Aug. 25, 1959 R. F. LEFTWICH 2,901,236

SINTERING APPARATUS

Filed July 27. 1956 5 Sheets-Sheet 1

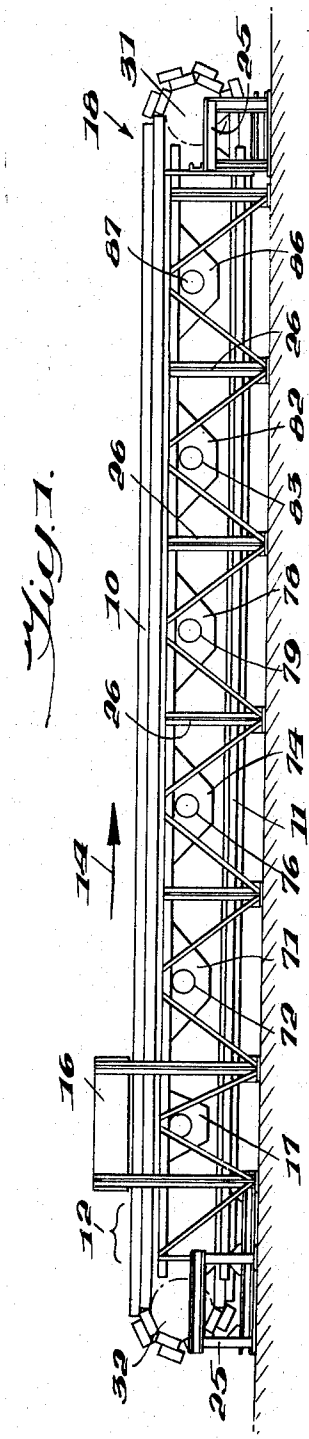


Fig. 1.

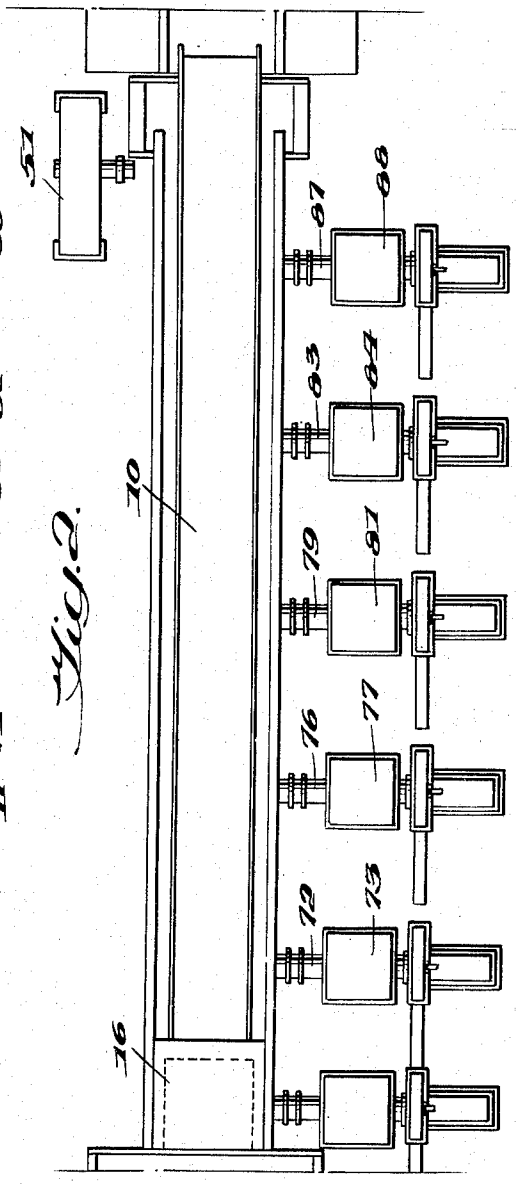


Fig. 2.

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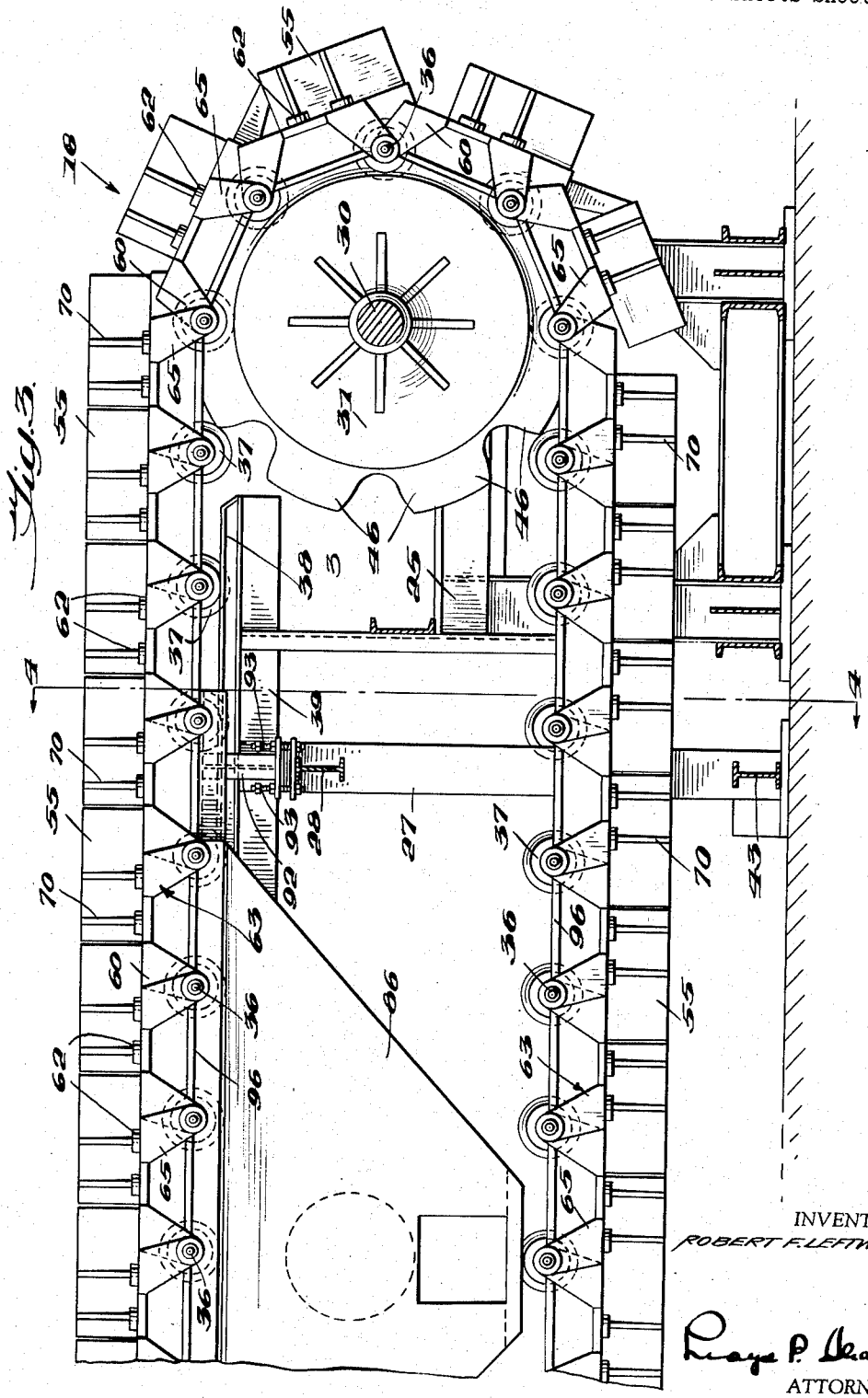


Fig. 3.

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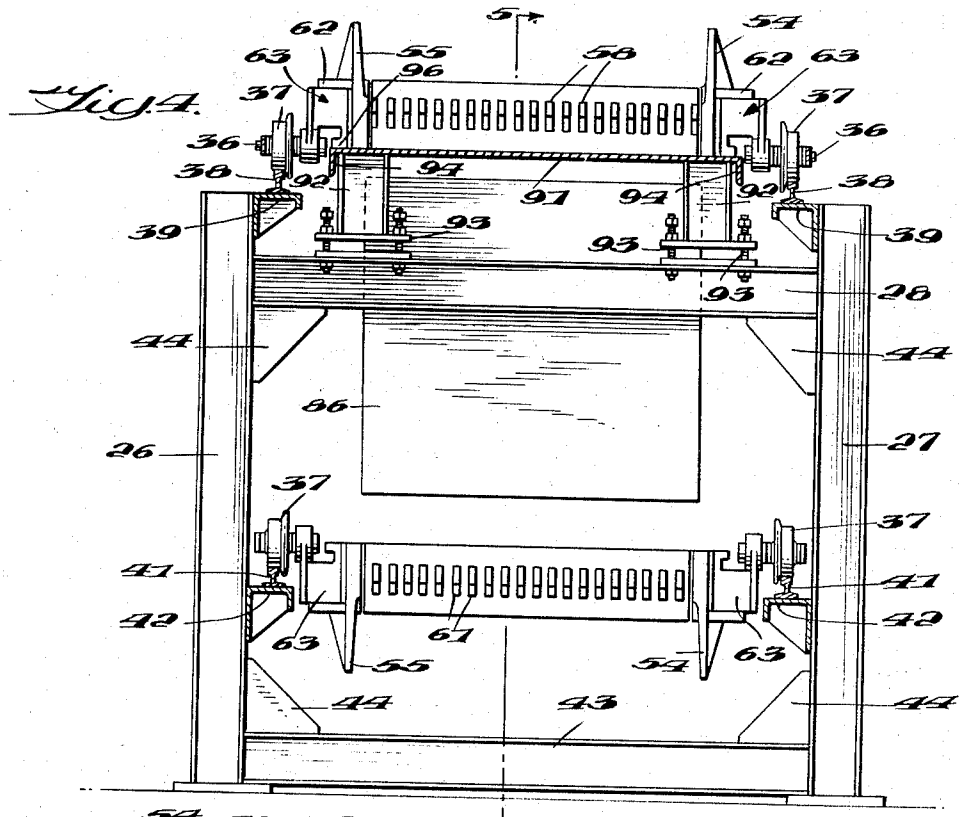


Fig. 4.

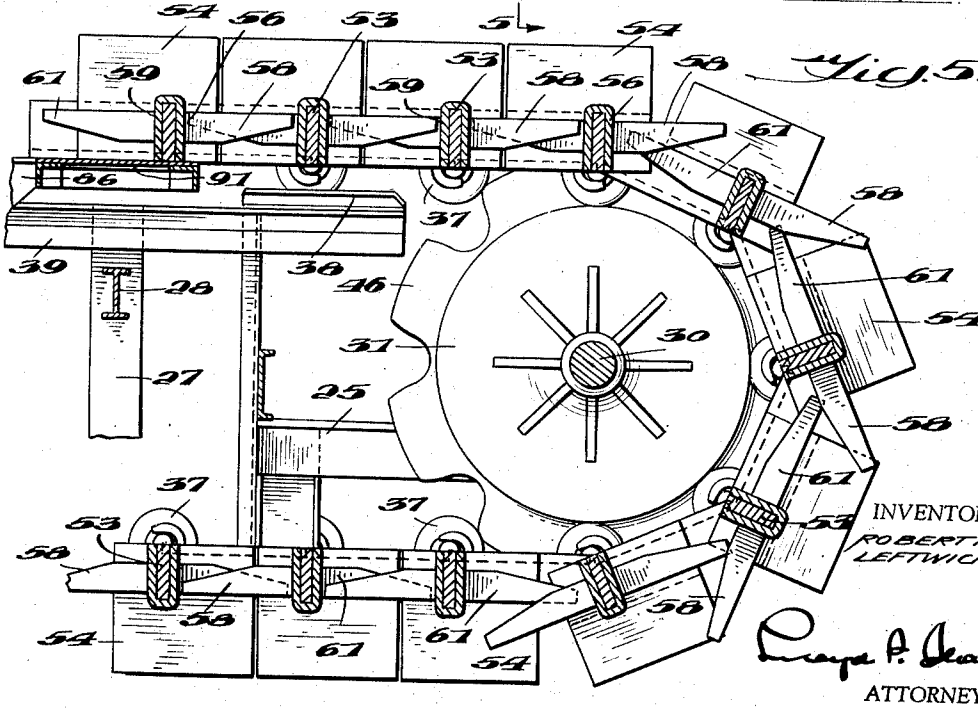


Fig. 5.

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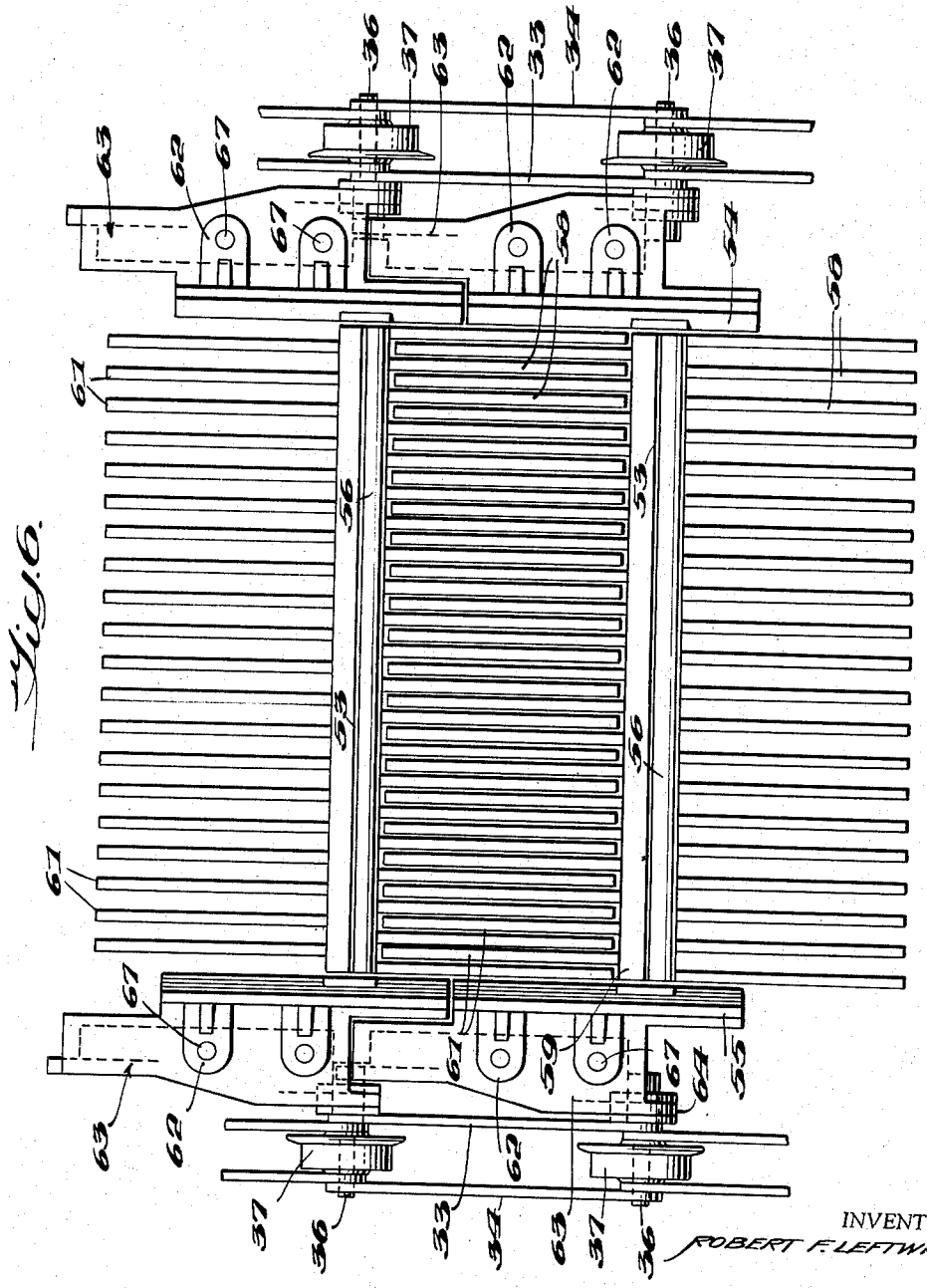


Fig. 6.

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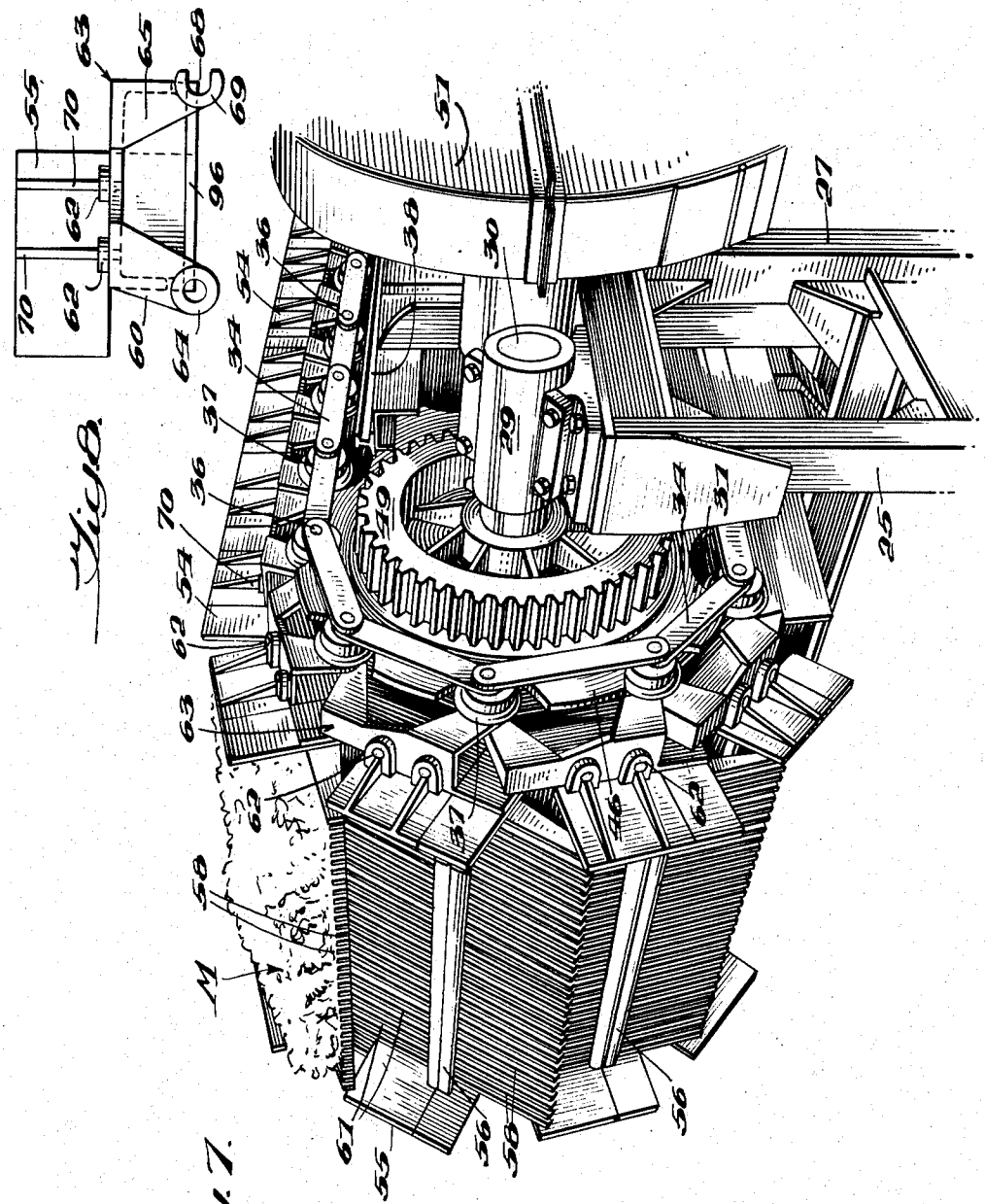


Fig. 8.

Fig. 7.

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2,901,236

SINTERING APPARATUS

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Application July 27, 1956, Serial No. 600,552

2 Claims. (Cl. 266—21)

The present invention relates to apparatus for sintering granular materials in a continuous operation to provide a fused cake or clinker which may be readily broken to provide an aggregate suitable for mixing with Portland cement to form lightweight concrete and the invention pertains to improvements over the apparatus disclosed in my Patent 2,646,980, dated July 28, 1953.

An object of the invention is to provide apparatus for supporting and moving a mixture of granular material and powdered solid fuel through an ignition zone and thereafter moving a layer of material over a plurality of windboxes maintained at sub-atmospheric pressures to develop downward movement of combustion supporting air through the layer and to provide a grate structure for supporting the materials being sintered and to provide for the discharge of cakes or clinkers of the fused material at the discharge end of the mechanism.

A more specific object of the invention is to provide improvements in the articulation of the elements which provide the grate structure so as to more efficiently discharge the sintering material as the fingers of the grates are moved into angular relationship with respect to each other at the discharge end of the conveyor to facilitate cleansing of the grate structure on which the granular material is supported during the sintering operation.

Another object of the invention is to connect the chains for moving the conveyor with the elements which form the grate structure in such a manner that the fingers thereof slope downwardly and forwardly with respect to the fingers of the next succeeding grate element as the conveyor turns downwardly over the sprocket wheels at the discharge end of the mechanism whereby the layer of sintered material is broken and the chucks are free to slide clear of the grate structure.

A still further object of the invention is to provide an improved windbox structure including a plurality of separate sources of suction so as to provide different sub-atmospheric pressures at different stages or zones along the upper course of the conveyor to facilitate ignition of the charge to be sintered and the progressive sintering or fusion of the material.

Another object of the invention is to provide improvements in the structure of the elements forming the conveyor and the grate structure to facilitate articulation thereof around the sprockets of the conveying mechanism and at the same time to provide an arrangement for more effectively sealing the respective grate units with respect to the suction boxes.

Other objects and features of the invention will be appreciated and become apparent to those skilled in the art as the present disclosure proceeds and upon consideration of the accompanying drawings and the following detailed description wherein an exemplary embodiment of the invention is disclosed.

In the drawings:

Fig. 1 is a side elevational view of apparatus embodying the invention.

Fig. 2 is a fragmentary plan view showing the manner in which the separate exhaust fans are connected with the respective windboxes.

Fig. 3 is an enlarged side elevational view of the discharge end portion of the conveyor assembly.

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is a fragmentary plan view of the grate structure showing the cooperative relationship of adjacent units.

Fig. 7 is a perspective view of the discharge end of the conveyor mechanism of the sintering apparatus.

Fig. 8 is a side elevation of one unit of the grate structure with an illustration of the grate fingers omitted.

The invention pertains to apparatus for the continuous sintering of granular materials to form an aggregate for mixing with cement to form lightweight concrete. The granular material may be composed of clay or shale mixed with powdered fuels, such as ground coal or coke breeze, and a small percentage of return fines from a previous sintering operation and having water mixed therewith to provide the desired consistency. Such mixed materials or others form the charge to be sintered and is distributed on the upper course of a travelling conveyor in an unpackaged or flocked layer of suitable thickness. The conveyor includes a number of units which provide an articulated grate structure arranged to travel under an ignition hood where a high temperature is maintained in the presence of the top surface to the layer carried by the conveyor. Air for combustion is drawn downwardly through the material to be sintered by a fan which produces a sub-atmospheric pressure under the grate structure causing the granular material to be ignited and burn. As the conveyor moves towards the discharge end the ignited charge passes out from under the ignition hood and continues to burn downwardly and air for supporting such combustion is caused to move downwardly through the layer by sub-atmospheric pressures provided by additional windboxes positioned under the upper course of the conveyor. Individual fans are connected to the respective windboxes through conduits and control valves to provide for flexibility of operation and adjustment of the downward draft provided at zones along the upper course of movement of the conveyor. The granular material is thus progressively fused towards the bottom and as the depth of burning is increased the more resistant the cake becomes to the passage of air for combustion. The individual windboxes and fans provide means for supplying the required air at proper locations which brings about a reduction in the energy required for creating the necessary draft in developing incipient fusion during the course of the movement of the charge from the ignition hood to the discharge end of the conveyor. The articulated grate structure is so constructed that as the conveyor turns downwardly about the sprocket wheels at the discharge end the fingers of the grate structure slope downwardly and each unit is devoid of a partition and overlapping side walls so that cakes or clinkers of the sintering material are broken from the layer and are free to slide from the grate units to facilitate cleansing of the grate structure for return movement to the loading end of the apparatus.

The general organization of the conveyor is shown in Fig. 1. It may be of any suitable length and is desirably supported so that the upper course **10** and the return path **11** of the conveyor are in substantially horizontal planes. The mixed material to be sintered is applied to the upper course **10** of the conveyor in the zone indicated at **12** where the mixed granular material is loaded into the grate structure which moves in the di-

rection of the arrow 14. An ignition hood 16 is supported over the upper course of the conveyor under which the material to be treated is ignited by any suitable means such as a high temperature flame (not shown). Ignition of the powdered fuel mixed with the granular material and the initial burning thereof is facilitated by means of a windbox 17 positioned under the upper course of movement of the endless grate structure and located under the ignition hood 16.

The rate of movement of the conveyor in the direction of the arrow 14 may be varied by adjusting the speed of the driving sprockets 31 so that the granular material will be completely sintered by the time it arrives at the discharge end 18 of the conveyor. Air for supporting downward burning of the charge as it is advanced by the conveyor is provided by additional windboxes supported at spaced intervals along the length of and below the upward course 10 of the conveyor.

The structural characteristics of the conveyor and the grate structure are shown in greater detail in Figs. 3 to 8, and it will be noted that spaced columns 26 and 27 are provided at opposite sides of the conveyor which extend vertically from a suitable foundation and are joined adjacent their upper ends by horizontal beams 28. As many of such columns and beams as are necessary are employed to provide a rigid framework on which the windboxes and the conveyor are supported. Additional framework structures 25 are provided adjacent the ends of the conveyor which support bearings 29 (one shown Fig. 7) for a shaft 30 on which the driving sprocket wheels 31 at the discharge end of the conveyor are mounted. The framework 25 at loading end of the conveyor supports sprocket wheels 32 for rotation.

A pair of chains are trained about the sprocket wheels at opposite ends of the conveyor mechanism. Each chain comprises a plurality of links 33 and 34 which are pivotally connected to each other by means of stub shafts 36. Each stub shaft carries a flanged railway type wheel 37. These wheels are supported for rolling movement on railway type rails 38 along the upper course of movement of the conveyor. The tracks 38 are supported by longitudinally extending bars 39 welded or otherwise attached to inner faces of the posts 26 and 27. The upper course of movement of the conveyor is desirably in a single plane and the track rails 38 terminate adjacent the periphery of the sprocket wheels 31 at the discharge end of the conveyor as shown in Figs. 3 and 5. The conveyor during its return movement from the discharge end and throughout the lower course of movement is supported by the flanged wheels 37 which then ride on horizontally disposed railway type rails 41 (Fig. 4). The rails 41 may be supported on longitudinally extending members 42 attached to inner faces of the posts 26 and 27. The framework for supporting the conveyor may be further reinforced by transversely extending members 43. Gusset brackets 44 may also be provided between the posts and the transverse members 28 and 43.

Two sprocket wheels 31 are provided at the discharge end of the conveyor and each sprocket wheel is provided with teeth 46 having notches therebetween for receiving the flanged wheels 37. The sprocket teeth 46 extend between the links 33 and 34 of the chains and the structural characteristics thereof will be appreciated from a consideration of Figs. 3 and 7. The sprocket wheels 31 are driven by the shaft 30 which is journalled in the bearings 29 to move the conveyor in the direction of the arrow 14 (Fig. 1). A suitable drive may be provided such as a gear wheel 49 keyed to the shaft 30 and driven by additional gears which are in part encased in a housing 51. Any suitable prime mover may be provided but it is desirably of such a type that the rate of movement of the conveyor may be varied. The sprocket wheels 32 at the loading end of the conveyor may be of similar construction and the two chains formed by the links 33 and 34 are trained about the sprocket wheels 32 which serve to support this end of the conveyor.

Two units which form a portion of the grate structure are shown in Fig. 6. Each unit comprises a transversely extending bar 53 which is connected at its ends to side walls 54 and 55 for one unit. An elongated member 56 L-shaped in cross section extends from one side wall to the other and is secured to the bar 53 in any suitable manner such as by welding. A plurality of fingers 58 extend laterally from the member 56 in spaced relationship as shown in Fig. 6. These fingers constitute some of the elements of the grate structure. A similar elongated member 59 of L-shape in cross section fits about the tend laterally from the member 56 in spaced relationship remainder of the transverse bar 53 and extends between the side walls 54 and 55. A plurality of fingers 61 extend laterally from the member 59 in spaced relationship. The fingers 61 extend into the spaces between the fingers 58 of the next adjacent unit when the units are supported on the rails 38 or 41. The fingers 58 extend into spaces provided between the fingers 61. It will be observed from a consideration of Fig. 5 that the lower edges of the transverse bars 53 are flush with the lower edges of the members 56 and 59.

The side walls of the adjacent grate units do not overlap and it will be noted from a consideration of Fig. 3 that the end of one side wall 55 is adjacent an end of an adjacent side wall 55 with slight clearance therebetween. A similar structural arrangement is provided by the side walls 54 as shown in Fig. 5. The members 56 and 59 do not extend materially above the upper surfaces of the aligned grate fingers as illustrated in Fig. 5 so that the material undergoing treatment will be fused over the bars 53. After the flanged wheels 37 leave the supporting tracks 38 the conveyor and grate structure is supported by the sprocket wheels 31 as shown in Figs. 5 and 7. As each unit turns about the sprockets 31 the fingers 58 of one unit slopes downwardly with respect to the fingers of the next succeeding grate unit and such angular displacement of the fingers of one unit breaks the layer of sintered material M (Fig. 7). Accordingly parts of the sintered material are broken away from the mass supported on the horizontal portion of the grate structure and these cakes or clinkers are free to slide downwardly on the inclined fingers of the grate structure so as to be removed from the presence of the conveyor.

The side walls 54 and 55 which are attached to the transverse bars 53 are provided with laterally extending lugs 62. The two lugs 62 of each side wall overlie a member 63 and the lugs are attached thereto by means of flat head rivets or bolts 67 as shown in Fig. 6. Each member 63 is provided with two legs 60 and 65 as best shown in Fig. 8. One of the stub shafts 36 at each side of one unit are secured in bosses 64 carried by the lower end of the leg 60. The other leg 65 is provided with a notch 68 for partly embracing an adjacent forwardly disposed stub shaft 36. The leg 65 is displaced laterally inward of the leg 60 so that open bosses 69 may fit about the next forwardly disposed stub shaft 36. The open portion 68 permits expansion and contraction of the grate structure and the chain links 33 and 34 in response to the heat developed during the sintering operation. A portion of the leg 60 overlaps the leg 65 of an adjacent grate unit to aid in the sealing of the conveyor structure. The weight of the units of the grate structure supported by the legs 60 and 65 is transferred by the wheels 37 onto the track rails. The length of the links 33 and 34 and the chains are such as to prevent the disengagement of the open bosses 69 from the stub shafts 36. The side walls 54 and 55 of each unit are reinforced in the vicinity of the lugs 62 by means of gusset webs 70.

A plurality of additional windboxes are mounted under the upper course of movement 10 of the conveyor. One

of this group of windboxes is shown at **71** (Fig. 1) having a conduit **72** extending therefrom for connection with a fan unit **73**. Another windbox **74** has a conduit **76** extending therefrom. A fan unit **77** is connected to the conduit **76**. A further windbox **78** mounted under the upper course of the conveyor and a conduit **79** extends therefrom and is connected to a fan unit **81**. Another windbox **82** is mounted under the upper course of the conveyor and is connected to a fan unit **84** by a conduit **83**. A further windbox **86** is provided near the discharge end of the conveyor having a conduit **87** extending therefrom connected to a fan unit **88**.

Each of the windboxes is provided with transversely extending plates **91** at the ends thereof which are supported by brackets **92** on the transverse beams **28** by means of adjustment screws **93** (Fig. 4). The upper side edges of each windowbox is provided with a longitudinally extending bar **94** which imparts rigidity to the side edges of the windbox and has an upper surface in the same plane as the transverse sealing plates **91**. The lower edges of the bars **53** and the lower edges of the members **56** and **59** as shown in Fig. 5 lie in sealed engagement with the transverse plates **91** of all of the windboxes. The members **63** are provided with outwardly extending flanges **96** which maintain a seal of the grate structure with the longitudinally extending bars **94** of the windboxes.

The provision of a plurality of windboxes under the upper course of the conveyor connected to individual fans provides the advantage of providing the required down draft at the proper location. As the grate structure of the sintering machine travels towards the discharge end **18** the burning layer passes out from under the ignition hood **16** and beyond the presence of the windbox **17** which serves to promote kindling and initial burning of the powdered fuel. The material to be sintered continues to burn downwardly as air for combustion is supplied by the additional windboxes and their individual fans. These provide flexibility of operation permitting adjustment in the speed or a different size of each fan to furnish the proper amount of air at the required static pressure. As the material fuses during burning the deeper the layer is fused the more resistant it becomes to the passage of air for combustion. The arrangement of the individual fans provides the required air at the proper location and provides a reduction in horsepower required for all the fans to approximately one-half that needed for a single fan and a sole windbox having compartments therein.

An advantageous feature of the conveyor mechanism is that the members **63** which support each grate unit are adapted to turn about the aligned axes of the stub shafts **36** when the conveyor breaks over the sprockets **31** at the discharge end of the conveyor. The center of the hinging of each unit coincides with the axis of the aligned stub shafts and is so related with the joints between the side walls of adjacent grate units as to avoid excessive clearance for the corners of the units and at the same time an airtight contact between the moving parts and the windboxes is maintained. Transverse partitions have been eliminated from the grate structure and the hinged units which form the grate are such as to cause the fingers to be angularly displaced with respect to each other to break the sintered layer and at the same time avoid the possibility of any broken portions of the sintered material becoming lodged in the grate structure as the units turn about the discharge sprockets **31**.

While the invention has been shown and described with reference to particular structural features and characteristics it will be apparent that changes may be made in the various elements. Such modifications and others including changes in the overall organization may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. In continuous sintering apparatus of the type including a plurality of units forming an endless grate structure, two axially aligned sprocket wheels at a loading end of the apparatus, two axially aligned sprocket wheels at a discharge end of the apparatus, a chain trained about two of said sprocket wheels at opposite ends of the apparatus, a chain trained about the other sprocket wheels at opposite ends of the apparatus, each chain comprising elongated links of substantially equal lengths, stub shafts pivotally connecting said links to each other, a flanged wheel rotatable on each stub shaft, rigid rails supporting said flanged wheels for rolling movement in a substantially horizontal upper course of movement from the first to the second sprocket wheels, means on the sprocket wheels engaging said chains maintaining the stub shafts at opposite sides of the apparatus in substantial alignment, a plurality of grate units each comprising two supporting members with one member spanning two adjacent stub shafts at one side of the apparatus, two side walls each rectangular shaped in side elevation for each grate unit, the side walls at each side of the apparatus having plane inner surfaces aligned with each other, means rigidly securing an intermediate portion of each side wall to an intermediate portion of one of said supporting members with a major portion of each side wall trailing one set of aligned stub shafts, a bar extending transversely of the apparatus secured to a forward portion of the side walls of each grate unit, spaced forwardly extending fingers and spaced trailing fingers carried by each bar with transversely aligned free ends terminating adjacent the bar of the next adjacent grate unit and with the trailing fingers of one grate unit intermeshing with the forward extending fingers of the next succeeding grate unit, upper surfaces of all of said fingers being in a substantially common horizontal plane and substantially flush with upper edges of said bars while the flanged wheels are supported on said rails, interengaging means on the sprocket wheels and the chains at the discharge end of the apparatus for advancing the elongated links around the second sprocket wheels whereby the fingers of a grate unit are inclined downwardly from said horizontal plane in proceeding forwardly as each unit starts to turn about the second sprocket wheels and the free ends of the trailing fingers do not extend above the plane of the forwardly disposed fingers of the next succeeding grate unit.

2. In continuous sintering apparatus according to claim 1 wherein end edges of the side walls are in parallel abutting relationship while the grate units are supported by said flanged wheels rolling on said rails with trailing ends of said side walls terminating short of the free ends of the trailing fingers.

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