, a device for directing hot gases through a portion of the furnace chamber, and devices for cooling a part of the chamber, the said feeding device being arranged to be driven at a speed changing automatically in accordance with the speed of the table, which feature is very important, as thereby the regulation of the rotary speed of the table and the regulation of the rate of feeding are combined into one single operation. If thus it be desired, for a furnace, to change from a richer to a poorer ore, which latter of course is more difficult to reduce, or if an increased degree of reduction is desired, then the rotary speed of the table is simply reduced, whereby at the same time the feeding is reduced in perfectly automatic manner, so that the thickness of the layer is maintained.

The accompanying drawings show, by way of example, one construction of the furnace according to the invention.

Fig. 1 shows a vertical section of the furnace, along the line I—I in Fig. 2,

Fig. 2 shows the furnace in top plan view,

Fig. 3 shows the furnace in vertical section, along the line II—II in Fig. 2,

Fig. 4 shows a section of the heating chamber, along the line III—III in Fig. 2,

Fig. 5 shows a similar section of a heating chamber for heating by means of electrodes,

Fig. 6 shows a section along the line IV—IV in Fig. 5, and

Fig. 7 shows a section, similar to Fig. 4, of a heating chamber for heating with electric heating units.

On the drawings, 1 indicates a tightly closed cylindrical furnace mantle with a cover 2, which parts together form a chamber 3 closed from the outer air. Centrally in the said chamber a vertical shaft 4 is disposed, which at the top supports radial arms 5, which serve to support an annular track 6 projecting into a corresponding annular channel 7 in the cover 2 and forming the bottom of the channel. To the bottom end of the shaft 4 a bevel gear wheel 8 is keyed, which engages a corresponding pinion 9 on a shaft 10 journalled in the furnace mantle and in an arm 11 on a step bearing 12 for the shaft 4. In order to support the cross of arms 5, rollers 13 are provided along the periphery and rest on a suitably water-cooled pipe 14, which is suspended, inside of the mantle, by means of brackets 30. To the annular conveyor or track 6 the ore to be reduced is supplied, preferably mixed with reducing means, by way of a hopper 15 and a rotary feeding cylinder 16, which is known per se, and delivers measured quantities of material to the conveyor or track 6. The shaft 17 of the cylinder 16 communicates, by means of a chain-drive 18, with the driving shaft 10, which produces the rotary motion of the table in such a manner that the supply of material to the table will at any time be dependent on the speed of the table. Diametrically opposite the feeder hopper 15, the annular channel 7 is expanded so as to form a chamber 19, in which the heat required for the reduction is generated, for instance by means of oil, gas or powdered coal supplied to the chamber under pressure by way of a burner 20, Figs. 2 and 4. Instead of by combustion, the generation of heat in the heating chamber may be effected electrically, either by electrodes, as shown in Figs. 5 and 6, or by means of electric resistance units as shown in Fig. 7, the electrodes or electric resistance units being swept by

compressed air. The hot gases are caused to pass through the channel 7 in a direction opposite the motion of the annular track or conveyor 6, and are discharged by way of the feeder device for the ore and, if desired, the said gases may be used again by being returned through the pipe 21 by means of a fan 22.

The other half of the annular channel 7 serves as a cooling zone for the reduced ore. At the end of that zone, i. e. closely in front of the feeder device, a disintegrating device is provided, for instance as shown in Fig. 3 a studded roller 23, which may be cooled by water, and which may be connected to a conveyor device. A wall or gate 24 (Fig. 2) separates the first heated zone of the channel 7 from the cooling zone. The disintegrating device, the gate 24, or both, may be shaped in such a manner that they discharge the ore from the conveyor. In that case, the gate 24 has the shape of a scraper. The finished material drops into a funnel-shaped hopper 25 (Fig. 3) disposed below the cross of arms 5 and closed entirely from the atmosphere, the said hopper having preferably its lowest point situated below the point at which the roller 23 or the gate 24 removes the ore from the conveyor. In the cooling zone, the channel 7 is fitted with a cooling mantle 26 through which water or, maybe, cold air is directed. The bottom part of the hopper is water-cooled, and is fitted with some known kind of discharging device. The wall 24 has also for its object to prevent the hot gases from entering into the cooled zone of the furnace chamber, and deflects the hot flow of gases upward through the feeding device for the ore.

The furnace acts in the following manner:

By a suitable gearing between the driving shaft 10 and the cylinder shaft 17, the rotary annular track is supplied gradually with a suitably thick layer of ore, with or without reducing means admixed, as the track passes the feeder device, and during its forward motion in the channel 7, the ore will constantly meet hot gases in counter-stream, preferably reducing gases from the heating chamber. Such a continuous feeding forward of ore in a relatively thin layer, in counter-stream relatively to hot gases acting on the ore from the supply opening of the furnace and until the heat action reaches a maximum at the passage through the heating chamber, will produce an efficient reducing, without any danger of sintering or agglomeration as the ore is not exposed to any compression, and the impurities contained therein will gradually be combusted and cause the ore to become porous. After having passed the heating chamber, the ore arrives at the cooling zone, and is finally removed from the track by means of the studded roller 23 assisted by the wall 24, so that it drops down into the water-cooled hopper below, from which it is removed in known manner.

The construction of the invention shown on the drawings is merely to be considered an example, and the invention may of course be varied in many manners, without the scope of the invention being thereby transgressed. The furnace may for instance be constructed with several continuous tracks situated above or alongside each other, and passed successively by the ore.

Having thus described by invention what I claim is:

1. A furnace for reducing ore with non-liquid reducing means, comprising a closed annular chamber divided into zones, a conveyor rotatable within said chamber, feeding means for charging a layer of ore mixed with solid reducing means on to said conveyor, means for supplying and leading hot gases and reducing gases through the first zone of the said annular chamber, means for cooling another zone of the said chamber and discharging means, the means for charging being in known manner driven automatically in synchronism with the speed of the conveyor, the means for supplying and leading gases through the chamber leading the gases countercurrently to the direction of rotation of the conveyor, and the layer being discharged with such means that the reduced layer is not exposed to fresh or cooling air, the conveyor being constructed as an annular plate, the means for feeding, for heating and for cooling being placed relatively to each other to compel the ore on the rotatable plate to first traverse in the hot gases countercurrent thereto, then the zone of the chamber in which the hot gas is introduced into the chamber, and finally to traverse the cooled zone of the chamber, said cooled zone being bounded by a wall formed as a scraper for the reduced ore, said wall serving to deflect the flow of hot gases upward through the feeding means, and to prevent the hot gases from passing into the cooled zone of the furnace chamber.

2. A furnace for reducing ore with non-liquid reducing means, comprising a closed annular chamber divided into zones, a conveyor rotatable within said chamber, feeding means for charging a layer of ore mixed with solid reducing means on to said conveyor, means for supplying and leading hot gases and reducing gases through the first zone of the said annular chamber, means for cooling another zone of the said chamber and discharging means, the means for charging being in known manner driven automatically in synchronism with the speed of the conveyor, the means for supplying and leading gases through the chamber leading the gases countercurrently to the direction of rotation of the conveyor, and the layer being discharged with such means that the reduced layer is not exposed to fresh or cooling air, and crumbling means consisting of a studded roller, a cooled hopper situated adjacent to said roller and adapted to collect the ore therefrom and fitted with discharging means for the ore.

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