

Feb. 12, 1935.

W. L. LAIB

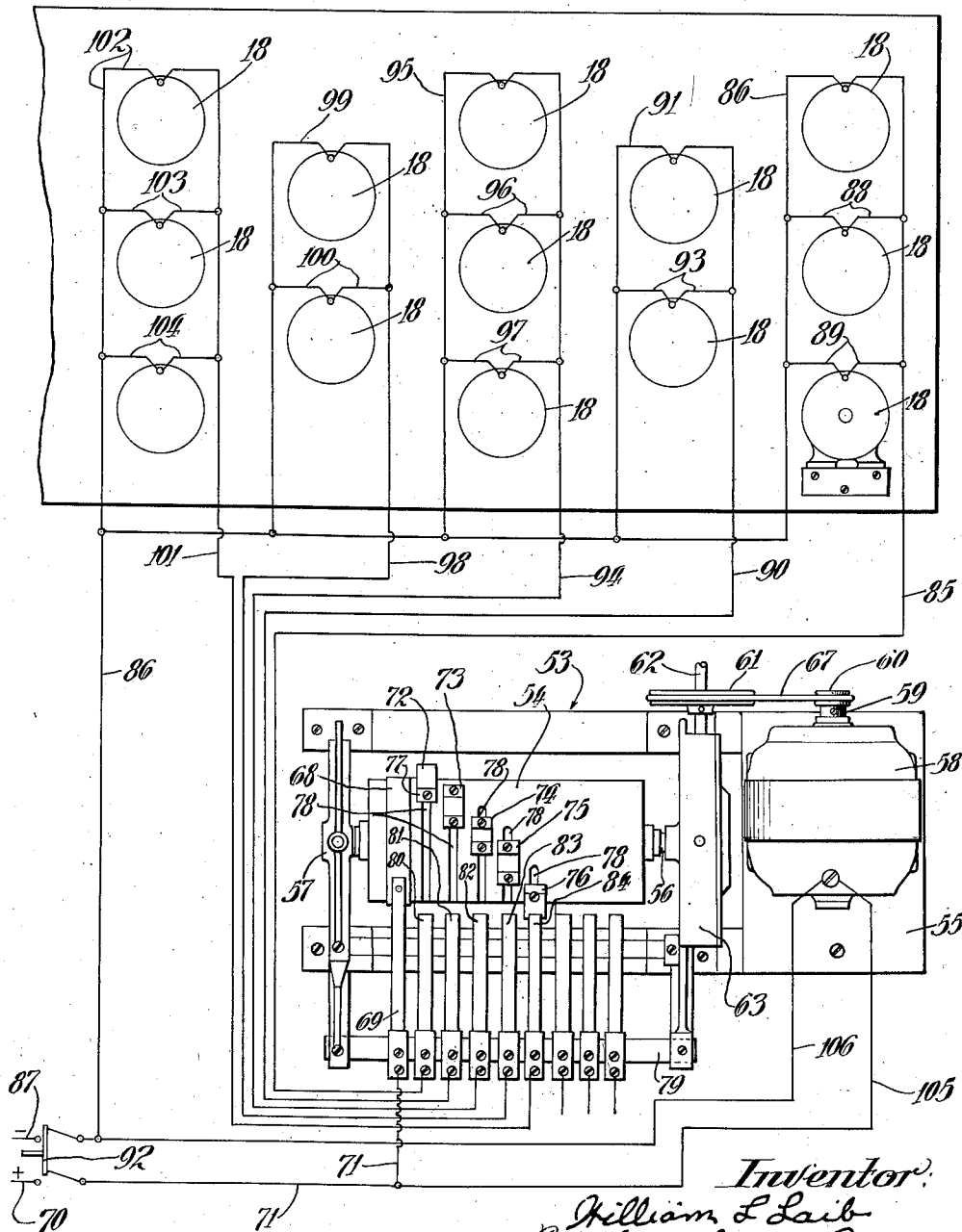
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DRYING APPARATUS

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5 Sheets-Sheet 1

Fig. 1.



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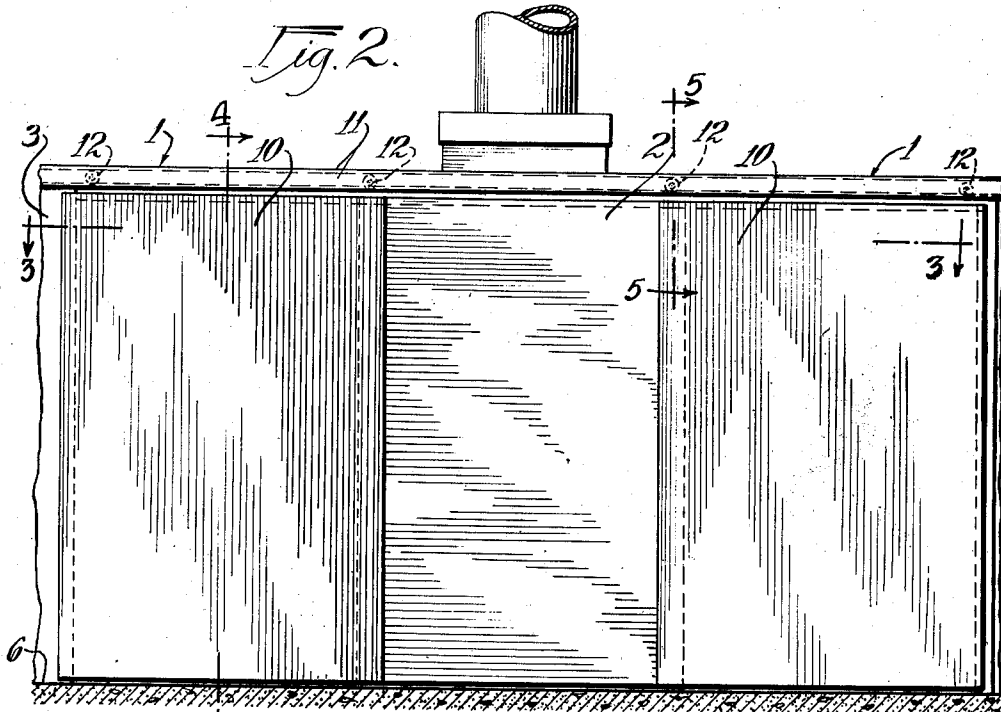
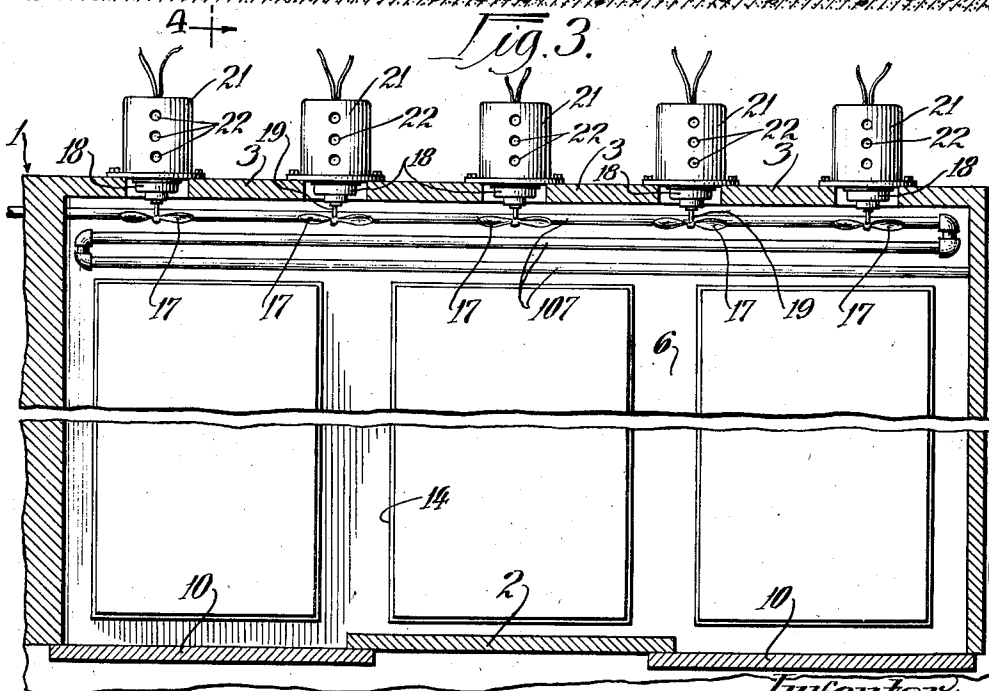
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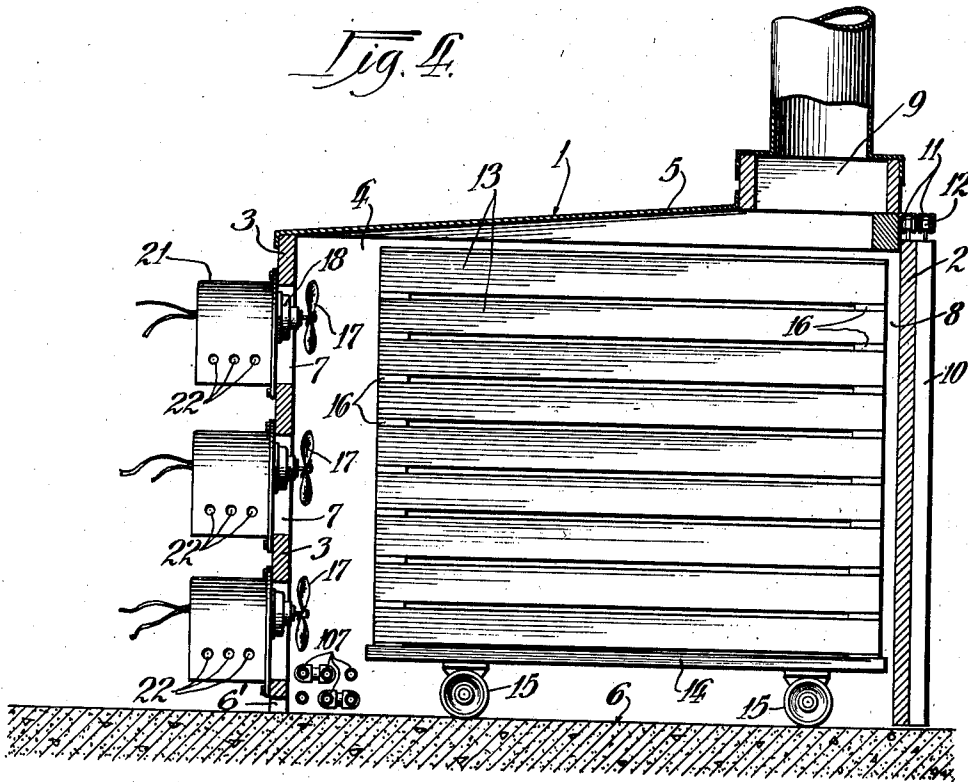
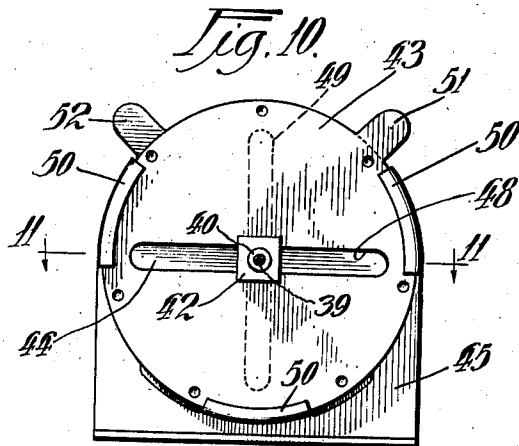
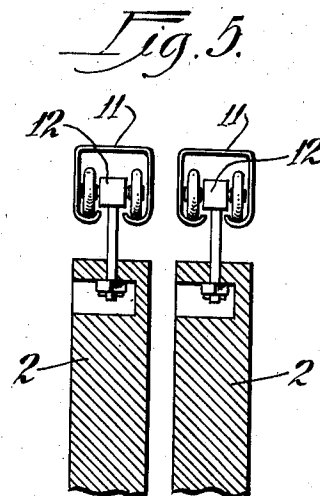
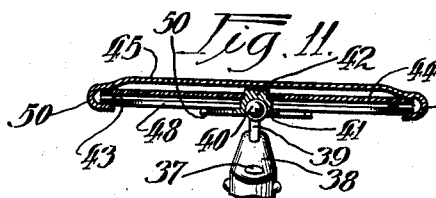
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DRYING APPARATUS

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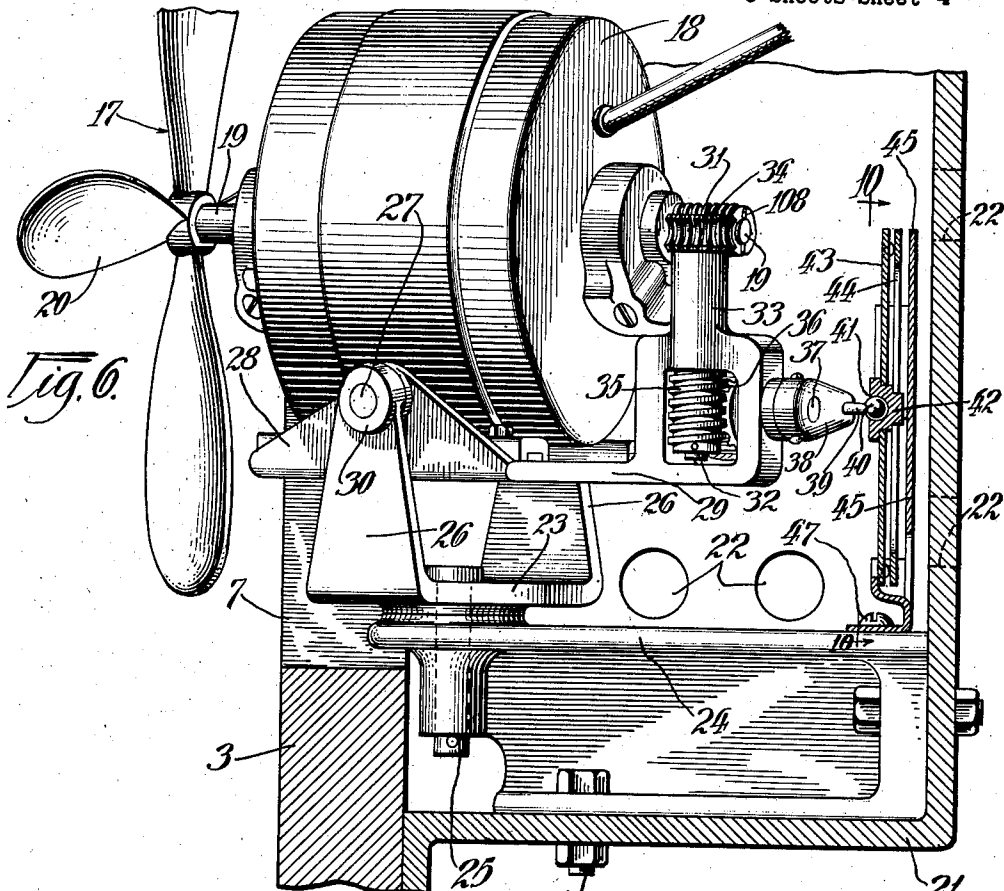
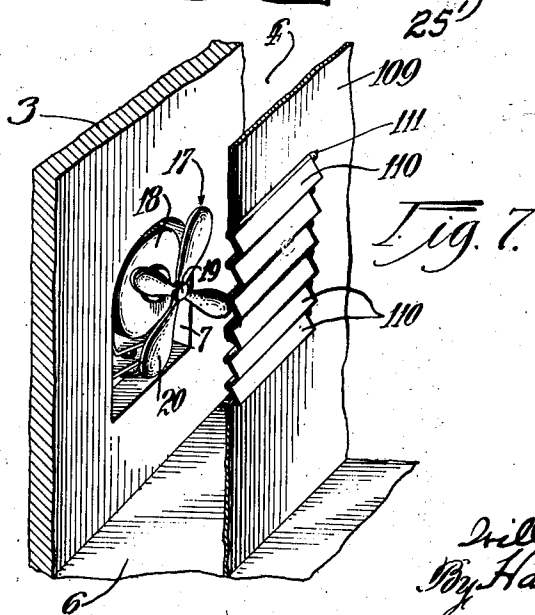
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5 Sheets-Sheet 4



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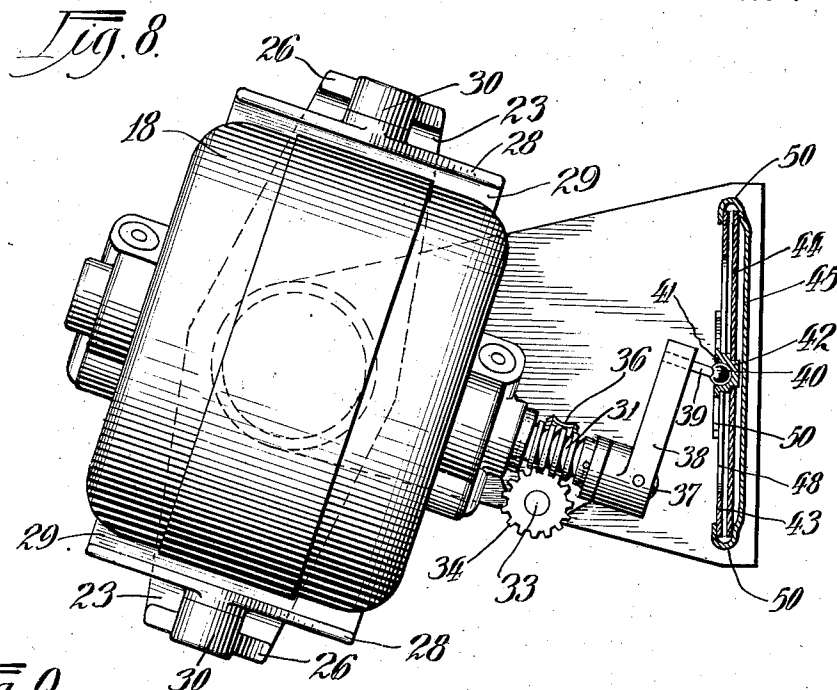
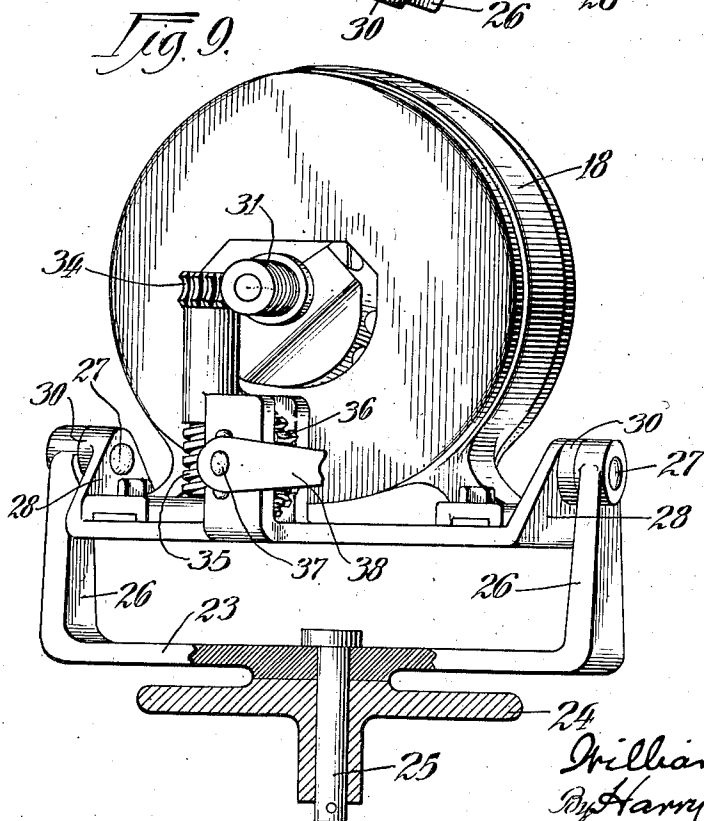
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DRYING APPARATUS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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DRYING APPARATUS

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Application July 31, 1929, Serial No. 382,501

3 Claims. (Cl. 34—19)

This invention relates to that class of driers having electrically actuated fans for circulating and controlling the circulation of air, for drying food products or other materials, and means for operating and automatically controlling the operation of electric fans for circulating air, for drying or other purposes.

The principal object of my invention is to provide an improved simple, economical and effective drier having electrically actuated means for circulating and controlling the circulation of air, for drying food products or other materials; and more particularly, to provide an improved drier in which a series of electric fans are employed for circulating and controlling the circulation of air; and to provide improved, simple and efficient means for automatically controlling the operation of the fans, and an improved electric fan suitable for use in connection with such driers or for other purposes.

A further object of the invention is to provide in a drier or other apparatus having a series of electrically actuated fans for circulating and controlling the circulation of air, for drying or other purposes, means for operating the fans intermittently in predetermined order, including electrically actuated automatic circuit-controlling means for connecting the respective fans or fan motors with a source of electric supply intermittently in successive or any desired predetermined order and for disconnecting the same, whereby food products or other materials to be dried or treated may be subjected to the action of a current or currents of air intermittently for any desired continuous or intermittent periods of time as desired.

Other and further objects of the invention will appear from the following description and claims, and from an inspection of the accompanying drawings which are made a part hereof.

The invention consists in the features, combinations, and details of construction and mode of operation of parts, as herein described and claimed.

In the accompanying drawings—

Figure 1 is a diagrammatic view of a part of one side of a drier provided with a series of stationary rotative electric fans in position to cause and control the circulation of air in the drier cabinet or housing, and having an electrically actuated circuit breaker or circuit-controlling means operatively connected with the fan motors and with a source of electric supply, for actuating and automatically controlling the operation of the fans and for stopping and starting the

same successively or in any desired predetermined order;

Fig. 2 is a front view in elevation of a drier or drier cabinet constructed in accordance with my invention and corresponding with the drier shown in Fig. 1, with parts broken away;

Fig. 3 is a view in horizontal section of the drier shown in Figs. 1 and 2, taken on line 3—3 of Fig. 2, looking downward, as indicated by the arrows;

Fig. 4 is a view in transverse vertical section of the drier shown in Figs. 2 and 3, showing the same as it would appear in section taken on line 4—4 of Fig. 2;

Fig. 5 is an enlarged detail view in vertical section of the upper part of a pair of the sliding doors and their supports shown in Figs. 2 and 3, taken on line 5—5 of Fig. 2;

Fig. 6 is a view in elevation of an improved electric fan constructed in accordance with my invention, and showing the same supported in a housing on the back wall of the drier cabinet shown in Figs. 1 to 4 inclusive;

Fig. 7 is a detail view in perspective of a part of an upright wall of a drier cabinet showing an electric fan mounted in a housing on said wall and extending through an opening in the wall and adapted to cause a current of air to flow through the opening and into the interior of the cabinet, which is provided with an inner partition having a series of depending tiltable horizontal shutters or baffle plates in superposed movable relation in front of the fan and adapted to be tilted to inclined open position by the action of the air forced through and between the series of shutters by the fan and closed by the action of gravity;

Fig. 8 is a plan view of an improved electric fan constructed in accordance with my invention;

Fig. 9 is a view in elevation of the fan shown in Fig. 8, with parts omitted, and the fan-support shown in section;

Fig. 10 is a detail view in elevation of an adjustable slotted socket member of the fan shown in Figs. 8 and 9, for guiding and holding in operative position the end of the crank arm for controlling and tilting of the fan and its oscillations;

Fig. 11 is a detail view in horizontal section, taken on line 11—11 of Fig. 10, looking downward as indicated by the arrows.

In constructing an improved drier having electrically actuated means for circulating and controlling the circulation of air for drying or treating food products or other materials in accordance with my invention, I provide a cabinet or housing 1 having upright front and rear walls

2 and 3, end walls 4, a top wall or cover 5 and a bottom 6, all of which may be of any suitable or desired form and dimensions. Air inlet openings 6' are provided, by preference, in the rear wall in position to admit air into the drying chamber or chambers 8; and an air outlet opening or flue 9 in the roof or cover 5 and communicating with the upper part of the drying chamber or chambers is adapted to permit the discharge or withdrawal of air from the interior of the housing or chambers.

Suitable means is provided for admitting material to be treated to the interior of the drying chamber or chambers, and for supporting the material to be treated in position to be subjected to the action of currents of air which may be either continuous or intermittent, and for enabling the treated material to be removed with facility. In the form of the device shown in the accompanying drawings an opening or doorway is provided leading directly into the drying chamber or chambers, respectively, for admitting material to be treated and permitting the removal of the same, and a door 10 which is, by preference, slidably supported on tracks 11 by door-hangers 12, is provided for opening and closing each of said openings or doorways as required.

The means for supporting the material in the drying chamber or chambers during treatment, when constructed as shown in the accompanying drawings, comprises, by preference, a series of material-supporting trays 13 which are mounted in superposed relation upon a suitable support which is, by preference, portable and may consist of a truck 14 on supporting wheels 15 adapted to be moved into the chamber loaded with any desired number of trays or shelves containing material to be dried or treated, and is adapted to support the loaded trays within the drying chamber during the operation of drying or treating the material, and carry the treated material from the chamber. The superposed trays 13 are spaced apart by means of spacing strips or supporting members 16 which obviously may be supported either upon a movable support or truck, or upon any suitable stationary support, such, for example, as the walls of the drying chamber, or housing; and the material may be introduced into the drying chamber either through a doorway or through a chute or other ordinary and well known or suitable means, according to the nature of the material to be treated.

Mounted adjacent to the side margins of the material-supporting means or trays 13 is a series of motor-driven rotative electric fans 17, which are arranged, by preference, in spaced-apart relation to each other in a series of rows each containing a plurality of superposed fans each of which comprises an electric motor 18 mounted upon a suitable support, a rotative motor shaft 19, fan blades 20 on and rotative with said shaft, and means for connecting said motors, respectively, with a source of electric supply. The fans are, by preference, mounted in individual fan housings 21, in the upright wall 3, each of said fan housings being adapted to cover an opening 7 therein through which the corresponding fan extends. The fan housings are each provided with air inlet openings 22 which are adapted to permit air to be drawn from the outside through the housing and adjacent inlet opening 7 by the action of the fan for cooling the fan motors.

The electric fans 18 may be of any ordinary, well known or suitable form mounted upon any desired stationary or movable support and pro-

vided with suitable means for operating the fans for causing and controlling the flow of currents of air in contact with the material to be dried or treated.

The electric fans shown in the accompanying drawings are adapted to oscillate upon a vertical axis and to tilt upon a horizontal axis, and are also adapted to be operated without either oscillating or tilting, when desired.

Each of the improved electric fans shown in the accompanying drawings comprises in its construction an electric motor 18, having a motor shaft 19, and having fan blades 20 on and rotative with said shaft, as already described.

An oscillating fan-supporting frame 23 is mounted upon and adapted to oscillate upon a vertical axis with respect to a stationary support or base 24 which is rigidly secured to the wall 3 of the cabinet and, by preference, to the inside of an individual housing 21 in which the motor 20 is contained, the stationary fan-base 24 being secured to the housing by bolts 25', and the housing being rigidly secured to the cabinet wall 3 by bolts or other suitable securing means.

The oscillating fan-supporting frame 23 is connected with the stationary base 24 by means of a vertical shaft or spindle 25 which extends through suitable openings in said oscillating frame and stationary base and forms a vertical axis upon which said frame 23 is adapted to oscillate. The fan motor 18 is tiltably mounted upon upwardly projecting frame arms 26 of the yoke-shaped oscillating frame 23, by means of horizontal trunnions 27 fixed to upwardly projecting side frame arms 28 of a tiltable fan-supporting frame 29 fixed to the motor, said trunnions 27 being adapted to extend into bearings 30 on said frame arms 26.

Means is provided and connected with and adapted to be operated by the motor shaft and motor 18, for oscillating the motor on the vertical axis formed by the upright spindle 25, and for tilting the same on the horizontal axis formed by the trunnions 27, as follows:

A worm 31 is fixed to the motor shaft 19, and an upright worm shaft 32 is mounted in an upright bearing 33 in the tiltable frame 29, and provided with a worm wheel 34 fixed to said upright shaft and in toothed engagement with the worm 31 on the motor shaft. A worm 35 is fixed to the lower extremity of the upright shaft 33 and in toothed engagement with a worm wheel 36 fixed to a normally horizontal shaft 37 which is journaled in suitable bearings in the tiltable frame 29 and extends rearward from the latter as shown in Figs. 6, 8 and 9. A crank arm 38 is fixed to the rearwardly projecting end of the rotative shaft 37 and provided with a wrist pin 39 having a spherical head 40 on its outer end which is mounted in a socket 41 formed, by preference, in a sliding bearing block 42.

Means is provided for supporting the socket member or bearing block 42 in operative position, which consists, by preference, of a pair of upright slotted metallic plates 43 and 44 which are supported in parallel relation to each other upon a stationary upright frame member or plate 45 rigidly secured to the stationary base 24 by a bottom horizontal flange fixed to the frame member 45 and securing screws 47 which extend through suitable openings in said flange and are anchored in the base. The plate or disc 43 is provided with a transverse slot 48 extending part way across the center of the plate; and the plate or disc 44 is provided with a similar transverse

slot 49 extending transversely across the central part thereof, said plates being supported in adjustable relation to each other by peripheral supporting flanges 50 on the stationary upright frame member 45, which flanges are adapted to overlap and slidably engage the peripheral margins of the slotted plates or discs 43 and 44 and permit the partial rotation of the same relatively to each other to different adjusted positions. (See Figs. 6, 8 and 10.)

The sliding block or socket member 42 in which the spherical head 40 on the crank arm 38 is rotatively supported, extends into and is supported by the transverse slots 48 and 49 in the relatively adjustable plates 43 and 44. Said plates are adapted to be adjusted relatively to each other to the extent of 90 degrees by partially rotating either of said plates while the other is stationary. In order to facilitate such adjustment the plate 43 is provided with a projecting peripheral arm 51, and the plate 44 with a similar projecting arm 52. By adjusting the concentric plates to the position shown in Fig. 10 slot 48 in plate 43 will be horizontal, while slot 49 in plate 44 is vertical, or extending at an angle of 90 degrees relatively to slot 48. The sliding bearing block 42 is thus held stationary at the center of said concentric plates and extends through both of the intersecting slots which thus intersect each other at the axial center of said plates or discs. By partially rotating the plate 43 with its slot 48 through a 90 degree arc the slots 48 and 49 will both be in the same vertical plane, and will register with each other, so that the sliding bearing block will be free to move upward and downward within said slots during the operation of the motor driven fan, thus causing the fan to oscillate with the oscillating fan-supporting frame 23 upon a vertical axis formed by the upright spindle 25. By partially rotating the plate or disc 44 with its slot 49 from the position in which it is shown in Fig. 10 through a 90 degree arc, the slot 49 in said plate will be brought to horizontal position in the same horizontal plane with slot 48 in disc 43. The sliding bearing block 42 with the spherical head 40 of the wrist pin 39 on the crank arm 38 journaled in said bearing block, will thus be free to move lengthwise of said horizontal slots in a horizontal plane and will be prevented from moving in other directions by said concentric slotted plates during the operation of the motor driven fan while said slotted plates are in said last mentioned adjusted position. The motor and fan will thus be caused to tilt upon the horizontal transverse axis formed by the horizontal trunnions 27.

Electrically actuated means is provided and operatively connected with the electric fans and fan motors for actuating the same as follows:

An automatic electrically actuated circuit controller 53 is provided which comprises in its construction a rotative collector drum or equivalent element 54, which is rotatively mounted in a suitable supporting frame 55 upon an axle 56 which is journaled in suitable bearings 57 and suitably insulated from its support. The axle or drum is operatively connected with suitable driving means, such, for example, as an electric motor 58, having a motor shaft 59, by means of a suitable train of gears or connecting means, which in the form shown in the drawings, comprises a belt pulley 60 fixed to the motor shaft, and a belt pulley 61 fixed to a rotative worm shaft 62 which is journaled in suitable bearings in a gear casing 63 on or forming part of said frame 55. The worm

shaft 62 is operatively connected with the axle 56 on the drum by means of a worm wheel and worm—not shown—located in the gear casing 63 and fixed to the said shaft and axle, respectively, and in operative engagement with each other. A belt 67 is mounted on and operatively connects said pulleys and thereby the shafts 59 and 62.

A contactor ring 68 is fixed to and completely encircles the drum 54 and is adapted to make electrical connection with a brush 69 which is electrically connected with a positive line 70 by means of a feed wire 71.

Mounted on the periphery of the drum 54 is a series of peripheral outwardly projecting segmental contactors 72, 73, 74, 75 and 76, each of which is, by preference, secured in circumferentially adjustable relation to the rotative drum by means of headed securing screws or bolts 77 which are mounted in perforations in the respective segmental contactors and extend into circumferential peripheral slots 78 in the periphery of the drum. The slots 78 are parallel to each other and may be of any desired length. The segmental contactors on the drum are thus adapted to be adjusted relatively to each other circumferentially of the drum and secured in any desired adjusted position. Mounted adjacent to the periphery of the rotative drum upon an insulating supporting bar 79 is a series of flexible stationary brushes each of which is adapted to be electrically connected with one or more of the fan motors 18 and with a source of electric supply, there being one of said brushes and a corresponding segmental drum contactor for each fan or individual group of fans and fan motors to be intermittently actuated or stopped and started by the making and breaking of the circuit controlled by the respective segmental contactors and the corresponding brushes which are adapted to be engaged and disengaged by said contactors, respectively.

For example, the series of brushes shown in Fig. 1 comprises stationary brushes or contact members 80, 81, 82, 83 and 84, and as many more as may be desired, each of which is adapted to extend into the path of movement of a corresponding segmental contactor on the drum. The brush 80 extends into the path of movement of the drum contactor 72, and is electrically connected with all of the fan motors 18 contained in the first group or vertical row of three fans shown at the right of Fig. 1, by a connecting wire 85 leading from said brush to one of the poles of the top fan motor in said group, a connecting wire 86 leading from the opposite pole of said fan motor to a negative line wire 87 or source of electric supply, and branch wires 88 and 89 which connect said wires 85 and 86 with the poles of the second and third fan motors 18 in said group.

The brush 81 extends into the path of movement of the drum contactor 73 and is electrically connected with the plurality of fans 18 contained in the second group or vertical row of two fans shown in Fig. 1, reading from the right, by a connecting wire 90 which leads from said brush to the top fan motor in said group, a connecting wire 91 which leads from the opposite pole of said motor and is connected with the negative line 87 by wire 86 and a switch 92 and branch wires 93 which connect said wires 90 and 91 with the poles of the second fan motor contained in said last mentioned group of fans.

The brush 82 extends into the path of movement of the drum contactor 74, and is electrically connected with all of the fan motors 18 contained

in the next group or vertical row of superposed fans and fan motors to that last described, by a connecting wire 94, which leads from said brush to one of the poles of the top fan motor in said group, a wire 95 which leads from the opposite pole of said fan motor, and is connected with the negative line wire 87 by wire 86 and switch 92, and branch wires 96 and 97 which connect said wires 94 and 95 with the other two fan motors, respectively, contained in said group or vertical row of three superposed fans.

The brush 83 extends into the path of drum contactor 75, and is electrically connected with the fan motors 18 in the next group or vertical row of superposed fans and fan motors located to the left of the group last described, by a connecting wire 98, which leads from said brush to one of the poles of the top fan motor in said group, a return wire 99 which leads from the opposite pole of said motor and is connected with the negative line wire 87 by wire 86 and switch 92, and branch wires 100 which connect said wires 98 and 99 with the respective poles of the other fan motor in said group of two superposed fans.

The brush 84 extends into the path of the drum contactor 76, and is electrically connected with all of the fan motors 18 contained in the first group to the left in Fig. 1, by a connecting wire 101, which leads from said brush to one of the poles of the top fan motor in said group, a wire 102 which leads from the opposite pole of said fan motor and is connected with the negative line wire 87 by wire 86 and switch 92, and branch wires 103 and 104 which connect said wires 101 and 102 with the other two fan motors, respectively, contained in said group or vertical row of three superposed fans.

The motor 58 is connected with the source of electric supply by a feed wire 105 which is connected with one of the poles of said motor and with the wire 71 which is adapted to be connected with and disconnected from the positive line wire 70 by the switch 92; and a return wire 106 is connected with the opposite pole of the motor 58 and adapted to be connected with the negative line wire 87 by the switch 92.

Suitable heating means is provided for heating the drier chamber or chambers: For example, steam coils 107 are arranged lengthwise of the drying chamber or chambers and are connected with a suitable source of steam supply. The steam coils are, by preference, located near the bottom of the drying chamber on the same side of the chamber which contains the electric fans and are adapted to heat the air as it passes from the fans which force the air transversely across the heating chamber and into contact with the superposed layers of material to be treated, and into and through the spaces between the layers of material, and finally upward and outward through the air outlet or flue 9 at the top of the heating chamber and on the opposite side of said chamber from the fans.

From the foregoing description it will be readily understood that the motor-driven fans of each group or vertical row of superposed fans is operatively connected with and adapted to be actuated intermittently by electrically actuated means, which, in this instance, comprises the automatic electric circuit controller 53; and that the circuit controller is adapted to automatically actuate the fans contained in each group or row of superposed motor-driven fans intermittently and in successive, or any desired, predetermined order relatively to the operation of the fans con-

tained in the other group or row of superposed fans respectively.

It should be noted that when the fans are so operated in groups intermittently and progressively in successive predetermined order, or consecutively in the order in which the fans are arranged in rows lengthwise of the drying chamber or chambers, the effect of such operation will be to cause a current or currents of air to flow into contact with the material to be treated and across the drying chamber and to shift the current sidewise progressively lengthwise of the chamber and the superposed layers of material to be treated. The sidewise movement of such air current or currents will occur and shift progressively in front of the revolving fans concurrently with the progressive consecutive operation of the fans in progressive and consecutive order lengthwise of the drying chamber, while the air in front of the idle fans remains stationary or moves in a different direction.

The material to be treated is thus subjected, by preference, to the action of currents of air moving into contact with the material and air which is stationary or moving at relatively lower speed alternately. Moisture from the interior of the material is thus caused to exude and accumulate on the surface of the material during the intervals in which the air in contact with the material is stationary or moving at a relatively slow speed; and the moisture thus removed from and accumulated on the surface of the material is absorbed and carried off by the intermittent currents of air.

It is also to be noted that the motor-driven fans are adapted to remain stationary while in operation or to be oscillated either horizontally or vertically, or both horizontally and vertically, as desired.

In order to cause the fans to remain stationary while in operation, it is only necessary to disconnect the motor shaft from the oscillating and tilting mechanism. This may be accomplished by removing the tapered pin 108 which normally secures the worm 31 to the motor shaft 19, thus permitting the motor shaft and fan to rotate while out of operative engagement with the worm and worm wheel mechanism for operating the crank shaft 37 which is thus allowed to remain stationary in any desired position.

In Fig. 7, an inner upright partition 109 is shown, arranged parallel to and spaced apart from the wall 3 which supports the fans. This partition is interposed between the fans and the drying chamber which contains the heating coils and the material to be treated, and is provided with a window in front of each fan, each window having a series of superposed tiltable shutters 110 which normally extend downward from horizontal supporting axles 111 journaled in supporting bearings at the opposite ends of said shutters. The shutters are adapted to be tilted inward and away from the fans to inclined open position by the currents of air which are forced between the shutters by the fans whenever the current is sufficiently strong to tilt and open the shutters.

I claim:

1. In a device of the character described, the combination with a substantially enclosed housing defining an air conditioning chamber for the supported confinement of materials to be treated, of a plurality of fans journaled for rotation within said conditioning chamber, motors operatively connected to each of said fans, said motors having fixed mounts attached to said housing for

supporting said motors exteriorly of said conditioning chamber, and means for sequentially controlling the operation of said motors to direct an intermittent flow of air in the path of materials to be treated.

2. In a device of the character described, the combination with a substantially enclosed housing defining an air conditioning chamber for the supported confinement of materials to be treated, of a plurality of fans journaled for rotation within said conditioning chamber, said fans being arranged in successive vertical series along a wall of said housing, motors operatively connected to each of said fans, said motors having fixed mounts attached to said housing for supporting said motors exteriorly of said conditioning chamber, and means for sequentially controlling the operation of each series of said motors to direct an intermittent flow of air in the path of materials to be treated.

3. In a device of the character described, the combination with a substantially enclosed housing defining an air conditioning chamber for the supported confinement of materials to be treated, of a plurality of fans journaled for rotation within said conditioning chamber, said fans being arranged in successive vertical series along a wall of said housing, motors operatively connected to each of said fans, said motors having fixed mounts attached to said housing for supporting said motors exteriorly of said conditioning chamber, there being means on said mounts for enabling the passage of air therethrough to said conditioning chamber, and means for sequentially controlling the operation of each series of said motors to direct an intermittent flow of air in the path of materials to be treated.

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