Jan. 2, 1923.

1,441,003

J. KNOX.
SINTERING MACHINE.
FILED JUNE 4, 1920.

2 SHEETS-SHEET 1

Fig. 1

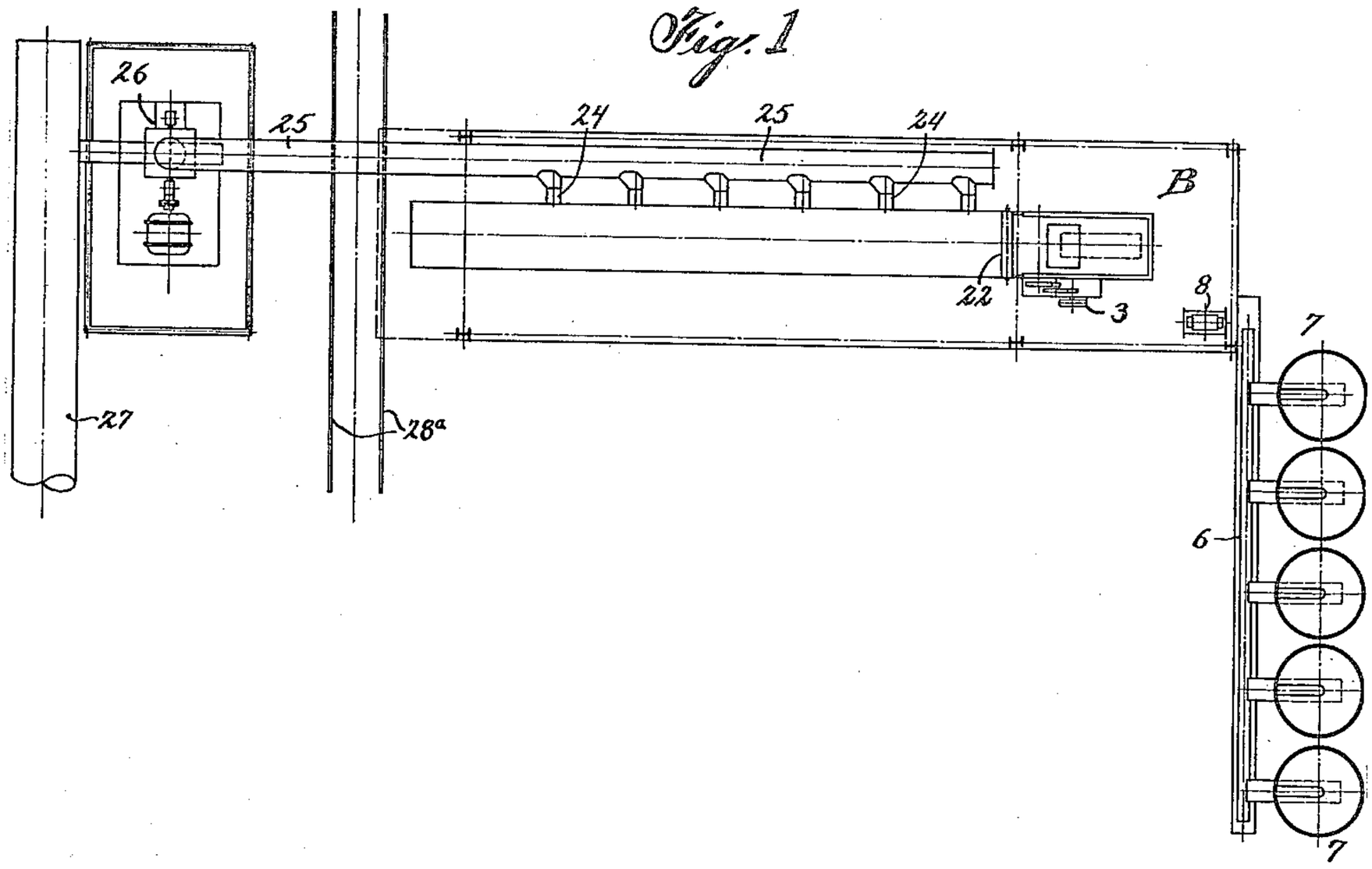
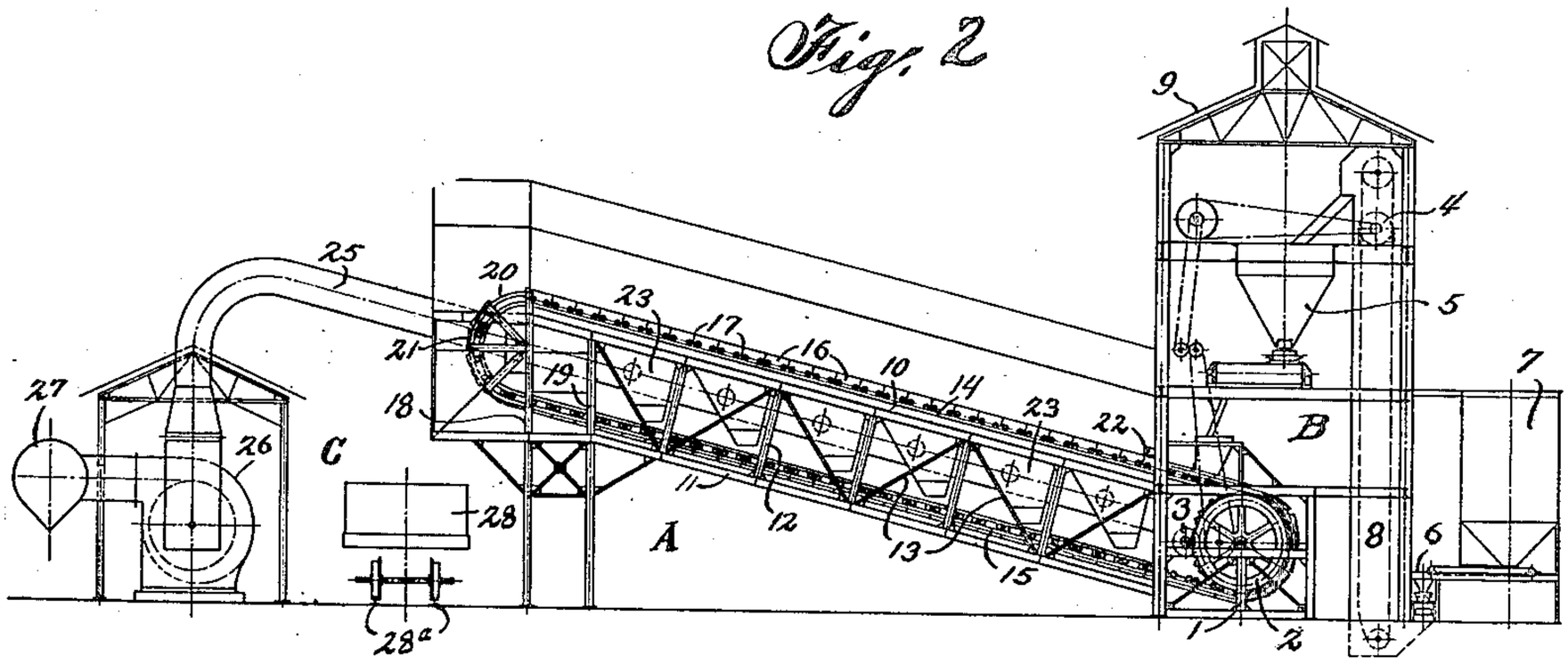


Fig. 2



INVENTOR
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BY
H. H. Blair
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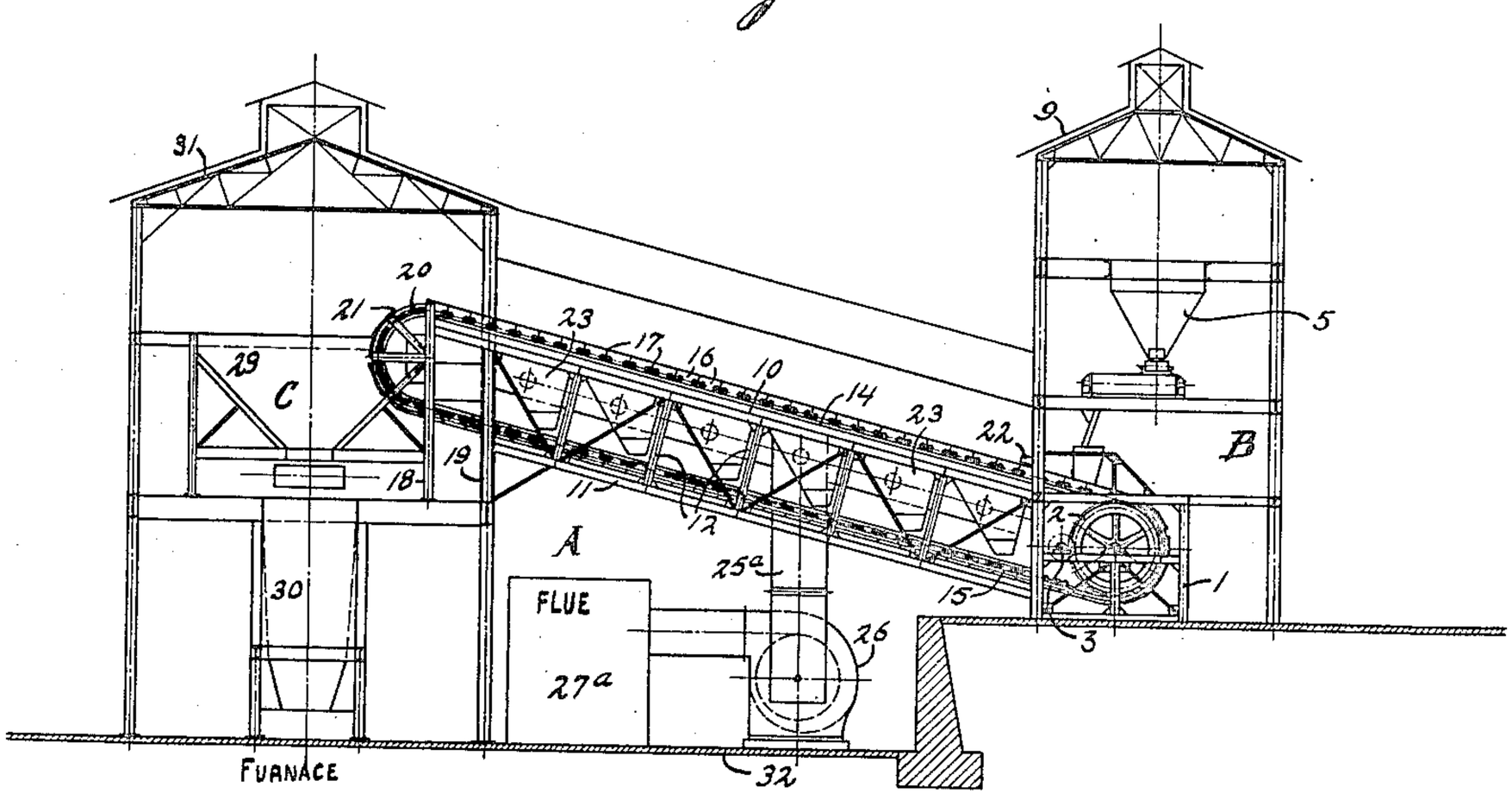
2 SHEETS-SHEET 2

Fig. 3



INVENTOR

John Knox

BY

H. H. Blair

ATTORNEY

Patented Jan. 2, 1923. 1,441,003

UNITED STATES PATENT OFFICE.

JOHN KNOX, OF PERTH AMBOY, NEW JERSEY, ASSIGNOR TO ARTHUR S. DWIGHT, OF NEW YORK, N. Y.

SINTERING MACHINE.

Application filed June 4, 1920. Serial No. 386,538.

To all whom it may concern:

Be it known that I, JOHN KNOX, a subject of the King of Great Britain, residing at Perth Amboy, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Sintering Machines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in apparatus for sintering ore; particularly apparatus of the sort having a series of traveling grate sections or pallets upon which, successively, the fine ore is delivered as a stratum, and which then carry it, first, to igniting devices and then through a region of air supply, and then after the sintering combustion is terminated carry the sinter to a place where its discharge is effected. After they are emptied, the pallets are returned along the track section below the working track, to points where they are elevated by power to the upper track, and are again propelled through the cycle described.

A very efficient apparatus for effecting this cycle of operations is that shown and described in U. S. Patent No. 1,027,084 granted May 21, 1912, to Henry J. Stehli, which consists of an upper track for the pallets, more or less horizontal, along which a train of disconnected pallet elements are pushed by a pair of large sprocket wheels, so that each pallet while on this upper track passes successively the region where it receives its charge of ore, the region where the combustible elements of the charge are ignited, the region of air treatment, and finally the region of discharge, which occurs when the end of the upper track is reached and the pallets successively are pushed over the brink into suitable guides which direct them in an inverted position on an inclined lower track upon which they move by gravity to a point under the place of beginning at the feed end of the machine. Here the pallets are successively engaged by the lower teeth of the same pair of large sprocket wheels which served to push them along the upper track, and are raised in a continuous train through a semi-circular path tangent to the upper track, and finally launched once more upon the upper track in a continuous train, as before. In order to effect by gravity the return of the pallets to the lifting sprockets it is evident that the inclination of the lower track must be sufficient to overcome the friction of movement. In practice, this angle is about 8°. 8 feet is found in practice to be about a maximum diameter for the sprockets from the standpoint of convenience and good construction. It is evident, therefore, that for a given diameter of lifting sprocket wheel and a minimum grade to the lower track the length of the upper horizontal track is limited. With the data already mentioned of 8 feet diameter of sprockets and 8° drop to the lower track per foot of horizontal length, the total length of the upper track is about 32 feet. If the upper track is to be longer than this, the lifting sprocket must have an inconveniently large diameter or undesirable complications must be introduced at the discharge end to assist gravity or otherwise mechanically effect the return of the pallets to the lifting sprockets.

The purpose of my invention is to make it possible to indefinitely increase the length of the upper track and yet secure the return by gravity of the empty pallets to the lifting sprockets without increasing the diameter of said sprockets. This I do by giving to the upper track a sufficient upward inclination from the feed to the discharge end to permit the empty pallets after discharge to return by gravity to the foot of the lifting sprocket wheels.

In the drawings:

Fig. 1 illustrates more or less conventionally in plan view a sintering apparatus embodying my inprovements.

Fig. 2 is a side elevation of the same.

Fig. 3 is a side elevation illustrating a modification of the apparatus as an entirety in respect to the mechanism which receives the discharged sinter.

A indicates that part of the apparatus which comprises the main elements of the path of the pallets, including the upper track, the lower or return track, the framework which supports these, and the devices for causing the movements of air and gases which are incident to sintering work.

B indicates, as an entirety, that part of the apparatus which comprises the power mechanism, the pallet lifting and driving mechanism, the initial storage and supply mechanism for the ore to be treated, the mixing apparatus, the receptacle for the ore coming from the mixing apparatus and for feeding the latter to the pallets, the devices

by which the ignition of the ore is effected, the heavy framework which sustains the lower end part of the sintering apparatus, and the housing which encloses all these elements of the apparatus.

C indicates the place where the sintered ore is discharged, and the means, of whatever sort is selected, for receiving it.

As the detailed parts, suitable for the general assemblages indicated, as entireties, by A and B, are well known, extended description is not necessary of those that are suggested, more or less conventionally, in the drawings.

Suffice it to say that at 1 there is a heavy framework built upon the ground foundations, and composed of extensive metallic elements, making it capable of supporting heavy sprocket wheels 2, 2, each several feet in diameter, and also of sustaining the power-transmitting shafting and gearing indicated by 3, for driving the mechanism which lifts the pallets and causes them to advance along the track with their heavy loads.

4 indicates the engine for transmitting power, through the gearing and shafting, to accomplish the work mentioned. Upon the framework 1 there is also supported a large storage hopper or bin 5, holding several tons of the ore which is to be delivered by the pallets for treatment. The ore is brought to this hopper from the ore mixing mechanism at 6, which is designed to take different masses and commingle them in such way that a predetermined mass of standard uniformity is produced preparatory to passing it to the hopper 5 and to the pallets.

7, 7 indicate initial storage bins, and 8, 8 elevators for carrying the material up to the region where it is mixed or graded and thence passed to the hopper 5.

A housing of suitable sort, such as is indicated at 9, can be arranged to enclose the mechanism referred to, if required.

That part of the apparatus generally indicated by A comprises a light framework having upper longitudinally extended parts 10, lower parts 11 approximately parallel thereto, the uprights 12, and braces 13. Upon the upper element of the frame are placed track rails 14 and on the lower element are secured track rails 15. Upon the guiding support provided by the track sections 14 and 15 the pallets or grate sections 16 are carried, there being end walls 17, and apertured bottoms. As shown the pallets are disconnected, each from the next, but they are adapted to be in such close contact that they provide a continuous perforated or apertured grate-like support for a continuous ore stratum, and provide continuous vertically disposed walls along the sides of the stratum. The tracks 14 and 15 at their lower ends are connected to the strong frame 1, and are respectively positioned so as to be approximately tangential to the lifting wheels 2.

The outer end of the frame structure above described is supported upon an upright frame having the standards 18, 19. To these are attached a curved track 20 having one end aligning with the track section 14 and the other aligning with the return track section 15.

The lower track section, extending from the curved track 20 to the lifting wheels 2, is sharply inclined. The pallets, after the sintering of the ore has been accomplished, successively reach the curved track 20, and as they pass down around it they discharge their loads as shown at 21. They then reach the lower or return track section 15, in inverted positions, and move, exclusively under the action of gravity, down the incline to the lifting wheels. When the normal number of pallets is present in the apparatus those on the return track form a continuous series of mutually contacting, car-like bodies moving freely under gravity, and they not only return automatically to the points where they are lifted, but also assist the lifting wheels by pressing against them with a large part of their combined weights.

At 22 are placed the devices for igniting the ore. These may be of any of the several sorts now well known.

The air is drawn through the ore by suction apparatus more or less similar to that which is now commonly used. 23, 23 indicate air boxes in an extended series below the upper part of the path of the pallets, each box being open at the top to permit the drawing of air downward through the ore and into it; and each is connected by an air pipe 24 with a main pipe or manifold 25, which in turn communicates with an exhaust fan 26. Or the system of parts for supplying air and exhausting the gases may be divided into sections, and two or more fans used, each connected with a number of the air boxes.

In Fig. 2 the sinter is discharged into cars 28 on tracks 28ª, and by these it is transported to any desired place. In the apparatus in Fig. 3 the ore discharged at 21 is delivered to a hopper 29 above a furnace 30. The hopper may have a damper or cut-off at the bottom so that the discharge of the sinter therefrom into the top of the furnace 30 can be regulated as desired. 31 is a housing for covering and protecting the furnace and hopper. It is carried by a framework which supports the uprights 18 and 19, on which the upper part of the sintering apparatus rests. The furnace and housing at the discharge end of the sintering apparatus necessitates an arrangement of the air suction devices differing from that in Fig. 2. There is an air duct 25ª leading

from the manifold 25 down to the fan or suction device at 26. The foundation or flooring is lowered, as shown at 32, to provide for the proper positioning of the furnace and of the sintering mechanism, in relation to each other.

As the process of sintering ore, by the well-known Dwight and Lloyd system, is usually carried out, a uniform layer of ore about six inches thick having been automatically disposed on the grate sections or pallets, the smooth upper surface of the ore mass is ignited as it passes under a suitable ignition device. The combustion of the fuel elements in the ore mass is propagated progressively in a downward direction by the downward moving induced air currents which permeate the mass as it is moved along the upper track toward the region of discharge, and the speed of travel of the pallets is so adjusted that a given pallet shall pass across the region of air treatment in exactly the same time that it takes the zone of ignition to travel from the upper surface where it starts to the underlying grates, which marks the completion of the sintering process. Thus the material is at the proper point ready to be discharged as soon as finished.

To increase the output of a single apparatus, it is necesary to increase the mass of ore undergoing treatment in a given time. There are important reasons why it is desirable to maintain the layer thin; 4 to 6 inches is the usual thickness. Hence, any increase in the mass must come from increased area. In this type of apparatus there are reasons, mostly mechanical, why it is undesirable to increase the width of ore stream beyond 42 inches, chiefly on account of difficulties in securing perfectly uniform distribution of coarse and fine ore particles, but also on account of the disproportionate weight of pallets that accompanies any increase in width. Therefore, an increase in the length of the apparatus is the only desirable way to increase its capacity for output. The time of sintering being a constant for a given class of ore and thickness of layer, it follows that as the length of the region of air treatment is increased, the faster must the pallets travel. Thus if the time of sintering is 13 minutes, the speed of the pallets will be 20 inches per minute on the longest machine which can depend upon returning the pallets by gravity to an 8 foot lifting sprocket, and such combination of conditions would represent a daily output of about 200 tons sinter. This output could be increased several fold by means of my improved construction, and at the same time the advantages of extreme simplicity which characterize the older type of construction can be maintained.

Among the other advantages presented by my improvement may be mentioned the fact that it is usually desirable to have the discharge end of the apparatus considerably elevated above the ground in order to deliver the product into a bin structure, or into railroad cars, or it might be desired to discharge directly into a blast furnace. At the same time, it is desirable to have the feed end of the machine comparatively close to the ground, in order to save elevating the ore, to avoid high and expensive structures to carry the ore feeding bins, the machine proper as well as shafting and other machinery. Both these desiderata are met by my improved machine, which if built in the form of a self-contained, inclined girder-like structure can convey the material undergoing the sintering process from a point of feed set comparatively near the ground, to a high point of discharge convenient to deliver where wanted, without the necessity of providing special elevating appliances, or introducing expensive elements of construction.

The arrangement of the support and guiding system for the pallets, so that there is a gradual travel upward of the ore during the process of sintering, is particularly advantageous in an apparatus such as shown in Fig. 3, inasmuch as not only can the sintering operation, considered by itself be carried on much more efficiently, economically and rapidly than it can be in the earlier apparatus having the ore carriers otherwise arranged, but it eliminates the elevating mechanism necessary for carrying the sintered ore to the top of a furnace stack; and delivers the ore while still highly heated so that the expense of the smelting operation is greatly reduced.

What I claim is:

1. In a sintering apparatus, a series of ore carrying pallets, a support which receives said pallets and guides them upward over an elongated inclined path while they are loaded, means for causing air to pass through the ore on the pallets over an area which is relatively extended in the lines of their travel, and an inclined guide for the empty pallets adapted to conduct them under the action of gravity to points in the vertical lines of the points where they are initially received by the first aforesaid guiding support.

2. In a sintering apparatus, a series of ore carrying pallets, an elongated upwardly inclined guiding support along which said pallets travel when loaded, means for causing air to pass through the ore on the pallets over an area relatively extended along the lines of travel of the ore to points where they can be caused to again engage with the said upwardly inclined support, and an inclined guide for the empty pallets adapted to conduct them under the action of gravity.

3. In a sintering apparatus, a series of ore carrying pallets, means for supplying ore to said pallets, an elongated upwardly inclined guiding support along which said pallets travel after being loaded, means for igniting the ore at the initial end of their travel, a relatively elongated series of air chambers below the pallets while they are moving on said support, means for causing air to move through said chambers and the ore, means for lifting the pallets to points where they can engage with the said guiding support, and means for automatically returning empty pallets to points where they engage with the lifting devices.

4. In a sintering apparatus, a series of ore carrying pallets, means for supplying ore to said pallets, an elongated upwardly inclined guiding support along which said pallets travel after being loaded, means for causing air to pass through the ore on the pallets over a relatively extended area, and means for automatically returning empty pallets to points where they engage with the said supporting guide.

5. In an ore treating apparatus the combination of ore carrying pallets, means for supplying ore to said pallets, an elongated upwardly inclined guiding support along which said pallets travel after being loaded, means for causing air to pass through the ore on the pallets over a relatively extended area after the ore has been ignited, a hopper or guide arranged to receive the ore immediately from the upper end of the pallet series, and a smelting stack below said hopper and arranged to receive the sintered ore therefrom.

In testimony whereof, I affix my signature.

JOHN KNOX.