

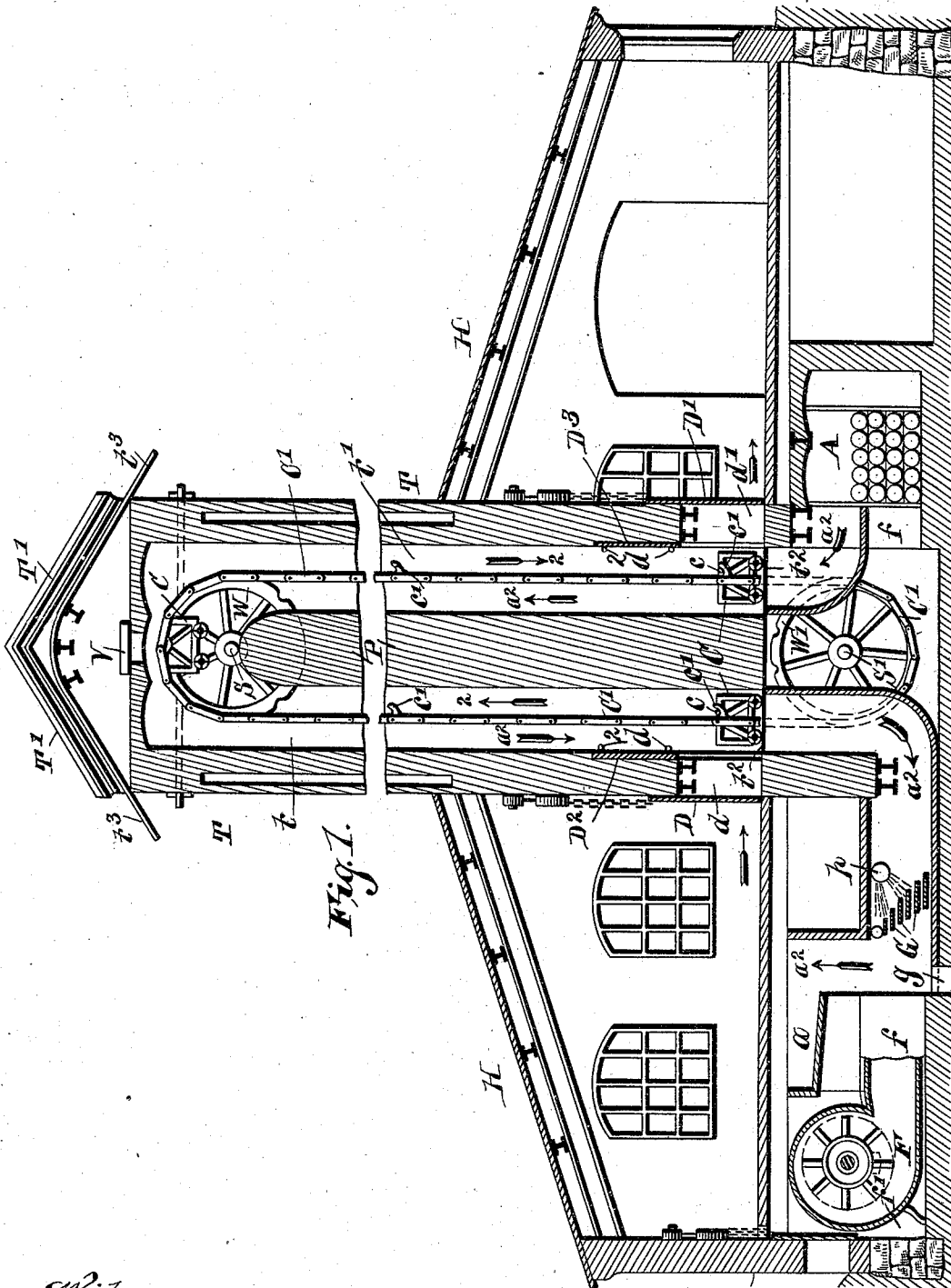
(No Model.)

3 Sheets—Sheet 1.

F. HIORTH.
DRYING APPARATUS.

No. 550,681.

Patented Dec. 3, 1895.



Witnesses:
H. G. Winterich
Henry Orth

Inventor:
Fredrik Hiorth
by Henry M. Th. Att'y

(No Model.)

3 Sheets—Sheet 2.

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Fig. 2.

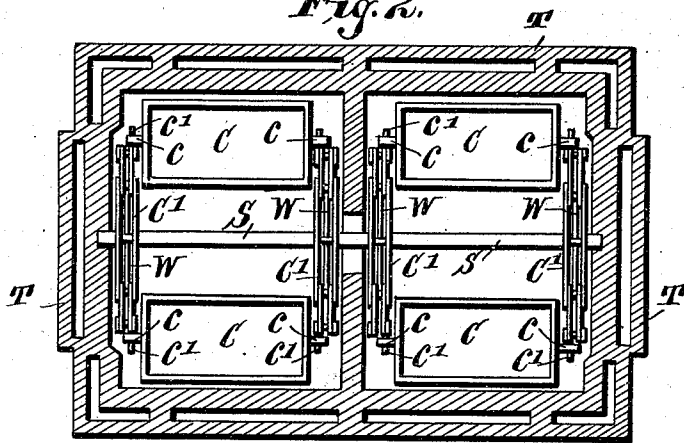
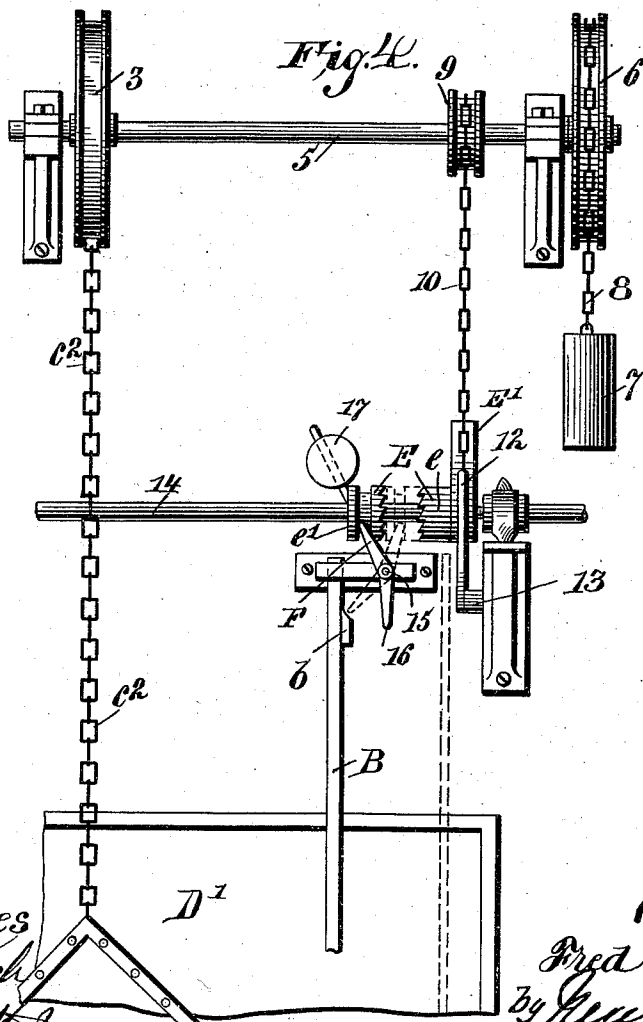


Fig. 4.



Witnesses

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(No Model.)

3 Sheets—Sheet 3.

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Fig. 3.

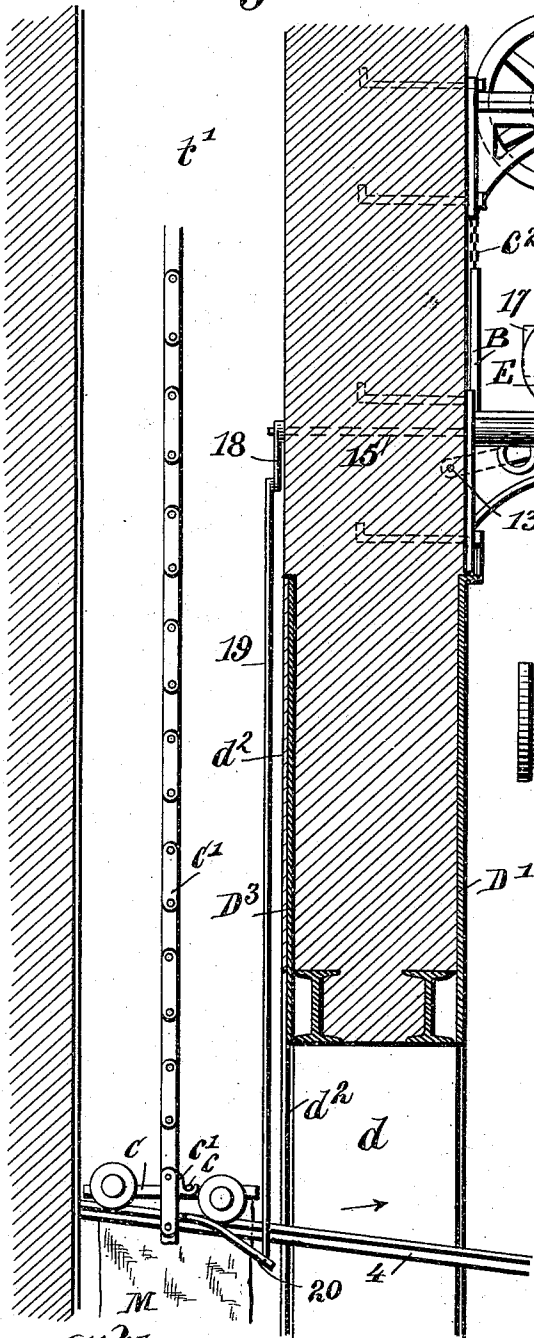


Fig. 7.

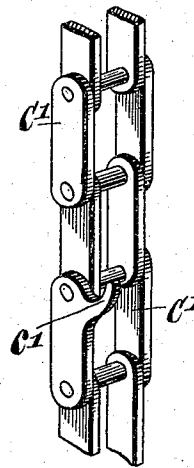


Fig. 5.

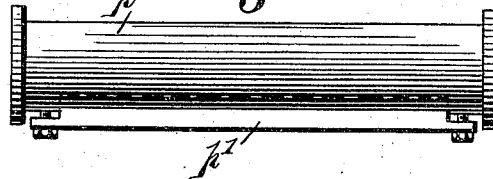
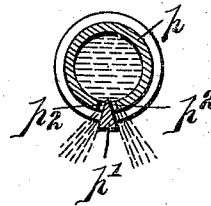


Fig. 6.



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UNITED STATES PATENT OFFICE.

FREDRIK HIORTH, OF CHRISTIANIA, NORWAY.

DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 550,681, dated December 3, 1895.

Application filed May 7, 1894. Serial No. 510,294. (No model.) Patented in Norway February 22, 1894, No. 3,682; in Sweden April 6, 1894, No. 6,294; in Germany April 21, 1894, No. 80,611; in Switzerland April 23, 1894, No. 8,522; in France April 23, 1894, No. 237,978; in Austria June 5, 1894, No. 3,179; in Canada June 7, 1894, No. 46,281; in Hungary June 26, 1894, No. 682, and in Finland December 7, 1894, No. 536.

To all whom it may concern:

Be it known that I, FREDRIK HIORTH, a subject of the King of Sweden and Norway, residing at Christiania, Norway, have invented certain new and useful Improvements in Drying Apparatus, (for which patents have been obtained in Norway, No. 3,682, dated February 22, 1894; in Sweden, No. 6,294, dated April 6, 1894; in Germany, No. 80,611, dated April 21, 1894; in Austria, No. 3,179, dated June 5, 1894; in Hungary, No. 682, dated June 26, 1894; in Switzerland, No. 8,522, dated April 23, 1894; in France, No. 237,978, dated April 23, 1894; in Finland, No. 536, dated December 7, 1894, and in Canada, No. 46,281, dated June 7, 1894;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

My invention has relation to drying kilns or apparatus in which the material to be dried is caused to travel or is propelled through heated chambers, passages, or flues; and it has for its object the provision of means whereby any substance or material, whether in a granular state or in the form of a sheet or plate or in the form of fashioned objects, may be thoroughly desiccated or dried by simply providing a suitable carrier for the material. Thus, for instance, fibrous materials in the form of sheets or plates—as textiles, paper, pasteboard, or sheets of cellulose, &c.,—as well as granular materials or objects of wood or other materials can be thoroughly dried or desiccated, while the apparatus can also be used for smoking flesh and fish by such alterations of construction as the circumstances may require and which can be made without requiring inventive genius; but that my invention may be fully understood I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical sectional elevation of a dry-house, illustrating my invention. Fig.

2 is a cross-section illustrating a modification in the construction of the tower. Figs. 3 and 4 are detail sectional views illustrating means for automatically opening and closing the charging and discharging doors. Fig. 5 is a detail elevation of the spray-pipe. Fig. 6 is a cross-section thereof, and Fig. 7 is a detail view of a portion of the propelling-chain.

Similar symbols of reference indicate like parts wherever such may occur in the figures of drawings just described.

Centrally of a suitable structure H rises a tower T, divided into two vertical flues *t* and *t'* by a partition P, that does not extend quite to the top of the said tower. At the foot of each shaft is laid a track *t*² for the wheeled carriers C, that contain or support the material to be desiccated or dried. In Fig. 1 I have shown these carriers as composed of a framed structure mounted on wheels, the opposite upper side rails of the frame being provided with journals *c*, adapted to be engaged by hooks *c'* on the endless carrier and propeller chains C', Fig. 7, said hooks being preferably secured to the chain-pivots at suitable distances apart in such manner that the carrier will be suspended between the two propeller-chains, as more plainly shown in Fig. 2.

The construction of carriers, as will be readily understood, will vary in accordance with the material to be dried, and the carrier C (shown in Fig. 1) is here merely given as an example, a carrier more especially adapted for the reception and carriage of materials in sheet form being shown in Fig. 3, also, as an example.

Above and below the partition-wall P bearings are provided for two shafts S and S', respectively, each having secured thereto two sprocket-wheels W W and W' W' for the two Galle chains C', motion being imparted to the lower shaft S' in any suitable manner and from any suitable motor.

The flute *t'* of tower T is connected at its foot with an air-heating chamber A, that is connected with the blast-duct *f* of a suction and blast-fan F, located in a suction chamber or housing *f'*, that is connected with a passage or

trunk *a* with the lower end of flute *t* of said tower T.

In the passage *a* between its inlet and outlet is arranged a grate G, and between said grate and the inlet of the said passage are arranged one or more spray-pipes *p*, (shown in detail in Figs. 5 and 6,) said pipe having a longitudinal slot that is wedge-shaped in cross-section, and in said slot is adjustably fitted a correspondingly-shaped regulating-bar *p'*. It is evident that when the bar *p'* is adjusted inwardly or outwardly, passages *p*² of greater or less cross-sectional area will be formed between the sides of the bar and the walls of the slot, so that the volume of water flowing through said passages is readily regulated, the water being supplied to the pipe under sufficient pressure to issue from the said passages in a more or less sprayed condition. The pipe is so arranged that the jet thereof is directed onto the grate G, the water flowing from the passage into a drainage-gutter *g*. The object of spraying the water into the passage G and preferably onto a series of plates arranged stepwise to form a grate G is to provide means for condensing the moisture from the materials to be desiccated or dried and taken up and carried along by the air-current, the said grate performing the function of a condenser over which the air from the flue *t* is caused to pass before it can reach the suction-chamber *f'* for the fan F.

The operation of the apparatus is as follows: The material to be desiccated or dried being placed on or suspended from suitable wheeled carriers, the latter are run one after another through doorway *d* onto the track *t*² at the foot of flue *t*, and as the propeller-chains *C'* move in the direction of arrow 2 or upwardly in said flue the hooks *c'* thereon will engage the journals *c* on the carriers and carry the same along until they reach the track *t*² at the foot of flue *t*, the propeller-chain *C'*, moving downwardly in the latter flue, the hooks will become disengaged from the journals *c'* on the carrier, so that the latter can be moved out of said flue *t'* through doorway *d'*, as many carriers as the chains will accommodate being brought into the path of its hooks until finally one carrier is introduced through doorway *d*, and at the same time another is removed through doorway *d'*, the fan F being of course set in motion and heat supplied to chamber A and the condensing-spray device supplied with water under a suitable head before the carriers are run into the tower. It will be seen that there is a continuous circulation of hot air from the heating-chamber A through flue *t'* and flue *t*, as indicated by arrows 2^a in Fig. 1, to the fan and back to said heating-chamber, and that the moisture taken up by the hot-air current is condensed by the cooled surfaces of the grate G, over which said air-current passes before it reaches the fan. It will further be seen that the materials travel from doorway *d* to doorway *d'*, or in a direction the reverse of that of the hot-air current, so as to un-

dergo a gradual deprivation of moisture, the air being gradually cooled on its way through the flues. Furthermore, by suitably speeding the chain-shaft S' or periodically stopping its motion the material in or on the carriers may be exposed to the action of the drying-current any desired length of time, or in accordance with the degree of moisture contained in said material, and any degree of heat up to a torrefying temperature may be employed. Finally, instead of hot air, cold air, or other heated gases may be used, or smoke from suitable materials may be caused to circulate through the flues for the purpose of smoking flesh or fish or other materials.

Instead of one pair of flues *t* and *t'* the tower may be so constructed as to contain four or more pairs of such, and in Fig. 2 I have shown a tower containing two pair of flues, the sets of chain sprocket-wheels W and W' for the chains of both sets of flues being secured on common shafts.

When readily inflammable materials are to be dried at high temperatures—as, for instance, varnished sheets or wares—as well as to guard against fire being communicated to the dry-house and materials stored therein from the tower-flues, I protect the door-openings *d* and *d'* both outside and inside with doors D D² and D' D³, respectively, made of fire-proof material—as sheet metal, for instance. The inner doors D² D³ are kept normally open and are held in guide-rails *d*² by means of a suitable metal or alloy or solder that will fuse or melt at such temperatures as would result in case of fire and allow the said inner doors to drop and close the door-openings from the inside. The outer doors are provided chiefly for preventing the influx of large volumes of air from the dry-house that would tend to cool the hot air circulating through the flues, and I provide means whereby the opening and closing of the said outer doors is controlled by the carriers, as will be explained presently.

To prevent an injurious accumulation of gases within the tower-flues *t* and *t'*, in case the material therein should become ignited, I form in the closed top of the tower an escape-port normally closed by a valve V, constructed of a fireproof material, and provide within the open-sided or open-ended topping cone T' of the tower a metallic protecting plate or shield *t*³ to protect the topping of the tower, as shown in Fig. 1.

The mechanism for automatically opening the outer doors D and D' for the openings *d* and *d'*, and the means for controlling the opening and closing of said doors through the medium of the carriers C, is as follows, reference being had to Figs. 3 and 4, in which I have shown said mechanism as applied to the door D' of the exit-opening *d'* of flue *t'*, said mechanism being controlled by a carrier of such a construction as to adapt materials M in sheet form to be suspended thereto, the track 4, on

which the carriers C are run out, being suitably elevated above the floor of the drying-house for the purpose.

The outer door D' is suspended by a chain 5 c² from a grooved pulley or sheave 3 on a shaft 5, that carries at its other end a like pulley 6, from which a counterweight 7 is suspended by a chain 8, and intermediate of said pulleys the said shaft carries a similar smaller pulley 10 9, connected by a chain 10 to the free end of an arm 12, adapted to rock or vibrate on a suitable fixed pivot 13. It is obvious that when the arm 12 is depressed the shaft 5 will be revolved, causing the chain c² to wind on pulley 3 and thereby lift the door D', the counterweight 7 assisting in rotating the said shaft 5, and that when the arm 12 is again released the door D' will drop of its own weight to close the door-opening d'. The arm 12 is actuated 20 by devices controlled by the carrier C, and these devices consist of a continuously-revolving shaft 14, that carries a clutch-coupling E, one half or section, e, of which is loose on said shaft, while the other, e', revolves therewith 25 and has endwise motion thereon in a well-known manner. The clutch-section e' is normally disengaged from the section e and is in perpetual engagement with a shifting-fork F, arranged radially on a shaft 15, that also has 30 a radial arm 16 and a radial weighted arm 17. At its inner end within the flue t' the said shaft 15 has a crank 18, to the wrist-pin of which is connected a rod 19, that extends downwardly in said flue a proper distance and terminates 35 in an arm 20, adapted to be engaged by the carrier in its downward movement to the track 4 and carry the said rod along with it, thereby imparting a half-revolution or thereabouts to the shaft 15 in such direction as to cause the 40 coupling-section e' to be moved into engagement with the coupling-section e, and lock the same to the continuously-revolving shaft 14. On the said shaft 14 is loosely mounted a cam or eccentric E', rigidly secured to or formed integral with the clutch-section e, the said cam or 45 eccentric having bearing on the arm 12 in such manner that said arm will be depressed by the cam or eccentric, thereby lifting the door D' through the instrumentalities hereinabove 50 described. The arrangement of the connecting or actuating rod 19 relatively to the carrier C is such that said rod will be fully depressed and the door D' lifted to uncover the doorway d' as soon as the carrier reaches the 55 track 4, and as the chain C' is in continuous downward motion in flue t', said carrier will be instantly released by the chain-hooks, and will then automatically run out of flue t' on track 4, thereby releasing rod 19. As the cam or eccentric E' continues to revolve with shaft 14, the arm 12 is again released and the door D' drops of its own weight into its normal position. To the said door is secured a bar B, that has a projecting lug b, which lies in the 65 path of the radial arm 16 on shaft 15 when the clutch-sections are in engagement, as shown in dotted lines in Fig. 4, and as the door D'

drops the said lug or projection engages the said arm to rock the shaft 15 back to its normal position, whereby the clutch-section e' is 70 again disengaged from the section e, the rocking motion of the shaft 15 in one or the other direction being assisted and accelerated by the weighted arm 17.

By means of the mechanism described the 75 outer door D for the doorway d may also be automatically operated by suitably locating the arm 20 of rod 19, or connecting the said rod with devices located outside of the flue t, or by locating the shaft 15 outside of said 80 flue, so that when a carrier is run to the said door the rod 19 will be moved downwardly to the required extent to set in motion the door-lifting mechanism described, said rod being released the moment the carrier is 85 within the flue t ready to be hooked to the ascending propeller-chain C', such arrangements being clearly within the province of any skilled mechanic.

Finally, I may observe that the flues t and 90 t', instead of being vertical, may be arranged horizontally.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. A drier comprising a tower divided vertically into two flues communicating at their upper end only, each of said flues provided with a doorway at its lower end, a return air flue below the tower connected with the lower 100 ends of the flues therein, a suction and blast apparatus interposed in the receiving portion of said return flue, an air heater interposed in the delivery portion thereof, and a condenser interposed in said receiving portion 105 of the return flue between one of the tower flues and the suction and blast apparatus, in combination with a carrier, and chain propelling devices adapted to propel the carrier from the lower end of one of the tower flues to the like end of the other, substantially as and for the purpose set forth. 110

2. A drier comprising two parallel flues communicating with each other at one end and provided with a door at their opposite end, a 115 carrier for the material to be dried, and a propeller operating to propel the carrier from one door to the other, of a lifting mechanism controlled by the carrier and operating to lift said door when said carrier approaches the 120 same, and a releasing mechanism operating to throw the lifting mechanism out of operation and allow the door to drop, for the purpose set forth.

3. The combination with the door D', of a 125 lifting mechanism comprising a counter-weighted rock shaft from which said door is hung, an actuating arm connected with said shaft, and an actuating cam having bearing on said arm, of means for imparting motion 130 to said cam intermittently, substantially as and for the purpose set forth.

4. The combination with the door D', a counter-weighted rock-shaft from which said door

is hung, and an actuating arm connected with and adapted to rock said shaft, of a continuously revoluble shaft, a cam or eccentric provided with a clutch face loose on said shaft
5 and having bearing on the actuating arm, a clutch revoluble with and adapted to slide on the shaft, said clutch normally out of engagement with the clutch face on the cam, a rock shaft, a shifting fork thereon in perpetual engagement with the clutch, and means for imparting a rocking motion to said shaft, as a crank, substantially as and for the purpose set forth.

5. The combination with the door D', a bar
15 B secured thereto and provided with a projection b, a counterweighted rock shaft from which said door is hung, and an actuating arm connected with and adapted to rock said shaft, of a continuously revoluble shaft, a cam or
20 eccentric provided with a clutch face loose on said shaft and having bearing on the actuating arm, a clutch revoluble with and adapted to slide on the shaft, said clutch normally out of engagement with the clutch face on the cam, a rock shaft, a shifting fork thereon
25 in perpetual engagement with the clutch, a radial arm on said shaft lying in the path of the projection b on the door D' when the clutch is in engagement with the clutch face of the

cam, and means for imparting a rocking motion to said shaft, as a crank, substantially as and for the purpose set forth. 30

6. A drier comprising two parallel flues communicating with each other at one end and provided with a door at their opposite
35 end, a carrier for the material to be dried, and a propeller operating to propel the carrier from one door to the other; of a lifting mechanism controlled by the carrier and operating to lift said door when said carrier approaches
40 the same, for the purpose set forth.

7. A drier comprising a shaft provided with an exit at its foot normally closed by a suitable door, and an inclined track extending into the shaft through said door; of an
45 endless chain propeller within the shaft, a wheeled carrier adapted to be connected with said propeller and means controlled by the carrier and propeller respectively adapted to lift the door and release the carrier when the
50 latter has reached the inclined track, for the purpose set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

FREDRIK HIORTH.

Witnesses:

ALPA J. BRYON,
JOH. VAALER.