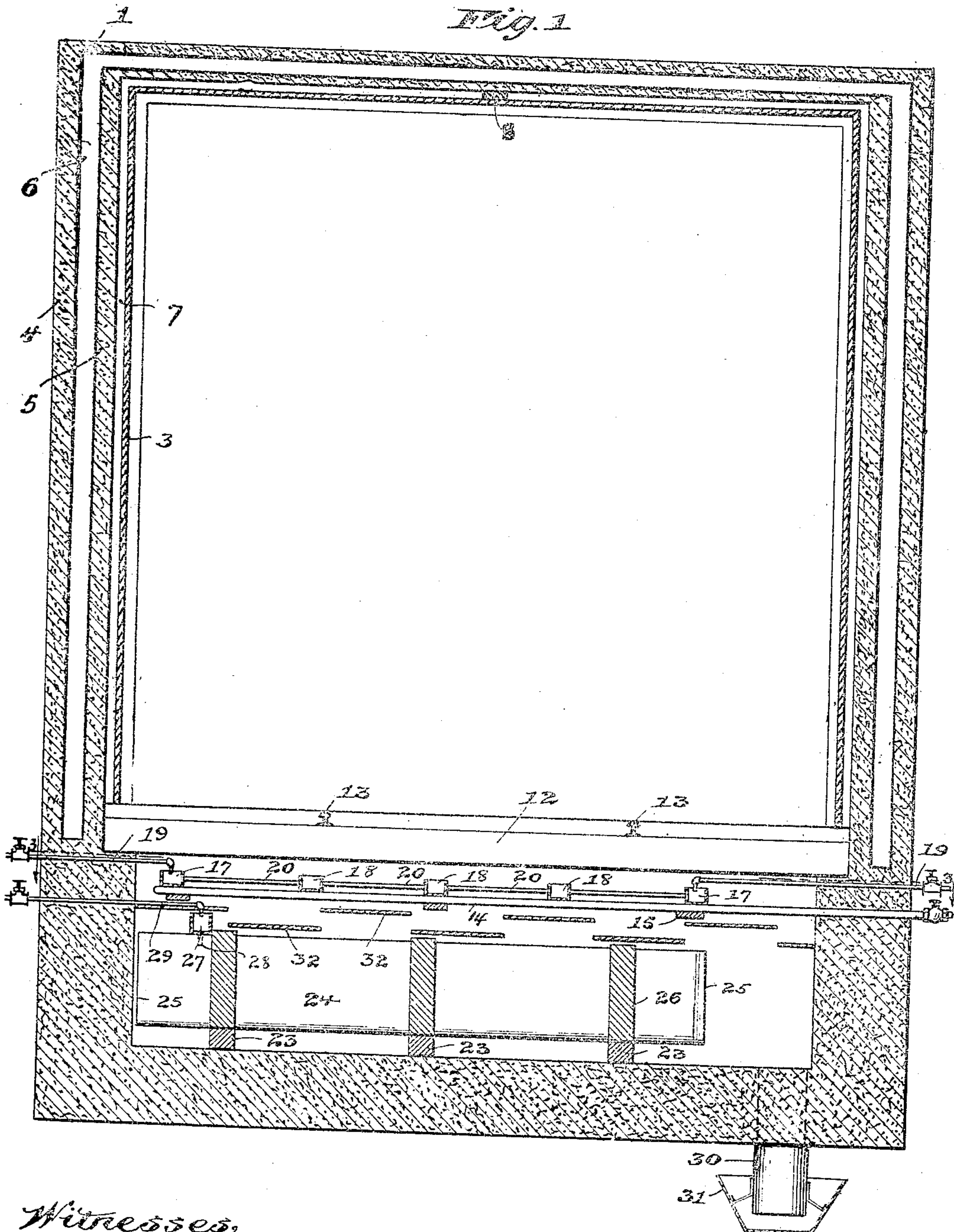


No. 875,368.

PATENTED DEC. 31, 1907.

G. W. McMULLEN.
DRYING APPARATUS.
APPLICATION FILED MAY 26, 1905.

4 SHEETS—SHEET 1.



Witnesses,
J. D. Mann,
A. N. Evans.

Inventor,
George W. McMullen,
By *Offield Fowler* Attorney.

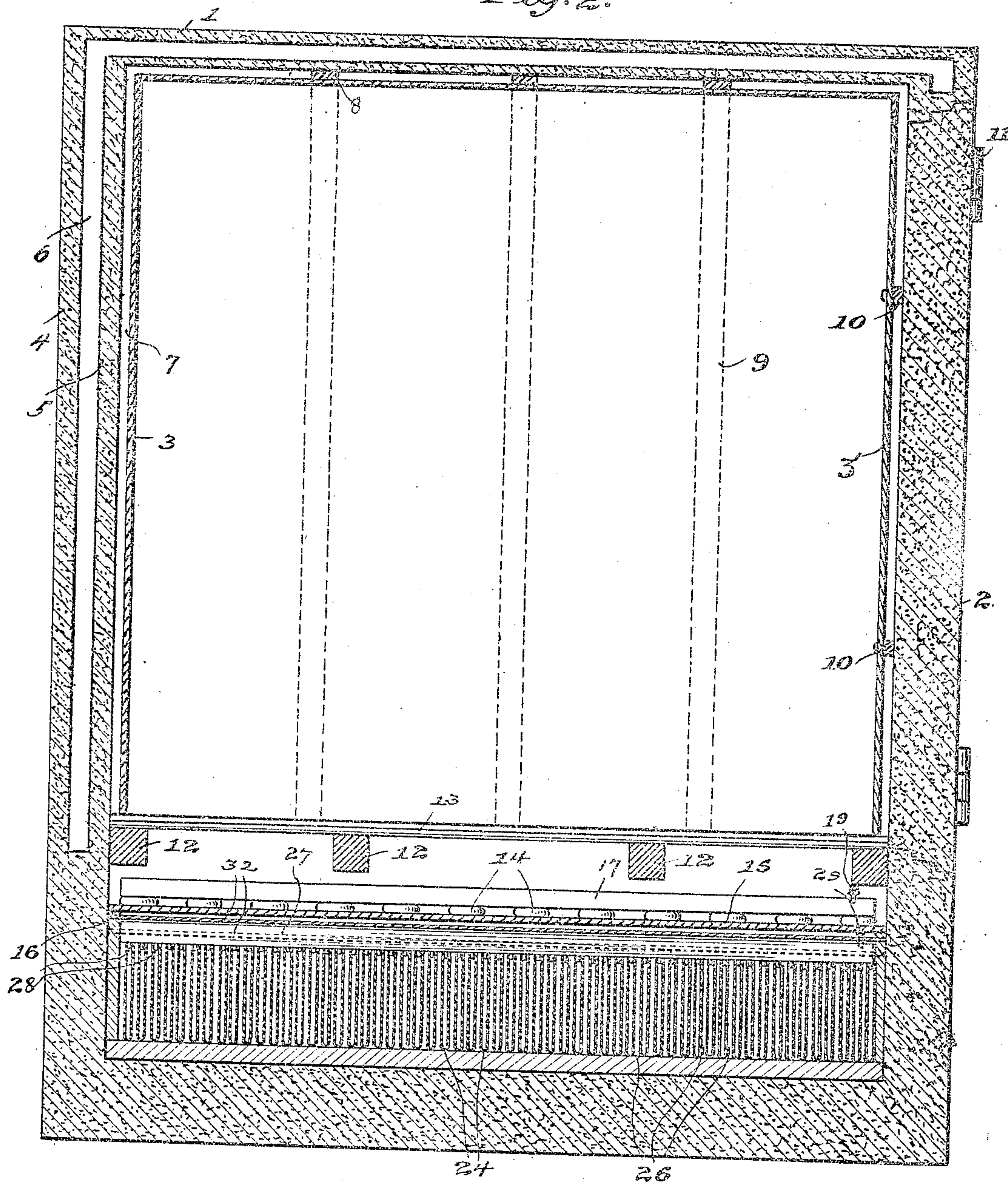
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4 SHEETS—SHEET 2.

Fig. 2.



Witnesses,
J. S. Mann,
A. N. Evans.

Inventor,
George W. McMullen,
By *Offield Work & Lathicum*
Attys

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4 SHEETS—SHEET 3.

Fig. 3.

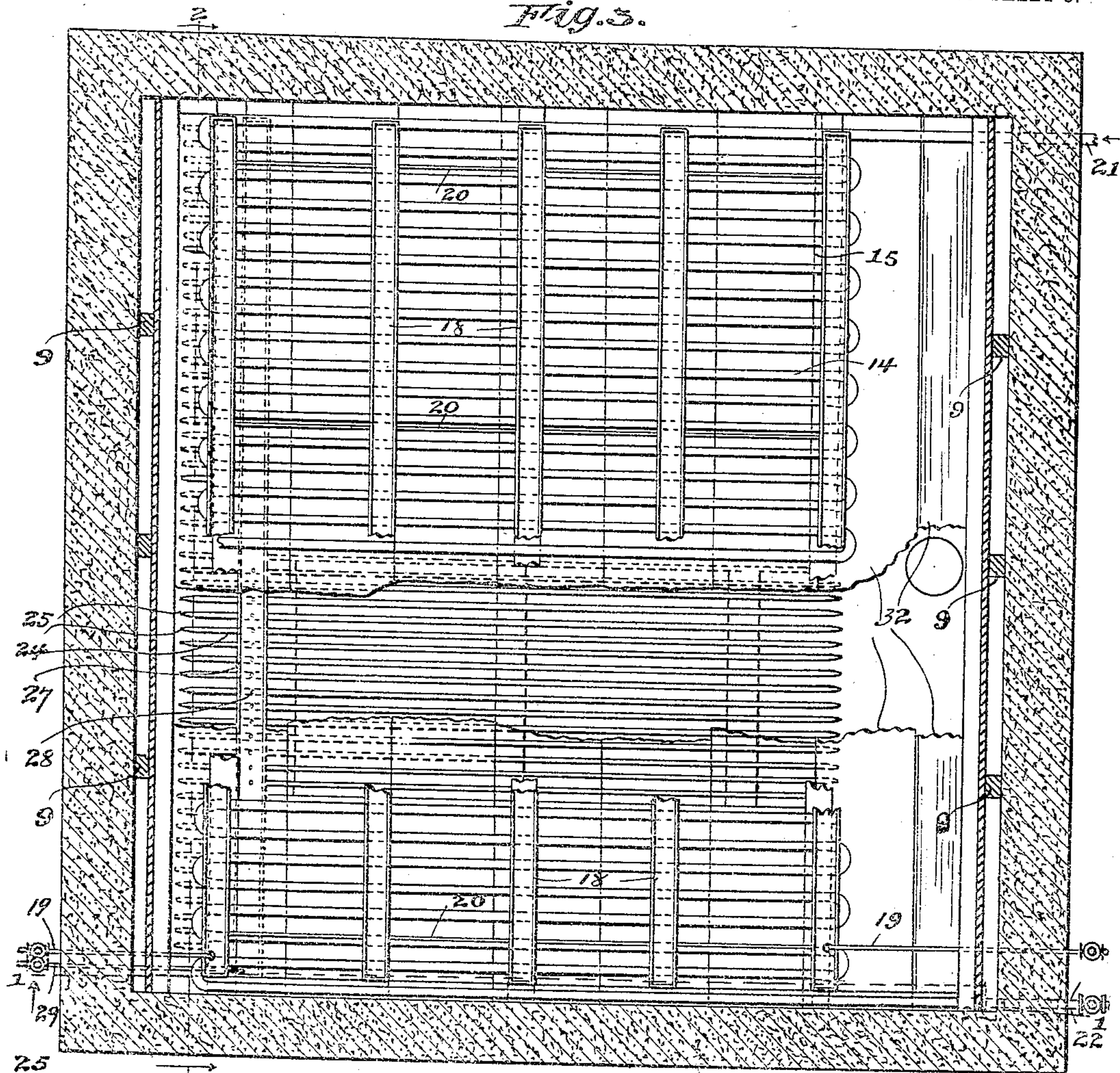


Fig. 4.

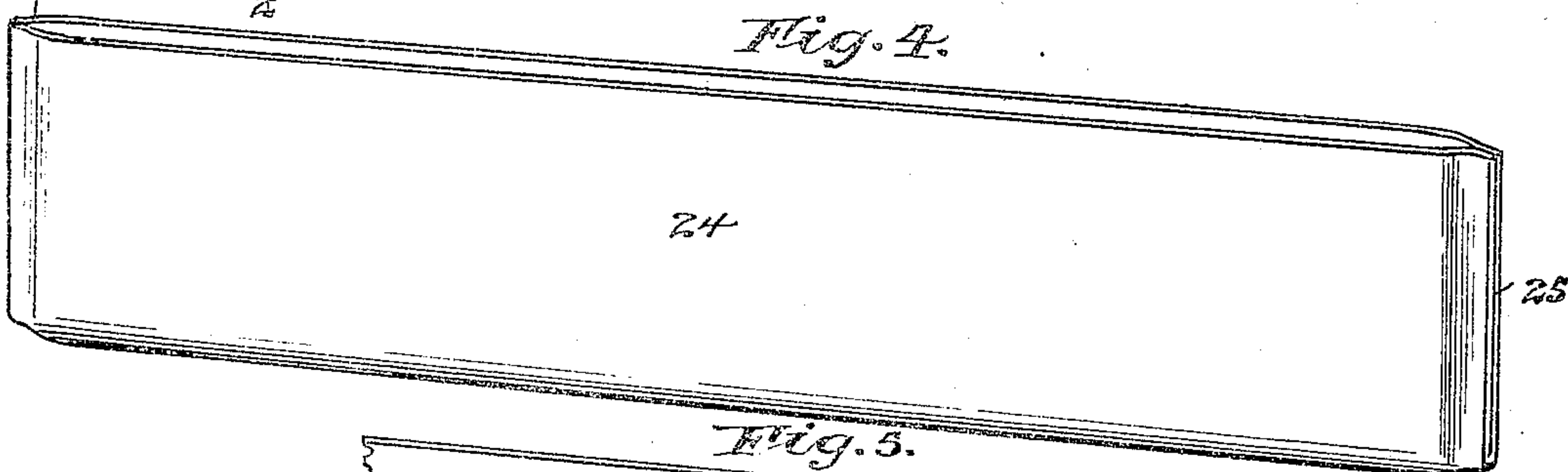
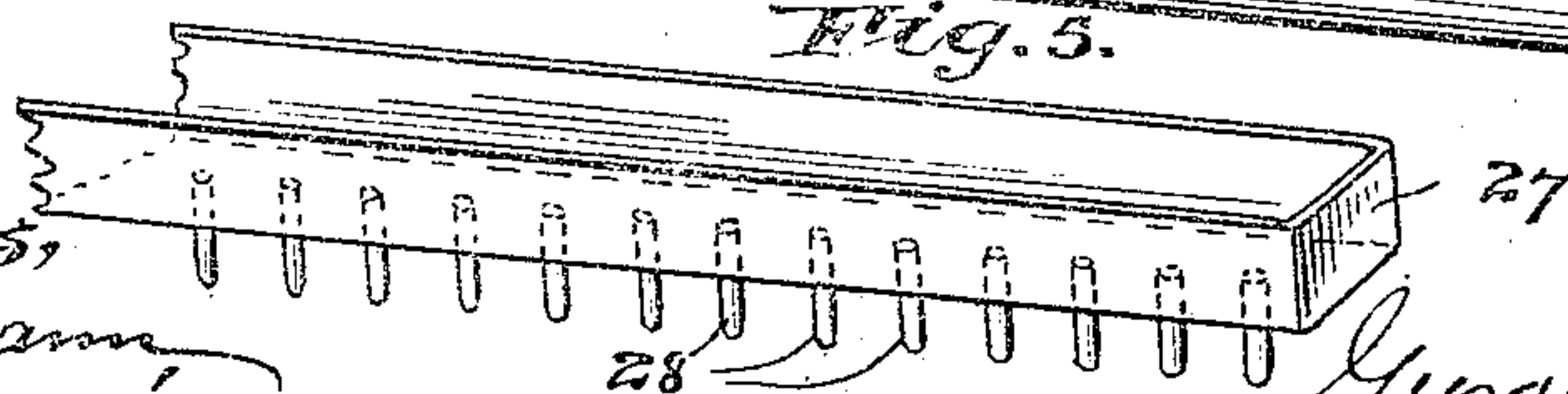


Fig. 5.



Witnesses,
J. D. Mann,
A. N. Harris.

Inventor,
George W. McMullen,
By Offield Tower & Lathicum,
Attys.

UNITED STATES PATENT OFFICE.

GEORGE W. McMULLEN, OF PICTON, ONTARIO, CANADA.

DRYING APPARATUS.

No. 875,368.

Specification of Letters Patent.

Patented Dec. 31, 1907.

Application filed May 26, 1905. Serial No. 262,381.

To all whom it may concern:

Be it known that I, GEORGE W. McMULLEN, a resident of Picton, Prince Edward county, Ontario, Canada, have invented certain new and useful Improvements in Drying Apparatus, of which the following is a specification.

This invention relates to improvements in drying apparatus, and refers more specifically to an apparatus partaking of the nature of a drying kiln.

Among the salient objects of the invention are to provide an apparatus whereby the water or other volatile constituents may be extracted from commodities under regulated and controlled conditions best suited for drying the specific substance or commodity in hand; to provide an apparatus whereby the desiccation may be effected in the presence of a moist and warm atmosphere, the degree of humidity of which is at all times under control and may be so regulated as to best secure the desired result; to provide an apparatus whereby substantially equable temperatures and conditions may be maintained at similar levels throughout the desiccating chamber; to provide an extremely efficient arrangement and construction of vapor condensing apparatus; to provide improvements in the construction and arrangement of the apparatus whereby the moist and warm condition of the drying atmosphere is maintained and controlled; to provide a construction in the drying chamber which is most effective in insulating the interior against external temperature conditions; and in general to provide a simple, efficient and economically constructed apparatus of the character referred to.

To the above ends, the invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

The invention will be readily understood from the following description, reference being had to the accompanying drawings, in which,—

Figure 1 is a vertical cross-sectional view taken in the plane indicated by line 1—1 of Fig. 3, and looking in the direction of the arrows; Fig. 2 is a similar view, taken in a plane at right angles to that of Fig. 1, and upon the plane indicated by line 2—2 of Fig. 3; Fig. 3 is a horizontal sectional view taken in a plane just above the radiators, and looking downwardly, parts of the radia-

tors and superposed liquid-receptacles being broken away to expose subjacent parts; Fig. 4 is a perspective view of one of the condenser elements; Fig. 5 is a fragmentary perspective view of one of the liquid distributing troughs; and Fig. 6 is a view similar to that of Fig. 1, showing a modified construction.

The apparatus herein shown is designed for that form of evaporating plant wherein the material to be acted upon is arranged in the upper portion of a vapor-tight or closed chamber which derives its heat from a source located below the same, and is provided at a still lower point with condensers. In the practical carrying out of desiccating with such an apparatus, the material placed in the drying chamber proper is subjected to the action of the heat, whereby its moisture is expelled, and this moisture-laden atmosphere is condensed as it descends and comes into contact with the condensers in the lower part of the apparatus.

In many cases it is necessary to supplement the moisture expelled from the commodity being dried with additional vapor, so that the air may at all times be in that condition best suited for effecting the desiccation without objectionably affecting the commodity under treatment. This moist atmosphere has been found essential, not only in maintaining the porosity of materials of the denser character, but also in drying those which contain larger percentages of moisture, such as fruits, eggs, vegetables, milk and other food and analogous products, in which case its presence arrests germ development and action, and maintains the color, natural flavors and other desirable characteristics of the materials.

In practice, I have found that many materials are sensitive to chemical or other physical changes in their nature, and require the maintenance of definite conditions during desiccation, to insure satisfactory results. One of the chief conditions usually required is an equable temperature in the drying chamber, that is, in all that area above the cooling or condensing chamber.

It will be apparent that in any substantially closed and heated chamber, where the structure is provided with well insulated walls so designed as to avoid to the utmost loss of heat by radiation, the temperature at the top will nevertheless be slightly in excess of that in the lower portions; but for certain

purposes it is necessary that the apparatus should be so constructed that the drying chamber will be equally heated in all its parts at the same level. It is also desirable that many, and, in fact, essential that some, substances be treated in an apparatus having the heating devices distributed throughout the drying chamber and arranged to locally heat the material. For example, where milk, tomatoes, apples and the like are being dried, it will not do to have all the pans and racks arranged in series about a single heating device, since those nearer the source of heat will dry more quickly than those more remote, and the results will be un-uniform.

The present apparatus is designed to afford means for maintaining the necessary conditions referred to for securing the desired results.

Referring to the drawings, 1 designates as a whole an outer inclosure, the walls whereof are of suitable heat-insulating material so as to confine the heat largely within the chamber formed by said closure and protect the latter against the influence of external temperatures. The inclosure is conveniently provided at one side with a large door 2, through which the materials to be heated may be introduced and withdrawn. The walls of said outer inclosure are desirably double, as indicated at 4 and 5, and spaced apart so as to provide an intervening insulating space 6, which surrounds the side walls and top of the chamber. Inside of the outer inclosure is arranged an inner inclosure 3, the walls whereof are likewise spaced away from the outer walls so as to provide a surrounding insulating space 7. Said inner inclosure may conveniently terminate at its lower edges coincident with the working floor or track rails of the kiln, since the material being treated is always supported above that level.

In order that there may be as little circulation of air as practicable in the insulating space 7 intervening between the outer and inner inclosures, said space is shown as subdivided more or less; partition strips 8 being shown as extending across the top of the kiln and also vertically at intervals apart around the side walls, as indicated at 9. That part of the inner inclosure opposite the door 2, is made separate from the remaining walls and supported by the door proper, said independent part being designated 3', and shown as supported upon the inner face of the door by means of a plurality of supporting and spacing studs 10. The door is shown as hinged at one edge, as indicated at 11.

12 designates a series of cross timbers arranged in a horizontal plane and extending across the lower part of the kiln at intervals apart, and upon these timbers are mounted track rails 13, which serve to support a wheeled drying truck (not shown) in a well

understood manner. A short distance below the timbers 12 are arranged a plurality of radiator coils 14; these coils being desirably, and as shown herein, formed of flat loops or turns of pipe arranged in the same horizontal plane and supported upon suitable cross strips 15 spaced at intervals apart, and in turn supported at their ends upon ledges 16.

17, 17 and 18 designate a plurality of open trough-like receptacles arranged to extend transversely of, and resting upon the radiator coils; these receptacles being spaced apart and desirably arranged to extend parallel with each other. A steam pipe 19 is arranged to communicate with each of the two outermost receptacles 17, and the receptacles 17 are arranged to communicate with each of the intermediate receptacles 18 by means of circulating pipes 20. A main steam-supply pipe 21 communicates with the inlet end of the radiator coils, while a similar exhaust pipe 22 is connected with the discharge end of said coils; all of these several steam pipes referred to being arranged to enter through the side walls of the kiln, as shown clearly in the drawings.

In the lower part of the kiln, and preferably arranged to rest upon a series of cross timbers 23, is a series of condensers 24, which may be of any suitable construction so far as the general scope of the invention is concerned, but are of peculiar and novel construction, as shown in the present instance. Each condenser unit consists of a metal trough of relatively deep and narrow form, and desirably made of such length as to extend across the principal width of the drying chamber. I conveniently construct these troughs 24 by bending up a rectangular sheet-metal blank to form a deep, narrow U-shaped trough, and then compress the end margins together and unite them by solder, so as to form a one-piece structure, as best seen in perspective view, Fig. 4. I preferably arrange these condenser troughs side by side parallel with each other, and spaced apart by means of space blocks 26, each having a thickness approximately equal to or slightly greater than, the width of the trough; the series being extended entirely across the interior of the kiln from side to side, so that the side walls support the outermost troughs and hold the entire series from tipping laterally. When so arranged, I can very readily lift out any one of the troughs for the purpose of repair or cleansing without disarranging the rest of the series.

In order to supply the several troughs with cooling liquid, I arrange a transverse feeder trough 27, extending across the end of the series of troughs, and provided in its bottom with a series of outlet nozzles 28, one for each of the respective condenser troughs. An inlet pipe 29 enters through the wall of the kiln

and delivers into the distributing trough 27. The several condenser troughs are intended to overflow in ordinary operation, preferably at all points along their upper margins, and to this end their upper margins are arranged in carefully disposed horizontal positions. In order to dispose of the overflow, a drain pipe 30 communicates with the bottom of the kiln, which drain pipe may, if necessary, be provided with a seal or trap 31.

In order to provide for a more ready descent of the heavy, moist atmosphere from the drying chamber, the heating coils or radiators and the condensers are made somewhat shorter than the transverse width of the chamber, as best seen in Figs. 1 and 3, thus leaving a more or less open space between the ends of the coils and condensers and the opposite side wall.

In order to prevent the establishment of a pronounced upward current in any one part of the drying chamber, I provide a series of baffle boards or plates, designated 32, which are interposed between the condensers and the radiator coils and so arranged that the air will filter upwardly through the spaces between the entire series. This insures an even distribution of the rising warm air and the longer retention of the charged air in the vicinity of the condensers, besides preventing the establishment of a distinct upward current confined chiefly to that side of the drying chamber remote from the side where the moisture laden atmosphere chiefly descends to the condensers.

The operation of the kiln constructed as described will be evident from the foregoing. The material being placed in the chamber upon a suitable support, as, for example, a wheeled truck, and the door closed, the heat is applied through the steam coils or radiators, thereby heating the surrounding air and causing it to rise through the drying chamber. At the same time cold water is introduced to the condensing troughs. The vapor pans or troughs having been previously filled with water, are supplied with a small quantity of steam through the pipes 19, and the water in said troughs or vapor pans 17—18 being thus heated, and also additionally heated by the radiators, begins to give off a supply of vapor. There being no escape at the top of the chamber, the vapor generated in the lower part of the chamber, and that expelled from the commodity being treated, charges the air and causes the latter to descend by gravity to the cooling chamber filled with the condensing troughs, where the air gives up its burden of vapor and again rises in its drier and re-warmed condition. The condensers are kept cool by the constant flow of cold water, which passes off through the drain pipe and trap.

In the modification shown in Fig. 6, means

are provided for supporting the commodities to be dried at various levels within the drying chamber, and for supplying heat locally at each of these levels. To this end a series of radiator coils, severally designated 33, is provided; each coil being formed into a series of horizontally-disposed flat loops substantially like those shown in the previous figures, and arranged to rest upon transverse supporting bars 34, the ends of which are carried by channel irons or other suitable ledge members 35 secured to the side walls of the chamber. The several radiator coils are united in series with each other to form a single closed heating system; and with the uppermost is arranged to communicate a steam or hot-water pipe 36; while with the lowermost radiator coil is connected a discharge pipe 37.

Across each of the coils arranged within the heating chamber proper are arranged to extend a plurality of cross bars or supports 38, and upon these are in turn arranged supporting slats 39, upon which the commodities may rest; the arrangement being such as to support the commodities slightly above and out of direct contact with the radiator pipes. Of course, any suitable supporting structure for this purpose may be substituted.

The operation of apparatus embodying this modification is obvious, and need not be described. It may be noted that in both this modification and that previously described the baffle-boards not only prevent the formation of distinct currents of air but also serve as shields which prevent much of the heat from the radiators reaching the condensers.

I claim as my invention:

1. In a drying apparatus, the combination of a substantially closed drying chamber having insulating side and top walls, a series of liquid troughs constituting condensers arranged in the lowermost part of said chamber, a series of baffles arranged in horizontally distributed order above said condensers, a radiator coil disposed in horizontally extended position above said baffles, one or more open water receptacles arranged in juxtaposition to said radiator coil, and means for supporting commodities in the drying chamber above said radiator and water receptacle.

2. In a drying apparatus, the combination of a substantially closed drying chamber having insulating side and top walls, a series of liquid troughs constituting condensers arranged in the lowermost part of said chamber, a series of baffles arranged in horizontally distributed order above said condensers, a radiator coil disposed in horizontally extended position above said baffles, one or more open water receptacles arranged in juxtaposition to said radiator coil, means for delivering steam into said open water recep-

tacle or receptacles, and means for supporting commodities in the drying chamber above said radiator and water receptacle.

3. In a drying apparatus, the combination of a substantially closed drying chamber having insulating side and top walls, a series of open water troughs arranged in horizontally distributed order in the lower part of said chamber, means affording a regulated supply of water to said troughs, a closed radiator pipe arranged in horizontally distributed order in a zone above said condenser troughs, a series of open vapor troughs supported in proximity to said radiator coil, means for circulating heating fluid through the radiator coil, means for discharging steam into the contents of one or more of said vapor troughs, and commodity supports arranged above the zone of the vapor troughs.

4. In a drying apparatus, the combination of a substantially closed drying chamber having insulating side and top walls, a series of open water troughs arranged in horizontally distributed order in the lower part of said chamber, means affording a regulated supply of water to said troughs, a closed radiator pipe arranged in horizontally distributed order in a zone above said condenser troughs, a series of open vapor troughs supported in proximity to said radiator coil, means for circulating heating fluid through the radiator coil, means for discharging steam into the contents of one or more of said vapor troughs, and commodity supports arranged above the zone of the vapor troughs.

ported in proximity to said radiator coil, means for circulating heating fluid through the radiator coil, means for discharging steam into the contents of one or more of said vapor troughs, a series of baffles arranged in horizontally distributed order extending across the entire chamber and interposed between the condenser troughs and radiator pipe, and commodity supports arranged above the zone of the vapor troughs.

5. In a drying apparatus, the combination of a substantially closed chamber having insulating side and top walls, a series of condensers arranged in horizontally extended order in the bottom of said chamber, a series of vapor generators arranged above said condensers, a series of horizontally disposed closed heating coils arranged at a plurality of levels throughout the drying chamber above said vapor generators, a heating coil arranged in proximity to said vapor generators, means for supplying cooling fluid to the condensers, and means for circulating the heating fluid through the several heating coils.

GEORGE W. McMULLEN.

Witnesses:

ALBERT H. GRAVES,
L. F. McCREA.