

(No Model.)

3 Sheets—Sheet 1.

A. EDWARDS.
Drying Apparatus.

No. 240,581.

Patented April 26, 1881.

Fig. 1.

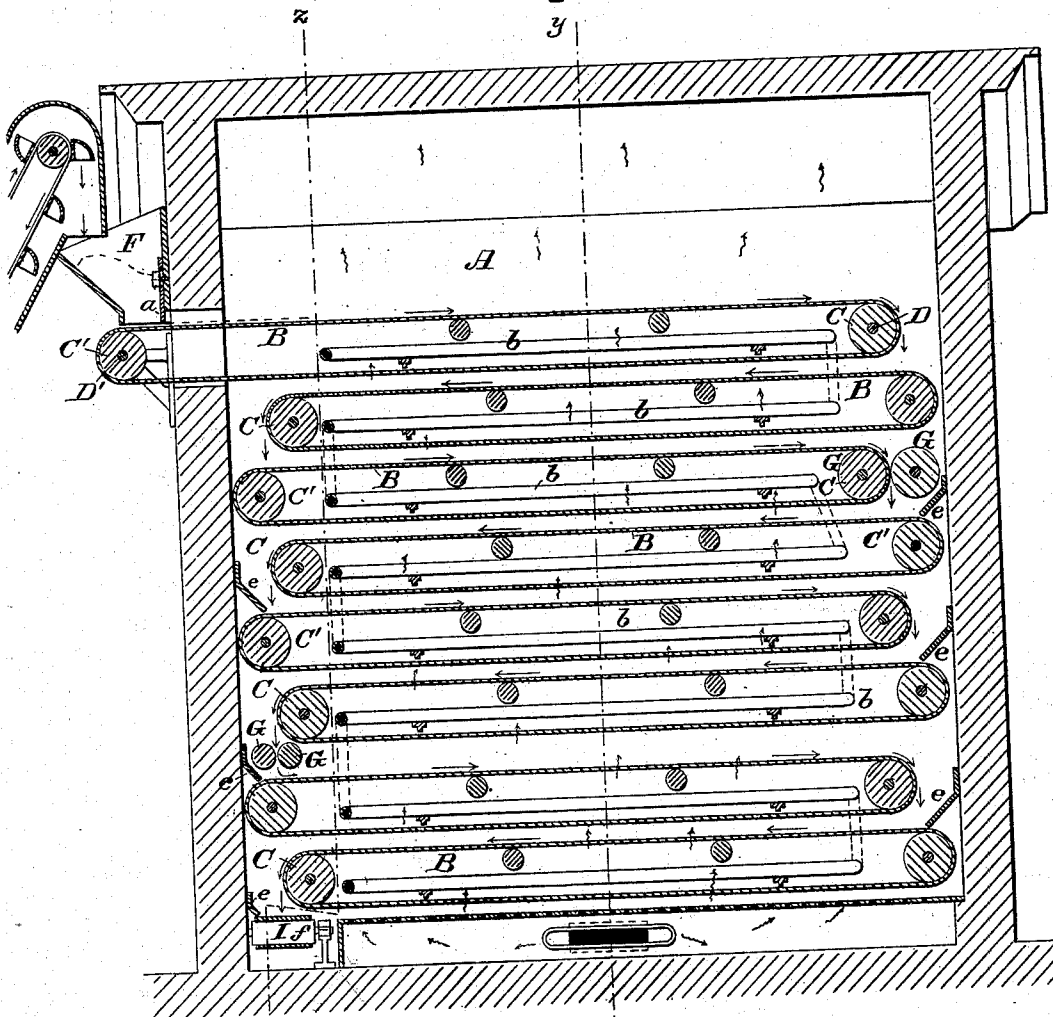


Fig. 4.

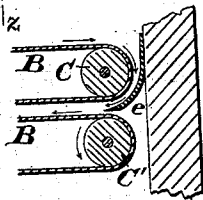
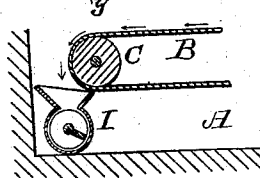


Fig. 5.

INVENTOR:

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By his Attorneys,

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(No Model.)

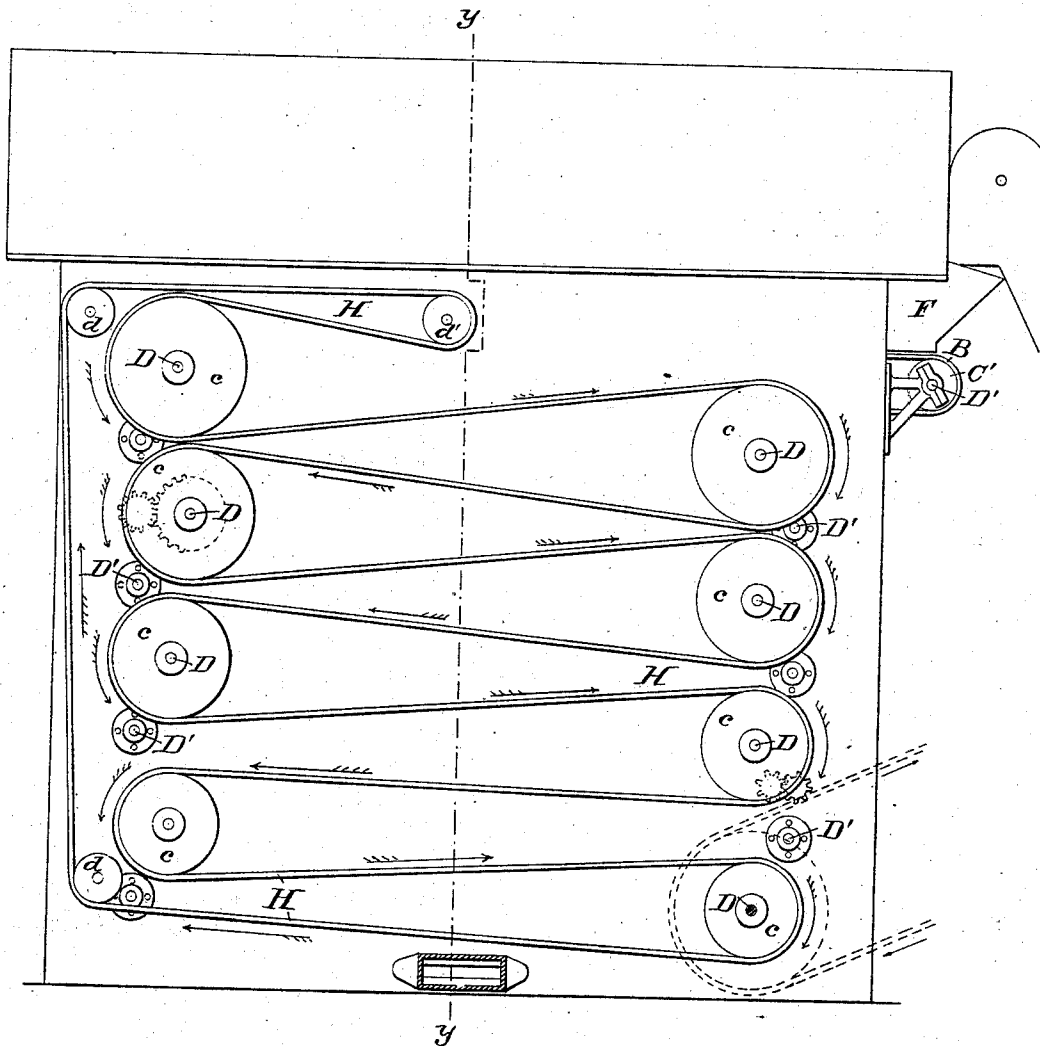
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Fig. 2.



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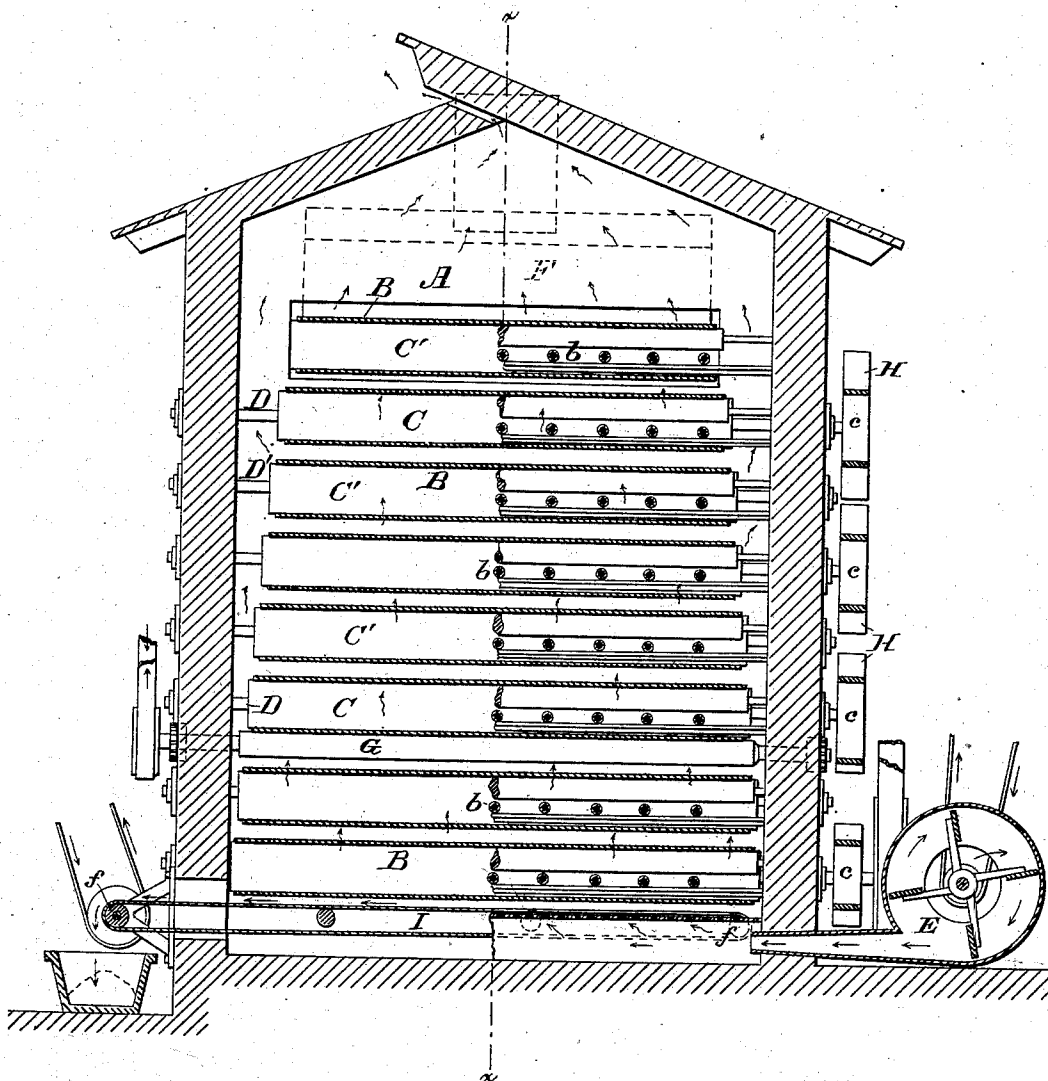
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Fig. 3.



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UNITED STATES PATENT OFFICE.

ALFRED EDWARDS, OF NEW HAVEN, CONNECTICUT.

DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 240,581, dated April 26, 1881.

Application filed June 25, 1880. (No model.)

To all whom it may concern:

Be it known that I, ALFRED EDWARDS, a citizen of the United States, residing in the city and county of New Haven, and State of Connecticut, have invented certain Improvements in Drying Apparatus, of which the following is a specification.

My invention relates to drying apparatus wherein a continuous layer of the substance to be dried is carried back and forth on endless aprons through a closed drying-chamber and subjected to the action of heat and of a current of air. The invention consists in several improvements upon the apparatus of this character, their principal object being to render the process of drying more rapid, thorough, and uniform than heretofore.

My improved drier is intended most especially for grain, starch, guano, hops, and some kinds of fruit; but it is also adapted for drying many other materials and substances.

In the accompanying drawings, Figure 1 is a vertical mid-section of my apparatus, taken in the plane of the line *xx* in Fig. 3. Fig. 2 is a side elevation, looking in the opposite direction from Fig. 1. Fig. 3 is a vertical section taken at right angles to Fig. 1, the right half being in the plane of the line *yy* and the left half in the plane of the line *zz*; and Figs. 4 and 5 are fragmentary sections taken in the same plane as Fig. 1, and showing modifications.

A is the drying-chamber, and B B are two or more endless aprons, arranged horizontally therein, one above another, and each carried by two pulleys, C and C', mounted on shafts D and D', which have bearings in the walls of the chamber or elsewhere, as most convenient. The aprons revolve in alternately opposite directions, the pulley C and its shaft D being arranged at the end of each apron toward which its upper side travels, and the pulley C' and shaft D' at the opposite end. Thus the pulleys C C' are arranged at alternately opposite sides or ends of the drying-chamber. The aprons are of considerable width, are preferably of pervious material, and have sufficient strength to enable them to carry a layer of the substance to be dried.

Fig. 2 shows the means by which the aprons B B are driven. One end of each shaft D is extended beyond the wall of the drying-cham-

ber, and bears a belt-pulley, *e*, and the several pulleys *e e* are all engaged by one belt, H, which passes around each, and extends from each to the next one opposite, being conveyed from the top one to the bottom one over guide-pulleys *d d*, and in case an even number of aprons is employed, as shown, passing also around an additional guide-pulley, *d'*, in place of over the pulley *e* of another apron. Power is applied to any of the shafts D, but preferably to the lower one, as shown. The aprons being set in motion, a continuous layer of the substance to be dried is fed to the upper apron and carried thereby toward its pulley C; and as it bends around said pulley the layer is dropped onto the next apron below near its pulley C', and this apron carries it back underneath the first and drops it onto the third, it being thus carried back and forth through the chamber and dropped at each end thereof until it falls from the delivering end of the bottom apron and is received in a suitable receptacle. In falling from one apron to another the substance is agitated and re-arranged.

So far as described there is no present novelty in this apparatus.

In addition to the parts already described, I have provided my machine with a series of heating devices, *b b*, preferably in the form of steam-coils, one of which is arranged within or directly beneath each of the aprons B, with a blower, E, arranged to force air into the chamber A at its bottom, and with a feeding apparatus for distributing the substance to be dried onto the uppermost apron in a continuous layer of uniform thickness, this device consisting of a hopper, F, whose mouth opens directly on top of said apron, provided with a spreader-blade, *a*, which is vertically adjustable, to regulate the thickness of the layer.

The operation is as follows: The movement of the upper apron draws out the substance to be dried from the hopper and under the blade *a* in a continuous layer, which layer is carried back and forth through the chamber on the aprons and dropped from one to another, as above described. As the layer descends it is heated by the several heating devices *b* successively, whereby its moisture is vaporized and driven out, and this moisture is absorbed by the ascending current of air from the blower.

This current of air enters the chamber cold, and is heated by the coils *b b*, and as it rises and successively encounters the several coils its temperature is successively raised in proportion as it encounters the successively moister portions of the substance under treatment. The speed of the aprons, the degree of heat, and the thickness of the layer are so proportioned that in passing once through the apparatus the substance will be entirely or sufficiently dried. As it falls from the bottom apron it is received in or on a conveyer, *I*, which carries it to the side of the machine and dumps it into a receptacle. I have shown this conveyer as of two forms—an endless revolving belt borne on pulleys *ff* being shown in Figs. 1 and 3, and a revolving screw working in a cylindrical hopper-mouthed case being shown in Fig. 5.

To insure the proper passage of the substance from one apron to the next the delivering-pulleys *C* of the several aprons may be set nearer the middle of the apparatus than the pulleys *C'*, as shown in Fig. 1; or the pulleys *C* and *C'* may be in the same vertical plane, and a guard-plate or chute, *e*, may be arranged to guide the substance in its descent, as shown in Fig. 4. The former arrangement drops the substance abruptly into the lower apron, while the latter conveys it thereto more gently.

To crush and break whatever lumps or cakes the substance operated upon may form as it dries, I provide crushing-rollers *G G*, arranged in pairs, and acting upon the material preferably as it leaves one apron and before it falls upon the next. In Fig. 1 I have shown two different arrangements of these rollers, the pair at the left being independent of the apron-pulleys, and arranged in a plane intermediate of the two aprons, while of the pair at the right one of the rollers forms also the pulley *C*, for carrying the apron, and the latter, as well as its layer of drying substance, is compressed between that roller and an additional one. The latter arrangement may answer for some substances; but, in view of the wear to which it will subject the apron, I prefer the one first described. I arrange one or more pairs of these crushing-rollers to act upon the drying substance once or oftener in its passage through the apparatus, the extent of their use depending upon the character of the substance under treatment. For fruits and other substances they will not be used.

In order that the layer of drying substance may be decreased in thickness as the substance becomes drier, so as to expose it more to the action of the heat and air, and thus accelerate the drying, I arrange the lower aprons to travel faster than the upper ones, each apron, by preference, moving faster than the one above it. To accomplish this difference in speed, I form the driving-pulleys *c c* of successively lesser diameter from the upper to the lower one, whereby, while their peripheral velocity is the same, their axial velocities are successively greater. I have shown the pulleys *C C* as the

driving-pulleys of the aprons *B B*; but, if preferred, the power may be applied through the pulleys *C' C'* or through the pulleys *C* of the alternate aprons and the pulleys *C'* of the remaining ones.

I prefer to form the aprons *B B* of successively increasing width from the top to the bottom, as shown in Fig. 3. As the layer of drying substance will spread out laterally to some extent at each fall, the corresponding widening of the aprons prevents its falling over their edges. An air-space is also thus left at the sides of the upper aprons, to permit some of the moister air to pass around and over the layers of substance, instead of compelling it to pass through them.

I claim as my invention—

1. In a drying apparatus, the combination of the endless aprons *B B*, arranged one below another, revolving in alternately opposite directions, adapted to carry a continuous layer of drying substance and to drop it from one to another at alternately opposite ends, with one or more pairs of crushing-rollers, *G G*, arranged to act upon and break said substance in the course of the drying operation, substantially as set forth.

2. In a drying apparatus, a series of endless aprons, *B B*, borne upon pulleys *C C'*, arranged one below another, revolving alternately in opposite directions, adapted to carry a continuous layer of drying substance back and forth and to drop it from one to another, and the bottom aprons, which carry the nearly-dried substance, arranged to travel faster than the upper aprons, which carry the moister substance, substantially as and for the purposes set forth.

3. In a drying apparatus, the combination of a series of endless aprons, *B B*, arranged one above another, with their carrying-pulleys *C C' C C'*, shafts *D D' D D'*, belt-pulleys *c c*, fixed on the prolonged ends of one shaft of each apron *B*, and formed of successively decreasing diameter from the top to the bottom one, with the continuous belt *H*, arranged alternately over the opposite pulleys *c c*, whereby the latter are driven with a uniform circumferential speed, but at successively faster angular velocities, substantially as and for the purposes set forth.

4. In a drying apparatus, a series of endless aprons, *B B*, borne upon pulleys *C C'*, arranged one below another, revolving alternately in opposite directions, adapted to carry a continuous layer of drying substance back and forth, and to drop it from one to another, and the several aprons, formed of successively greater width from the top to the bottom ones, substantially as and for the purposes set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ALFRED EDWARDS.

Witnesses:

ARTHUR C. FRASER,
HENRY CONNETT,