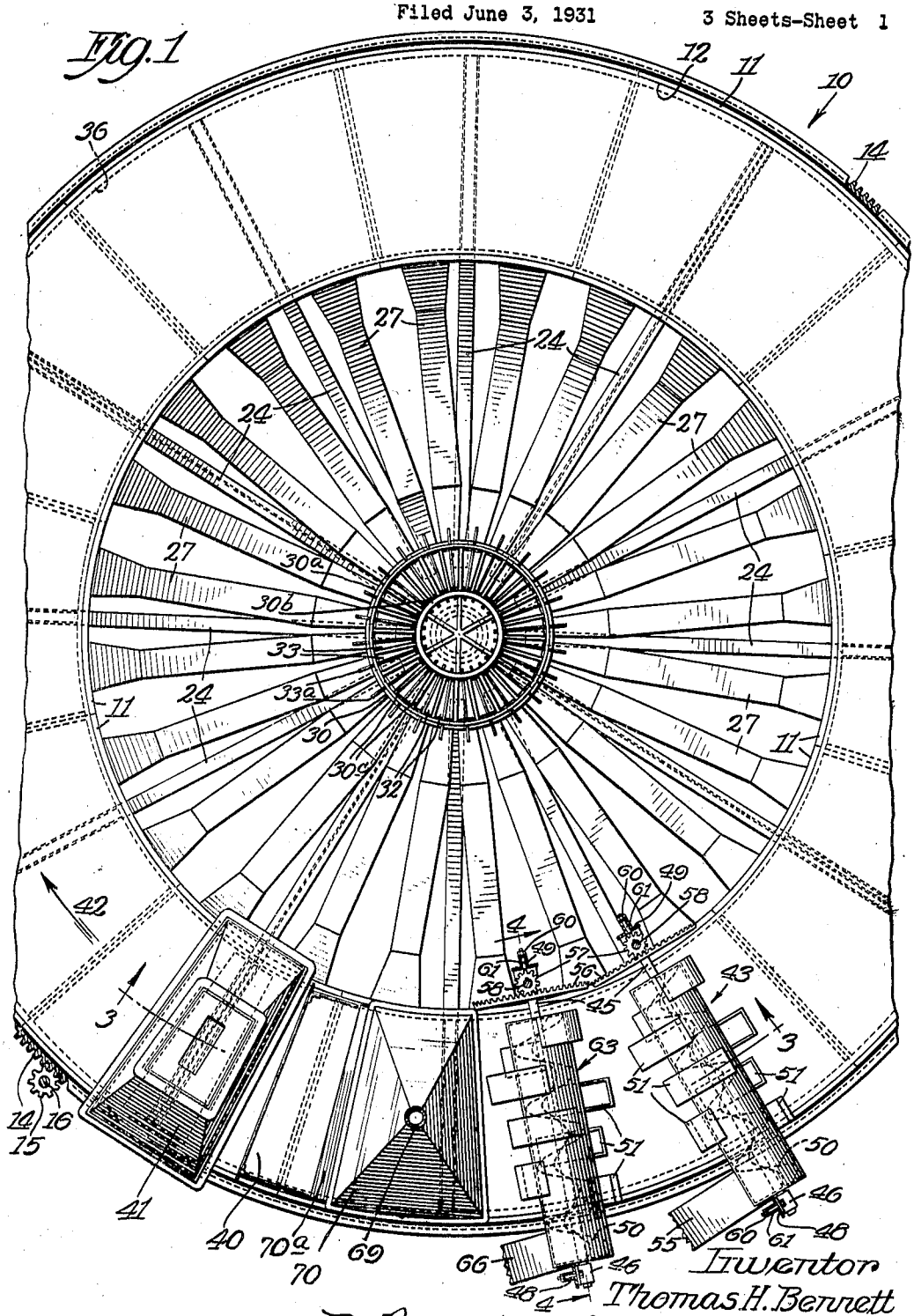
Dec. 26, 1933. T. H. BENNETT 1,940,935

METHOD OF SINTERING ORES AND APPARATUS THEREFOR

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Fig. 1



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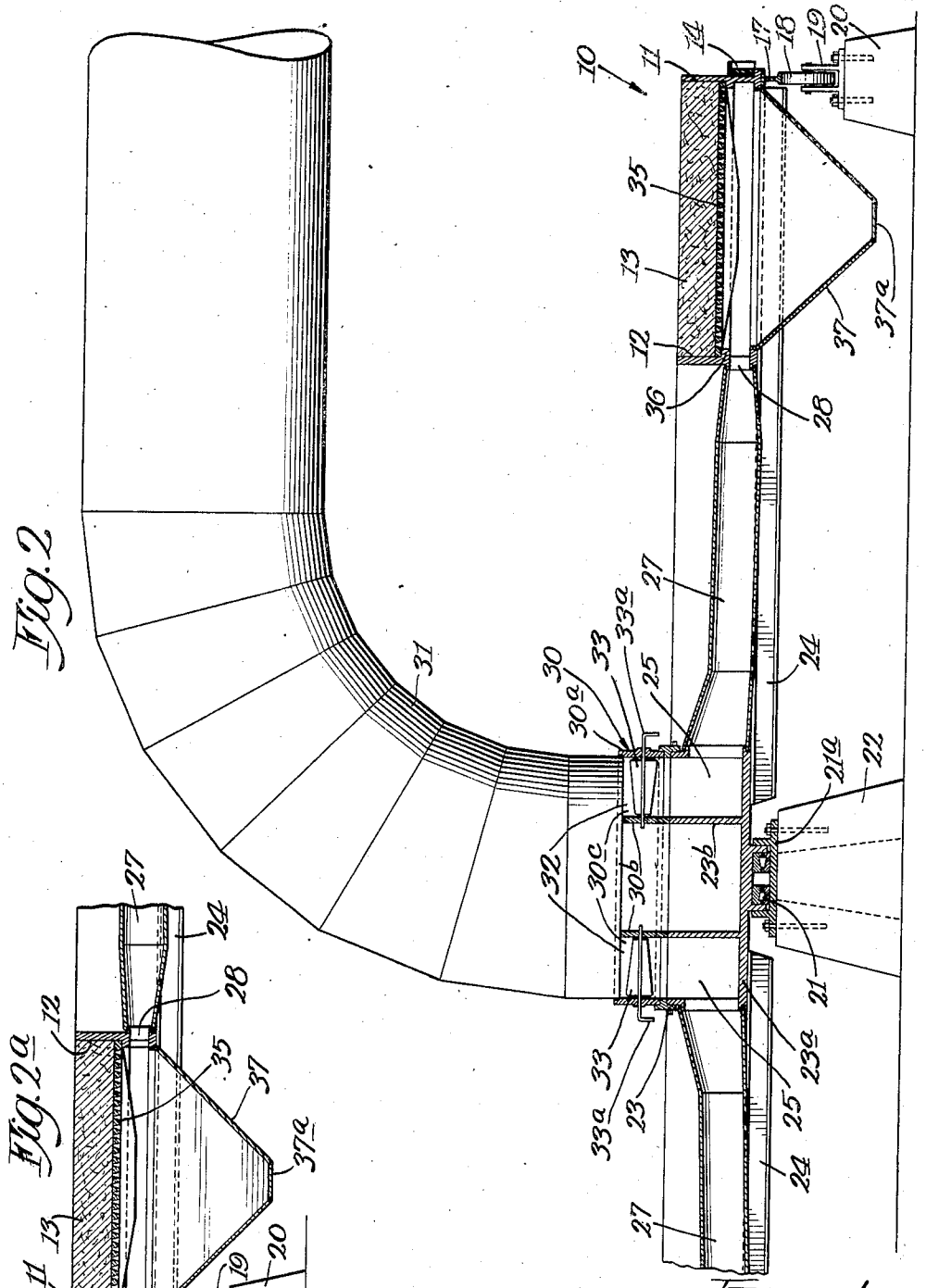


Fig. 2

Fig. 2a

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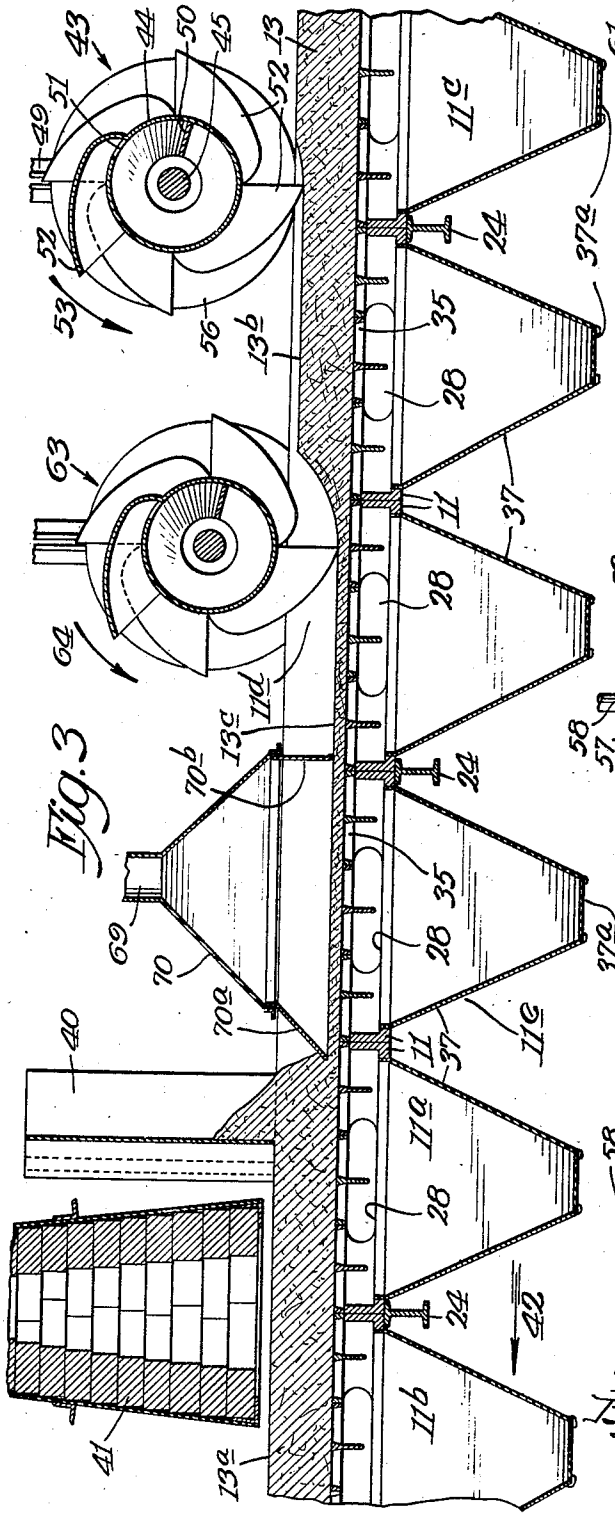


Fig. 3

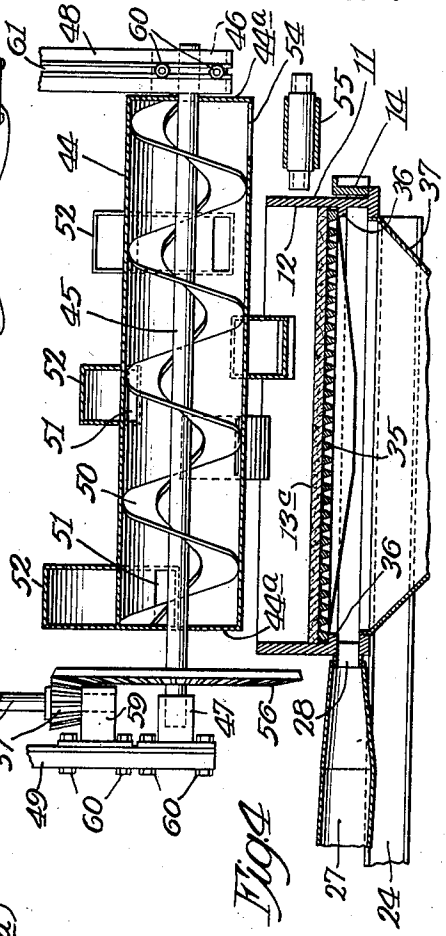


Fig. 4

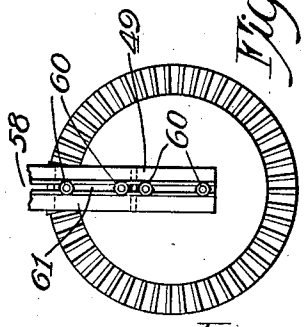


Fig. 5

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Patented Dec. 26, 1933 1,940,935

UNITED STATES PATENT OFFICE

1,940,935

METHOD OF SINTERING ORES AND APPARATUS THEREFOR

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Application June 3, 1931. Serial No. 541,812

14 Claims. (Cl. 266—21)

This invention relates to an improved method of sintering ores and to improved sintering apparatus whereby the roasting and sintering of ores may be carried on as a simple, economical and flexible operation, to effect a simultaneous production of one or more grades of sintered ore. The method is adapted for use with pulverized ores, such as copper and zinc ores, having either a natural or an intermixed combustible ingredient, for example, a considerable sulphur content, which after being ignited maintains a combustion in the body of ore during the process of sintering.

The present invention is distinguished from prior methods of sintering in that it is carried on as a continuous process and produces a plurality of different grades of ore which are separated from each other continuously as the process proceeds. The improved apparatus in which the method is carried on comprises a series of grates upon which the bed of ore is placed and as this ore moves in a continuous path of travel on the grates, one or more layers of ore are continuously separated from the upper portion of the body of ore as the sintering operation is completed, leaving a lower layer on the grates which is preferably allowed to remain there as a bedding-layer which is automatically prepared to protect the grates during the sintering of a succeeding charge which is continuously applied. Another object of the invention is to provide an improved sintering apparatus comprising a rotatable table made up of a plurality of connected pallets or sections which form a continuous annular channel in which the body of pulverized ore is placed and in which the sintering operation takes place during the rotation of the table, in combination with movable excavating and conveying devices which operate during the rotation of the bed of ore to remove one or more layers of sintered ore therefrom. A further object of the invention is to provide a sintering apparatus having means for removing a plurality of layers of ore from the body of sintered ore as the sintering operation is carried on as a continuous process, leaving a bedding layer which is automatically broken up by a blast of air to form a porous protection for the grates of the apparatus during the operation of sintering a succeeding charge of ore. Other objects relate to various details of the process and to various features of construction and arrangement of the apparatus which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one method of practicing the invention is explained in connection with the construction of one embodiment of the improved sintering apparatus.

In the drawings,—

Figure 1 shows a partial top plan view of the improved sintering apparatus with certain parts thereof removed;

Figs. 2 and 2ª show, when taken together, a complete vertical section through the axis of the sintering apparatus on the line 2—2 of Fig. 1;

Fig. 3 shows a vertical sectional view taken on the line 3—3 of Fig. 1, which is substantially concentric with the axis of the rotating table;

Fig. 4 shows an enlarged detailed section taken on the line 4—4 of Fig. 1; and

Fig. 5 is a fragmentary side elevation of the supporting means at one end of the excavating conveyer shown in Fig. 4, illustrating the means of adjusting the elevation thereof.

As illustrated in the drawings, the invention comprises a rotatable table 10 which in this embodiment is made up of twenty-four similar pallet-sections which are identical in form and which are molded to each other along their contacting edges so that they form a complete circular channel 12, adapted to contain the body of ore 13 which is subjected to the sintering process. The pallet sections 11 are bolted or otherwise secured to a sectional annular girth-gear 14 which meshes with a pinion 15 secured on a vertical power-driven shaft 16 so that as this shaft revolves, it drives the gear and causes the table to rotate about a vertical axis. The outer lower edges of the pallet sections 11 are secured to a circular rail 17 which rests upon the supporting rollers 18 journaled in brackets 19 on the supporting blocks 20. The table rotates about a central axis which is formed by a dust-tight grease-packed roller bearing 21 having the lower casing 21ª thereof mounted upon a central supporting pedestal 22. The upper casing of this roller bearing is secured to the lower wall 23ª of a central housing 23 and this plate 23ª is also secured to a plurality of I-beams 24 which extend radially outward and which have their upper flanges secured to alternate pairs of contacting edges of the pallet sections as shown in Fig. 3.

The central housing 23 comprises an inner, annular wall 23ᵇ and the annular space between this wall and the outer circular wall of the housing is divided into a number of segmental sections or chambers 25, by means of a series of radiating partitions, as shown in Fig. 1. The outer wall of the housing is provided with a

series of openings each communicating with one of the chambers 25 and these openings lead from pipes 27, each of which has its outer end connected to communicate with one of the pallet sections 11 through an opening 28. The central housing 23 is surmounted by a stationary wind-box 30 which communicates with a stack 31 having its other end connected to a suction fan so that a suction may be exerted through the pipes 27 upon the contents of the pallet sections 11. The stationary wind-box 30 has an outer annular wall 30^a and an inner annular wall 30^b with the space between these walls divided into segmental sections by means of radial partitions 30^c, thus forming a number of chambers 32 in each of which there is located a damper 33 adapted to be operated by a handle 33^a, so that the degree of suction exerted through any one of the pipes 27 in any region around the path of travel of the pallet sections 11 may be varied as desired.

Each pallet section 11 is provided with a grate 35 which is supported on flanges 36 extending inwardly from the inner and outer walls of the pallet sections. The open space beneath each grate, formed by the frame of the pallet sections, is closed on its underside by a dust hopper 37 provided with a clean-out door 37^a at the bottom to permit the periodical removal of fines that may be drawn downwardly through the grates.

The pulverized ore 13 is fed into the annular channel formed by the pallet sections from a feed hopper 40 which is mounted in stationary position and arranged with its lower edge extending in a horizontal plane adjacent to the level of the upper edges of the inner and outer walls of the pallet sections so that when a pallet section reaches the position 11^a beneath the hopper 40, it is filled with ore and as the pallet continues to travel this ore is scraped off in a horizontal plane by the lower edge of the hopper so that it presents a flat upper surface 13^a, as shown in Fig. 3. Immediately after passing the hopper 40, each pallet section passes to a position 11^b, beneath a stationary furnace 41 which is fired by gas or oil to direct the flame downwardly upon and through the mass of pulverized ore beneath it. The combustible content of the ore is kept burning by means of the suction which is exerted upon the ore through the radiating pipes 27 and the roasting of the ore then continues as the pallet sections assume successive positions around the circular path of travel thereof during the rotation of the table in the direction of the arrow 42. The dampers 33 are preferably so adjusted as to cause the amount of suction to decrease as the distance of the pallet sections from the furnace 41 increases and finally when the pallet section reaches the position 11^c, as shown in Fig. 3, the sintering of the ore is practically complete and the extreme upper layer of the ore is then automatically removed.

As a result of the sintering process, the quality of the sintered material varies somewhat at different depths of the bed 13, the uppermost layer having a greater proportion of impurities than the next adjacent intermediate layer of greater depth, which may be substantially free of sulphur, lead and cadmium compounds and other impurities, while the lowermost layer, adjacent to the grates, may have the highest percentage of impurities due to the condensation therein of volatile gases which are liberated in the upper layers of the ore and drawn downwardly by the action of the suction system. Means are, therefore, provided for separating the several layers of ore of different degrees of purity from each other and this is preferably accomplished by the use of one or more automatic excavating conveyors which scrape off the ore from the body of ore to a predetermined depth and automatically remove it without interfering with the continuous travel of the pallet sections around their circular path.

The first excavating conveyer or conveying-scalper 43 is located in a position to engage the ore above each pallet section when it reaches the position 11^c. This conveying-scalper 43 comprises a cylindrical screw conveyor 44 extending radially of the table above the path of travel of the pallet sections and supported by a rotatable shaft 45 which has its outer end journaled in a bearing 46 and its inner end journaled in a bearing 47 carried by overhead supports 48 and 49, respectively. The tubular shell of each conveyor 44 is provided on its inner side with a helical conveyor ribbon 50 having its outer edge secured to the wall of the conveyor casing and having its ends secured to the end walls 44^a thereof. The outer wall of the casing 44 is provided with a plurality of spaced and helically arranged openings 51 each of which communicates with an excavating bucket 52. These buckets have three edges thereof attached to the shell of the conveyor around one of the openings 51 and their edges project from the shell so that as the device 43 rotates in the direction indicated by the arrow 53, each bucket engages and picks up a portion of the uppermost layer of ore. The several buckets are so arranged that the edge of one bucket projects beyond the vertical plane of the edge of the next adjacent bucket with the result that the composite action of all of the buckets during one rotation of the excavating conveyor is to pick up all of the ore of the uppermost layer down to a predetermined depth as shown at 13^b in Fig. 3. This ore is conveyed by the conveyor ribbon 50 to the outer end of the conveyor where it is discharged through an opening 54 and carried away by a belt conveyor or other device 55 for further treatment. The rotation of the excavating-scalper is effected by means of a large gear 56 secured upon the shaft 45 and driven by a pinion 57 secured upon a power-driven vertical shaft 58 having its lower end journaled in a bearing 59 secured upon the above described supporting frame member 49. In order that the depth of the layer excavated and conveyed by the device 43 may be varied, the driving shaft 58 has a splined connection with its driving member, and the bearings for the ends of the shaft 45 and the bearing 59 are adjustably mounted by bolts 60 which are slidable vertically in slots 61 formed in the supporting frame members 48 and 49.

After excavating the uppermost layer of the body of material to the level 13^b, each pallet section then passes along to a position 11^d where it is engaged by another excavating scalper 63, similar in construction to the device 43 previously described, except that it is set to excavate the material at a lower level so that as this device rotates in the direction indicated by the arrow 64, it picks up and conveys away the intermediate body of ore having the greatest purity, and discharges it over the outer edge of the table so that it may be conveyed away by a belt 66 or other device, for further treatment. This leaves in the channel of the pallet sections a lower layer of ore having an uppermost surface 13^c which is spaced above the grates, thus providing a bedding layer.

This bedding layer of ore is utilized as a support for the next succeeding charge of unsintered ore and, in order that it may be broken up and caused to assume a porous condition, after having become more or less caked by the roasting process, it is subjected to the action of a blast of air which is applied under pressure through a pipe 69 leading to a hood 70 mounted in stationary position so that each pallet section 11 passes beneath it when it reaches the position 11^e. The hood 70 has walls 70^a and 70^b which project downwardly into the channel 12 with their lower edges adjacent to the upper surface 13^c of the ore. As each pallet section reaches the position 11^e, the blast of air is automatically applied and the bedding-layer is broken up so that it assumes a porous condition immediately before passing to the position 11^a where it receives a new charge of unsintered ore from the hopper 40.

It will be apparent that the present invention provides an improved process which is carried on continuously with the result that several different grades of ore are continuously produced and continuously separated from each other so that the sintering of a given body of ore may be effected much more quickly and conveniently than has heretofore been possible by previous processes or known forms of apparatus.

Although one form of apparatus has been shown and described in connection with the explanation of one method of practicing the improved process, it will be understood that the invention may be practiced in various ways and constructed in various embodiments within the scope of the appended claims.

I claim:

1. The method of sintering ore which consists in continuously supplying ore and roasting it while conveying it along an endless path of travel, and separately removing different layers of said ore as the roasting thereof is completed.

2. The method of sintering ore which consists in continuously supplying ore and roasting it while conveying it along an endless path of travel, separately removing different layers of said ore as the sintering thereof is completed, leaving the lowermost layer of ore after the other layers are removed, and continuously supplying a fresh body of unsintered ore upon this lower layer.

3. The method of sintering ore which consists in continuously supplying ore and roasting it while conveying it along an endless path of travel, separately removing different layers of said ore as the sintering thereof is completed, leaving the lower layer of said ore and putting it into a porous condition, and continuously applying to said lower layer a new charge of unsintered ore.

4. The method of sintering ore which consists in roasting the ore while conveying it along an endless path of travel and continuously and separately removing different layers of said ore of different degrees of purity as the sintering thereof is completed.

5. The method of sintering ore which consists in conveying it along an endless path of travel, roasting the ore while it is so conveyed, continuously removing different layers of ore of different degrees of purity as the sintering thereof is completed, leaving the lowermost layer of ore and rendering it porous, and then applying to said lowermost layer a new body of unsintered ore.

6. The method of sintering ore which consists in roasting the ore and subjecting it to the action of suction while conveying it along an endless path of travel, continuously removing different layers of sintered ore of different degrees of purity, and leaving the lowermost layer as a bedding layer for a new body of unsintered ore.

7. The method of sintering ore which consists in roasting the ore while conveying it along an endless path of travel, separately removing different layers of ore of different degrees of purity as the sintering is completed, leaving the lowermost layer of ore and rendering it porous by an air blast, and then applying a new body of unsintered ore to said porous layer.

8. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, suction means for maintaining the combustion of certain contents of said ore during the rotation of said table, and means for continuously removing different predetermined layers of said ore at predetermined points around the path of travel of the ore upon said table.

9. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, and means for continuously removing different predetermined layers of said ore at predetermined points around the path of travel of said ore upon said table.

10. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, means located at one point around the path of travel of said ore for removing the uppermost layer thereof, and means located at a later point in the path of travel of said ore for removing the next lower layer thereof.

11. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, and a self-loading rotary tubular conveyor mounted over the path of travel of said ore for positively removing a predetermined layer thereof.

12. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, a conveying tube extending transversely of said table over the body of ore carried thereon, means for rotating said tube, conveying means located in said tube, and means carried by said tube for picking up and discharging into said tube a predetermined layer of said ore on said rotating table.

13. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, a conveying tube extending transversely of said table over the body of ore carried thereon, means for rotating said tube, conveying means located in said tube, and a series of excavating buckets carried by said tube for picking up a predetermined layer of said ore

at a predetermined point in its path of travel on said table and discharging it into said conveying tube.

14. The combination in sintering apparatus, of a rotatable table having an annular ore receiving channel, means for continuously supplying unsintered ore to said channel, means for igniting the combustible content of said ore, means for rotating said table, suction means for maintaining the combustion of certain contents of said ore during said rotation, means for continuously removing a predetermined layer of the sintered ore at a predetermined point in the annular path of travel of said ore while leaving a lower layer of ore in said channel, and air blast means for rendering said lower layer porous in advance of said means for supplying unsintered ore thereto.

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