G. D. HARRIS.

CONVEYER DRYING APPARATUS.

APPLICATION FILED APR. 20, 1918. RENEWED FEB. 2, 1920.

1,405,781. Patented Feb. 7, 1922.

2 SHEETS—SHEET 1.

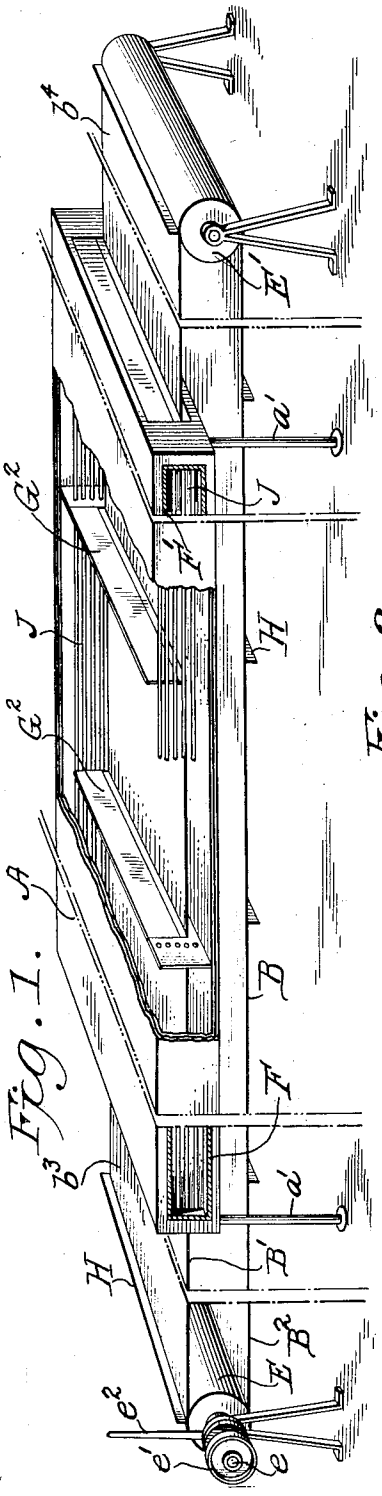


Fig. 1.

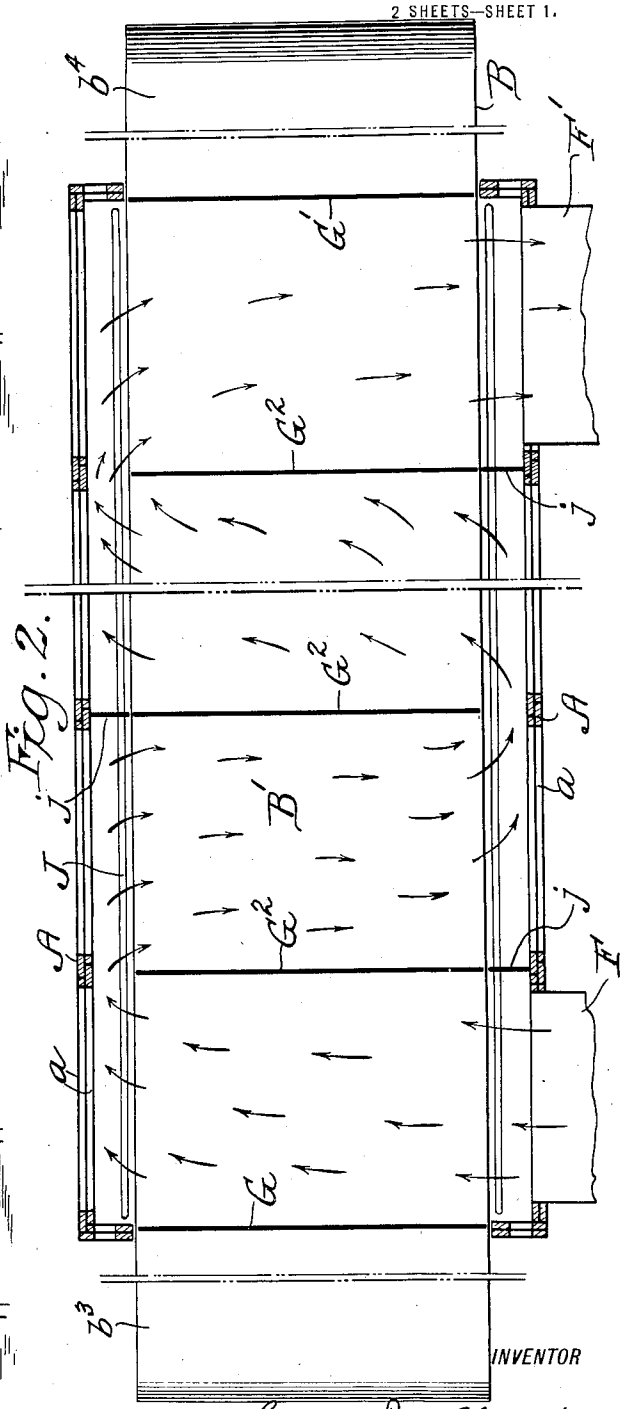


Fig. 2.

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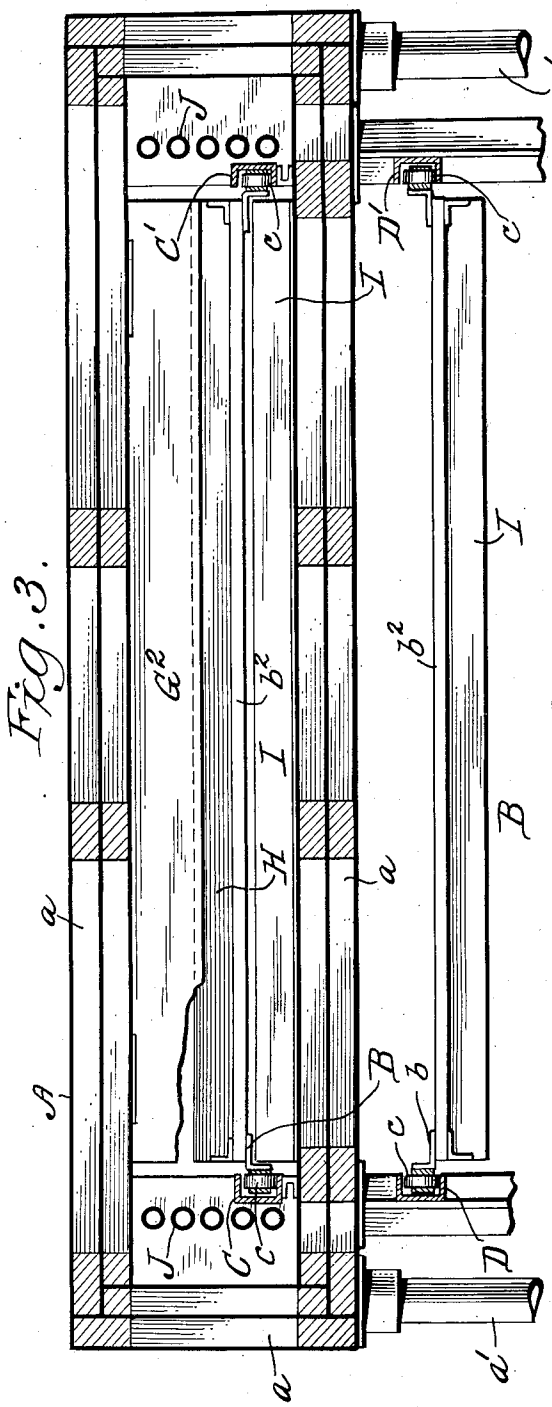


Fig. 3.

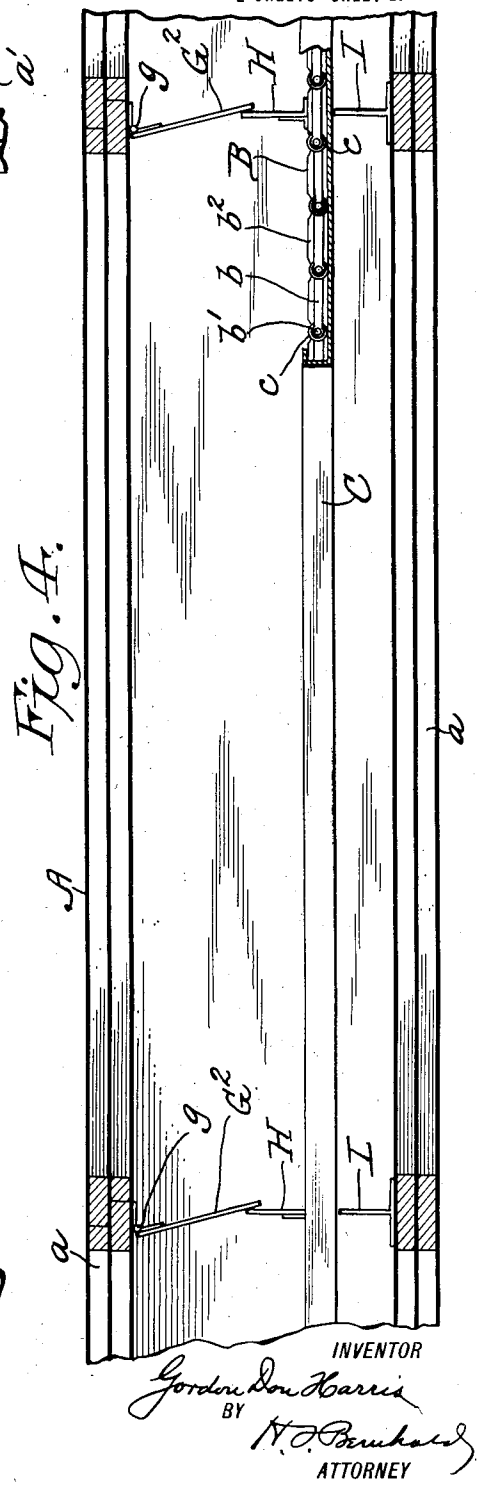


Fig. 4.

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GORDON DON HARRIS, OF FREEPORT, NEW YORK, ASSIGNOR TO NATIONAL EVAPORATOR CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEVADA.

CONVEYER DRYING APPARATUS.

1,405,781. Specification of Letters Patent. Patented Feb. 7, 1922.

Application filed April 20, 1918, Serial No. 229,803. Renewed February 2, 1920. Serial No. 355,701.

To all whom it may concern:

Be it known that I, GORDON DON HARRIS, a citizen of the United States, residing at Freeport, county of Nassau, and State of New York, have invented a certain new and useful Conveyer Drying Apparatus, of which the following is a specification.

This invention is a drying apparatus wherein a conveyer is utilized for moving the material within a treatment chamber for the purpose of subjecting said material to the action of a gaseous drying agent in accordance with certain basic inventions in the drying art made the subjects matter of prior applications for patents Serial Nos. 60,889 and 60,890.

The apparatus of this invention is useful, more particularly, in the treatment of such materials as can be readily handled by an endless conveyer, the latter being adapted to be loaded with the material at one end portion thereof and to be unloaded at the opposite end portion, whereas that part of the conveyer intermediate said end portions and loaded with the material to be treated is movable within a drying chamber in a manner to expose or subject said material to the action of the drying agent, for which purpose it is preferred to impart intermittent movement to said endless conveyer, whereby there results periods of rest or dwell during which the operations of loading and unloading the conveyer are carried on, and simultaneously therewith the drying agent circulates into contact with the material supported by said conveyer within the drying chamber. The conveyer being operated intermittently, it follows that the material loaded thereon is moved successively from one compartment to another throughout the length of the drying chamber, and thus the period that said material is exposed to treatment is prolonged to a substantial extent.

According to this invention, the conveyer carries the material through the chamber in the direction of the length thereof, but provision is made for circulating the drying agent across the chamber, in a direction transversely to the length of said chamber, said drying agent flowing back and forth across the chamber and successively through the compartments thereof, whereby said drying agent is brought into contact repeatedly with the materials contained within the several compartments.

The drying agent, usually air, is heated preliminarily to a desired temperature, but as it circulates into successive contacts with the material and thereby exchanges its heat for moisture, said agent has a tendency to become decreased in temperature. In my invention, however, any decrease in temperature is overcome or precluded by boosting the drying agent in the intervals between its contacts with the moist material, whereby the drying agent is heated repeatedly during its circulation, as a result of which treatment the efficiency of the drying agent is unimpaired; in fact, the drying agent flowing out of the apparatus is at the same temperature as, or even reheated to a higher temperature than, when initially admitted to the chamber, notwithstanding said agent carries moisture almost to the point of saturation, whereby the drying agent is conditioned so as to act efficiently as a carrier for heat, so that the batch of material in the last compartment of the drying chamber is treated as efficiently as the material in the first compartment, and in the intermediate compartments, of said chamber.

The loaded conveyer being impelled intermittently and the drying agent being circulated back and forth across said conveyer transversely to the line of travel thereof, it becomes important in my apparatus to make provision for precluding the escape of the heated drying agent and for the passage through the successive compartments of the loads in transit upon the movable conveyer. To these ends, the interior of the drying chamber is divided into compartments by the employment of movable walls, the same being preferably hung from the top of the chamber so as to depend into close proximity to the conveyer. Attached to the conveyer at intervals corresponding to the spaces between the hinged walls or partitions are baffles or flights which travel with the conveyer and are adapted, when said conveyer is at rest, to register and to contact with the hinged walls or partitions, said baffles or flights on the movable conveyer cooperating with the hinged walls in forming the barriers against the escape of the drying agent and in directing the line of flow

of said agent across the conveyer and said hinged walls or partitions being yieldable to the movement of the baffles or flights when the conveyer is in motion.

Other features and advantages of the invention will appear from the following description taken in connection with the drawings, wherein—

Fig. 1 is a perspective view with parts broken away to illustrate the interior of the drying apparatus.

Fig. 2 is a horizontal sectional plan view through the drying chamber, the arrows illustrating the direction of flow of the drying medium crosswise to the line of travel of the endless conveyer.

Fig. 3 is a vertical transverse section through the drying chamber and the conveyer, illustrating the parts on an enlarged scale.

Fig. 4 is a vertical longitudinal section through a part of the drying chamber and the conveyer, certain parts being broken away to illustrate said conveyer and the baffles on said conveyer being shown in contact with the hinged partitions in order to produce one complete compartment and two partial compartments of the drying chamber.

A designates a drying chamber, and B an endless conveyer adapted for movement within said chamber in order to carry material into, through and out of the chamber. As shown, chamber A is comparatively shallow in depth, but the length and width of the chamber is within a desired capacity of the conveyer to be used, hence the length and width of chamber A and conveyer B may be within limits determined by the skilled constructor. It is apparent that the drying chamber may be constructed in any way known to those skilled in the art, but it is preferred to utilize a plurality of metal plates or sheets disposed in parallel order and separated by interposed spacing members so as to produce dead air insulating spaces *a* in the bottom, top and the two side walls, the opposite ends of said drying chamber being open. The shallow drying chamber may be supported by any suitable means at a height convenient to the operator; as shown, said chamber is supported on legs *a'*.

The endless conveyer is of any type approved by the skilled constructor, but in Figs. 3 and 4 said conveyer is shown as consisting of links *b* pivoted together at *b'* and carrying slats b^2, said conveyer being provided at suitable intervals with wheels or rollers *c*. The upper lead or run B' of the endless conveyer is movable within the drying chamber, preferably close to the bottom thereof, whereas the lower run or lead B^2 of said conveyer extends exteriorly to the bottom of the drying chamber. For supporting the upper run of the conveyer channeled rails C C' are secured within the drying chamber, whereas the lower run B^2 of the conveyer is supported by channeled rails D D' supported by suitable means below the bottom of the drying chamber, see Fig. 3. It is apparent that the channeled rails C C' are supported within the drying chamber near the respective side walls thereof, so that the rollers *c* of the conveyer may travel in contact with the rails and be substantially housed thereby. The load-carrying run of the conveyer is thus adapted to operate within the drying chamber at the lower part thereof and to be supported against sagging within said chamber by the rollers *c* running upon the channeled track rails. In like manner, the idle or return run of the conveyer is supported against sagging by the rollers traveling within the rails D D'. Owing to the location of the rails D D' below and exteriorly to the drying chamber, and to the contact of the return run of the conveyer with said exteriorly positioned rail, it is made possible to decrease the vertical dimensions of the drying chamber, thus simplifying and effecting economy in the construction of the apparatus.

According to one form of this invention, the material to be treated within the chamber A is loaded upon one end portion of the conveyer, and after said material shall have been carried through the drying chamber the treated product is removed from the other end portion of the conveyer. Accordingly, the conveyer exceeds in length the longitudinal dimensions of the chamber, whereby the loading end portion of the conveyer extends in one direction beyond the chamber, whereas the opposite unloading end of the conveyer extends in an opposite direction from the other end portion of the chamber, said exposed end portions being indicated at b^3 b^4 in Figs. 1 and 2 of the drawings. Rollers or drums E E' are employed for supporting the end portions of the endless conveyer, although it is apparent that other supporting and driving means may be substituted for the drums. The drums afford means for retaining the exposed end portions of the conveyer in proper relation to the drying chamber, whereas the channeled rails C C' and D D' in conjunction with the wheels *c* afford the means required to support the intermediate portions of the conveyer along the upper and lower runs thereof.

The apparatus and its conveyer are adapted for carrying a variety of materials into and through the drying chamber, and by extending the opposite end portions of the conveyer beyond the similar portions of the drying chamber, the material may be loaded advantageously upon one end portion of the conveyer, and in like manner removed from the other end portion of said conveyer. It is apparent that bulk or flow material

may be discharged by gravity upon the exposed end portion b^3 of the conveyer, whereas the dried bulk or flow material may be rapidly discharged at the end portion b^4. Again, the exposed end portion b^3 of the conveyer, when the latter is at rest, is within convenient reach of an operator stationed at one end of a machine so as to manually load the material upon said end portion b^3. It is apparent that another operator stationed at the opposite end portion b^4 of the conveyer can easily remove the dried product therefrom, should such product be of a nature requiring manipulation by hand.

In this invention the conveyer is not intended to run continuously, even at slow speed, although it will be understood that a slow speed conveyer may under some circumstances be utilized. It is preferred, however, to operate the conveyer intermittently with periods of rest or dwell in order that the conveyer may be loaded and unloaded while it is at rest, and in order, further, that the material in transit through the drying chamber may be exposed to the action of the gaseous drying agent for a long period of time. Any desired means preferred by a skilled constructor may be employed for the intermittent operation of the endless conveyer, but in Fig. 1 I have shown drum E mounted loosely on a shaft e equipped with a driving pulley e', said drum being made fast with the shaft e by a clutch (not shown) under control of a lever e^2. It will be understood that when the clutch is disengaged from the drum E the conveyer is at rest, but by shifting the lever e^2 the clutch is operated to make the drum E fast with the shaft e so as to drive the conveyer B a certain distance equal to the length of certain compartments in the chamber A, as will presently appear.

The gaseous drying medium, usually preheated air, is conducted by suitable means into the drying chamber, as for example by means of a flue F, and the drying medium, after its circulation is carried away from the chamber by a flue F′, see Fig. 2. The flues F and F′ are positioned to discharge the air into the chamber so it will flow in a direction crosswise of the conveyer.

Cooperating with the chamber and the conveyer are devices which localize the flow of the drying medium, said devices performing the function of means for directing the flow of air crosswise of the direction of movement of the conveyer and back and forth across said conveyer, as indicated by the arrows in Fig. 2.

At the point where the conveyer enters the drying chamber I employ a partition G; at the point where the conveyer leaves the drying chamber a partition G′ is employed, and intermediate said partitions G and G′ are other partitions G^2. Said partitions are arranged preferably above the load bearing run of the conveyer and extend crosswise of the conveyer and the chamber. The partitions are yieldable to the movement of the conveyer and the load thereon, for which purpose it is preferred hingedly connect each partition, as at g, to the top of the drying chamber, see Fig. 4, whereby the hinged partitions are suspended within the chamber so as to assume by gravity vertical positions within said chamber and intermediate the top thereof and the upper run of the conveyer.

The conveyer is equipped with flights H, said flights being attached to the slats of the conveyer and being spaced apart for distances equal to the intervals between the hinged walls G^2. The flights extend upwardly from the conveyer and they are adapted for cooperation with the hinged walls by contacting therewith, as in Fig. 4, whereby the contacting partitions and flights produce barriers crosswise of the drying chamber, which barriers operate to direct the flow of the gaseous drying medium back and forth across the chamber, as indicated by the arrows in Fig. 2.

As shown in Figs. 3 and 4, the rails C C′ and the upper run of the conveyer are positioned in close relation to the bottom of the chamber A, but to localize the flow of the drying medium it is preferred to position other baffles I intermediate the bottom of the drying chamber and the under surface of the top run of the conveyer. Said baffles I are fixed in position to the bottom of the drying chamber and are normally below the hinged partitions J, and substantially in alinement vertically therewith, said baffles I being below the upper run of the conveyer so as to preclude the flow of the air longitudinally of said conveyer and the drying chamber.

Experience in the drying of moist materials shows that the repeated contact of the drying agent with such moist materials effects the exchange of heat for moisture, so that the agent becomes more or less saturated by the absorption of moisture from said material, and such contact of the drying agent with the material decreases the temperature of the agent so that if the operation is continued for an indefinite length of time the drying agent loses its capacity for exchanging heat for moisture. In order to attain efficiency in the drying operation certain of my inventions embody means whereby the drying atmosphere is boosted by reheating said atmosphere in the intervals between its contacts with the moist material. In applying this principle to the apparatus of the present invention I employ boosters J positioned within the respective side portions of the drying chamber and in the path of the

drying agent as it flows crosswise of the conveyer. As shown, the boosters are in the form of coils extending for substantially the full length of the drying chamber at the respective sides thereof, said reheating coils or boosters constituting boundaries of the drying chamber at the respective sides thereof. These boosters or reheating coils are quite close to the channeled rails C C′ and are spaced sufficiently from the side walls of said chamber to allow for the circulation of the drying agent, certain baffles *j* being positioned between the coils and the side walls of the chamber so as to effect the reversal in the line of flow of the drying agent.

This being the construction of the apparatus of this invention, the operation is as follows:—

The material is loaded upon the exposed end portion b^3 of the conveyer and a current of heated air is conducted by the flue F to the drying chamber, the barriers and baffles in which direct the air back and forth across the conveyer and transversely to the direction of movement of said conveyer. A desired amount of material having been loaded upon the conveyer, the operator manipulates lever e^2 so that the drum E will impart movement to said conveyer, whereby the material first deposited upon the conveyer will be moved into the compartment of chamber A formed by the partitions G and G^2 and the flights H in contact with such partitions. The clutch is now thrown out of gear to allow the belt to remain at rest for loading the next batch of materials upon the conveyer, whereupon the clutch is thrown into mesh with the drum E and movement again imparted to the conveyer so as to carry the first load into the second compartment of the drying chamber, whereas the second load is carried into the first compartment of the drying chamber. During the movement of the conveyer and the loads thereon, the flights H contact with the hinged partitions which are yieldable to the movement of the flights and the conveyer load, but after the flights shall have passed the partitions, the latter swing back by gravity to their normal positions. The operation of placing successive loads upon the conveyer and intermittently moving said conveyer so as to advance the materials into the different compartments of the drying chamber are continued until the conveyer shall have been fully loaded and the successive compartments charged with the material to be treated, but during these several operations the drying medium is circulated back and forth within the drying chamber and crosswise of the conveyer so that the drying medium will have contact successively with the different batches of material. Said drying agent during its circulation flows into contact also with the boosters, the effect of which is to reheat the drying agent and thus maintain the same at a substantially uniform temperature or to even increase the temperature of the drying agent should it be found desirable, whereby the efficiency of the drying agent as a carrier for heat is not impaired by the exchange of heat for moisture. The operation of intermittently moving the conveyer is continued so that the successive batches of the treated material are exposed for access upon the exposed delivery end portion b^4 of the conveyer, whence said material may be discharged by gravity or manually removed as desired, but during such operations the flow of the drying agent is constant, the waste moisture-laden air being delivered from the apparatus by the flue F′, or its equivalent.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. In a drying apparatus, the combination with a drying chamber, and a conveyer operable therein, of means for circulating a drying agent, and means for directing the flow of said drying agent in a path transversely to the direction of movement of said conveyer, said directing means being supported within the chamber independently of the conveyer.

2. In a drying apparatus, the combination with a drying chamber, of an endless conveyer movable therein, means for circulating a drying medium within the chamber and in a direction crosswise of the direction of movement of the conveyer, and means yieldable to the movement of the conveyer for directing the circulation back and forth across the path of said conveyer.

3. In a drying apparatus, the combination with a drying chamber, of an endless conveyer the upper and lower leads of which are positioned for operation within and exteriorly to said chamber, respectively, means for circulating a drying medium, and means cooperating with the upper lead of the conveyer for directing said drying medium in a path crosswise of the direction of travel of said conveyer.

4. In a drying apparatus, the combination with a chamber, and a conveyer operable therein, of means for circulating a drying agent, means in operative relation to said conveyer and supported independently thereof for directing the flow of the drying agent in a path transversely to the travel of said conveyer, and means for boosting the drying agent in the intervals between its contacts with the load of said conveyer.

5. In a drying apparatus, the combination with a chamber, and a conveyer operable therein, of means for circulating a drying agent, a plurality of devices separate from said conveyer and in operative relation thereto for directing the flow of the drying agent

in a path transversely to the travel of the conveyer, and means for imparting movement intermittently to said conveyer.

6. In a drying apparatus, the combination of a chamber, a conveyer operable therein, means for imparting movement intermittently to said conveyer, means for circulating a drying agent, and means for directing said drying agent crosswise of the direction of movement of the conveyer, said directing means being in the path of and movable relatively to said conveyer.

7. In a drying apparatus, the combination of a chamber, an endless conveyer operable therein, means for imparting movement intermittently to said conveyer, means for circulating a drying agent, and partitions withing said chamber for directing the flow of the drying agent crosswise of the conveyer, said partitions being installed normally within the chamber and yieldable to the travel of the conveyer.

8. In a drying apparatus, the combination of a chamber, an endless conveyer operable therein, means for imparting movement intermittently to said conveyer, means for circulating a drying agent, partitions supported within the chamber and yieldable to the travel of the conveyer, and means carried by the conveyer and adapted for contact successively with said partitions so as to cooperate therewith in the production of barriers adapted to direct the flow of the drying agent crosswise of the conveyer.

9. In a drying apparatus, the combination with a chamber and a conveyer, of barriers positioned intermediate the chamber and the conveyer, and means for circulating a drying agent into contact with said barriers the latter operating to direct the flow of said drying agent crosswise of the load-bearing run of said conveyer.

10. In a drying apparatus, the combination with a chamber, of a conveyer the load-bearing run of which is movable within said chamber, flights movable with said conveyer, partitions arranged in the chamber and in the path of said flights so as to contact therewith in the production of a barrier, one of said parts being yieldable to the movement of the other part comprising the barrier, and means for circulating a drying agent.

11. In a drying apparatus, the combination with a chamber, of a conveyer the load-bearing run of which is movable within said chamber, flights movable with said conveyer, partitions hung within said chamber and positioned for contact with said flights so as to cooperate therewith in the production of barriers operating to direct the flow of a drying agent crosswise of the conveyer, and means for imparting movement intermittently to said conveyer.

12. In a drying apparatus, the combination with a chamber, of a conveyer the load-carrying run of which is movable within said chamber, means for circulating a drying agent, movable barriers within said chamber for directing the flow of the drying agent crosswise of the conveyer, and boosters adjacent to said conveyer and in the line of flow of said drying agent.

13. In a drying apparatus, the combination with a chamber, of a conveyer, the load-carrying run of which is movable within said chamber, means for circulating a drying agent, movable barriers within said chamber for directing the flow of the drying agent crosswise of the conveyer, and boosters ranging lengthwise of said chamber and positioned to form the boundaries of the drying chamber at the respective sides thereof.

14. In a drying apparatus, the combination with a chamber, of an endless conveyer the loading and discharging portions of which are extended beyond the ends of said chamber and the load-carrying run of which is movable within said chamber, means for circulating a drying agent, means for directing the flow of said agent within the chamber, and means for imparting movement intermittently to said conveyer.

15. In a drying apparatus, the combination with a chamber, of an endless conveyer the load-carrying run of which is movable within said chamber, means for circulating a drying medium, baffles positioned within the chamber for directing the flow of the drying agent crosswise of the line of movement of the conveyer, and means for imparting movement to said conveyer with intervals of rest or dwell.

16. In a drying apparatus, the combination with a chamber, of an endless conveyer the load-bearing run of which is movable within said chamber, flights carried by said conveyer, baffles hung within the chamber and adapted for contact with said flights, means for imparting intermittent movement to said conveyer, means for circulating a drying agent within the chamber, and boosters adjacent said conveyer and in the line of flow of said drying medium adapted for circulation in the chamber.

17. In a drying apparatus, the combination with a chamber, of rails fixed within said chamber at the respective sides thereof, an endless conveyer the load-bearing run of which is provided with wheels adapted to ride against said rails, baffles operating within the chamber for directing the flow of a drying agent into contact with the load upon said conveyer, means for circulating said drying agent, and boosters adjacent said rails and in the line of flow of said drying agent.

18. In a drying apparatus, a relatively shallow chamber, an endless conveyer the load-bearing run of which is movable within

the chamber and the return run of which is exteriorly to said chamber, baffles fixed between the bottom of the chamber and the load bearing run of the conveyer, other baffles hung within the chamber, flights movable with the conveyer between the fixed and movable baffles, and means for circulating a drying agent.

19. In a drying apparatus, a chamber, an endless conveyer, means for circulating a drying agent, baffles positioned within the chamber, flights movable with the conveyer into cooperative relation to the baffles so as to produce barriers operating to direct the line of flow of said drying agent, and means for intermittently moving the conveyer for a distance equal to the intervals between the baffles.

20. In a drier, a chamber, means for transporting material within said chamber, means for circulating a drying medium, and means for directing the flow of said drying medium in a path crosswise of the direction of movement of said material transporting means, said flow directing means being separate from the material transporting means.

21. In a drier, a chamber, means for transporting material within said chamber, means for circulating a drying medium, means separate from the material transporting means for directing the flow of the drying medium in a path crosswise of the direction of the material transporting means, and means for reheating the drying medium during its circulation within the chamber.

22. In a drier, a chamber, means for carrying material therein, means for circulating a drying medium, boosters positioned at the respective sides of the path of said material transporting means, and flow directing means separate from the material transporting means for directing the drying medium in a path crosswise of the direction of movement of the material transporting means and into contact alternately with said boosters and the material adapted to be carried by said transporting means.

23. In a drier, the combination with a chamber, of a material conveyer operable therein, means for circulating a drying atmosphere within said chamber, and flow-directing means for controlling the course of the drying atmosphere crosswise of said conveyer, said flow-directing means being mounted separately from said conveyer.

24. In a drier, the combination with a chamber, and means for circulating a drying atmosphere therein, of a material conveyer, and flow-directing means yieldable relatively to the travel of said conveyer, said flow-directing means being so related to the conveyer as to direct the drying atmosphere crosswise of said conveyer.

25. In a drier, a chamber, means for circulating a drying atmosphere therein, a conveyer movable within said chamber, and cooperating baffles for directing the flow of the drying atmosphere crosswise of the conveyer, certain of said baffles being movable with the conveyer and other baffles being yieldable relatively to the conveyer.

In testimony whereof I have hereunto signed my name.

GORDON DON HARRIS.