(No Model.) 3 Sheets—Sheet 1.

F. M. F. CAZIN.

APPARATUS FOR DRYING STARCH OR OTHER SOLID MATTER.

No. 424,760. Patented Apr. 1, 1890.

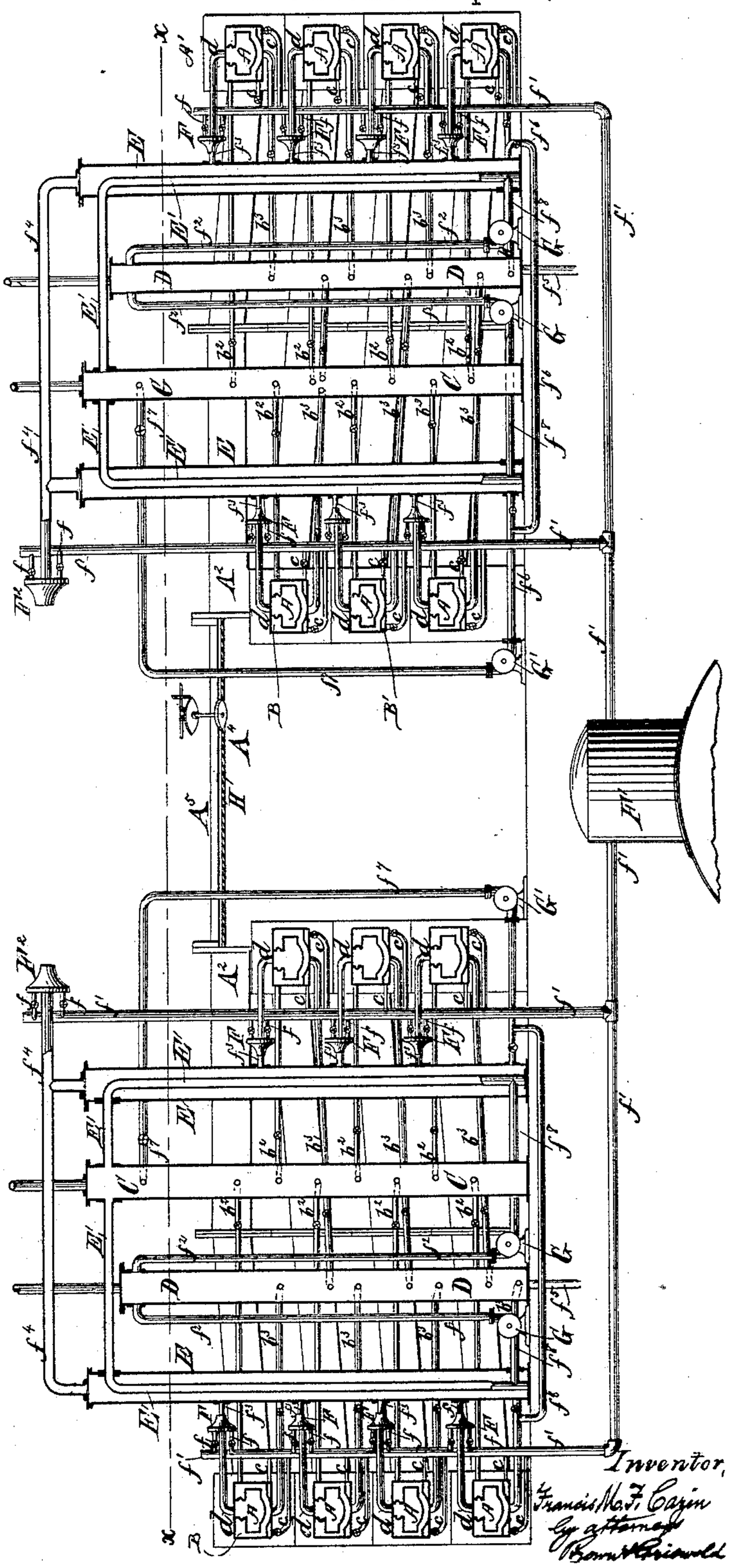

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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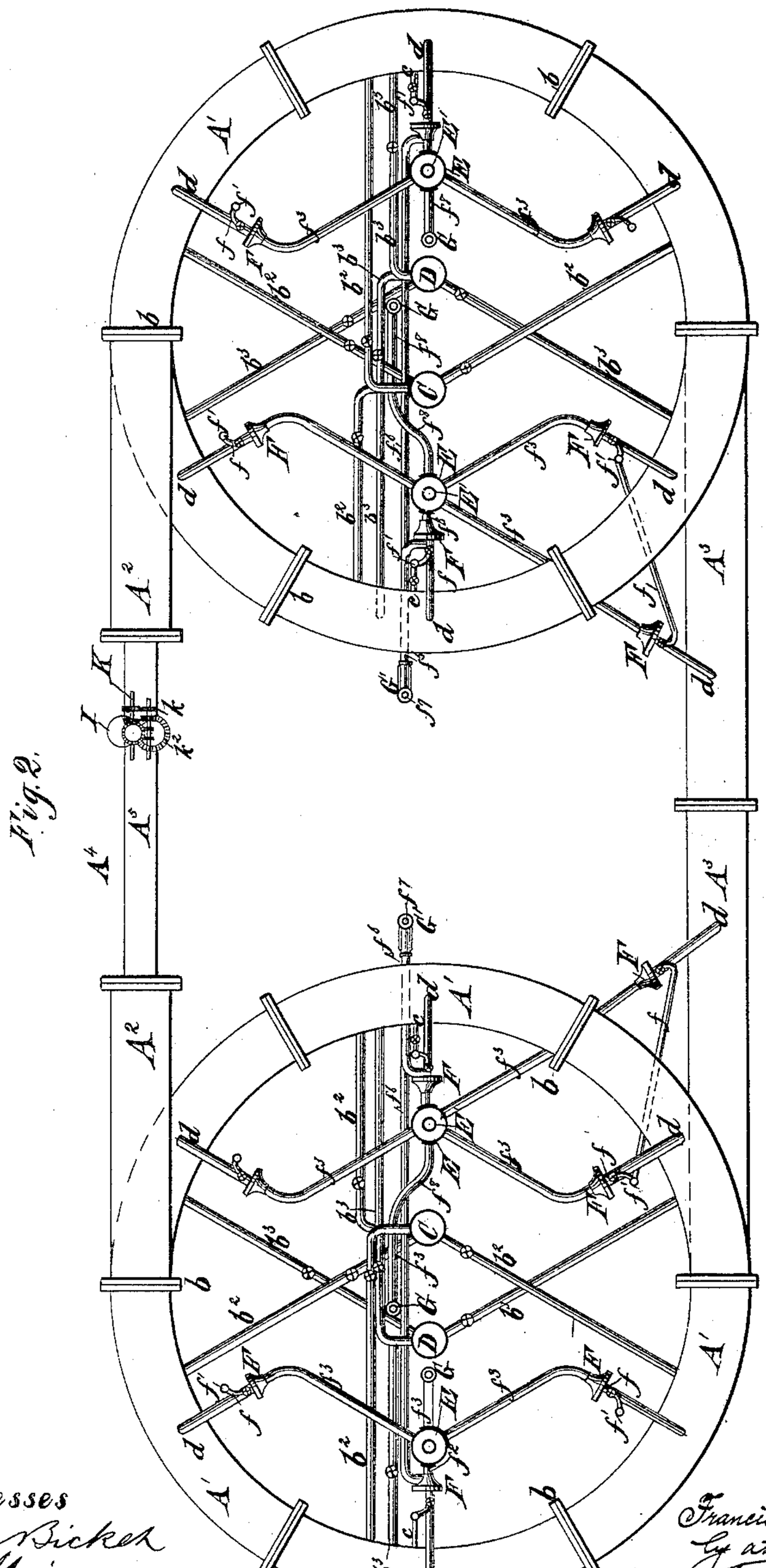

Fig. 2.

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(No Model.) 3 Sheets—Sheet 3.

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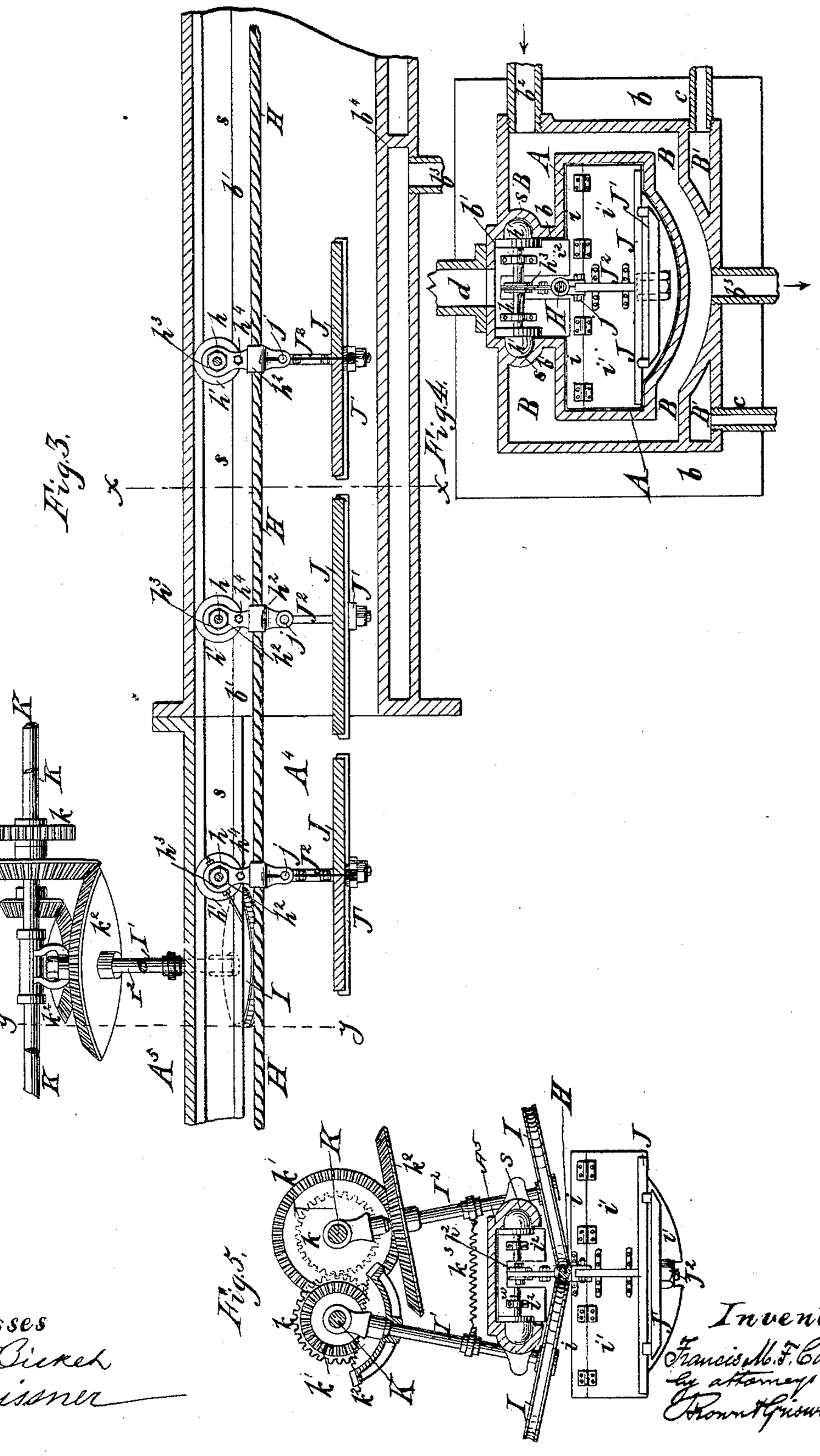

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UNITED STATES PATENT OFFICE.

FRANCIS M. F. CAZIN, OF WEST FAIRLEE, VERMONT.

APPARATUS FOR DRYING STARCH OR OTHER SOLID MATTER.

SPECIFICATION forming part of Letters Patent No. 424,760, dated April 1, 1890.

Application filed April 4, 1889. Serial No. 305,964. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. F. CAZIN, of West Fairlee, in the county of Orange and State of Vermont, have invented a new and useful Improvement in Apparatus for Drying Starch and other Solid Matter, of which the following is a specification.

The invention consists in novel combinations of parts, which are hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a sectional elevation of an apparatus embodying my invention and including a drying tube or chamber made in the form of two upright spirals placed at some distance apart and connected by tangential portions or continuations at the upper and lower portions of the spirals. Fig. 2 is a plan of such apparatus, partly in horizontal section on the plane of the dotted line *x x*, Fig. 1. Fig. 3 is a longitudinal section, upon a larger scale, of a portion of the drying tube or chamber, which is tangential to or at the upper termination of the spiral, and including a portion of the interval between the two spirals, where opening or space is afforded for access to the carriages or supports, and also including a portion of the chain of carriages or supports and the mechanism for driving them. In this figure certain parts (shown more clearly in Fig. 5) are omitted. Fig. 4 is a transverse section upon the plane of the dotted line *x x*, Fig. 3, and upon the same scale; and Fig. 5 is a transverse section approximately upon the plane of the dotted line *y y*, Fig. 3, and upon the same scale.

Similar letters of reference designate corresponding parts in all the figures.

A designates the drying tube or chamber, which is, as here shown, made in the form of two upright spirals A′, connected at the top and bottom by tangential portions or continuations A^2 A^3. I would here remark that the diameter of these spirals is supposed to be very large—say from forty feet upward—in order to afford sufficient time for drying during the passage of solid matter through the apparatus and varying with the different kinds of solid matter to be operated on and the height of the spiral structures. In the drawings, Figs. 1 and 2, the diameter of these spirals is shown less than it should be in proportion to the size of the other parts in order to bring the complete apparatus within the prescribed size of the drawings.

The drying tube or chamber A may be made of segmental sections of cast metal or other material united by flanged or other joints *b*, as shown in Fig. 2. The upper tangential connection or continuation A^2 between the two spirals may have the drying tube or chamber omitted for a space, as shown at A^4, in order to afford access to the endless chain of carriages or supports, hereinafter described, for loading them with material to be dried and unloading such material after drying. The space A^4 between the tangential continuations A^2 may be occupied by a bridge-piece A^5, which forms continuations of the track within the drying tube or chamber on which the carriages are supported, and which will be hereinafter further described.

One form of drying tube or chamber which may be employed is shown in transverse section in Fig. 4 and in longitudinal section in Fig. 3, to which I now refer. This drying tube or chamber A is approximately of rectangular transverse section, with an upwardly offset portion or channel *b′* in its upper portion, and having its lower portion curved transversely. This particular form is, however, immaterial.

Surrounding the drying tube or chamber is a space B for steam or for heat-conveying liquid—such as water—and I have also shown the tube or chamber as having outside the jacket B a supplemental jacket or jackets B′, which may receive steam in order to maintain any desired degree of temperature in the heat-conveying fluid within the jacket or space B throughout the length of the drying-tube, or to maintain different temperatures at different portions of the length. The jacket B is provided at suitable intervals in the length of the drying-tube with inlet-pipes b^2, for introducing thereto water or other heat-conveying liquid, and at the bottom of the jacket or heat-space B are outlet-pipes b^3, through which the water or other liquid may escape from the jacket after performing its work therein. At

the points around the spiral where the outlet-pipes b^3 for water or liquid are arranged the jacket B may be carried downward to the bottom of the drying-tube structure, as shown in Fig. 4, so as to provide for the convenient attachment of the outlet-pipe b^3, and at the portions of the length of the drying-tube which are not provided with the outlet-pipes, or in the portions between such outlet-pipes, the steam jacket or space B′ may be extended entirely across the bottom of the drying-tube below the jacket B.

I have shown the steam jackets or spaces B′ as having connected with them pipes *c*, through which steam may be conducted to them, and they should also be provided with pipes, whereby the water of condensation may escape from them.

Where it is desirable that the matter to be dried should be subjected to a uniform temperature throughout its entire length of travel through the drying tube or chamber A, the jacket or heating-space B for liquid may be continuous and uninterrupted lengthwise of the drying-tube; but for drying starch or other substances it might be desired to subject them to different temperatures at different stages in the drying operation, and to provide for this jacket B may be intercepted or divided, as shown at b^4, Fig. 3, at suitable intervals in the length of the drying-tube in order to form separate jacket-compartments into which water or other liquid heat-conveyer may be supplied by the pipes b^2. Such partitions b^4 dividing the jacket B may be provided at any points in the length of the drying-tube. It will of course be understood that the several pipes b^2 b^3, through which the liquid heat-conveyer is supplied to and exhausted from the heat-jackets B, also the pipes *c*, for supplying steam to the steam-jackets B′, should be provided with suitable valves controlling the passages through them. From the top or other part of the drying-tube extend pipes *d*, which communicate directly with the interior space containing the matter to be dried, and through which the vapors from the drying matter and the air liberated from such matter in the drying operation may be exhausted in order to maintain within the drying-space a pressure below that of the atmosphere. This exhaustion of vapors and air and the consequent reduction of pressure which is produced within the drying tube or chamber are of great importance in drying starch or other matters which must be subjected to a comparatively low heat to effect their drying.

I will now describe the arrangement of apparatus for condensing the vapors exhausted from the drying tube or chamber and heating the water or other liquid thereby and for supplying such water or liquid to the heating jacket or space B of the drying tube or chamber.

C designates a hot-water distributer, from which extend the supply-pipes b^2, for conveying hot water or other liquid to the jacket B of each spiral, and D designates a cooled-water collector, which receives through pipes b^3 from the jacket B of each spiral the water or other liquid which has performed its useful effect in the jacket B and has become thereby so reduced in temperature as to necessitate the imparting of further heat to it to enable it to be reused.

E E designate two dry condensers, which are here shown as of their simplest form, but which may be modified to suit the requirements of the apparatus. If desired, ordinary multitubular surface condensers may be employed for the purpose. In this example of my invention vapors and air from the drying tube or chamber are exhausted by steam-jet exhausters F, which are supplied with steam for their operation through branch pipes *f* from the main steam-pipes *f′*, and from such main steam-pipes the pipe *c*, for conveying steam to the jacket or jacket-space B′, may extend. The several main steam-pipes *f′* may be supplied with steam from a boiler F′. The exhausters F deliver to the condensers E through pipes f^3.

The condensers E which I have represented consist in the simple form shown of a vertical pipe or column having arranged within it a smaller pipe or column E′, and these smaller pipes or columns E′ have continuations (also designated by E′) which communicate with the hot-water distributer C. The cooled water which is delivered from the jacket of the drying tube or chamber after performing its useful effect therein is delivered through the pipes b^3 to the cooled-water collector D. From this collector such cooled water or other liquid is taken by pipes f^2 and by pumps G, which may be of the rotary type, is discharged through pipes f^8 to the bottom of the inner pipes E′ of the dry condensers E, and through such inner pipes is forced to the top of the dry condensers, and thence delivered into the hot-water collector C, from which it is supplied through the pipes b^2 to the several portions of the heating space or jacket B surrounding the drying tube or chamber.

I have shown the vapor-spaces of the condensers E as connected by pipes f^4 at the top with a steam-jet exhauster F^2, which is supplied with steam through a pipe *f′* and through branch pipes *f*, provided with valves.

In lieu of the steam-jet exhauster F^2 an air-pump may be employed.

Any suitable construction of steam-jet exhausters F F^2 may be employed, although I prefer for the purpose of my invention to employ an exhauster of the construction shown in my Letters Patent No. 408,824, dated August 23, 1889.

The cooled-water collector is provided at the bottom with a pipe f^5, through which the surplus water may be discharged.

The water of condensation may be taken

from the lower portions of the condensers E E through pipes f^6, and by a pump G′ may be discharged through a pipe f^7 into the hot-water distributer to augment the volume therein. The point at which the pipes f^2 communicate with the cooled-water collector D should be somewhat lower than the level of hot water maintained in the distributer C, in order that the circulation of water through the heating space or jacket B of the drying tube or chamber shall be produced by the difference of hydrostatic pressure in the hot-water distributer C and the cooled-water collector D.

The chain of carriages or supports for conveying the starch or other solid matter to be dried may be of any suitable construction, and have continuous or intermittent motion imparted to it by any suitable mechanism. In the construction here shown the carriages or supports are attached to an endless rope or cable H, to which motion may be imparted by friction-wheels I, arranged upon opposite sides thereof at the gap or interval A^4 between the tangential continuations A^2 of the two spirals. Each carriage or support comprises an axle or support h and wheels h', which run upon tracks s, provided within the offset channel portion b' of the drying tube or chamber A, as is shown best in Fig. 4. These wheels may be of hemispherical shape, so as to close the space within the grooves or channels s, and they may be of slightly different diameters in order to conform to the differences in the diameters of the two circles in which the tracks s are arranged. Upon each axle is a two-part clamp h^2, which by means of nuts h^3 upon the axle, and also by means of a bolt h^4, if necessary, may be clamped upon the rope H, and rubber or other suitable packing may be provided in the cavities of the two parts of the clamp in order to give it a firm hold upon the rope.

As here represented, each carriage or support comprises a slab, plate, or platform J, which is supported by a spider J′ beneath it and a rod or suspending-link J^2, pivoted by a pin j to the lower portion of the clamp h^2. The slabs or platforms J may therefore maintain their horizontal position notwithstanding the inclination of the drying tube or chamber and the rope or cable H. I prefer to make the slabs or platforms J of some absorbent material—such as gypsum or unglazed earthenware—which will absorb moisture from the bottom surface of the blocks of starch, thereby effecting the drying of such surfaces as well as those which are exposed.

As before stated, the drying tube or chamber is discontinued in the space A^4, and the bridge A^5, which extends across this space, has formed in it continuations of the tracks or channels s in the drying tube or chamber.

I have here represented the grooved wheels I, which operate upon the rope or cable H to move it by friction, as fixed upon shafts I′ I^2, having a pivoted or swiveled connection with driving-shafts K, which are connected or geared together by wheels k, and which, through pairs of bevel-gears k' k^2, transmit rotary motion to the shafts I′ I^2. The gear-wheels should be so proportioned as to drive the shafts I′ I^2 at equal speed, and the wheels I may be held in frictional engagement with the cable or rope by a spring k^3, applied between their shafts I′ I^2, or in any other suitable way.

In order to enable the vapors and air to be exhausted from the drying tube or chamber and to maintain therein a pressure below the atmosphere, notwithstanding the opening which the drying tube or chamber has to the atmosphere at the space A^4, I provide at intervals along the line of the endless chain of carriages partition-plates which approximately fit the interior of the drying tube or chamber and which form moving valves dividing the drying tube or chamber into separate compartments, which are shifted in position as the chain of carriages moves. I have here represented such partitions or valves as made in sections, in order to permit them to pass the driving-wheels I.

As here represented, each valve or partition comprises a portion i, which is fixed in position relatively to the clamp h^2, so as to extend upon opposite sides of the same, it being arranged in a saw-cut or division in the clamp, as shown in Fig. 3, and to this portion of the partition, which is fixed to the clamp, is hinged a main portion i', which extends downward to the slab or platform J, and also through the spider J′ and to the bottom of the drying tube or chamber. As shown in Fig. 3, the depending rod J^2 is divided in a direction transverse to the length of the drying tube or chamber, and the hinged portion i' of the partition or valve is clamped and secured by riveting or otherwise between the two portions or sections of the rod J^2 and corresponding portions or sections of the slab or platform J and the spider J′. The movable partition or valve also comprises an upper portion i^2 of a size to fit as closely as is possible the channeled offset portion b' of the drying tube or chamber A, and this upper portion i^2 of the valve or partition is pivoted upon an axle h and may swing thereon, so that it may be readily deflected by the wheels I as it reaches them in the travel of the chain of carriages. This deflection or swinging aside of the portion i^2 of the partition or valve is illustrated in Fig. 5. The wheels I may be notched in their peripheries, so as to receive clamps h^2, or they may be destitute of notches and another corresponding pair of driving-wheels I may be employed and so geared that they will have a frictional hold upon the rope or cable H when the clamps are passing the wheels here shown.

I have in Fig. 3 represented alternate carriages as provided with movable partitions or valves i i' i^2.

If found desirable, paper, cloth, or other material may be placed between the platform or slab J and the starch or other solid matter to prevent the latter from adhering to the platform or slab.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with a spiral drying tube or chamber surrounded by a heating space or jacket separated therefrom by metal walls, of a chain of carriages or supports arranged for progressive travel through said tube or chamber, whereby matter to be dried may be conveyed through the tube or chamber while maintained in a state of rest relatively to its supporting-surfaces, and an exhauster connected with the drying tube or chamber for withdrawing vapors and air therefrom and maintaining therein a pressure below that of the atmosphere, substantially as herein described.

2. The combination, with a drying-tube composed of two spirals and surrounded by heating-jackets separated from them by metal walls and connected at top and bottom by tangential continuations of the spirals, and an endless chain of carriages or supports for solid matter, arranged for progressive travel through said drying-tube and connecting continuations, one of such connecting continuations of the drying-tube being interrupted for loading and unloading the carriages or supports and for the operation of driving mechanism to move the chain of carriages or supports, of an exhauster for withdrawing air and vapor from said drying-tube and maintaining therein a pressure below that of the atmosphere, substantially as herein described.

3. The combination, with a drying tube or chamber having a surrounding heating-jacket separated from it by metal walls, of a chain of carriages or supports for conveying solid matter through said tube or chamber while in a state of rest relatively to its supporting-surfaces, partitions or valves attached to and moving with the chain of carriages, whereby the length of the drying tube or chamber is divided into compartments, and an exhauster for withdrawing air and vapor from said drying tube or chamber and maintaining therein a pressure below that of the atmosphere, substantially as herein described.

4. The combination, with a spiral drying tube or chamber surrounded by a heating-jacket separated from it by metal walls, of a chain of pendent carriages or supports arranged for progressive travel through the tube or chamber to convey matter while in a state of rest relatively to its supporting-surfaces and for maintaining the horizontal position of such supporting-surfaces, and an exhauster for withdrawing air and vapor from said drying tube or chamber to maintain therein a pressure below that of the atmosphere, substantially as herein described.

5. The combination, with a drying tube or chamber surrounded by a jacket or heating-space for heat-conveying substance, and also comprising a supplemental jacket or space for steam or other fluid to regulate the temperature of the said heat-conveying substance, of a chain of carriages or supports arranged for progressive travel through said drying tube or chamber for conveying solid matter in a state of rest relatively to its supporting-surfaces, and an exhauster for withdrawing vapors and air from said drying tube or chamber to maintain therein a pressure below that of the atmosphere, substantially as herein described.

6. The combination, with a drying tube or chamber having a surrounding heating-jacket, and through which solid matter to be dried is conveyed, of an exhauster for withdrawing air and vapor from said tube or chamber to maintain therein a pressure below that of the atmosphere, a condenser to which such vapors are conducted and in which they give up their heat to liquid, and pipes for supplying liquid so heated to the heating-jacket of the drying tube or chamber, substantially as herein described.

7. The combination, with a drying tube or chamber having a surrounding heating-jacket, and through which solid matter to be dried is conveyed, of an exhauster for withdrawing vapors and air from said drying tube or chamber, heating apparatus consisting of a condenser into which said vapors and air pass, a pipe or pipes arranged in said condenser and through which liquid escaping from said jacket will flow, and pipes whereby the water after absorbing heat from the vapor and the water of condensation of the vapor are returned to said jacket, substantially as herein described.

8. The combination, with a drying tube or chamber having a surrounding heating-jacket, and through which solid matter to be dried is conveyed, of steam-jet exhausters operated to withdraw vapors and air from said drying tube or chamber, and heating apparatus consisting of a condenser for receiving such vapor and air and steam from the said exhauster, a pipe or pipes arranged in said condenser and through which flows the liquid escaping from the jacket, and pipes whereby the liquid after absorbing heat from the steam and vapor is returned to said heating-jacket, substantially as herein described.

9. In an apparatus for drying starch and other solid matter, the combination, with a drying tube or chamber having a surrounding heating space or jacket separated therefrom by metal walls, of a chain of carriages or supports arranged for progressive motion for conveying through said tube or chamber solid matter to be dried, driving-wheels for engaging with the chain or rope to produce the movement of the carriages, partitions or valves attached to and moving with the chain of carriages to divide the drying tube or chamber

into compartments and comprising portions which are movable to enable them to pass the driving-wheels, and an exhauster for withdrawing from said tube or chamber the vapors emanating and air liberated from the drying matter in order to reduce the pressure within said drying tube or chamber below that of the atmosphere, substantially as herein described.

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Witnesses:
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