

(No Model.)

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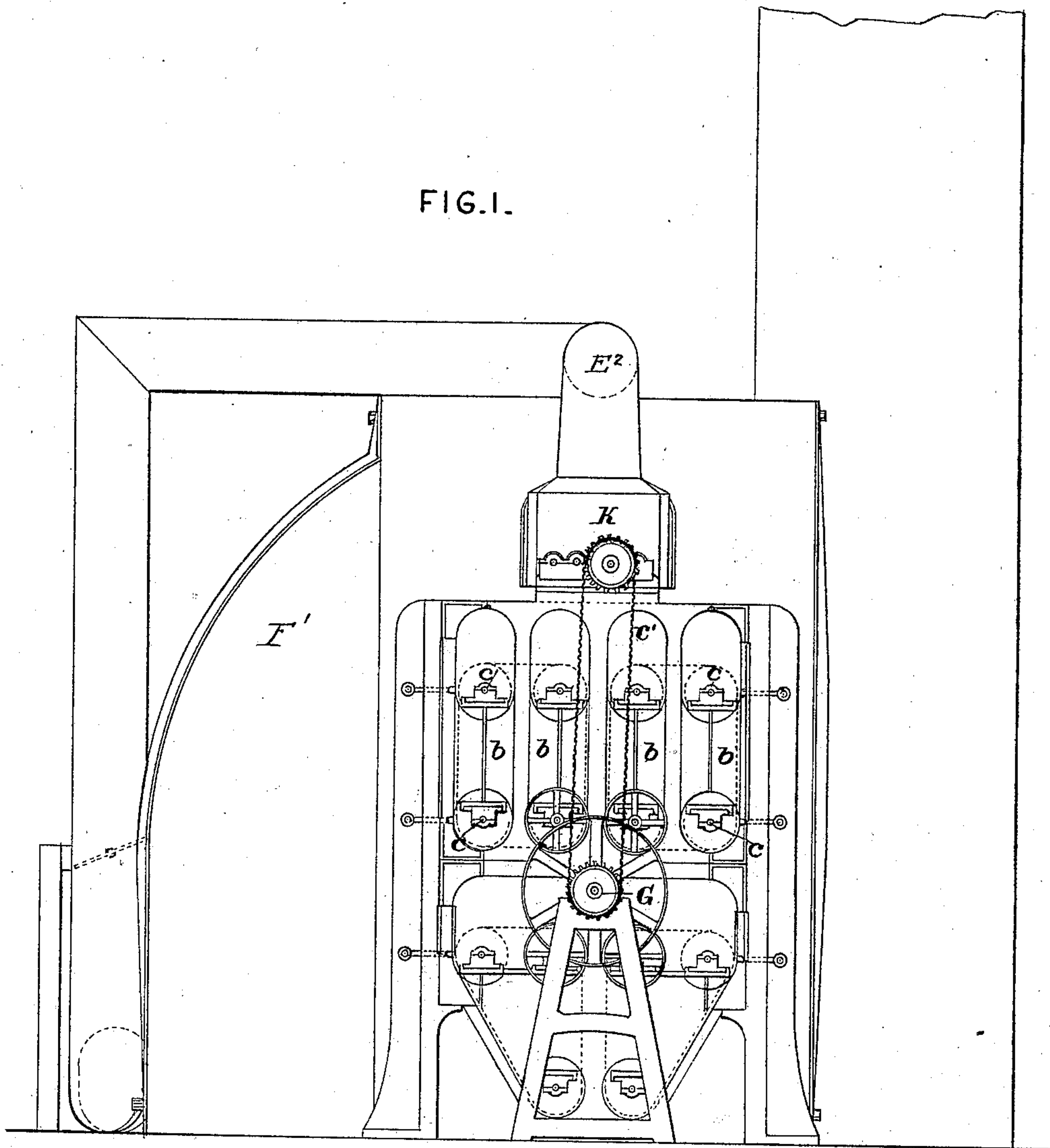
J. H. McDONALD.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.

FIG. 1.



Witnesses:

W. H. Martin
David St. Mead

Inventor:

Joseph H. McDonald,

by
R. G. Glenforth,
his Attorney

(No Model.)

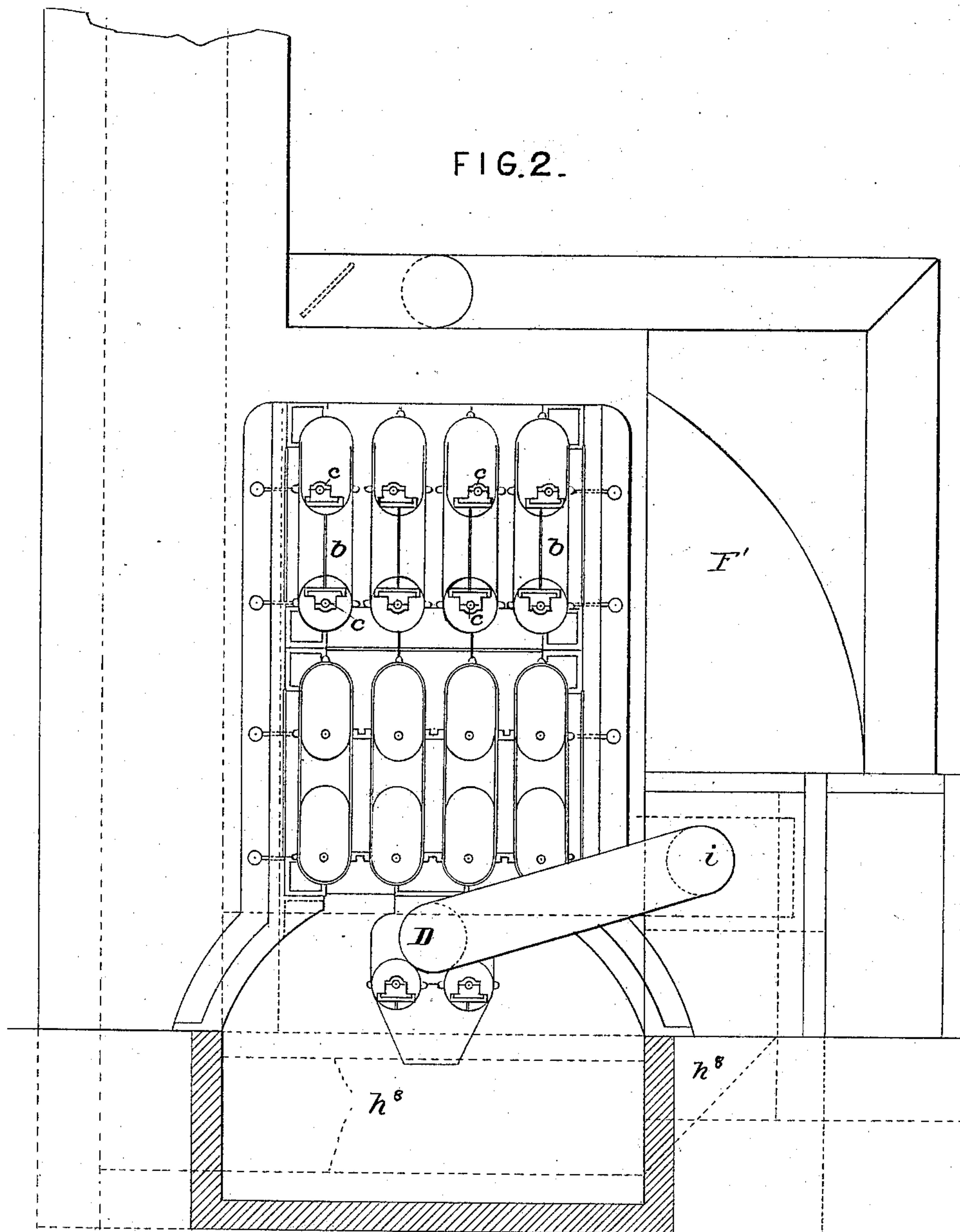
6 Sheets—Sheet 2.

J. H. McDONALD.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.



Witnesses:

W. W. Northrup
David St. Mead

Inventor:

Joseph H. McDonald,
by *R. L. Dyrenforth,*
his Attorney.

(No Model.)

6 Sheets—Sheet 3.

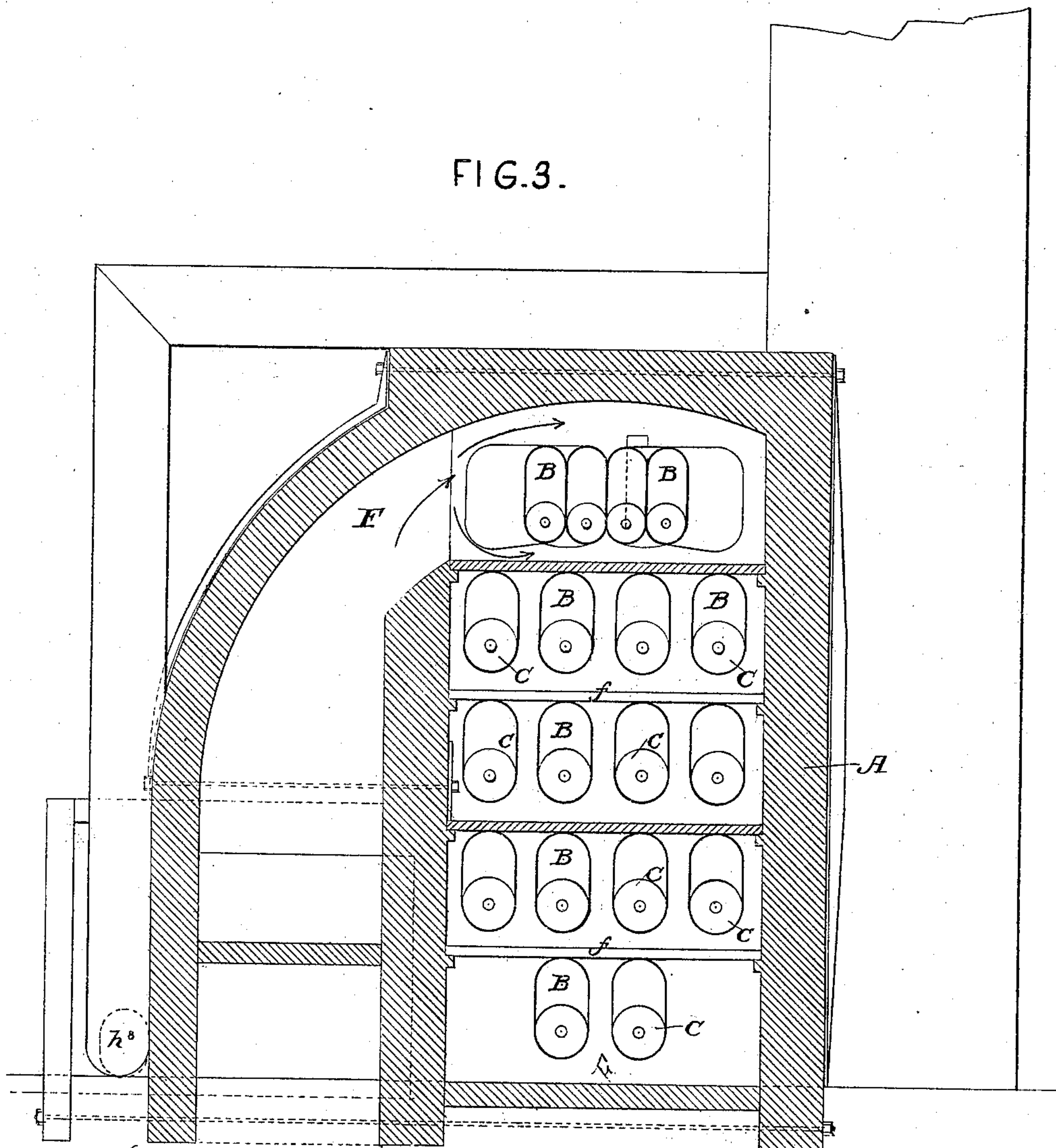
J. H. McDONALD.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.

FIG. 3.



Witnesses:

N. N. Northrup
David S. Mead

Inventor:

Joseph H. McDonald,
by
R. S. Dylenforth,
his Attorney.

(No Model.)

6 Sheets—Sheet 4.

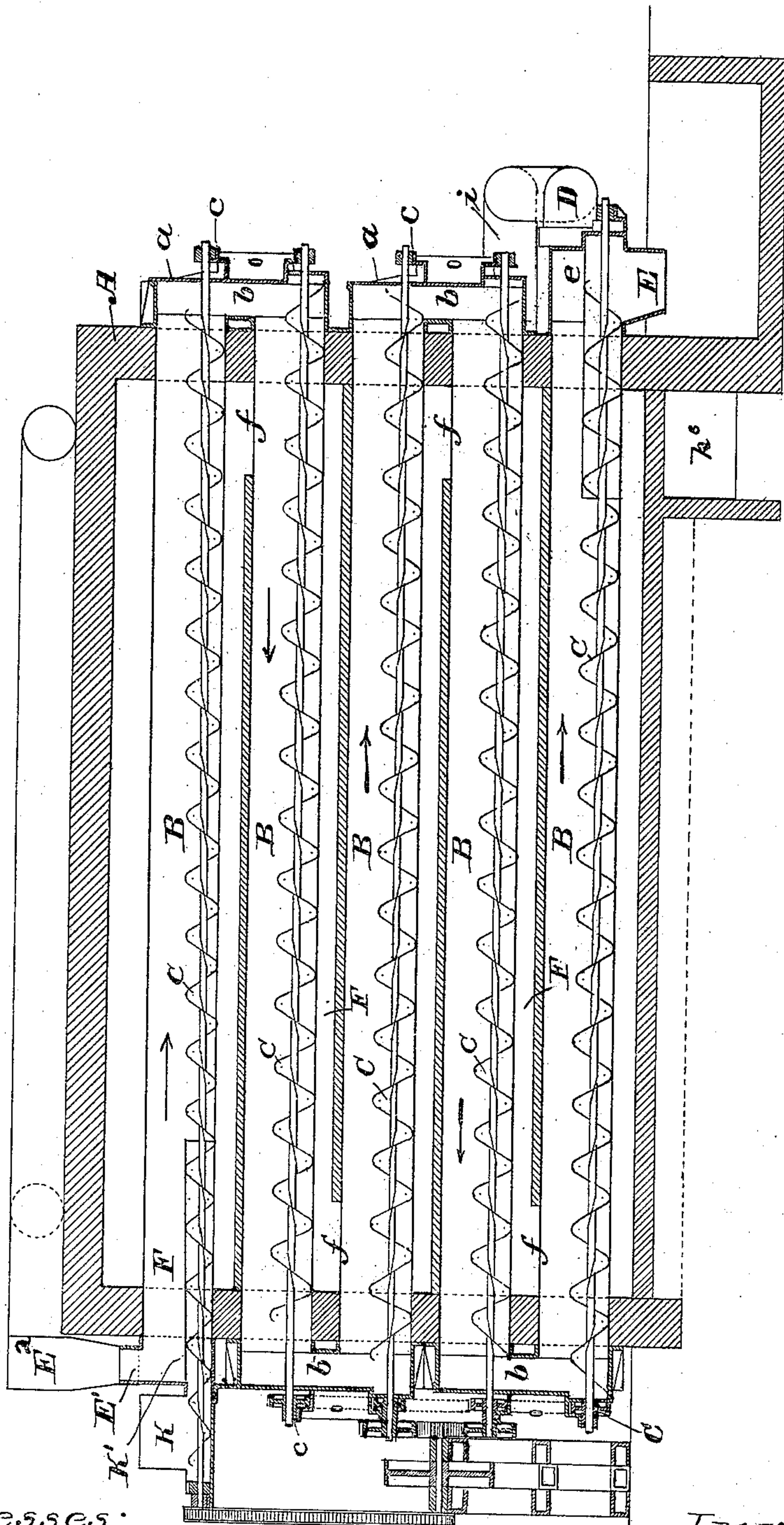
J. H. McDONALD.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.

FIG. 4.



Witnesses:

W. W. Mortimer
David H. Mead

Inventor:
Joseph H. McDonald
by *R. G. Dyrenforth*
his Attorney

(No Model.)

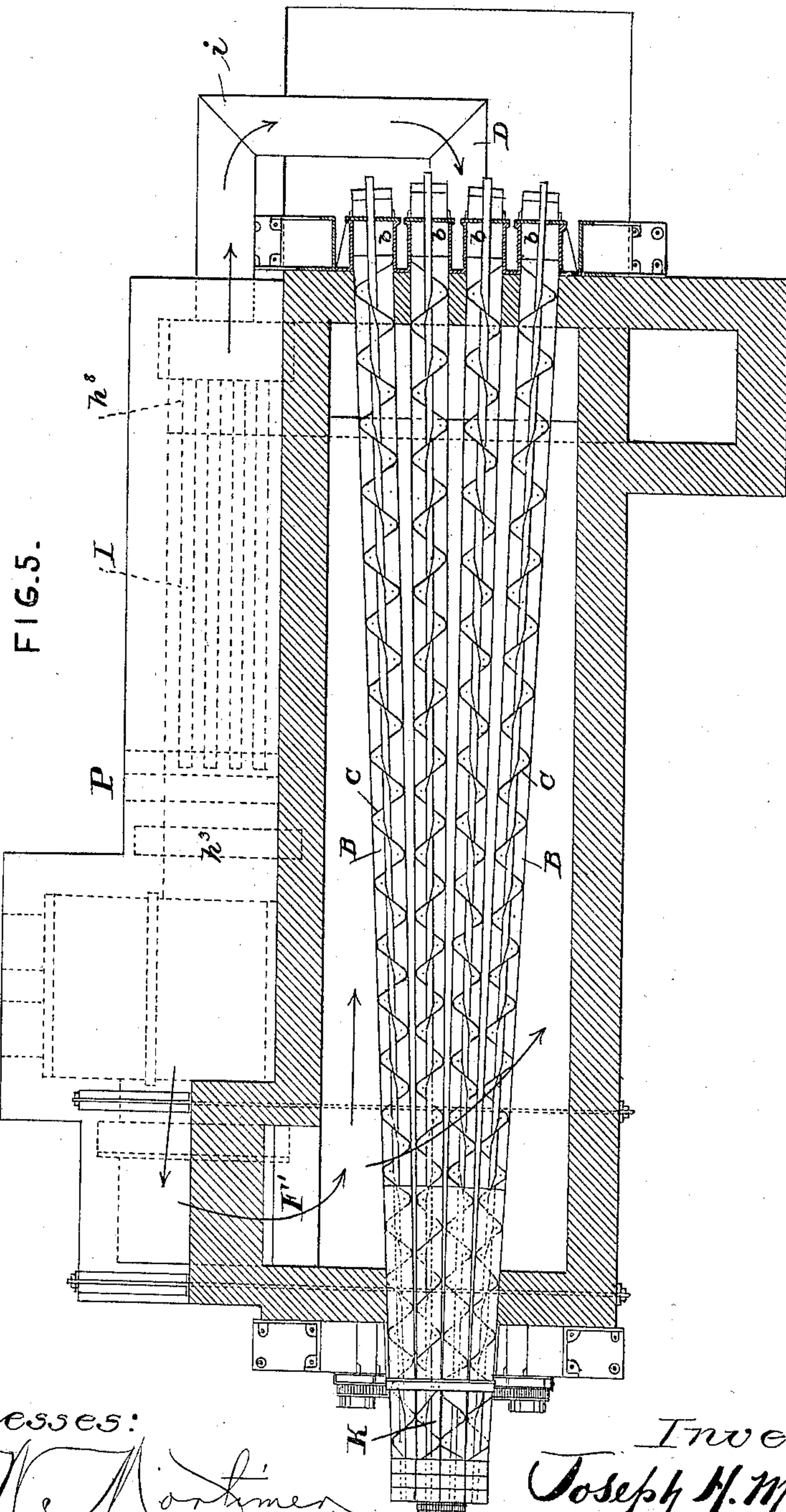
J. H. McDONALD.

6 Sheets—Sheet 5.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.



Witnesses:

M. H. Mortimer.
David H. Mead.

Inventor:

Joseph H. McDonald,
By *R. G. Dyrenforth,*
his Attorney

(No Model.)

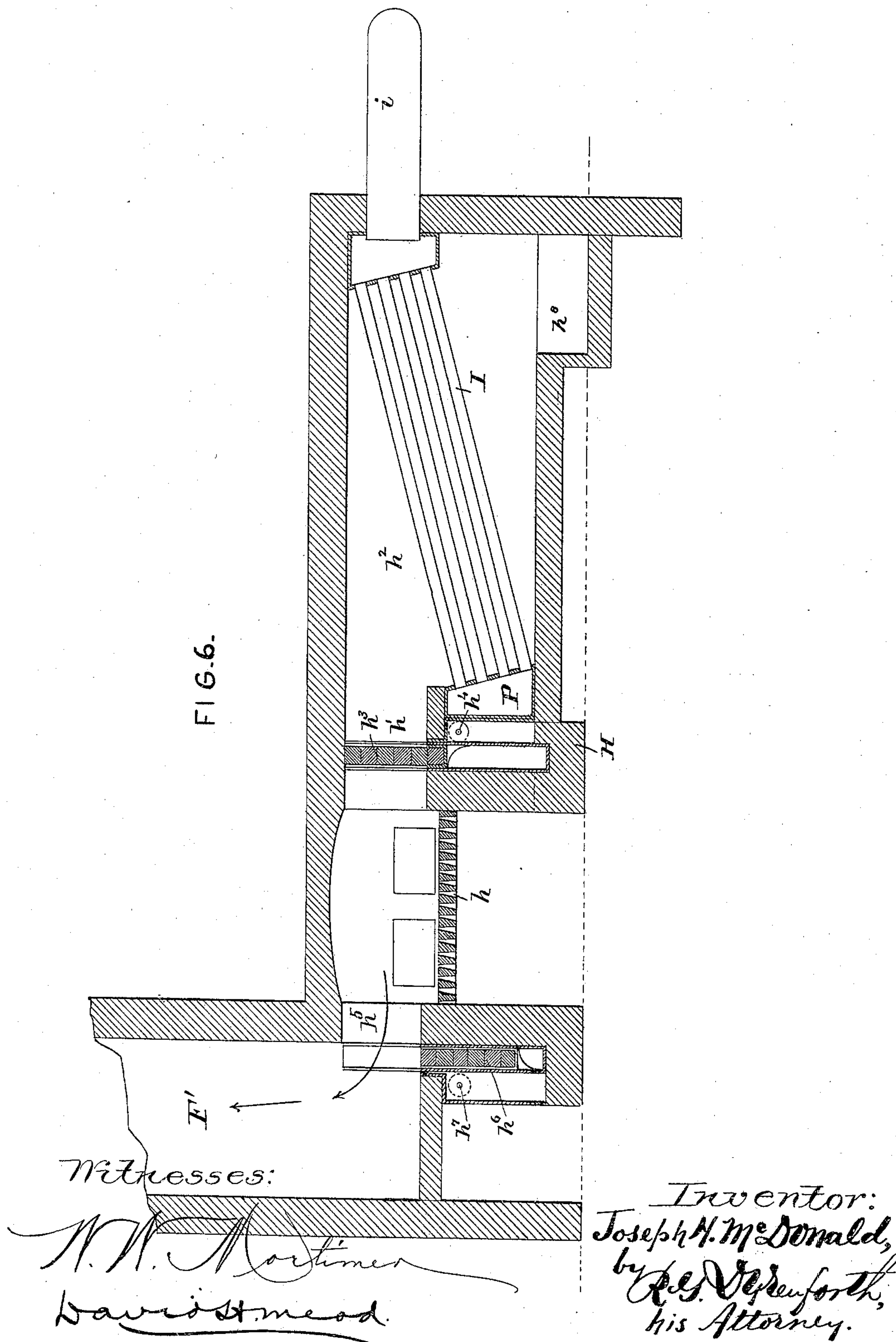
6 Sheets—Sheet 6

J. H. McDONALD.

GRAIN DRIER.

No. 369,607.

Patented Sept. 6, 1887.



UNITED STATES PATENT OFFICE.

JOSEPH H. McDONALD, OF BROOKLYN, NEW YORK.

GRAIN-DRIER.

SPECIFICATION forming part of Letters Patent No. 369,607, dated September 6, 1887.

Application filed August 20, 1886. Serial No. 211,412. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. McDONALD, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Driers; 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 ap-
10 pertains to make and use the same.

This invention relates to driers, and particularly to that class designed for operating upon finely-divided or pulverulent substances.

The object of the invention is to produce a
15 drier which shall be comparatively simple and uncomplicated in construction, and whereby an even and complete drying of substances may be accomplished.

Furthermore, the object is to produce a drier
20 of moderate size and having its parts so arranged that the substance to be treated shall be brought into contact with a very large amount of heated surface.

Furthermore, the object is to produce a
25 drier having its parts so arranged that the material is carried in such position as to have heat impinge upon all sides, in order more thoroughly to accomplish the elimination of moisture.

Furthermore, the object is to produce a
30 drier in which the heat-generator shall be so constructed as to be capable of manipulation instantly to reduce or to increase the amount of heat employed.

With these objects in view the invention
35 consists in the construction and arrangement of parts, hereinafter particularly described in the specification, and illustrated in the drawings.

I have illustrated the invention in the ac-
40 companying drawings, in which—

Figure 1 is a front elevation of my improved
drying apparatus. Fig. 2 is a rear end eleva-
tion showing the hot-air-inlet pipe. Fig. 3 is
45 a cross-section. Fig. 4 is a central longitudinal vertical section. Fig. 5 is a horizontal section, and Fig. 6 is a longitudinal section of the furnace and air-heating apparatus.

In the drawings the frame or casing of the
50 drier, preferably of brick, is represented by

the letter A. Secured in any suitable manner to this frame are plates *a*, which form bearings for the moving portions of the apparatus.

B represents tubes or conduits of a suitable size and length attached at each end to the
55 frame A. These tubes are arranged in tiers, and any desired number may be arranged abreast of each other, the number being governed by the desired capacity of the drier. Each tube or conduit communicates with a
60 passage, *b*, which connects it at one end with the adjoining or next upper tube or conduit, and at the other end with a similar passage, which connects it with the adjoining or next
65 lower tube or conduit.

C represents screw or other suitable conveyers, which are mounted in bearings *c*, fixed in the frame A. These conveyers are so mounted as to play upon the lower surfaces of the tubes B, and they receive a motion in such direction
70 as to convey the substances to be dried in the direction indicated by arrows. By means of these conveyers the substances are carried from the point of inlet along the tubes to the passages *b*, through which they drop upon the
75 conveyer in the next lower or adjoining tube. In this manner it will be seen that the substances are carried through a great extent of tube or conduit. Hot air is admitted at an inlet-opening, D, and thence passes through the
80 tubes B and passages *b* in a direction opposite to that in which the substances to be dried move. As the hot air is introduced above the discharge-opening E, it is found to be of
85 advantage to place a circular plate, *e*, within tube B, a short distance above the discharge-opening, to act as a stuffing-box, so that the entrance of any cold air, which might comingle with the hot air, is prevented. The
90 hot air, after passing through the tubes and through the substances which are acted upon by the conveyers, is discharged at an opening, E', and thence conducted either to the chimney or to the open air through a pipe, E². If so desired, the hot air thus discharged, and
95 which is laden with combustible gases eliminated from the substance dried, may be conducted to the fire-pot of the furnace used to heat the air and be utilized to increase the heat. As the hot air is discharged at a point
100

immediately adjoining the feed-opening, it is found to be of advantage to place a circular plate, K', within the tube B to cover the conveyor a short distance from its entrance into the feed-hopper K and act as a stuffing-box to prevent the entrance of cold air.

In order that the substance to be treated shall be acted upon on all sides by hot air, I provide the passages F, which are arranged below and around the tubes or conduit B in such manner that hot air passing through them heats the exterior of the tubes. The passages for hot air below and around the different tiers of tubes or conduits communicate with each other through the vertical passages f.

In Fig. 5 of the drawings I have illustrated the upper tier of tubes in the form in which I prefer to employ them. In this figure I have shown the tubes as tapering toward the point at which the substance to be treated is introduced, the purpose being to economize space by having the inlet or feed-hopper box K, through which the tubes are supplied, comparatively small, thus rendering the feed easy of control.

The preferred form of furnace to be used in connection with my drier is shown in Fig. 6 of the drawings. In this figure, H represents the casing of the furnace, and h the grate-bars. Cold air is admitted at the opening P, and, passing through heating-pipes I and through a conducting-pipe, i, is admitted in a heated condition at the opening D into the lower tier of the tubes or conduits B, and passes through the series of tubes B to the outlet E². Hot air, smoke, and the products of combustion from the fire-pot of the furnace pass through an opening at h' into the chamber h², where they come in contact with the outer surfaces of the heating-pipes I, and thence escape through the lower smoke-passage, h⁸, to the chimney in any suitable course. The amount of heat which is allowed to impinge against the outer surfaces of the heating-pipes is governed by means of a vertically-moving bridge-wall, h³, composed, preferably, of fire-brick or analogous material, so arranged as to be raised and lowered by the operation of a pinion, h⁴, mounted in the casing of the furnace in contact with the bridge-wall. It will be seen that by the raising and lowering of this bridge-wall the amount of heat utilized may be instantly and accurately regulated. Hot air, smoke, and other products of combustion also pass through an opening, h⁵, from the fire-pot, and thence through a conduit to a point, F', Fig. 5, where they enter the upper tier of passages, F, and are thus utilized to heat the outer surfaces of the conduits B. The passage h⁵ is capable of being closed by a vertically-sliding-gate bridge-wall, h⁶, operated by means of a pinion, h⁷, mounted in the casing of the furnace and meshing with the gate bridge-wall in such manner that the turning of the

pinion will move the gate up and down to regulate the size of the passage h⁵, and thus prevent the scorching of the substance to be dried.

The shafts of the conveyers preferably are connected by belts or chains c' to a power-shaft, G, from which all of the conveyers receive a motion in such direction as to move the substances to be dried.

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

1. The combination, with a drier consisting, essentially, of a series of tubes or conduits arranged in tiers and communicating in such manner as to form a serpentine passage for the substance to be dried, conveyers for moving the substance to be treated through the tubes, a hot-air conduit admitting air to the tubes in such manner as to commingle with the substance to be dried, and passages arranged contiguous to the tubes, whereby the exterior of the tubes may be heated, of a furnace having an air-heating attachment and a flue for the escape of products of combustion, the air-heating attachment communicating with and discharging hot air into the material to be dried at the lowest tier, and the air passing upward commingling with the substance in the successive tiers to the outlet and in a direction opposed to that of the direction of the substance to be dried, and the flue carrying off the hot products of combustion communicating with the passages arranged contiguous to the tubes at the uppermost tier, whereby the tubes and the material will be more uniformly heated, substantially as described.

2. In combination with a hot-air tube, the lower passage B, containing a conveyer by which the material to be dried is fed, such passage having a discharge-opening for material to be dried at its lower end, provided with a plate, e, a short distance above to act as a stuffing-box, so that the entrance of cold air will be prevented, substantially as described.

3. In combination with the upper passage B, containing a conveyer and provided with a feed-opening for material to be dried and an opening adjacent thereto for the discharge of hot air, a circular plate, K', within the tube B, to cover the conveyor a short distance from its entrance into the feed-hopper and act as a stuffing-box to prevent the entrance of cold air, substantially as described.

4. In a drier having tubes arranged in tiers with any desired number of tubes abreast of each other, the upper tier of tubes made tapering toward the point at which the material is fed, in combination with a hopper located at the tapering end, whereby all the tubes abreast may be fed from a single hopper, substantially as described.

5. The combination, with a drying apparatus, of the furnace provided with movable

bridge-walls, whereby the amount of heat brought in contact with the substance to be dried is regulated.

6. In combination with a drying apparatus,
5 the heating apparatus consisting of a fire-pot provided on each side with movable walls, the heating-tubes I, and conduits for conducting the heated air and products of combustion

to the drying apparatus, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH H. McDONALD.

Witnesses:

I. BOTTOMLEY,
OSCAR BLEEZARD.