L. P. BAUER.

STARCH DRYING APPARATUS.

APPLICATION FILED SEPT. 30, 1910.

1,099,276.

Patented June 9, 1914.

4 SHEETS—SHEET 1

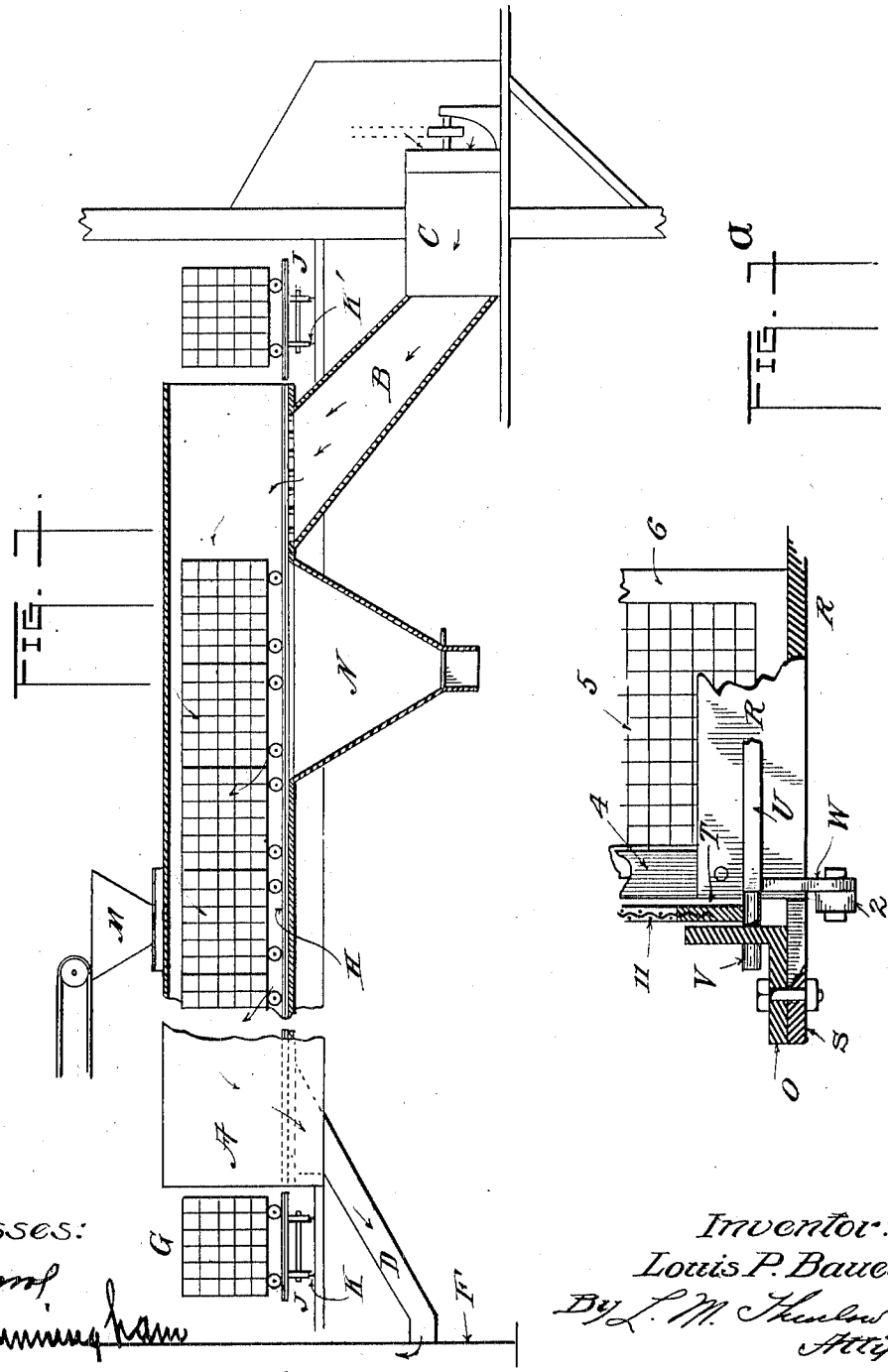


FIG. 1.

FIG. 2.

Witnesses:
E. J. Stamp
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4 SHEETS—SHEET 2.

FIG. 2a.

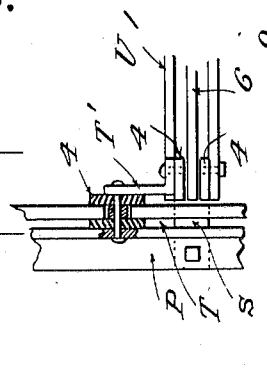


FIG. 2b.

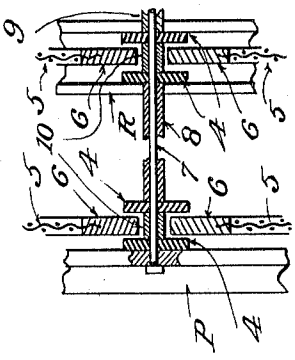
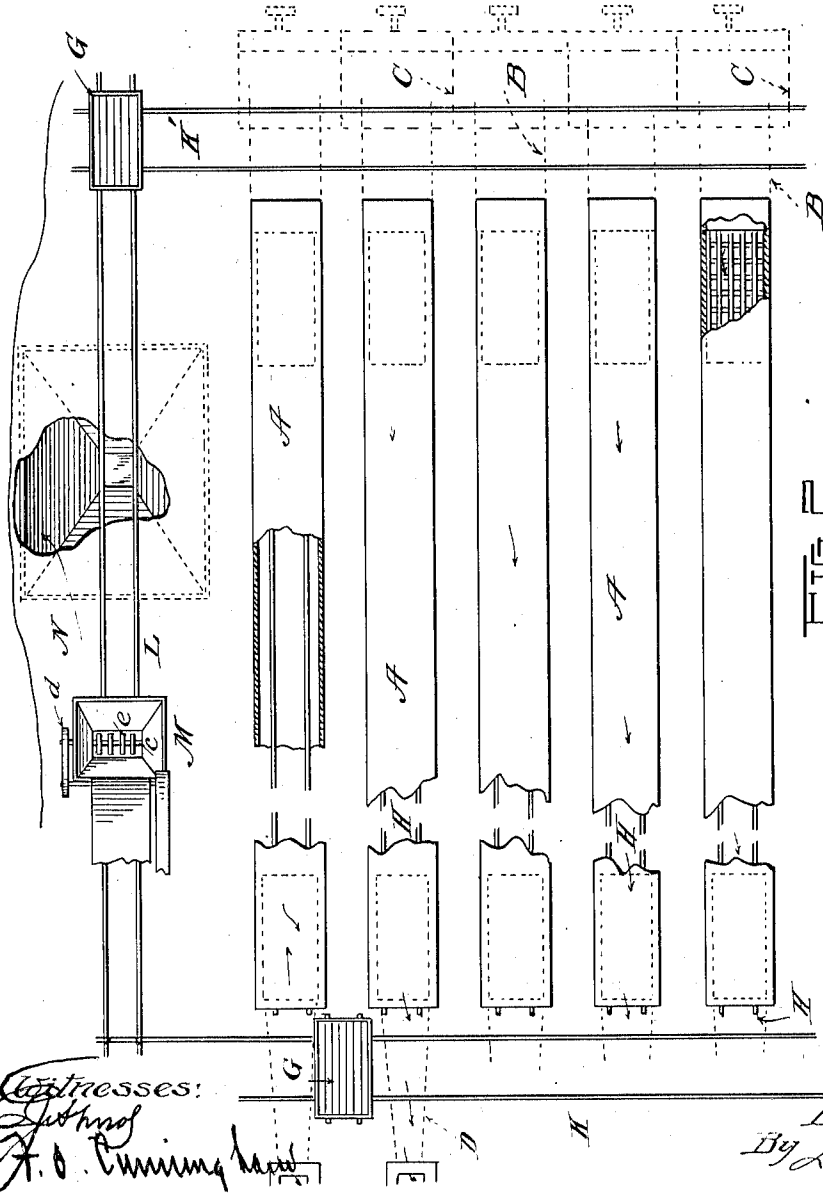


FIG. 2.



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4 SHEETS—SHEET 3.

FIG. 3.

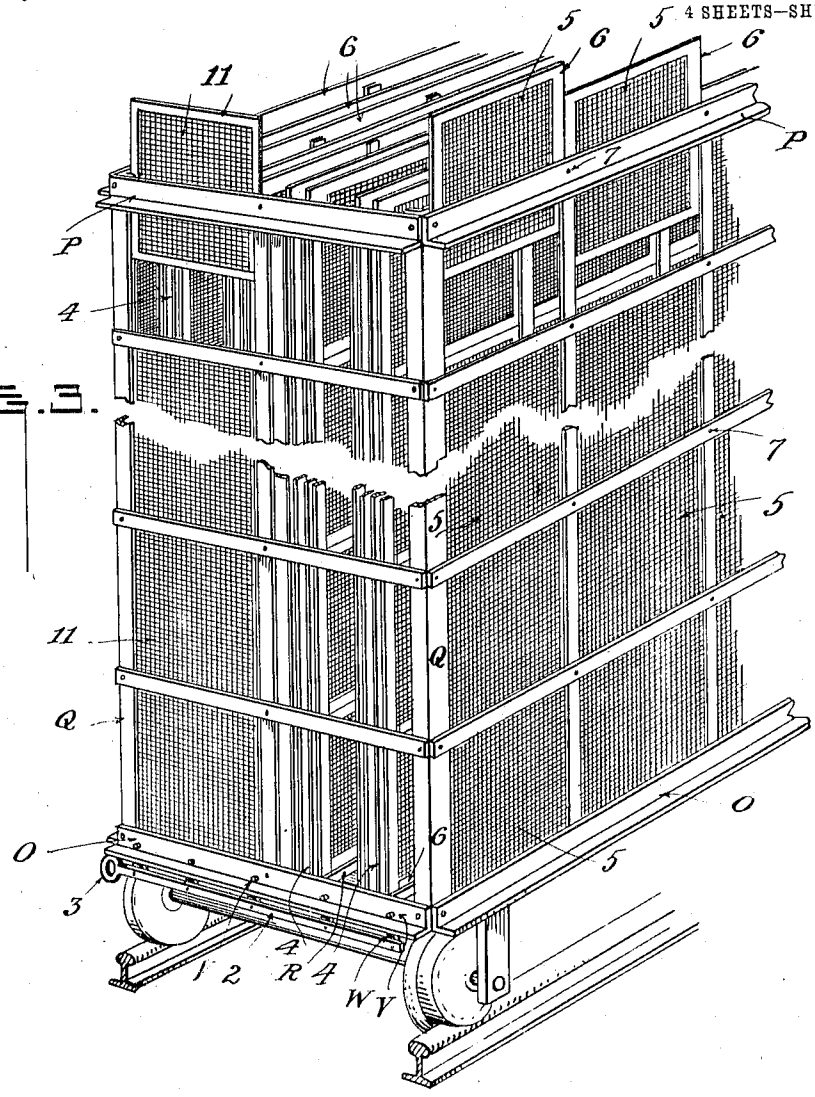
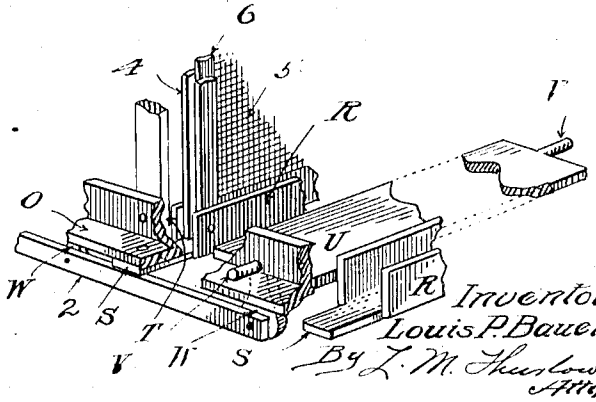


FIG. 4.



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APPLICATION FILED SEPT. 30, 1910.

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4 SHEETS—SHEET 4.

FIG. 7.

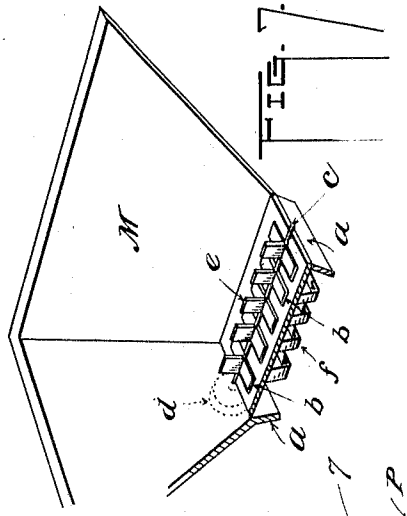


FIG. 8.

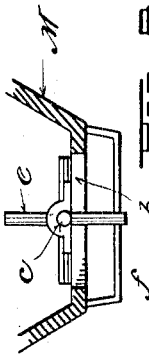


FIG. 6.

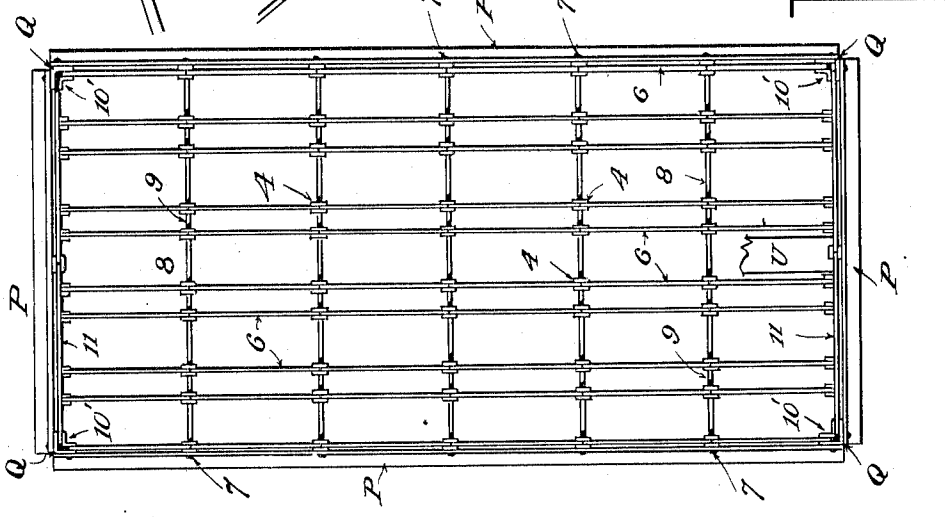
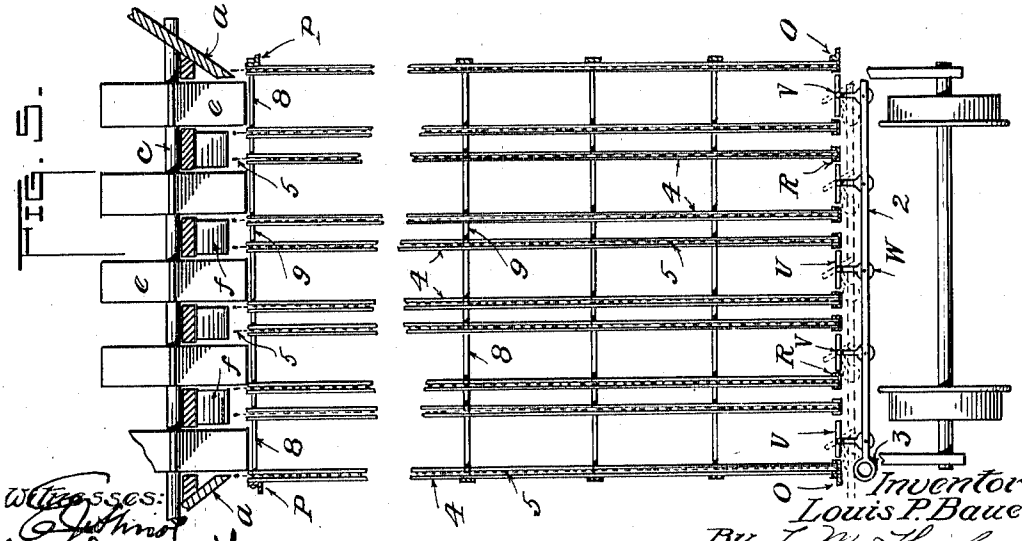


FIG. 5.



Witnesses:

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UNITED STATES PATENT OFFICE.

LOUIS P. BAUER, OF PEKIN, ILLINOIS, ASSIGNOR TO CORN PRODUCTS REFINING COMPANY, A CORPORATION OF NEW JERSEY.

STARCH-DRYING APPARATUS.

1,099,276. Specification of Letters Patent. Patented June 9, 1914.

Application filed September 30, 1910. Serial No. 584,619.

To all whom it may concern:

Be it known that I, LOUIS P. BAUER, citizen of the United States, residing at Pekin, in the county of Tazewell and State of Illinois, have invented certain new and useful Improvements in Starch-Drying Apparatus; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to apparatus for drying starch.

As the process of drying starch is carried out at the present time the wet starch from the tables is broken up and spread out as evenly as possible on relatively shallow trays, the frames of which are of wood and the bottoms of burlap. The trays are then placed one above the other and spaced apart in wagons which are moved step by step through long kilns or drying tunnels through which hot air is forced. Each wagon as it emerges from the tunnel is taken to a convenient place of discharge and the trays taken out by hand and emptied of their contents. As the trays have to be placed in the wagons and removed therefrom by hand the process of handling the starch is an expensive one requiring, in a large factory, a very considerable force of laborers. The disadvantage of this has been recognized for some time and considerable effort has been spent in the attempt to devise machinery for automatically handling the trays but so far without practical success. The attempt has also been made to convey the starch through the tunnels on continuous operating conveyers but this method, for reasons which need not be stated, has not proven satisfactory.

One of the primary objects of my invention is to provide a drying apparatus which will very materially lessen the amount of labor required in handling the starch before it goes to the tunnels and afterward, and this result is accomplished by providing wagons or carriers made up of compartments into which the wet starch can be fed by a continuously operating feeding mechanism and from which the dried starch may be dumped by gravity.

Another object of my invention is to so dispose the starch in the carriers that the drying process will be facilitated, cheapened and made more uniform.

The arrangement of the starch in horizontal layers has several disadvantages. In the first place, the starch being wet and lumpy and the lumps of different sizes, the layers can never be made perfectly uniform. This means that it does not dry evenly. For the same reason considerable clearance has to be left between the trays which limits the capacity of the apparatus. Furthermore, as the starch is introduced into the tunnel at the end remote from the hot air supply, the fact that the circulation is between horizontal layers causes a condensation of moisture near the air outlet which makes the incoming starch wetter than it would otherwise be. Again, the trays ordinarily consist of wooden frames and burlap bottoms. Wire mesh has been tried for the bottoms but it is not practical as, among other reasons, the finer particles of starch when dry will sift down through the trays and so clog the tunnel. The burlap has to be renewed frequently, which in itself is a cause of expense, and this use of burlap makes the employment of wooden frames necessary in order that the burlap may be readily nailed to and detached from the frames. The fact that the burlap and the frames soon wear out makes it necessary to clean the dry starch very carefully because there is always danger that scraps of burlap, splinters of wood, nails, etc., will be found in it. I have overcome all of these objections by the process of the present invention in which the starch is transported through the tunnels in carriers which can be made entirely of metal and which are provided with relatively thin compartments extending from top to bottom of the car, provided with foraminous sides and spaced apart so as to provide circulation spaces which extend lengthwise of the carrier, that is, in the direction of the circulation of hot air through the tunnel. With the tunnel filled with a number of carriers of this sort the circulation spaces aline, provided the cars be of uniform construction as they should be, so that the passage of the hot air through the tunnel is unobstructed. The result is that the moisture at the end of the tunnel which the carriers enter instead of being in part de-

posited on the incoming starch is carried off through the discharge flue as it should be. Furthermore, carriers of this sort can be made of much greater capacity and experience has shown that this can be done without lengthening the drying process. The starch can be continuously fed in at the top and discharged from the bottom of the compartments by simple manipulation of levers so that the expensive and laborious work of handling trays is done away with. Furthermore, by making the wagons entirely of metal the life of the carriers is increased, the necessity of repair minimized, and the danger of getting foreign matter into the starch during the drying process entirely eliminated. Further, since the volume of each of the vertically disposed layers of starch is fixed by the dimensions of the compartments, a proper design of the compartments having regard to the temperature to be used, the length of tunnel and the frequency with which the carriers are introduced into the tunnels will make it possible to get just the proper degree of dryness in the starch, a common form of commercial starch, for example, containing ordinarily from ten to fourteen per cent. of water. Finally, this circumstance gives perfect uniformity in the degree of dryness.

The invention is illustrated, in a preferred embodiment, in the accompanying drawings, wherein—

Figure 1 is a sectional elevation of a drying apparatus; Fig. 1ª, a sectional elevation of a part of the carrier or wagon; Fig. 2, a plan view of the apparatus shown in Fig. 1; Fig. 2ª, a fragmentary plan of the carriage, with parts in section; Fig. 2ᵇ, another fragmentary plan view of the same; Fig. 3, a fragmentary view, in perspective, of the wagon; Fig. 4, a detail perspective view of a portion of the same; Fig. 5, a sectional elevation showing the wagon under the filling hopper; Fig. 6, a plan view of the wagon; Fig. 7, a fragmentary view, in perspective, of the filling hopper and distributer, and Fig. 8, a sectional elevation of a portion of the same.

Like characters of reference designate like parts in the several figures of the drawings.

By way of making the entire operation clear I illustrate in Figs. 1 and 2 the usual arrangement of a series of tunnels indicated at A A of considerable length and severally supplied with hot air blasts through ducts B from fans (not shown) in ovens represented at C. At the opposite ends of the tunnels are discharge pipes D connected for example into flues F. The ends of the several tunnels are provided with any usual closures (not shown) by which the said tunnels can be made practically tight so far as the induction of outside air is concerned. However, as to the particular arrangement and means for introducing and withdrawing the air I attach no importance in this application.

The wagons containing the material to be dried are indicated at G and run upon any one of the tracks H extending throughout the several tunnels. These wagons are preferably carried upon wheeled trucks J mounted upon tracks K and K′ outside of and at opposite ends of the tunnel and disposed at right angles to the tracks H.

L is a track lying parallel to the tunnel-tracks H and above it is a hopper M from which the wagons are filled but this will be more particularly described hereinafter. Beneath said track is a receiving hopper N for the finished products discharged from the wagons. The general arrangement is such, it will be seen, that the loaded wagons are moved along the track L from beneath the hopper M, after being filled, and run upon a truck J on the track K, thence along that track to and into any one of the tunnels A by being run off the said truck J upon a track H, finally emerging to run along the track K′ to the track L where their contents are deposited into the hopper N.

The wagons consist preferably of framings of angle iron or the like, bottom members being indicated at O while P indicates similar upper frame members. Upright corner supports of angle iron are represented by Q and these are properly attached to the upper and lower frames; a skeleton form for the wagon being thus made. The bottom of the wagon consists, for example, of a series of channel bars R extending from end to end of the wagon and carried preferably on wheels, each bar, Figs. 1ª and 4 having an extension S at each end, but one of which is shown, to extend beneath the end bars O and suitably bolted thereto leaving a space T between said bars O and the end of the channel-bar for the reception of a wall-section, to be described, for the end of the wagon. Between pairs of the channel bars, as also shown in the figures referred to, are dumping-bars U having supporting trunnions V at their ends which extend through the vertical limbs of the said end bars O. Depending from the bars U are weighted arms W having pivotally attached thereto a rod 2, Fig. 3, provided with a suitable handle at 3, said rod when shifted in the direction of its length tilting the bars U as indicated in broken lines whereby to cause the discharge of the material resting thereon.

At each end of the several channel bars R and at intervals throughout their lengths are erected pairs of bars 4, those at the ends of the bars R being separated from the end bars O and P so as to leave an upward continuation of the space T to receive the said end wall-section above mentioned, each pair of said

end bars being supported at their upper ends by means, for instance, of a tie-member T′, Fig. 2ª, attached thereto and to any suitable part of the framing. Between the pairs of bars and supported in a vertical position thereby are partition-sections of foraminated material 5 preferably in the form of metal screens of the desired size of mesh. These sections are preferably made in squares, and strengthened by stiff metal edgings 6 as clearly shown in Fig. 3 and stand edge to edge within the members 4, the bottom sections resting in the channel-bars R hereinbefore described and as shown in Figs. 4 and 5. The said pairs of bars 4 are spaced apart as shown in Fig. 6 in such a way as to provide alternating wide and narrow spaces when the partition sections are in place, the wide ones constituting compartments for receiving the material to be dried while the narrow spaces provide passages for air and said pairs of bars are firmly held by means of bolts 7, for example, extending through said bars and entirely across the wagon from side to side there being, for example, a series of sleeves 8 and 9 of the proper length thereon to properly space the partitions apart to provide the wide and narrow compartments mentioned while collars 10 Fig. 2ᵇ separate the members 4 of each pair to allow for the insertion of the partitions.

The vertical corner bars Q hereinbefore described, which are secured to the bars O P, are disposed as shown in Fig. 6 with their hollow sides innermost and spaced inward from each is a second angle bar 10′, these forming receptacles for both the side and end-wall sections 5 and 11 the latter corresponding in type and size to the former, if desired, so that the wagon may be built up entirely of sections of but one size; no careful selection of these parts being required to fit a given space.

The bolts 7 may, of course, be limited in number and so placed that they will properly strengthen the parts and yet be so distributed that they will not interfere with the free filling and discharge of the material.

The spaces T created between the members 4 and the upper and lower end bars O and P provide for the easy insertion of the end sections 11 referred to as shown in Fig. 1ª. Preferably I extend the partition made up of the section 5 slightly above the top edge of the members P and the particular reason for this will be set forth later herein.

The advantage in having the partitions and outer walls of the wagon made up of small sections is that in case any part of a partition or outer wall is damaged or broken so as to be useless, that particular part may be readily replaced by a new section at little cost. Furthermore, framings for various sized wagons can be readily supplied with partitions from a stock size. In addition to these advantages the small sections in being reinforced by the edging of metal are very strong and will not bulge or buckle as might result when using a partition of but one or even a few parts.

The bottoms for the compartments containing the material are closed by the dumping members U whereas the intermediate compartments are entirely open at the bottom as well as the top to permit free passage of air.

I have referred above to the hopper M from which the wagons are filled. This is suspended in any suitable manner over the track and has two depending aprons, *a*, which are suspended quite close to the outer walls of the wagon, when the latter is placed in position to be filled, for preventing the material discharged from the hopper from spilling out of the wagon during the filling operation. The floor of the hopper is preferably provided with a series of slots, *b*, corresponding in number to the number of compartments to be filled, and lying across these slots is a shaft, *c*, driven by a pulley, *d*, said shaft being furnished with a series of arms, *e*, constituting agitators for positively feeding the material to the compartments through said slots. As shown in Fig. 5 the agitator-arms, *e* hang between the partitions as to reach a short distance down into the compartments. Depending from the hopper are guards, *f*, lying between adjacent agitator-arms and these closely overhang the air compartments so as to prevent the material falling into them. In practice the wagons to be loaded lie quite close together so as to form practically solid trains as indicated, for instance, in Fig. 1 so that when pushed along the track beneath the hopper the constantly revolving agitator will feed the material in a continuous manner to the cars, one after another as the train is gradually advanced. The material is deposited into the hopper from any source and is more or less lumpy and sticky and in that state is broken up into smaller parts and fed in that form into the several compartments of the wagons and as the latter move along the agitator levels off the material throughout the compartments the upwardly extending partitions preventing it falling out at the sides. The starch falls loosely into the compartments and rests against and builds up upon the sides of the screen 5, 11 and these during the filling operation prevent the starch-portions from dropping into a soggy mass which is the condition in which it is found when using the "tray" method since there is nothing to support it. And the narrower the compartments are made the more lightly the starch will lie since the partitions or screens form more of a resistance to the downward passage of the starch and prevent it spreading out. In depositing the

starch upon the old style horizontal tray it settles into a mass through which the air does not pass because the bottom of the tray must be tightly closed in order to support the starch but even if it were possible to have the bottoms perforated the broad solid layer of starch would form a bar to the passage of air through it. The air therefore can only pass over the top of the tray drying the one exposed surface of the starch only. In my device the starch lies loosely in its compartments, as stated, and the perforate walls or partitions permit the air to freely reach the starch and as the latter lies in this loose condition the air can pass through and through it drying every particle thoroughly and quickly. My method of causing the air to pass vertically between the starch compartments instead of horizontally thus provides for using perforate partitions that could not otherwise be employed, and in referring to walls or partitions of the compartments for the materials as having vertical positions I mean that they may be vertical or substantially so, it being understood that though they may have an inclination for any reason whatever that arrangement would fall within the meaning of the invention. When dry the material is discharged into the hopper N by shifting the rod 2 having control of the dumping members U forming the bottom of the compartments. As the starch dries out although shrinkage takes place it still retains its original position and arrangement of its lumps or parts thus allowing free circulation of the air but at the same time when properly dried a jar as in shifting the dumping-bar, for example causes the whole structure to collapse and fall and readily discharge. But starch as dried commercially retains from 10 to 13 per cent. of moisture and in this state it cannot readily sift through the screen partition and be lost. After the dumping operation the weighted members W together with the rod 2 will cause the members U to close automatically by gravity when released.

Actual use has shown that a wagon provided with my vertical compartments will handle nearly two and one-half times the amount as the same wagon will hold having the largest number of trays it is possible to place in it under the old method; the conditions being equal as to the amount of fuel used and the length of time necessary for the drying operation. I am enabled also by my method to make a much clearer starch since it requires no screening as is necessary with the tray system since such articles as wood, bits of cloth, tacks and nails of which the trays are made, and which mix with the material, are not now to be considered. In addition, a great saving results in cost of labor in practising the tray method as well as in the maintenance of the trays, the life of which is very short.

I have stated that the walls of the compartments may be of some open form other than foraminated material and by this I mean that said walls, as well as the outer walls of the wagons, may be built up of parts as, for instance, separate strips so placed that the air can pass between them without permitting the material to fall out as, for example, slats placed one above another and inclined at an angle from the vertical. I am not, therefore, confined to any exact form of the walls so long as the desired result is obtained. Further, than this I may construct the wagons as to constitute separate compartments instead of making a series of compartments but this is also within the meaning of the invention.

I claim—

In apparatus for drying starch, the combination with a drying tunnel and means for causing a circulation of hot air through the same from end to end, of a carrier for the starch adapted to be moved through the tunnel and formed with a plurality of starch compartments, the sides of which are foraminous and which are spaced apart so as to form circulation spaces extending lengthwise of the carrier, separate closures for said compartments which are movable so as to allow the dry starch to discharge by gravity, and means for feeding the wet starch into said compartments.

In testimony whereof I affix my signature, in presence of two witnesses.

LOUIS P. BAUER.

Witnesses:
AUGUSTA BURKHARDT,
L. M. THURLOW.