

Feb. 27, 1945.

J. O. REED

2,370,422

DEHYDRATORS

Filed Sept. 22, 1942

5 Sheets-Sheet 1

Fig. 1.

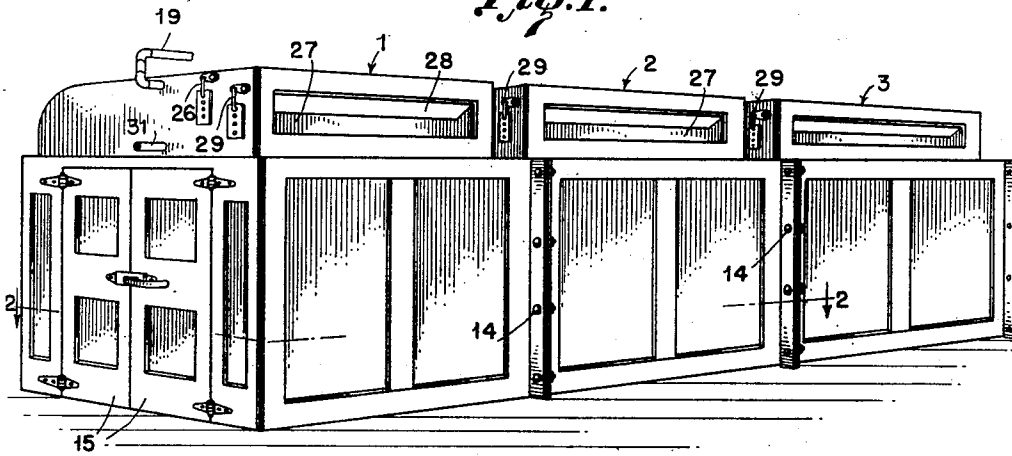
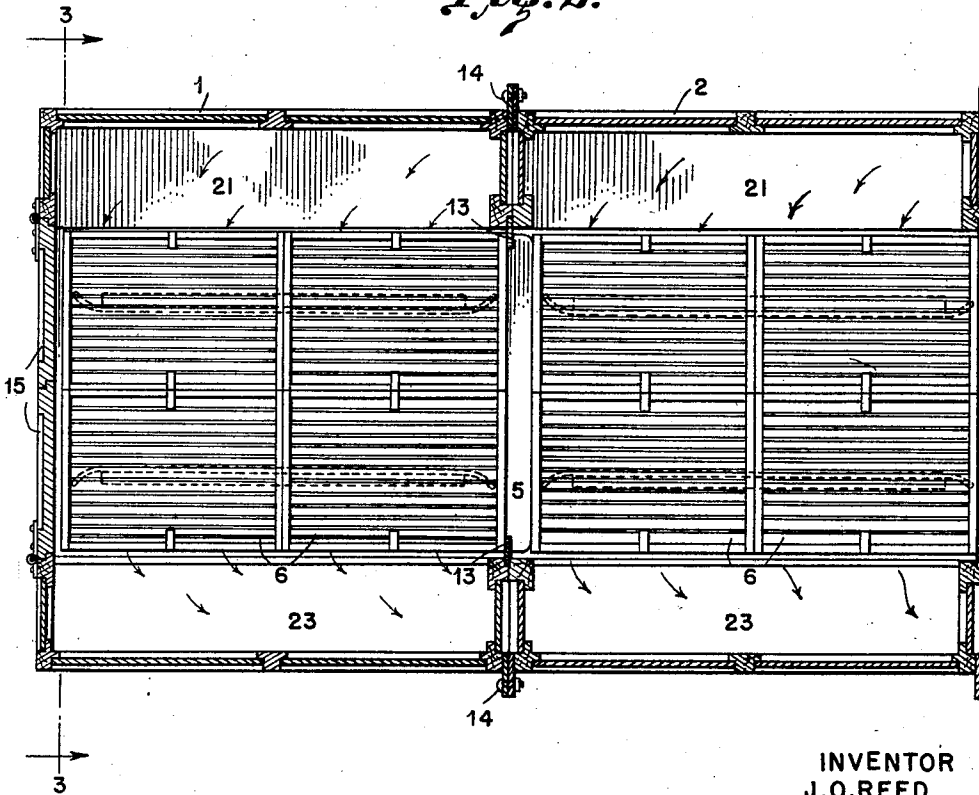


Fig. 2.



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Fig. 3.

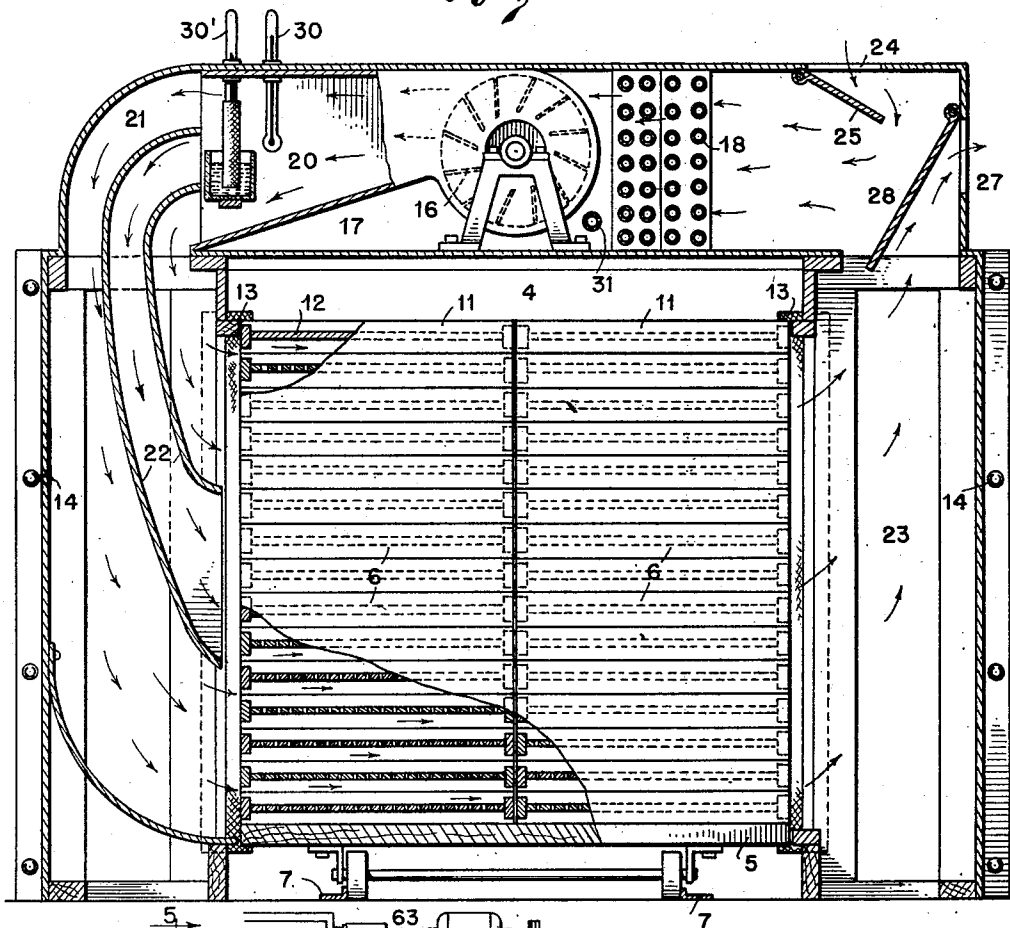
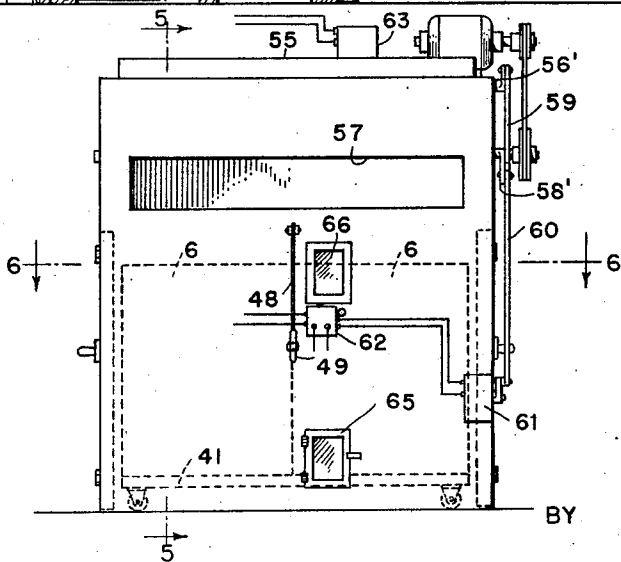


Fig. 4.



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Fig. 5.

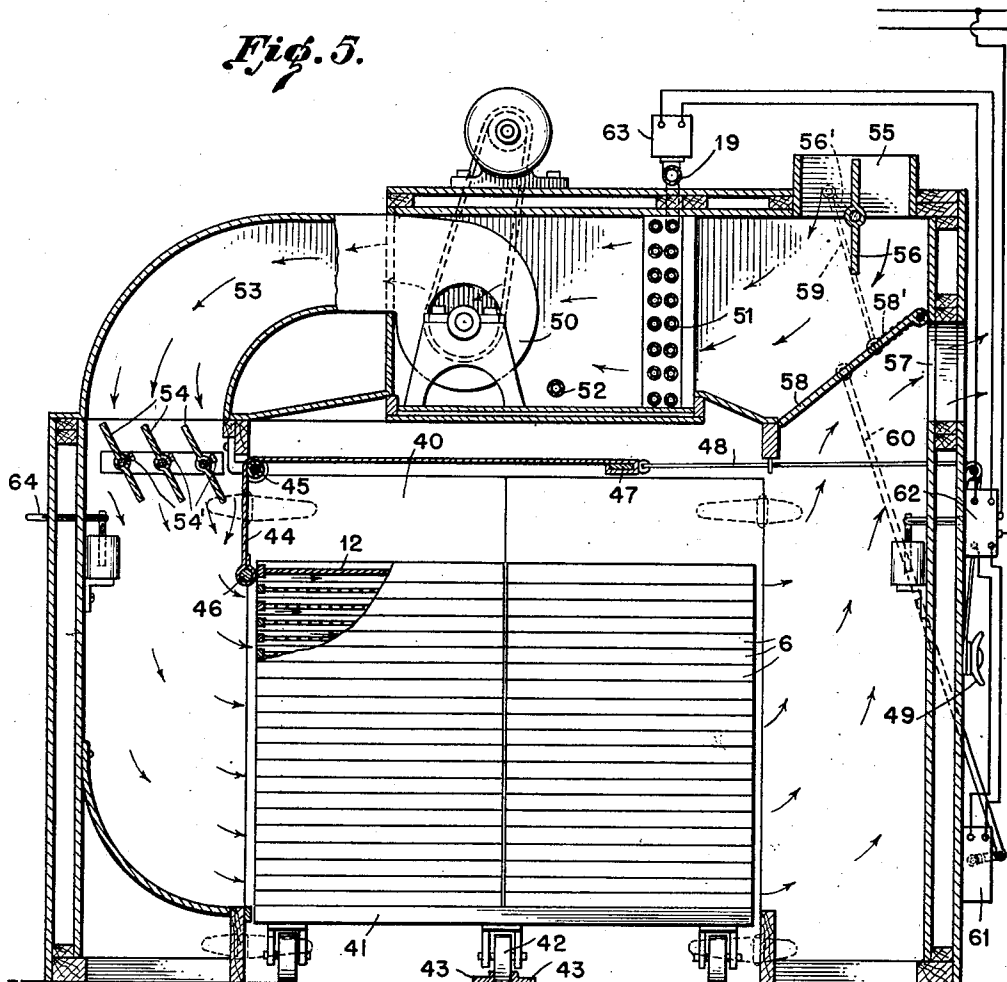
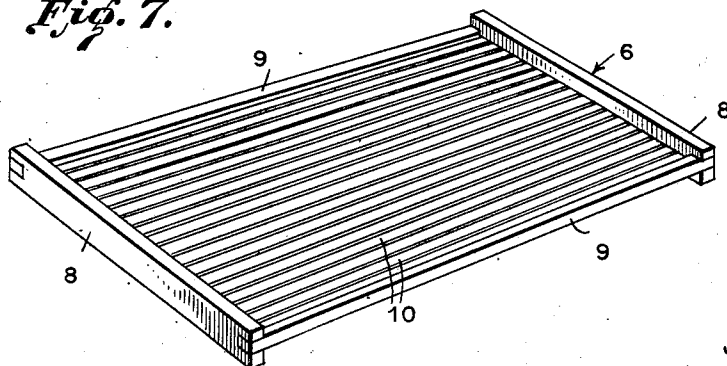


Fig. 7.



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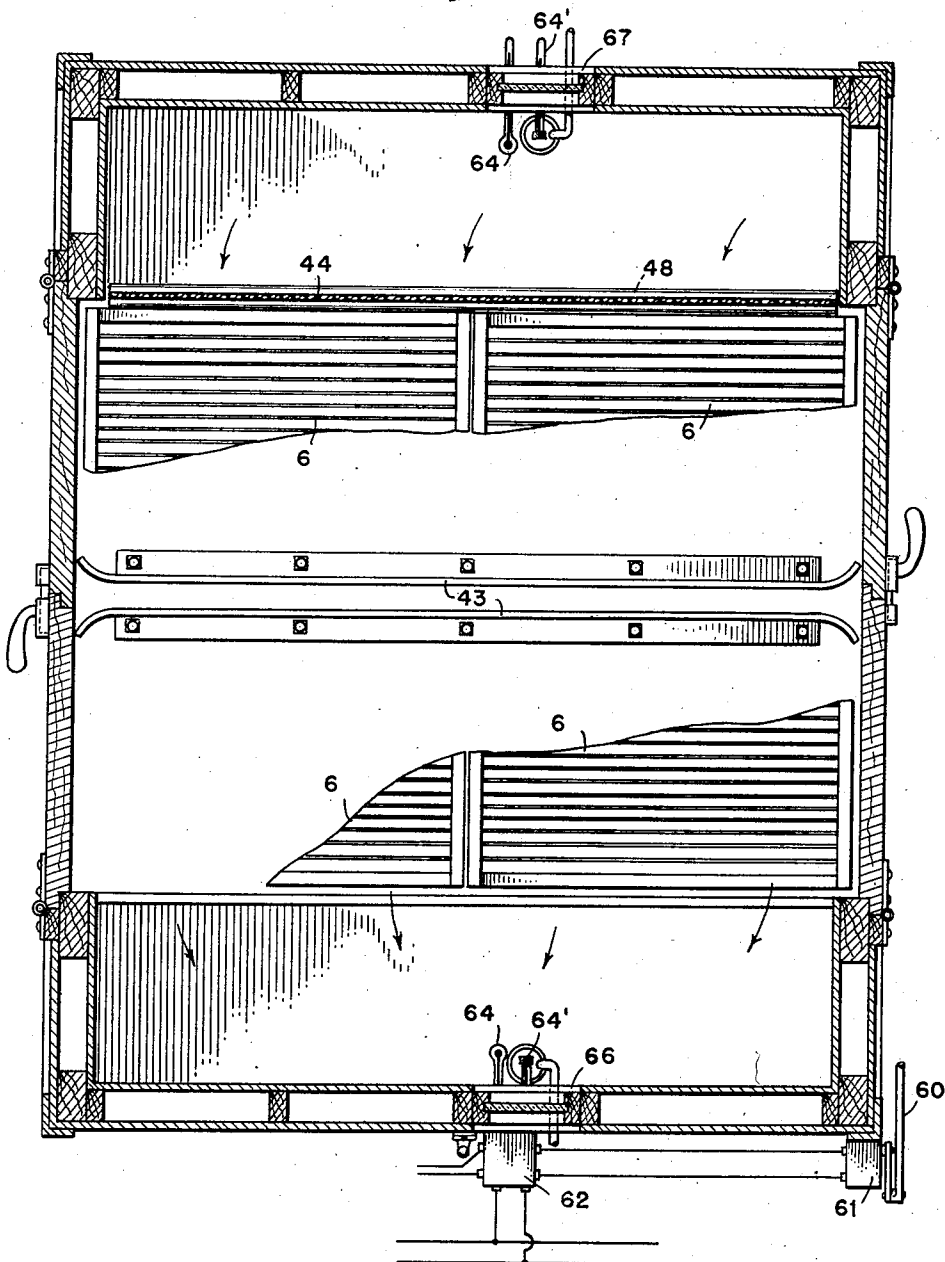
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Fig. 6.



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Fig. 8.

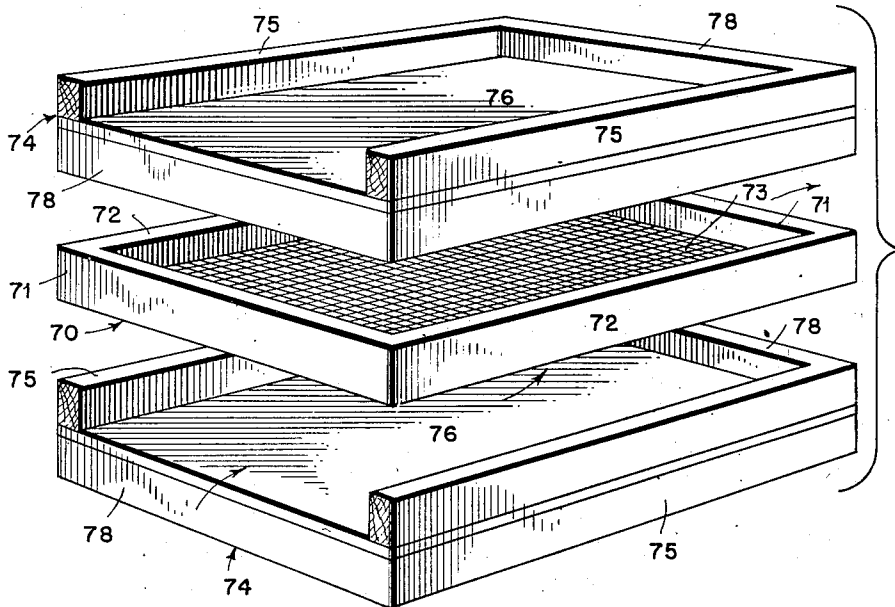


Fig. 9.

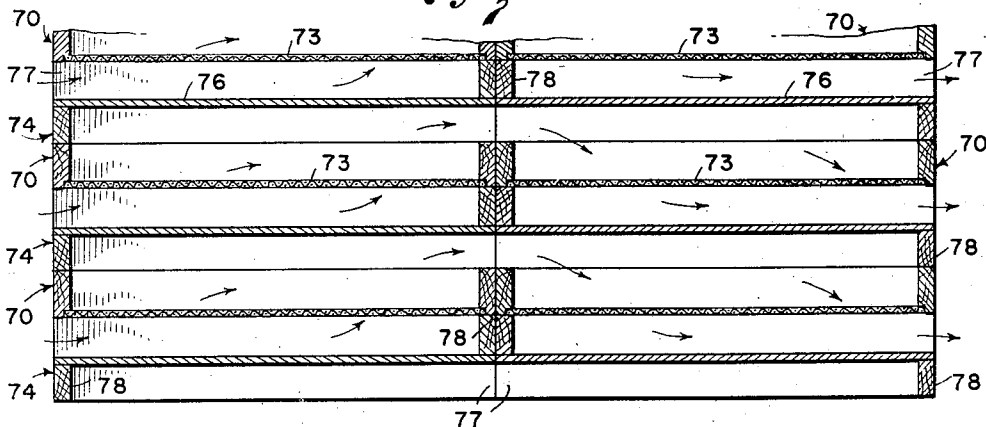
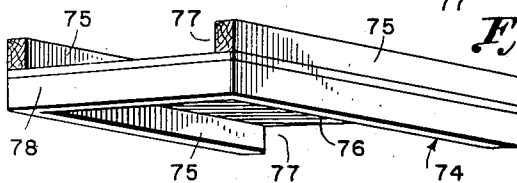


Fig. 10.



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UNITED STATES PATENT OFFICE

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DEHYDRATOR

Jesse O. Reed, Washington, D. C., assignor to
Claude R. Wickard, as Secretary of Agriculture
of the United States of America, and his suc-
cessors in office

Application September 22, 1942, Serial No. 459,289

3 Claims. (Cl. 34-60)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented, may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates to dehydrating apparatus, particularly useful in the dehydration of food products.

At present, two general types of dehydrators, known as the cabinet and tunnel types, are in use. In the cabinet type, the food products are loaded on open trays which are placed in a closed cabinet, and drying air or other gas is circulated over them to remove the desired amount of vaporizable water. The trays are then removed, and the process is repeated for each batch. In the tunnel type the process is continuous rather than in batches. The trays of food products are started at one end of the long tunnel, and means is provided to move them gradually toward the other end. Drying air or gas is circulated in the tunnel throughout its length so that during the passage of the trays the food products are dehydrated.

The tunnel type has certain advantages over the cabinet type. In large scale operations, a continuous process is more desirable than a batch process. The flow of materials in a continuous process is more even and regular and fewer operations are necessary.

The usual tunnel type also has several disadvantages, however. The air passes lengthwise of the tunnel from one end to the other, and it cannot be kept at the same temperature or relative humidity throughout. Ordinarily, the tunnel cannot operate successfully at the same time upon different types of products requiring different conditions of temperature and humidity. Also, in dehydrating certain food products, it is desirable to subject them at some point in the process to treatments other than dehydrating, such as blanching. This can be accomplished with some types of cabinet dehydrators, but not with usual tunnel dehydrators, since all the food products in the tunnel are operated upon simultaneously with respect to one operation or another. There is also loss in the starting and stopping of the tunnel type of dehydrators. The entire tunnel must be conditioned when the first trays are started through at the beginning of the run, and maintained until the last trays of the run have passed completely through. This involves a

waste both in the heat and in the power required to circulate the air through zones in which no dehydrating is being accomplished.

Among the objects of this invention are the provision of a dehydrating apparatus which combines the advantages of both the tunnel type and the cabinet type; the provision of a flexible dehydrating apparatus adapted to use for dehydrating all types of food products; the provision for obtaining and maintaining all desired conditions of dehydrating; the provision of an apparatus which is convertible from a unit type to the tunnel type by the mere addition of similar units; the provision of an apparatus of few parts which can be made into a unit type or a tunnel type at will; and the provision of improvements in cabinet type dehydrators generally.

Other objects of the invention will be apparent from the following detailed description and attached drawings, in which,

Figure 1 is a perspective view showing several cabinet units joined together, forming a tunnel type dehydrator.

Figure 2 is a section on the line 2-2 of Figure 1.

Figure 3 is a section on the line 3-3 of Figure 2, certain parts being broken away to illustrate the structure more clearly.

Figure 4 is a side view of an improved cabinet type of dehydrator.

Figure 5 is an enlarged section on the line 5-5 of Figure 4.

Figure 6 is an enlarged section on the line 6-6 of Figure 4.

Figure 7 is a perspective view of a tray suitable for use in any of the dehydrators.

Figure 8 is an exploded three-dimensional view of a modified tray and baffle suitable for use in any of the dehydrators.

Figure 9 is a sectional view of a few trays and baffles of the type shown in Figure 8, showing the manner of operation.

Figure 10 is a three-dimensional view of one of the baffles of Figure 8.

Referring to the drawings, and in particular to the apparatus of Figures 1, 2 and 3, similar separable individual cabinet units 1, 2 and 3 are shown, coupled together in Figure 1. Three units are shown, although the apparatus is adapted to any number, and may have as many as six or more for carrying out the most complete process. The various constructional details which are obvious and are shown in the drawings will not be described in detail.

Each individual unit comprises a complete

cabinet dehydrator in itself. It provides a drying or processing chamber 4 into which a truck 5 loaded with trays 6 may be pushed. Guide rails 7, provided on the floor in the drying chamber, properly position the truck. Each tray shown in detail in Figure 7 is provided with end pieces 8 and open side pieces 9. Figure 3 shows a double row of trays stacked one on the other, with the end pieces forming partitions which close the ends of the drying chamber. Air to pass over the trays is admitted and exhausted through the open side pieces 9, which restrict the area and act as a grille to control the delivery of air over the trays. The total inlet and total exhaust areas provided by the open side pieces should be substantially equal to the cross-sectional area of the fan exhaust duct to maintain a substantially constant air velocity.

The floors of the trays are shown as formed from spaced apart slats 10, although screen may be used. The tops 11 have solid floors 12 forming a ceiling for the drying chamber. It may be observed, when several individual cabinet units are arranged as shown in Figure 1 and no trucks are present, that a tunnel results.

The trucks and trays are of a predetermined definite length relative to the individual cabinet units, so that they may be pushed into the tunnel at one end, and when the rear truck is stopped at its proper location, all other trucks will be properly positioned. In order to isolate the individual chambers of the several cabinet units from each other, flexible flaps 13, acting as seals, are fixed in the chambers at positions near the junctures of the individual cabinet units to engage the ends of the trays when the trucks are properly positioned. These flaps allow the trucks and trays to pass, but they substantially prevent gas circulation between the individual chambers in conjunction, of course, with the end pieces of the trays and the solid floors of the tops.

The various cabinet units are secured together with flanges and bolts, as shown at 14. Each unit has openings in its opposite end walls for the admission and egress of products to be dehydrated, and the several units are connected together with the openings matched. The end units are provided on their free ends with suitable doors 15, which can be removed and flanges substituted, if other units are to be added on the ends. If only one cabinet unit is desired, doors are generally provided at both its ends, although the doors may be omitted.

Each cabinet unit is provided with a circulating and heating means. A fan 16, preferably of the forced feed multiple type, is located in compartment 17 above the unit. The fan is driven by a variable speed motor (not shown) and circulates air through a heater 18, which may be of any desired type, but is preferably a steamheated radiator, a connection of which is shown at 19. The heated air leaves each fan unit through an exhaust duct 20 and is forced through chamber 21 which is provided with deflecting fins 22 to distribute the air evenly over the sides of the trays.

After the air passes over the trays and has gathered moisture from the food products, it enters exhaust duct 23 from which it is directed partially or wholly to the outside atmosphere by a suitable damper system. An air inlet port is provided at 24, the opening of which is controlled by a valve 25, which may be held set in a selected position by adjusting means 26. An air outlet port is provided at 27, the opening of which is

controlled by damper 28, which may be held set in a selected position by adjusting means 29. Damper 28 also acts as a deflector to direct the air into the outlet port. As can be seen in Figure 3, the damper in one extreme setting will direct all the outlet air to the outside, and in the opposite extreme setting will direct it all back into the heater.

The function of the damper system is to control the humidity of the drying air. Any part of the exhaust air may be returned to the heater rather than to the outside atmosphere. Returning larger quantities of the exhaust air to the heater increases the humidity of the drying air.

Suitable instruments, such as a dry bulb thermometer 30 and a wet bulb thermometer 30', may be positioned in the drying air current for observation, whereby manual adjustments can be made on the heat admitted to the heater for maintaining the desired dry bulb temperature and on the damper system to maintain the desired wet bulb temperature of the circulating air.

Each cabinet unit is provided with means rendering it useful for other steps than drying. A perforated steam pipe is provided at 31, to admit steam for blanching purposes. This pipe may also be used for increasing the relative humidity of the air, as may be necessary at the start of dehydrating a new batch, for example. By completely closing ports 24 and 27 and admitting steam, blanching can be carried out to any desired extent. The chamber can then be immediately aerated and drying started by simply shutting off the steam and resetting the damper system.

If it is desired to treat the food products with flue gas or sulphur dioxide, as is necessary in some cases to inhibit enzyme reactions, such gases are admitted through the inlet port 24.

The adaptability of this apparatus to a wide variety of conditions and uses is apparent. A complete process may be carried out with one cabinet unit by successively effecting different processing steps on a batch of products loaded in the unit. If, however, it is desirable to operate several units together as a tunnel, each may be set and made to perform any desired step such as blanching, gas treatment or drying. To illustrate, the first cabinet unit may be used for blanching or used for gas treatment to inhibit enzyme reactions, or if separate units are desired for these treatments, the first and second may be thus employed. In the next unit dry gases may be used and circulated with high velocity, since the food product is heavy at this stage. In the next two units, the drying may be effected at increasing temperatures and at decreasingly lower air velocities, to prevent blowing the light, dry products off the trays. All units may be operated at the same time on different batches, the trucks being pushed ahead to convey the products from one unit to the next unit.

Referring to the modified type of Figures 4, 5 and 6, the cabinet type of dehydrator herein shown is generally similar to the cabinet unit used in Figure 1. It provides a processing chamber 40 into which the truck 41 is pushed. The truck in this instance is provided with guide wheels 42 at its center running between rails 43. The trays 6 are the same as those described above.

It may be desirable to run various size batches, and means in this form provides for blocking off air from the part of the chamber not occupied if the truck is loaded to less than its full capacity. Figure 5 shows, for example, a truck about four-

fifths loaded. A flexible curtain 44 extends over a roller 45, and is held taut by a rod 46 acting as a weight at its free hanging end. The other end of the curtain, provided with a stiffener 47, is attached to a pull rope 48, which extends outside the dehydrator, and is wound on a bracket 49. When the truck is in position, the operator can readily adjust the curtain to block off all the air inlet area above the top tray.

The fan 50 and heater 51 of this dehydrator may be a commercially obtainable heating unit of predetermined capacity, if desired, and if constant heat and air are supplied, the tray capacity can be adjusted to care for varying conditions.

A blanching steam admission pipe 52, similar to that described in reference to the first modification, is provided.

Air is exhausted from the fan through exhaust duct 53, and passes a set of fins 54—54—54, adjustably mounted on axes 54'—54'—54' to direct the air over the sides of the trays.

In the damper system of this modification, the air inlet port 55 is controlled by a valve 56, and the air outlet port 57 is controlled by damper 58. The valve and damper are so coupled together that when the valve is opened to admit dry outside air, the damper is set to open the air outlet port and to deflect the air away from the heater and out of the port. Figure 5 shows an extreme setting of the system in which all of the air is deflected to the outside. The coupling is provided by a link 99 connecting crank arms 56' and 58' attached to the valve and damper, respectively, at their pivotal axes. A control rod 60 for setting the damper system is attached to the damper crank arm 58'.

Observation dry and wet bulb thermometers are shown at 64 and 64', respectively, which may be used in connection with manual control means as described in reference to Figure 3. Automatic control is, however, preferable, and may be provided by the following described means shown schematically.

A modulating motor control 61 of known type can be coupled to the control rod, and the damper system regulated automatically to maintain a desired humidity by coupling the motor control to a humidostat or wet bulb control apparatus of well known type, located in the box shown at 62. The dry bulb temperature may be controlled by a thermostat or dry bulb control apparatus also located inside box 62 and coupled to a motor controlled valve 63.

By automatic control of the damper system which exhausts the moisture-laden air and admits outside air so as to maintain a constant wet bulb temperature of the circulating air, and by automatic control of the dry bulb temperature, a very efficient heat consumption is obtained, as no excess air is heated or exhausted.

Inspection windows are provided at 65, 66 and 67.

In the embodiments thus far described, the trays provide for circulating the air over the food products. Figures 8, 9 and 10 are directed to an improved tray system in which the air is forced to circulate through the tray floors or screens. With some products, this results in a more uniform drying, and makes it possible to load the trays deeper. The tray 70 is provided with side and end walls 71 and 72, respectively, of the same height, and a perforated floor 73, herein shown as a screen. A baffle 74, positioned between each pair of screens, is provided with solid end walls 75 of the same height and a solid floor 76. Each

side wall of the baffle, however, is open above the floor on one side and below the floor on the other side, as shown at 77, but is otherwise closed by pieces 78.

The trays and baffles are alternately stacked, as shown in Figure 9. Due to this arrangement, the air is forced to travel as shown by the arrows, and is forced through the tray floors and food products loaded on the trays.

Strips may be fastened to the end walls 75 of baffles 74 so as to hold said baffles in spaced apart position, and the trays 70 may be slid between the baffles.

Having thus described the invention, what is claimed is:

1. A dehydrating apparatus comprising at least two separate, similar, individual cabinet units, each unit having an opening in each of its end walls for the admission and egress of products to be dehydrated and each unit being provided with means for effecting a first gas-processing step and with means for effecting at least one more gas-processing step different from that of the first-mentioned means, whereby a single unit may be employed to effect the first processing step followed by effecting the next processing step on a batch of products loaded in the unit, and means for detachably connecting the units together with the openings matched to form a tunnel type dehydrator, whereby when so connected together the first unit may be employed to effect the first processing step on a first batch of products loaded in the first unit, following which the first batch of products may be conveyed into the second unit and a second batch of products placed in the first unit and the second unit may be employed to effect the second processing step on the first batch of products while the first unit is effecting the first processing step on the second batch of products, and means for preventing gas circulation between the individual units when the said units are connected together.

2. A dehydrating apparatus comprising at least two separate, similar, individual cabinet units, each unit having an opening in each of its end walls for the admission and egress of products to be dehydrated, trays having closed ends so constructed that when the trays are stacked on each other the ends form a closed wall, each unit being provided with means for effecting a first gas-processing step and with means for effecting at least one more gas-processing step different from that of the first-mentioned means, whereby a single unit may be employed to effect the first processing step followed by effecting the next processing step on a batch of products loaded on the trays in the unit, and means for detachably connecting the units together with the openings matched to form a tunnel type dehydrator, whereby when so connected together the first unit may be employed to effect the first processing step on a batch of products loaded in the first unit, following which the first batch of products may be conveyed into the second unit and a second batch of products placed in the first unit and the second unit may be employed to effect the second processing step on the first batch of products while the first unit is effecting the first processing step on the second batch of products, and inwardly extending flexible flaps fixed in the tunnel near the junctures of the individual units, the flaps engaging the stacked trays and forming with the closed wall means for preventing gas circulation between the individual units and

permitting the trays to be conveyed from the first unit into the second unit.

3. In a dehydrator, a tray system comprising removable trays each having a perforated floor and solid side and end walls, said side and end walls being of the same height, and removable baffles corresponding in size to the trays, said baffles each comprising a solid floor, solid end walls extending above and below the floor, one

side wall closed below and open above the floor and another side wall open below and closed above the floor, the end walls of the baffles being of the same height, whereby when said trays and baffles are stacked and supported on each other in alternate arrangement processing gas when circulated through the system is forced to pass through the perforated floors.

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