July 28, 1953 R. F. LEFTWICH 2,646,980

SINTERING APPARATUS

Filed Oct. 11, 1948 5 Sheets-Sheet 1

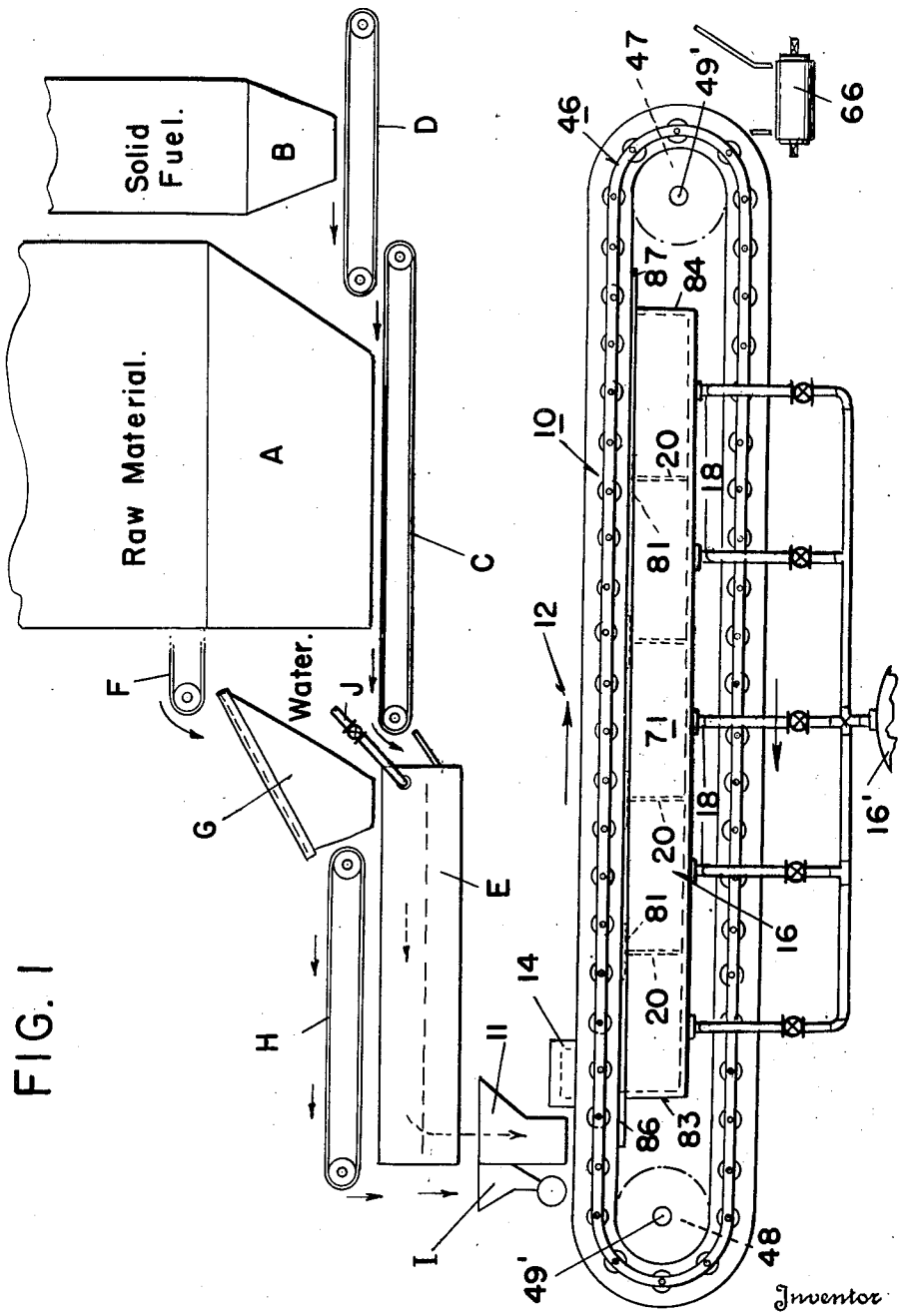


FIG. 1

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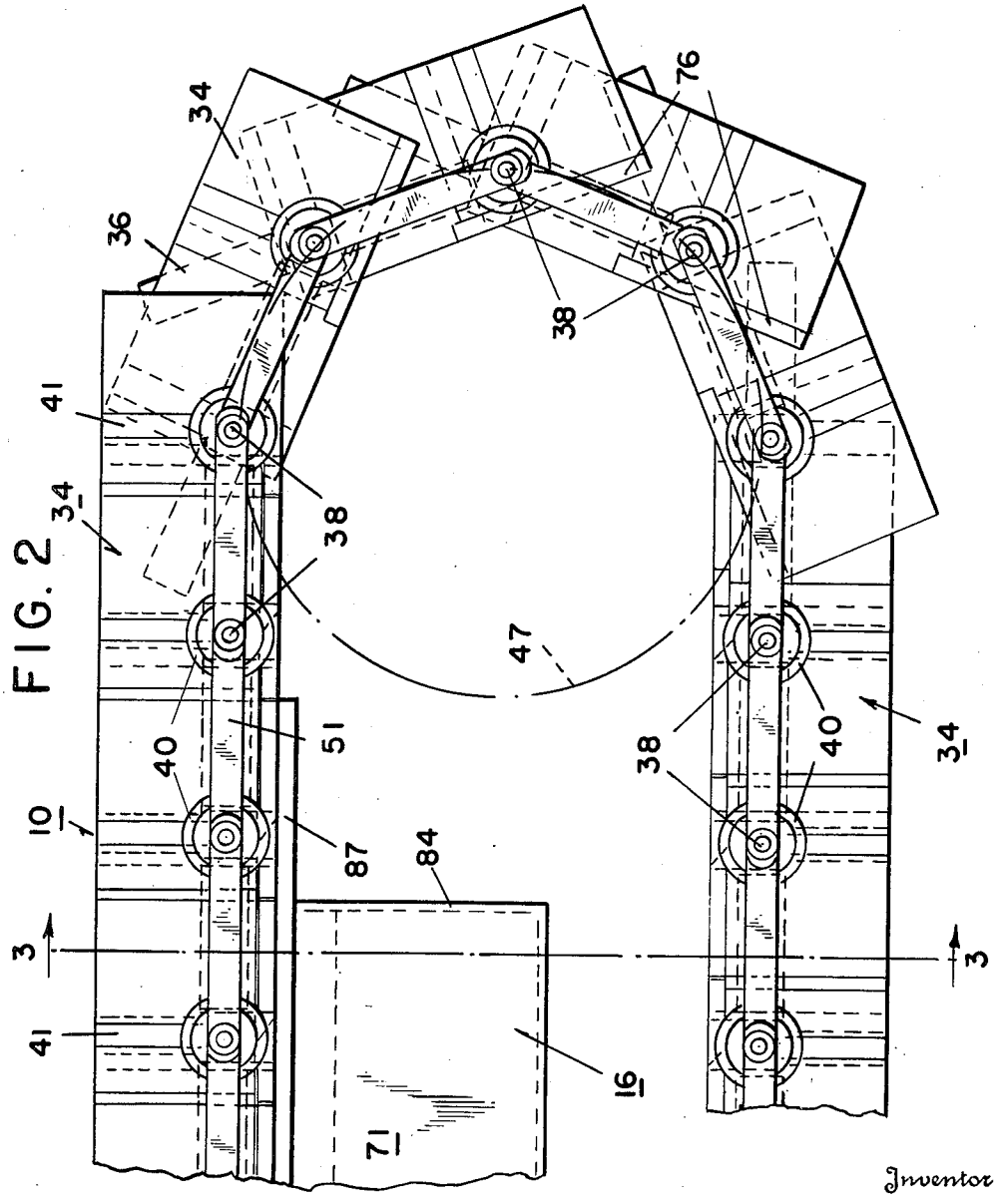


FIG. 2

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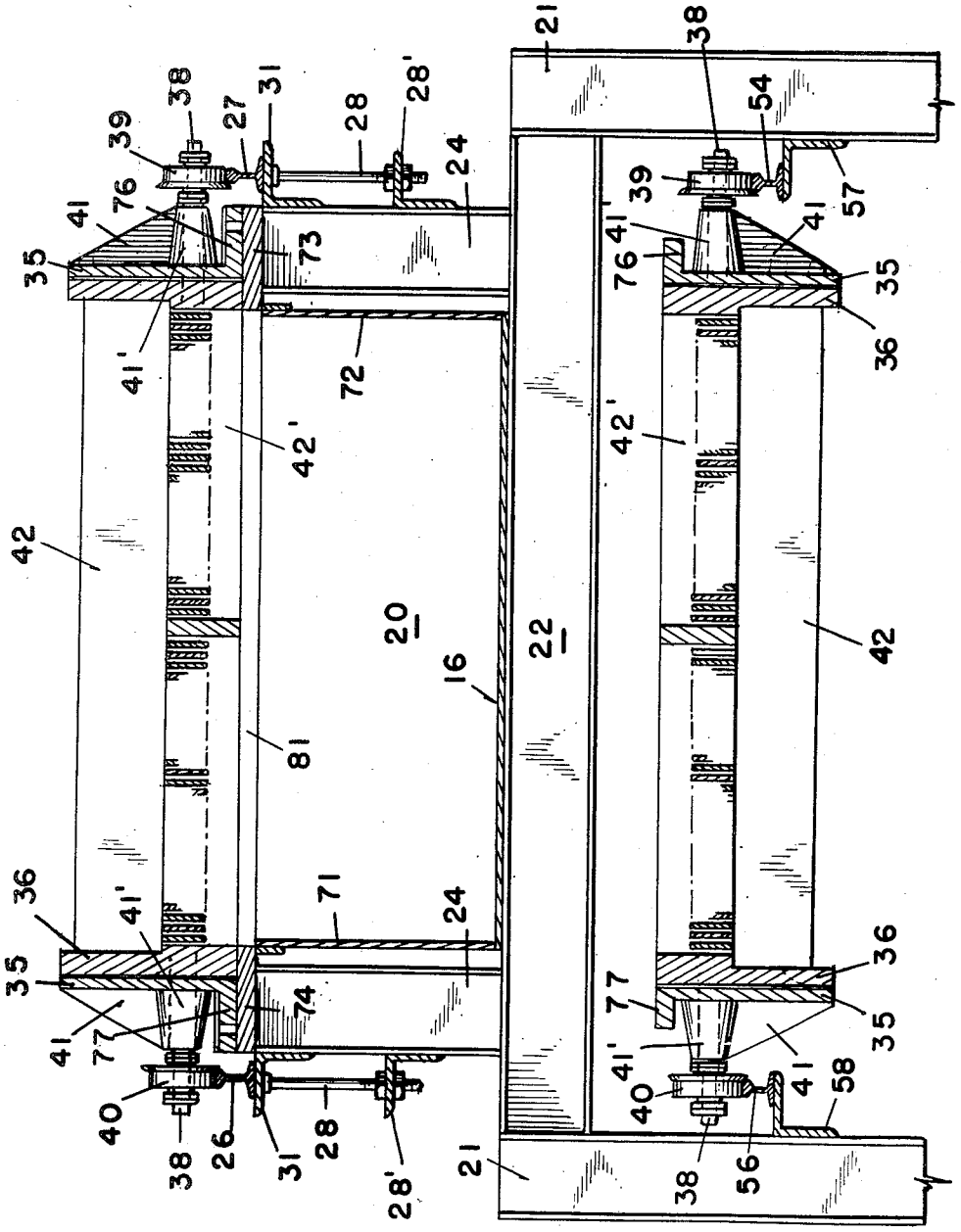


FIG. 3

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SINTERING APPARATUS

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FIG. 4

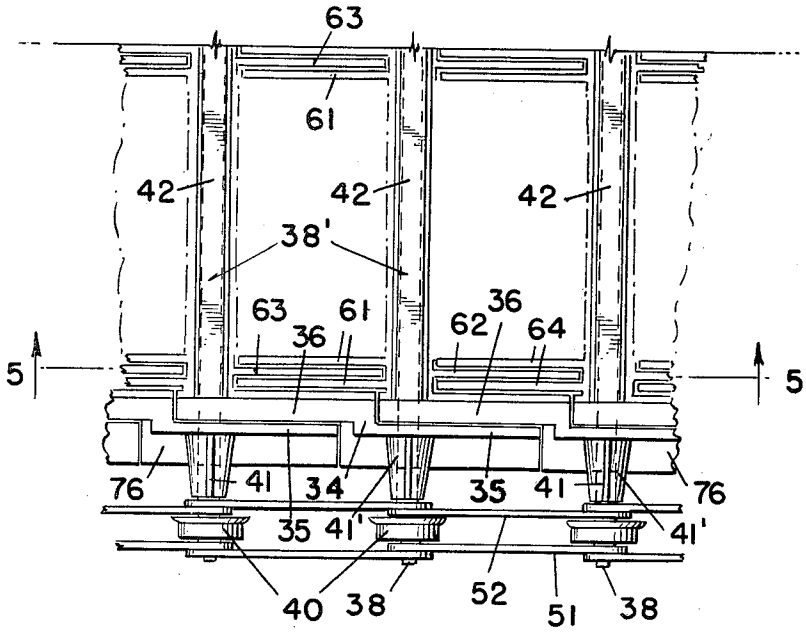


FIG. 5

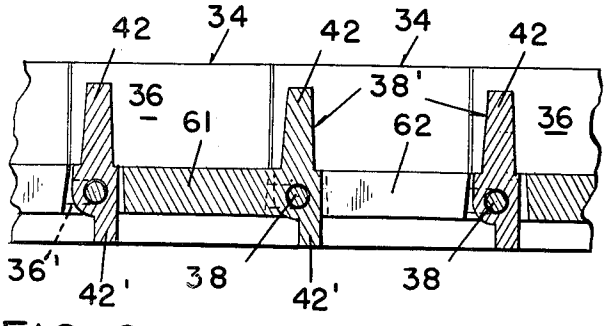
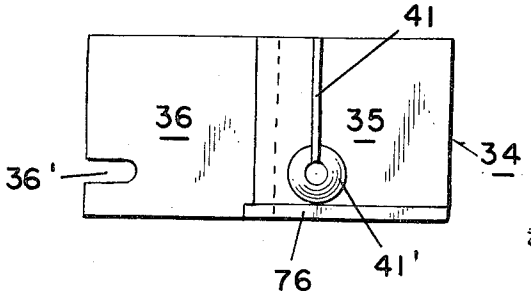


FIG. 6



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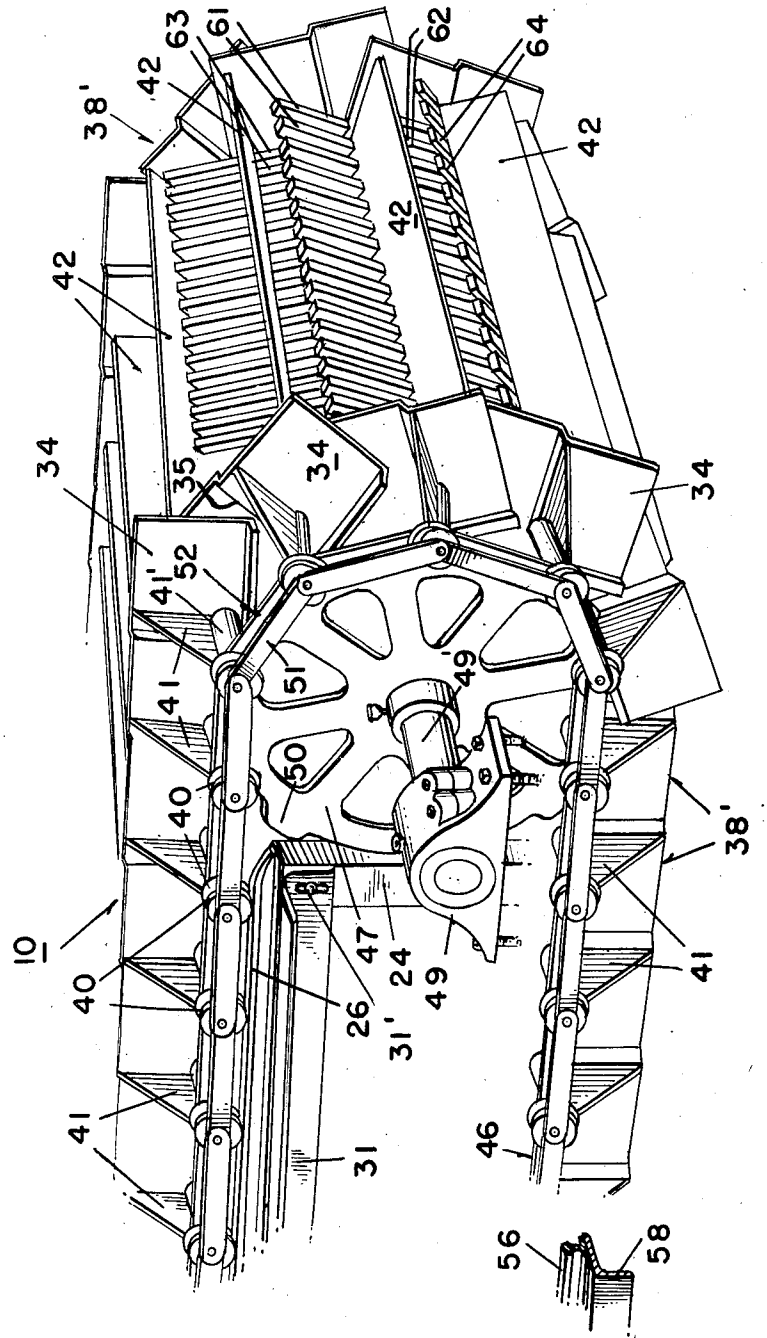
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Filed Oct. 11, 1948 5 Sheets-Sheet 5

FIG. 7



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UNITED STATES PATENT OFFICE

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SINTERING APPARATUS

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Application October 11, 1948, Serial No. 53,807

7 Claims. (Cl. 266—21)

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This invention relates to the preparation of light weight concrete aggregate and more particularly to apparatus for preparing and treating the charging stock. In accordance with the invention a charging stock is prepared by mixing finely divided materials of the class consisting of clay, shale, silicates of calcium, alumina and magnesia, blast furnace slag, flue dust and coal ash clinker, with solid fuel particles and water, before subjecting the charging stock to sintering; that is, to heat sufficient to obtain incipient fusion. The charging stock during heating is transported by an endless conveyor constituting a series of substantially horizontally movable boxes or containers having reticular bottoms so that the charge, after being ignited, may be subjected to combustion-supporting air, passing downward through the charge into a windbox. The air is so regulated as to maintain each batch of the charge at a substantially uniform temperature until the point of incipient fusion has been reached.

In keeping with the invention, the finely crushed clay, shale, or other suitable raw material, with a small amount of crushed coal, lignite or cinders, return fines (screened from a previously sintered charge) and sufficient water to bulk the mixture and obtain satisfactory consistency for sintering, is first prepared, and the fuel is burned as the charge is transported so as to generate heat by internal combustion of the fuel. Each batch of the charge is deposited in one of the pans of the conveyor, after a bedding layer has previously been placed therein. As each pan travels, the freshly deposited charge passes under an ignition hood where a flame is momentarily applied to the top surface, as air is drawn downward through the charge and the reticular bottom of the pan. The ignited charge passes from under the hood and burns continuously downward as the pan travels over a cellular windbox toward the discharge end of the sintering part of the apparatus. Air for combustion is furnished by a suction fan which draws it down through the charge causing the burning to proceed downward until the charge in each pan is fused into a solid cake or clinker. The products of combustion from sintering, pass to the windbox, from which they may be moved by the fan to a stack or the like. The speed of sintering-pan travel is controlled so that the cake is completely sintered before it is discharged from the pans. After sintering, each finished cake is dumped onto an apron conveyor or the like which transports it into a primary crusher

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that reduces it to a maximum size of approximately 4". The crushed material is passed over a return fines screen and the minus ¾" size is used as return fines in the charging stock mixer. The larger particles of the return fines may be used as the bottom layer or bed in each pan of the sintering grate or conveyor. The plus ¾" size is crushed and graded for concrete aggregate.

One of the objects of the present invention is to provide an improved apparatus for the production of a light weight concrete aggregate with greater capacity and lower costs.

Another object is to supply an apparatus for the purpose having a conveyor unit designated to automatically discharge the sintered cake or clinker and clean the reticular grate at each discharge operation.

A further object is to provide a novel conveyor mechanism for supporting and moving the sintered charges first through an ignition zone and afterwards over a windbox divided into compartments maintained at sub-atmospheric pressures.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail in connection with the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a diagrammatic side elevational view of an apparatus exhibiting the invention.

Fig. 2 is an enlarged fragmentary side elevational view of the main conveyor mechanism or travelling grate with some of the parts omitted to more clearly illustrate articulation of the pans.

Fig. 3 is a transverse vertical sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary plan view of a portion of the conveyor pan or grate assembly.

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

Fig. 6 is a side elevation of one of the units of the conveyor pan or grate assembly.

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

Referring first to Fig. 1, A designates a raw material storage bin for granulated clay, shale, fly ash, or any other raw material of the class previously mentioned. B is a bin for the storage of ground solid fuel such as coal, lignite, or coke breeze. C and D are conveyors for carrying and proportioning fuel and raw materials, respective-

ly, to the mixer E. A conveyor F transports return fines, screened out of previously sintered material, to a screen G which separates the oversize bedding from the finer particles which pass through the screen and into the mixer to become part of the sinter charge. The oversized particles (used as a bedding) are transported by conveyor H and discharged into bedding hopper I, from which the oversized particles are fed into the pans of conveyor 10. The ingredients of the main sinter charge, which is composed of solid fuel from bin B, raw material from bin A, and return fines from screen G, are fed into the mixer E where water is added by pipe J to provide the proper consistency for sintering before passing through chute 11 to conveyor 10. The water and return fines serve to bulk the charge and provide porosity, respectively, in order to facilitate the passage of air through the charge when placed on the grate forming the bottoms of the sintering pans. As each sintering pan of conveyor 10 travels in the direction of the arrow 12, a strata of coarse bedding material is uniformly deposited from bedding hopper I on the grate.

The sinter charge is deposited from hopper A in a thicker layer on top of the bedding strata. As the pans travel, the freshly deposited charge passes under the ignition hood 14 where a flame is momentarily applied to its top surface as air is drawn downward through the charge and grate, into windbox 16 by means of exhaust fan 16', connected to the partitioned windbox by valved flues 18. The ignited charge in the pans, passes successively from under the ignition hood 14 and continues to burn downwardly as the grate travels over the windbox, while air for combustion is induced down through the charge into the box by the exhaust fan. Combustion continues to propagate downward, creating sufficient heat to cause fusing of the charge into a solid cake or clinker, as each sintering pan travels toward the discharge end of the conveyor 10. The speed of travel may be controlled so that the charge is burned and completely sintered before the cake or clinker is discharged onto an auxiliary conveyor 66. The finished sinter cake is transported by the latter into a crusher (not shown) which reduces it in size to approximately 4'' maximum. The crushed material passes over a screen (not shown) which deposits the fines below approximately ¾'' in size, on conveyor F which transports them to screen G. The fines pass through said screen G and become part of the new charge while the oversize pieces of the fines pass over the screen and reach the conveyor H which dumps them into hopper I from which they pass into the pans of the conveyor as a bedding strata for the new charge. The particles over ¾'' in size eventually become the light weight concrete aggregate.

With reference to the novel features of the apparatus it will be noted from Fig. 3 that spaced posts 21 at opposite sides of conveyor 10, project upwardly from a suitable foundation (not shown) and are joined at their upper ends by transverse horizontal beams 22. As many posts and beams as are necessary are used, and they form a rigid framework from which pairs of shorter posts 24 project upwardly. Bearings 49 at the ends of the framework support transverse horizontal shafts 49' on which are fixedly mounted pairs of spaced sprocket wheels 47 and 48. The shaft driving the sprocket wheels 47 may be driven by an electric motor (not shown), the speed of which may be regulated by conventional means to control the speed of travel of the conveyor 10.

As best shown in Fig. 7, the teeth 50 of sprocket wheels 47 drive chains 46, at each side of the conveyor, made up of pivotally connected and spaced links 51, 52. The pivotal connections are formed by end portions of horizontal shafts 38 on which flanged wheels 39 and 40 are rotatably mounted. These wheels, on the top flight of the conveyor, travel on horizontal tracks 26 and 27, and on the bottom flight, travel on horizontal tracks 54 and 56. The tracks 54 and 56 merely support the lower flight without load, while the pans of the conveyor are inverted and, therefore, these tracks may be fixed in position. They may be rigidly mounted on horizontal angle irons 57 and 58 fixedly secured to the posts 21. As it is desirable to provide adjusting means between the upper flight of the conveyor and the windbox 16 for air sealing purposes, one way to accomplish this is to mount the tracks 26 and 27 so that they may be adjusted up and down relatively to the top of the windbox 16. For such purpose, tracks 26, 27 may be fixed to horizontal angle irons 31 resting on jack screws 28 supported by angle irons 28'. The angle irons 28' can be rigidly secured to the short posts 24 while the angle irons 31 may be connected to these posts by bolts or screws 31' passing through slots in the angle irons and entering suitable apertures in the posts 24 (see Fig. 7).

Each shaft 38 is pivotally connected to a novel element 38' of the conveyor 10 and said elements or units form the pans with the reticular bottoms. As illustrated in Figs. 3 to 6 inclusive, and as shown in the top flight of the conveyor, each element 38' consists of an intermediate upstanding transverse wall 42 and a depending transverse flange 42'. Each element also has a pair of integral irregular end walls 34 taller than the transverse wall 42 and consisting of an outer vertical part 35 and an inner vertical part 36, and it will be clear from Figs. 3, 4 and 7 that the inner part 36 of each wall overlaps and slidably engages the outer part 35 of the adjacent end wall of the next unit. It will be noted from Fig. 6 that the inner portion 36 of each end wall 34 is provided with a substantially horizontal notch 36' to accommodate the cross shaft 38 of an adjacent unit. Therefore, each pallet or sintering pan is not fixed at both ends, as usual, but has a slotted bearing at the trailing end, so the pan "floats" between adjacent shafts 38 to permit inequalities of pull by the chains 46 as well as compensation for expansion of the conveyor. Consequently, the parts 42 and 34, in effect, provide a series of pans, to receive the bedding layer and a layer of charging stock. The bottoms of these pans are reticular, or formed like a grate, and to this end fingers 61 project horizontally in one direction from the transverse wall 42 while horizontal fingers 62 project in the opposite direction from said wall. Since the fingers 61 are staggered with reference to the fingers 62, it will be evident that the fingers of adjacent units 38' may interengage one another. In explanation, it will be noted in Fig. 4 that spaced fingers 61 receive between them spaced fingers 63 of an adjacent unit, while the oppositely extending fingers 62, receive between them the fingers 64 of another unit. Consequently, as one unit swings about its axle 38 in turning on the sprocket wheels 47, the fingers of one unit disengage themselves or unmesh from

the fingers of adjacent units and act to loosen and eject any clinkers within the pan.

For reinforcing purposes, each end wall **34** is provided with an outwardly extending triangular gusset **41** merging with a sleeve **41'** through which the shaft or axle **38** passes. Each end wall **34** is also provided with a horizontal flange **76, 77** designed to move in close proximity to a planar sealing member **73, 74** at the top of each side **71, 72** of the windbox, as the top flight of the conveyor travels over said box.

It is desirable in a structure of this sort, to prevent any air from entering a pan except through the top thereof, and that is the reason for shortening the height of walls **42** and arranging the inner portion **36** of each end wall **34** in close proximity to the outer portion **35** of the end wall of an adjacent unit, and also, for providing the flanges **76, 77** at the bottom of said walls.

It may also be seen from Fig. 3 that the planar members **73** and **74** form the upper edges of the side walls **71** and **72** of the compartments of the windbox **16** and the transverse partitions **20** of the windbox are provided at their upper edges with transversse horizontal straps **81** which cooperate with the depending flanges **42'** of the units of the conveyor to prevent air from entering the compartments of the windbox except through the tops of the conveyor pans. Should leakage occur, the valves in the pipes **18** may be adjusted so that more air can be drawn through a compartment of the windbox where there is leakage than where no leakage is present.

I also preferably provide the ends **83** and **84** of the windbox (Fig. 1) with horizontal flanges **86** and **87** to cooperate with the flanges **42'** of the pans to prevent leakage of air.

In the operation of the apparatus, it will be understood that a bedding layer is deposited in each pan of the conveyor **10** as the top flight thereof leaves the sprocket wheels **48**. After such layer is deposited, a second layer of suitable thickness and constituting the charging stock, is deposited on the bedding layer through hopper **11**. Then, as the pan travels beneath the hood **14** the fuel in the charging stock will be ignited while air is drawn downwardly through the pan into the first compartment of the windbox **16**. Then, as the pan travels over the windbox and past the several compartments thereof, more air will be drawn downwardly so that the fuel will burn until the charge is sintered. When sintering is completed, the upper flight of the conveyor will reach the discharge end thereof and as the pan units travel about the sprocket wheels **47**, the end walls **34** of adjacent units will be displaced with reference to one another, and at the same time, the fingers **61** (**64**) of one unit will be displaced with reference to the fingers **63** (**62**) of adjacent units, so as to loosen the clinkered cake and cause it to fall out of the pan and onto the conveyor **66**, as the pans travel from the upper flight to the lower flight of the conveyor **10**.

As heretofore mentioned, the cake deposited on **66** will be subsequently crushed so as to obtain three grades of materials. First, the fines, which are reintroduced into the charging stock; second, the intermediates, to be used as bedding and which are fed into the bottom portion of the pans through the hopper I, and third, the oversize, which is crushed and graded for concrete aggregate.

From the foregoing it is believed that the novel features of the apparatus may be clearly understood, and I am aware that changes may be made in the organization described, and in the details of the apparatus without departing from the spirit of the invention as expressed in the claims.

What I claim is:

1. In sintering apparatus, an endless conveyor comprising a pair of opposed chains, pairs of sprocket wheels engaging said chains, shafts connecting the chains and each carrying a pair of wheels, a plurality of sintering pans formed by units each pivotally mounted on one of said shafts, a pair of rigid rails arranged in spaced relation and supporting the last mentioned wheels, each pan including a transverse partition wall and sets of oppositely extending fingers, the fingers of each set meshing with the fingers of the other set of an adjacent unit, each unit having end walls including inner and outer portions, the inner portions of the end walls overlapping the outer portions of the end walls of adjacent units, and the inner portions of the end walls having notches therein for receiving one of said shafts.

2. In a sintering apparatus, pairs of sprocket wheels, opposed chains mounted on the sprocket wheels and driven by certain of the wheels, transverse shafts joining said chains, rail-engaging wheels mounted on the shafts within the chains, rails for supporting said last mentioned wheels as they roll along the rails, sintering pans comprising units each pivotally mounted on one of said shafts, each unit comprising end walls overlapping end walls of an adjacent unit, a transverse partition wall joining the end walls of each unit in radial alignment with the axis of the associated shaft, oppositely extending fingers projecting from the transverse partition of each unit and meshing with the fingers of adjacent units, said chains and sprocket wheels being so positioned that each unit in travelling about one pair of sprocket wheels will be displaced relatively to adjacent units whereby the fingers will unmesh and hump between the partitions to eject material from the pans.

3. In sintering apparatus, a pair of rails, a shaft spanning said rails, a railway type wheel mounted at each end of the shaft rollable on said tracks, a partition arranged transversely of the rails and arranged radially of said shaft, grate fingers extending from the partition, additional grate fingers extending in an opposite direction from said partition, side walls carried by the ends of said partition, and one portion of each side wall being laterally offset with respect to the other portion.

4. In sintering apparatus, a shaft, a load supporting wheel on each end of the shaft, a partition in alignment with said shaft, end wall members carried by and projecting from each side of the partition, a plurality of spaced fingers projecting from said partition, a second shaft, a load supporting wheel on each end of the second shaft, a second partition in alignment with said second shaft, end wall members carried by the second partition overlapping the first end wall members, a plurality of spaced fingers projecting from the second partition into spaces between the first fingers, a link pivotally connected to the first shaft and pivotally connected to the second shaft, a second link pivotally connected to the other end of the first shaft and pivotally connected to the second shaft, and the end wall members carried by one partition having notches therein to receive the other shaft.

5. In continuous sintering apparatus, discharge

end sprockets, chains formed of links pivoted to each other trained about said sprockets, load supporting wheels carried by said chains at the pivot points of said links, rails supporting said wheels in a generally horizontal plane, a partition arranged transversely of the chains mounted to turn about the axis of opposite wheels, end wall members carried by and projecting from said partition, a plurality of spaced fingers projecting from said partition adjacent a lower portion thereof and approximately at right angles thereto, a second partition arranged transversely of the chains spaced from the first partition and mounted to turn about the axis of another pair of said wheels, end wall members carried by and projecting from the second partition overlapping the end wall members carried by the first partition when the wheels are supported on said rails, a plurality of spaced fingers projecting from a lower portion of the second partition approximately at right angles thereto into spaces between the first fingers and lying in a generally common plane therewith when the wheels are supported on said rails, said rails terminating short of the sprockets so that the transverse partitions may swing as the chains pass around the sprockets to displace the fingers from said common plane.

6. In sintering apparatus, spaced sprockets, chains formed of links trained about said sprockets, shafts arranged transversely of the chains pivotally connecting said links, load supporting wheels carried by said shafts, rails supporting said wheels, a partition arranged transversely of the chains mounted to turn about the axis of one shaft, end wall members carried by and projecting from said partition, a plurality of spaced fingers projecting from said partition adjacent a lower portion thereof, a second partition arranged transversely of the chains and spaced from the first partition and mounted to turn about the axis of another shaft, end wall members projecting from the second partition and overlapping end wall members carried by the first partition, a plurality of spaced fingers projecting from the second partition into spaces between the first fingers and lying in a substantially common horizontal plane therewith when the wheels are supported on said rails, said rails terminating short of the sprocket wheels whereby one group of fingers assume an angle with respect to the other group of fingers as wheels move around the sprockets.

7. In sintering apparatus, a pair of substantially parallel horizontal rails, a wind box including side walls and end walls mounted between the rails, transverse barriers connecting said side walls dividing the wind box into a plurality of compartments, a valved pipe connected to each compartment, a suction fan connected to said pipes for exhausting gases from said compartments, a plurality of pans each having a partition arranged transversely of the rails, a wheel mounted at the end of each partition supporting the pans for rolling movement on said rails, chains connected to the wheels, sprockets beyond ends of the rails for moving the pans therealong, fingers extending from one partition interengaging fingers extending from another partition to form a grate for the support of material undergoing treatment in the pans, straps carried by upper portions of said barriers cooperating with the lower edges of said partitions to form a seal between the top of each barrier and each partition, outwardly extending flanges at the upper portion of the side walls of the wind box, side walls carried by each partition having laterally extending flanges for engaging the first flanges to seal sides of the wind box.

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