No. 712,894. Patented Nov. 4, 1902.

C. A. BALL.

DRIER.

(Application filed Feb. 6, 1902.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

Witnesses.
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W. A. Edmonds.

Inventor.
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By Percy B. Ellis
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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(No Model.) 5 Sheets—Sheet 2.

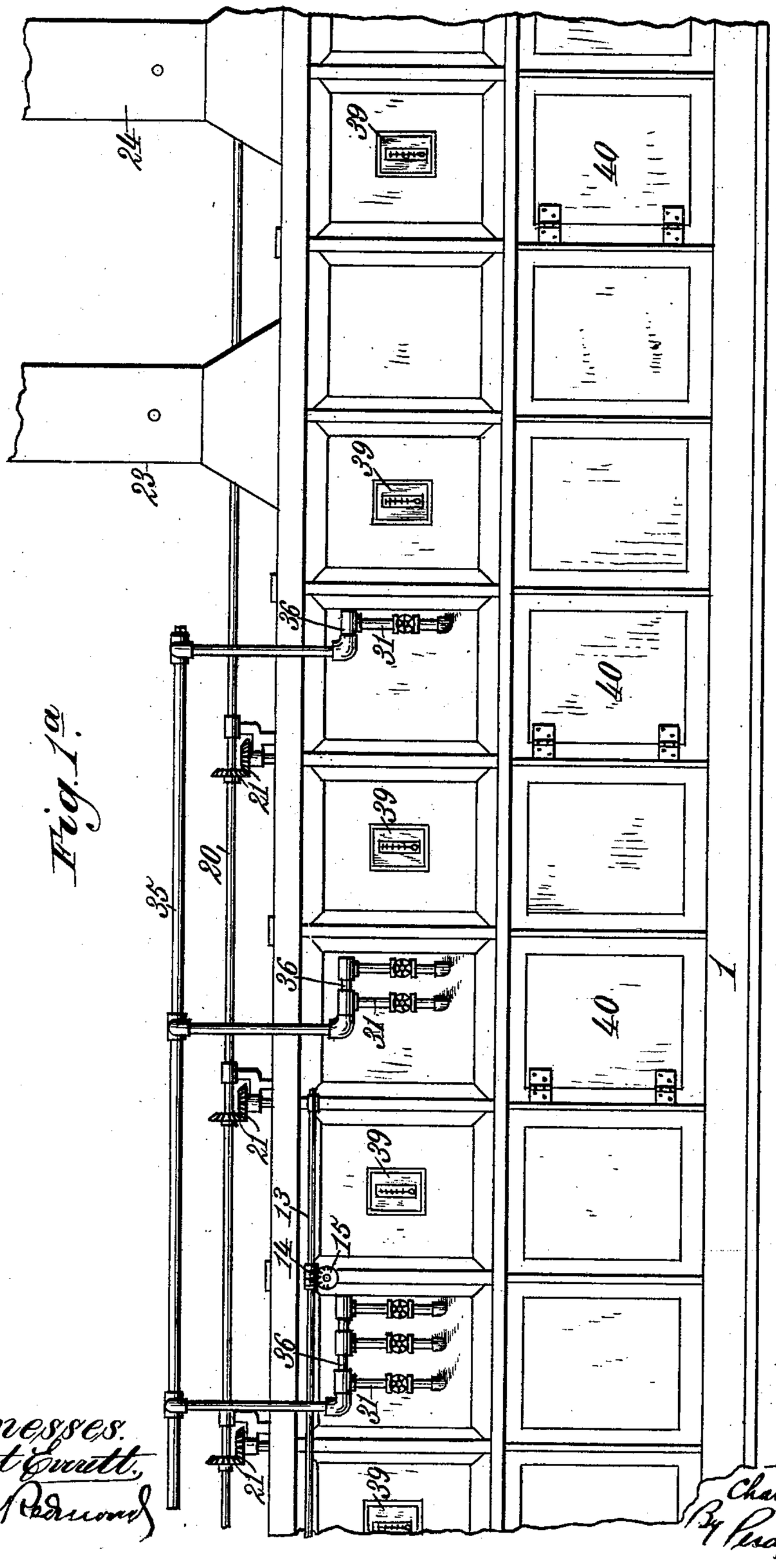

Fig. 1a.

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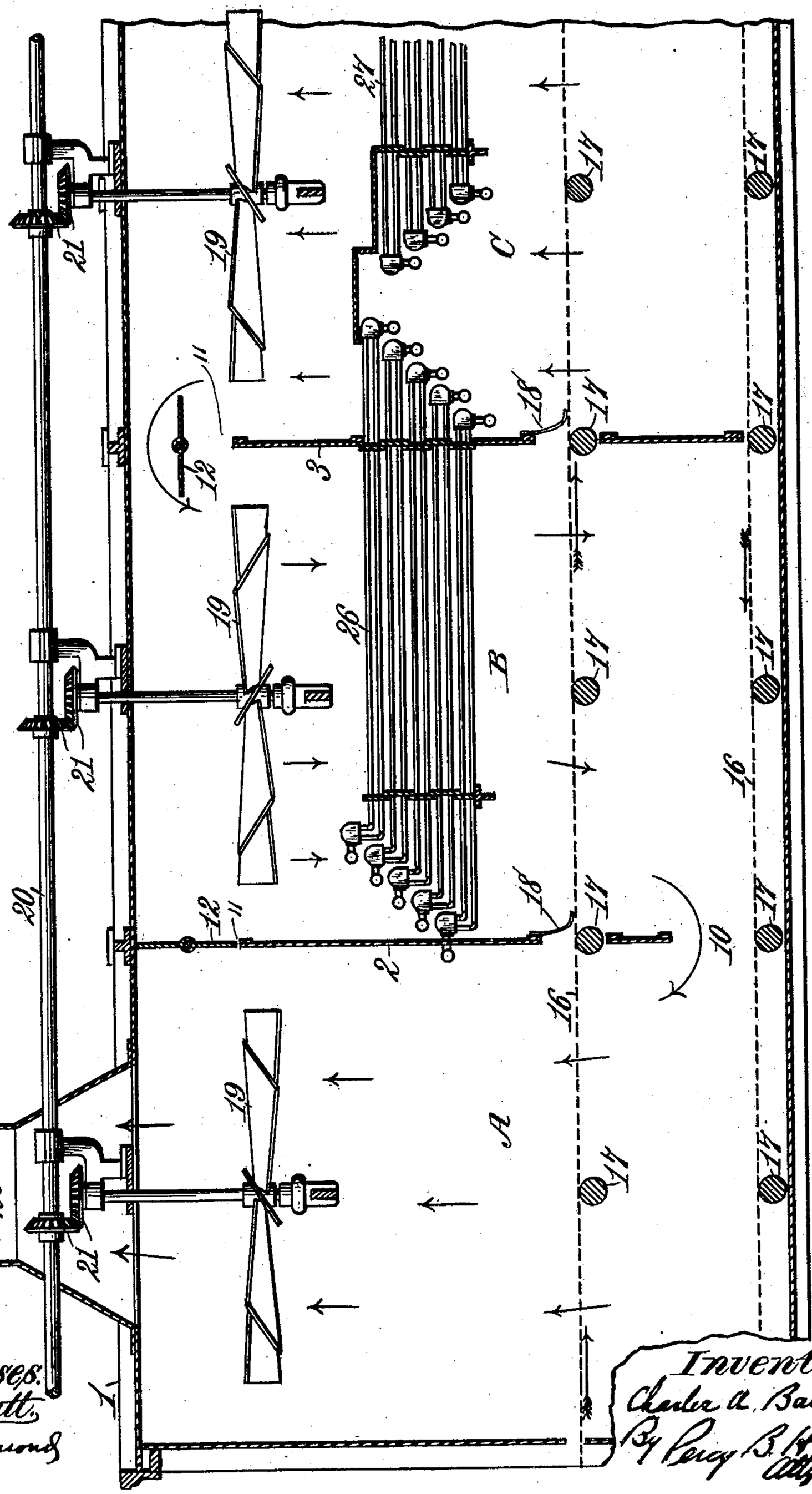
(Application filed Feb. 6, 1902.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 2.



Witnesses:
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No. 712,894. Patented Nov. 4, 1902.

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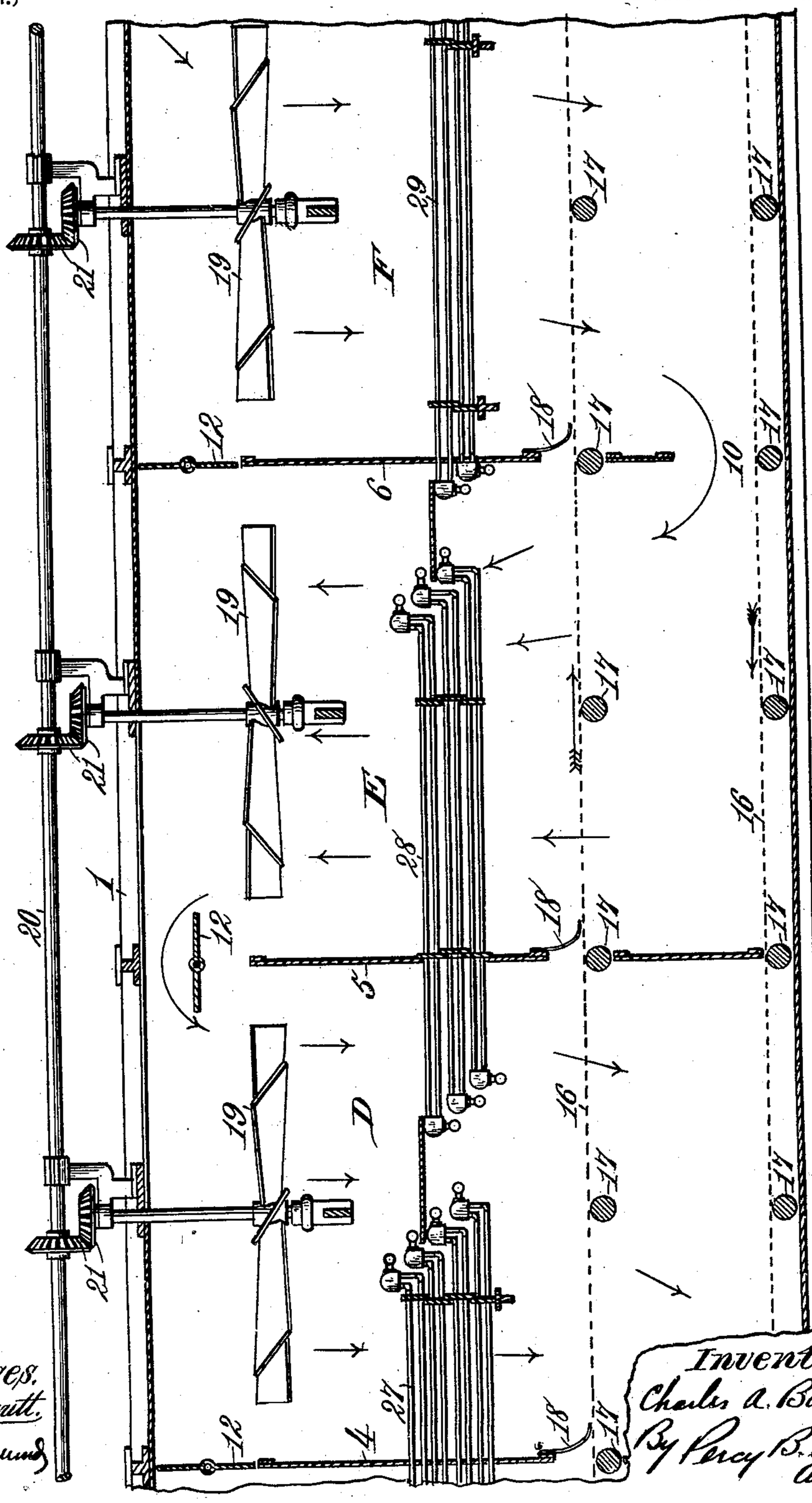
DRIER.

(Application filed Feb. 6, 1902.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 2a.



Witnesses.
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No. 712,894.

Patented Nov. 4, 1902.

C. A. BALL.

DRIER.

(Application filed Feb. 6, 1902.)

(No Model.)

5 Sheets—Sheet 5.

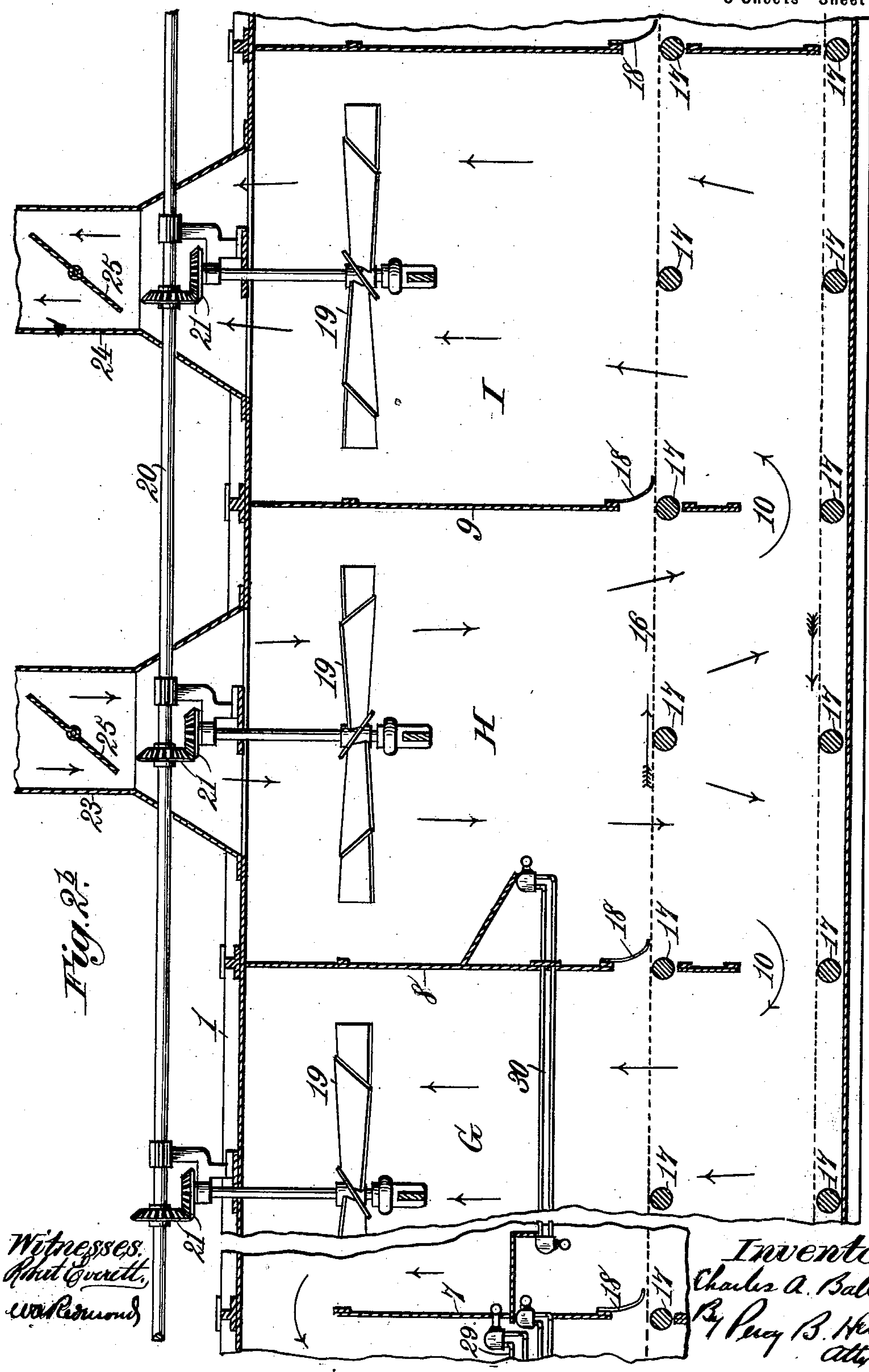

Fig. 2½.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES A. BALL, OF WASHINGTON, DISTRICT OF COLUMBIA.

DRIER.

SPECIFICATION forming part of Letters Patent No. 712,894, dated November 4, 1902.

Application filed February 6, 1902. Serial No. 92,855. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. BALL, a citizen of the United States, residing at Washington, in the District of Columbia, have invented new and useful Improvements in Driers, of which the following is a specification.

My invention relates to driers of that type wherein the material to be dried is carried through the device by means of a conveyer and is subjected to the combined action of heat and an air-current, and has for its objects, first, to provide means for dividing the structure into chambers supplied with heat at controllable temperatures; secondly, to provide means for causing either a circulation of air longitudinally from one chamber to another and a final discharge of the same or a recirculation of the air in the several chambers or a combination of both these features, and, thirdly, to provide means for supplying to the said chambers as the heating medium either live or exhaust steam, or both, as may be desired. These objects I accomplish in the manner and by the means hereinafter described and claimed, reference being had to the accompanying drawings, in which—

Figures 1 and 1ª, taken together, constitute a side elevation of my improved structure. Figs. 2, 2ª, and 2ᵇ, taken together, constitute a vertical longitudinal sectional view of the same on an enlarged scale.

Similar characters of reference denote corresponding parts in the several views.

In the said drawings the reference-numeral 1 denotes a casing or structure divided by vertical transverse partitions 2, 3, 4, 5, 6, 7, 8, and 9 into a plurality of chambers A, B, C, D, E, F, G, H, and I, the partitions 2, 4, 6, 8, and 9 having each a transverse opening 10 at the bottom thereof, while all but partitions 7, 8, and 9 have each a transverse opening 11 at the top thereof, in each of which is located a damper 12. Said dampers are controlled in their position by a longitudinal shaft 13 common to all and communicating motion thereto by means of worms 14 and gear-wheels 15, it being observed that the dampers in partitions 2, 4, and 6 are arranged to open or close simultaneously, as do those in partitions 3 and 5, the two sets of dampers being also so arranged that one set is open when the other set is closed, and vice versa.

Passing longitudinally through the drier is an endless conveying-belt 16, formed, preferably, of woven wire, the same being supported and guided on suitable transverse rollers 17, as shown, and being driven in the direction of the arrows by any suitable driving mechanism. This belt 16 passes through suitable transverse apertures in all the partitions, the upper apertures thereof being provided with suitable flexible flaps or aprons 18 to permit the passage of the material being carried by said belt and yet preventing the passage of air therethrough.

Mounted in each of the chambers A to I is a fan 19, all of the same being driven by a power-shaft 20 common to all and communicating its motion thereto by suitable bevel-gearing 21, as shown. It will be observed that the blades of these faces are arranged to force air alternately upward and downward, those in chambers A, C, E, G, and I forcing the air upward, while those in chambers B, D, F, and H force it downward.

Tapped into the top of chambers A, H, and I are the stacks 22, 23, and 24, communicating with the atmosphere and each provided with a damper 25, all for a purpose hereinafter to be described.

Located in the chambers B, C, D, E, F, and G and longitudinally above the belt 16 are the banks of steam heating-coils 26, 27, 28, 29, and 30, there being five banks in set 26 and the sets successively decreasing by one bank each, so that set 30 will consist of but one bank. Each of the banks in each set has its separate supply and return pipes, the former being shown at 31 in Figs. 1 and 1ª and being shown provided each with a cut-off valve 32, whereby the steam-supply to each bank may be separately controlled. A pipe 33, communicating with all the pipes 31 of sets 26 and 27, also communicates on one side with a live-steam main 34 and on its other side with an exhaust-steam main 35. Pipes 36, common to the pipes 31 of sets 28, 29, and 30, however, communicate only with the exhaust-steam main 35, as shown in Fig. 1ª. Suitable cut-off valves 37 and 38 are

provided to control the live or exhaust steam supply to each set of pipes, as will be readily understood.

In drying some forms of material it is desirable that the temperature at various points in the drier be known and a visual inspection be had of the material, which I obtain by locating at intervals in the side wall of the drier glass-closed sight-openings 39, having thermometers on the inner sides thereof, as shown. So, also, the side wall is provided with a series of doors 40 to permit a manual inspection of the material being dried.

From the above description the operation of my improved structure will be understood to be as follows: Assuming that the dampers 12 and 25 are in the position shown in Figs. 2, 2^a, and 2^b and that exhaust-steam from suitable power-fixtures is being admitted from exhaust-steam pipe 35 to all the banks of all the sets of steam-pipes 26 to 30 and that the valves 37, controlling the admission of live steam to sets 26 and 27, are closed, it will be seen that heat is being supplied to chambers B to G in successively-decreasing degree, due to the successive decrease in the banks of steam-pipes from B to G. As shown by the arrows, cold air is being drawn down stack 23 into chamber H, some of which will pass through the opening in the bottom of partition 9 and out through stack 24, the same thus causing chambers H and I to operate as cooling-chambers. Some of the cold air driven down into chamber H, however, will be drawn through the opening in the bottom of partition 8 by the upward draft of the fan in chamber G and will thus serve to supply the draft longitudinally through the structure, as follows: through opening in top of partition 7 into chamber F, thence downwardly through opening in bottom of partition 6 into chamber E, thence upwardly through opening in top of partition 5 into chamber D, thence downwardly through opening in bottom of partition 4 into chamber C, thence upwardly through opening in top of partition 3 into chamber B, thence downwardly through opening in bottom of partition 2 into chamber A, and finally out through stack 22. Under these conditions the material to be dried when fed upon the belt 16 passes successively through chambers A to I, where it is subjected first to a high degree of heat in chambers A and B and then to successively-decreasing degrees of heat in chambers C to G, and finally to the action of cold air in chambers H and I.

It will be obvious that as the material on the endless belt 16 in chambers A to H will offer some resistance to the passage of the air-current therethrough, while the passage of air upward through chamber I is comparatively unobstructed, most of the air drawn down into chamber H will pass into chamber I, thus interfering with the supply necessary to maintain the circulation in chambers A to G, and to obviate this I may partially open door 40 in the side wall of the structure opening into chamber I, which will supply the air to satisfy the demands of the fan in said chamber I, leaving the air drawn into chamber H to pass into chamber G, as will be readily understood.

In the drying of some materials, such as tobacco, for which my improved device is particularly well adapted, it is necessary to subject the different forms of the same—such as cased fillers, dipped fillers, case-tobacco, and dipped wrappers—to a different treatment. Thus, for instance, with cased fillers a retention and recirculation of the air saturated with moisture is desirable in order that the casing will not be dried on the surface of the leaf, whereas with dipped wrappers which are very wet a maximum of heat, together with a free circulation of air and a speedy relief of the moisture-saturated air, is necessary. The latter result will be obtained with the several dampers 12 and 25 in the position shown in Figs. 2, 2^a, and 2^b and with all the banks in all the sets of heating-coils 26 to 30 supplied with steam. Now to obtain a recirculation of the air it is only necessary to rotate shaft 13, controlling the several dampers 12, so that the position of said dampers shall be reversed—that is to say, the dampers in partitions 2, 4, and 6 shall be opened, while those in partitions 3 and 5 shall be closed. The damper in stack 22 being at the same time closed, it will be seen that chambers A and B are open to each other at top and bottom, and there being no escape for the air therein the reverse action of the fans therein will cause a rotary circulation of the air from one chamber to the other. The same will be true of chambers C and D and E and F, while chamber G, although in constant communication with both chambers F and H, will act as a dead-air chamber, the reversal of dampers 12 closing communication through partitions 3 and 5, which, together with the closing of the damper in stack 22, completely stops the draft from chamber H back through the structure. It will be obvious that by partially opening all the dampers 12, as well as the damper in stack 22, a partial recirculation, as well as a partial discharge, of the saturated air will occur, and the degree of either may be accurately and readily regulated to suit the material being treated.

As hereinbefore set forth, each bank of steam-coils in the sets 26 to 30 is provided with a separate cut-off valve in its supply-pipe 31, so that the amount of steam supplied to each set of coils may be variably controlled, as will be readily understood, the same in conjunction with the controllable variation in the air-current conditions in chambers A to G affording a maximum variation for the treatment of different materials.

It is well known that exhaust-steam from

power-fixtures although deprived of substantially all of its elasticity is still capable of efficient use as a heating medium, and I therefore contemplate using the same in the sets of steam-coils 28, 29, and 30 through pipe 35, the sets of coils 26 and 27 being separately supplied with live steam through pipe 34. It will be observed that exhaust-steam pipe 35 is also connected to the sets of coils 26 and 27, the object of the same being to enable pipe 35 to be used to supply live steam to all the sets of steam-pipes when so desired, this alternate use of pipe 35 as an exhaust-steam or a live-steam supply pipe being accomplished by employing my approved system of steam-heating disclosed in my Letters Patent No. 644,961, granted March 6, 1900, in which no thermostatic valves are employed.

In Fig. 2[b] I have shown the apron 16 extending through chamber I into still another chamber, and the structure may thus be continued into one or more chambers for the further treatment of the material—such, for instance, as ordering-chambers when tobacco is being treated—such extension of the structure, however, forming no part of my present invention.

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

1. A drier, consisting of a plurality of chambers, a conveyer for carrying the material successively through said chambers, means for supplying heat to said chambers, and controllable means for maintaining a continuous sinuous air-draft through the structure and in reverse vertical direction in alternate chambers through the material being operated on, or for maintaining a recirculation of the air in said chambers.

2. A drier, consisting of a plurality of chambers, a conveyer for carrying the material successively through said chambers, means for supplying heat to said chambers, dampers in the walls separating said chambers, and means for controlling said dampers so as to connect said chambers in series alternately at top and bottom or to divide said chambers into pairs communicating at top and bottom.

3. A drier, consisting of a plurality of chambers, a conveyer for carrying the material successively through said chambers, means for supplying heat to said chambers, dampers in the walls separating said chambers, means for controlling said dampers so as to connect said chambers in series alternately at top and bottom or to divide said chambers into pairs communicating at top and bottom, and fans for forcing the air alternately up and down in the said chambers.

4. A drier, consisting of a plurality of chambers forming heating and cooling chambers, said cooling-chambers communicating permanently with the adjacent heating-chamber, a conveyer for carrying the material successively through said chambers, means for connecting said heating-chambers in series alternately at top and bottom or for dividing said chambers into pairs communicating at top and bottom, means for controllably supplying heat to said heating-chambers, and means for causing an alternate up-and-down circulation of air through said heating-chambers, whereby an air-draft will be maintained from the cooling-chambers through the heating-chambers or a recirculation of the air maintained in said heating-chambers.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES A. BALL.

Witnesses:
HARRY T. STODDART,
ALFRED N. KEIM.