(No Model.)

5 Sheets—Sheet 1.

J. BUCKNER.

APPARATUS FOR MANUFACTURING ICE.

No. 485,149. Patented Oct. 25, 1892.

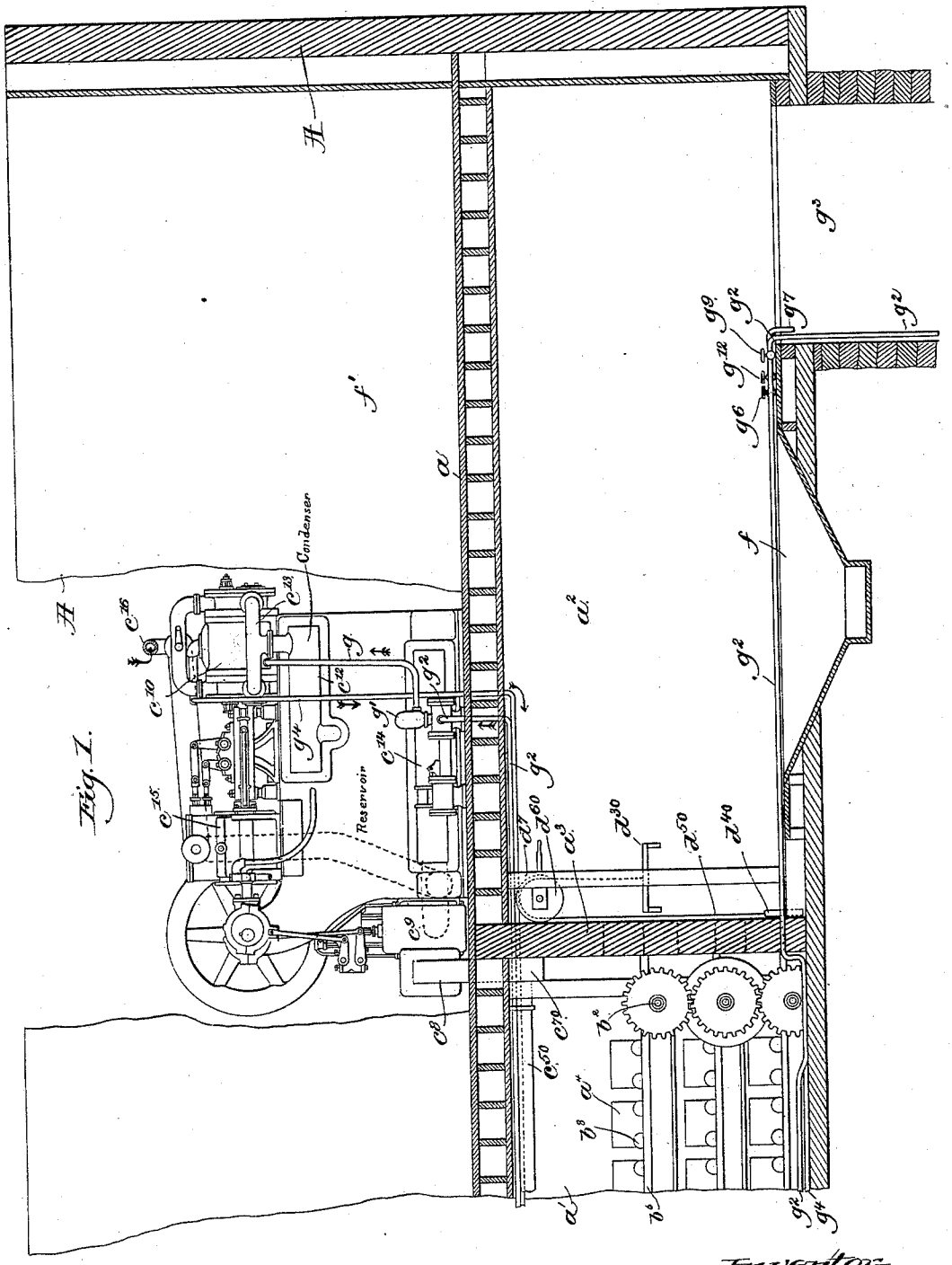


Fig. 1.

Witnesses.
John F. C. Priemkert
Frederick L. Emery

Inventor:
James Buckner,
by Lemley & Gregory
Atty's.

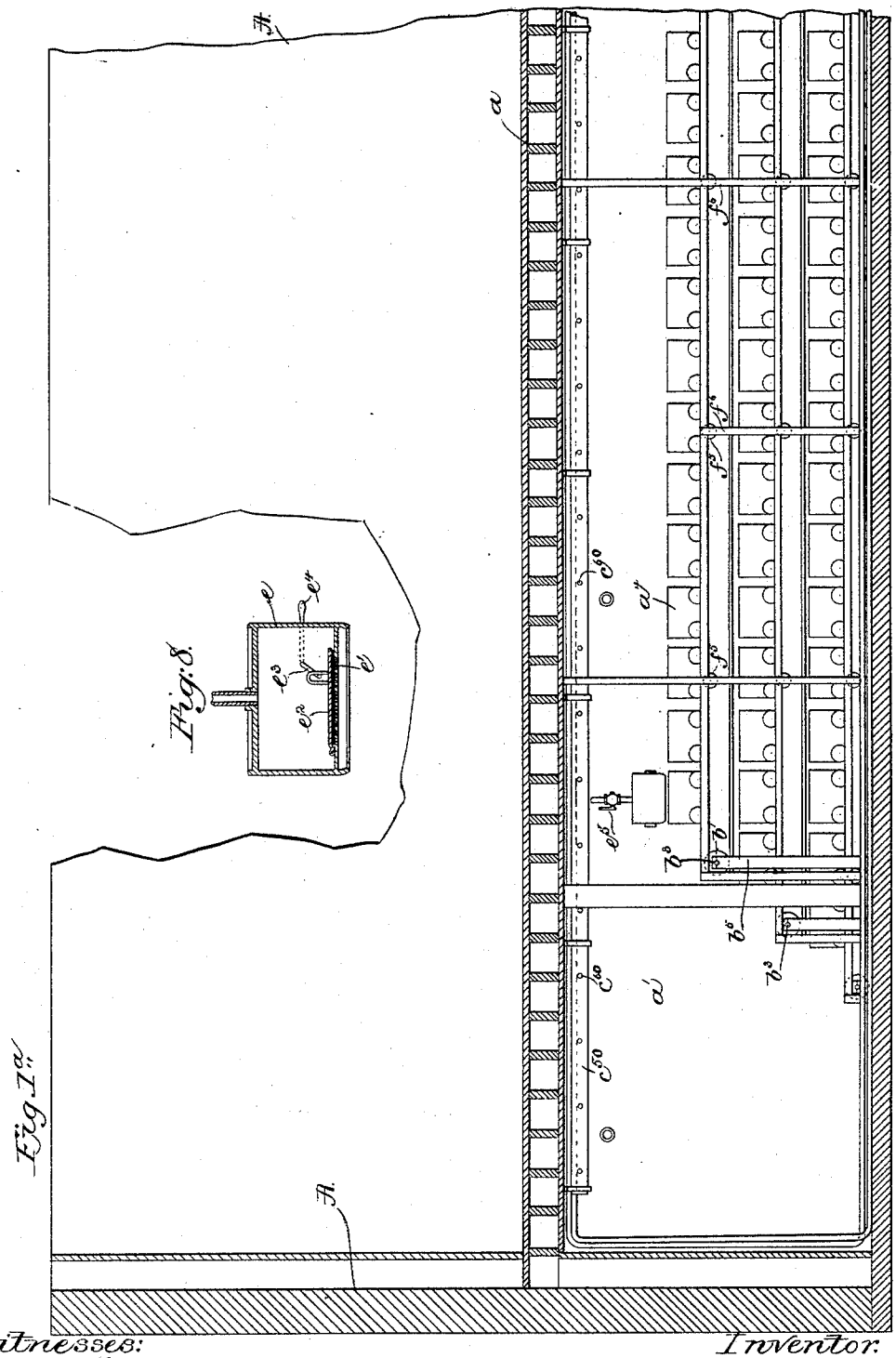
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 5 Sheets—Sheet 2.

J. BUCKNER.

APPARATUS FOR MANUFACTURING ICE.

No. 485,149. Patented Oct. 25, 1892.



Witnesses:
Edgar A. Goddin.
Frederick L. Emery.

Inventor:
James Buckner,
by Lemby & Gregory Attys.

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

(No Model.) 5 Sheets—Sheet 3.

J. BUCKNER.

APPARATUS FOR MANUFACTURING ICE.

No. 485,149. Patented Oct. 25, 1892.

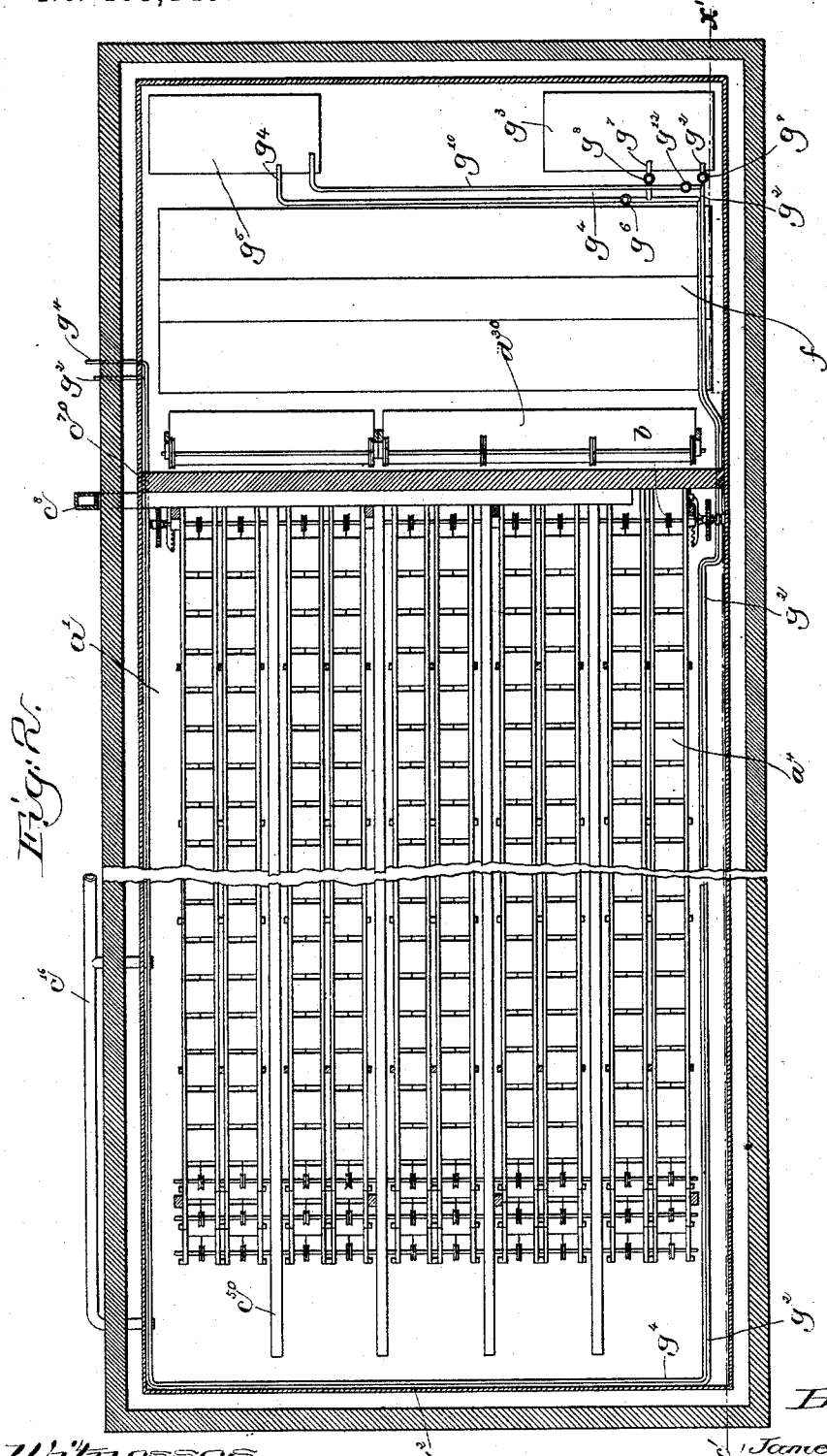


Fig. 2.

Witnesses.
Howard F. Eaton.
Frederick L. Emery.

Inventor:
James Buckner.
by Lemby & Gregory
Attys.

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

(No Model.) 5 Sheets—Sheet 4.

J. BUCKNER.

APPARATUS FOR MANUFACTURING ICE.

No. 485,149. Patented Oct. 25, 1892.

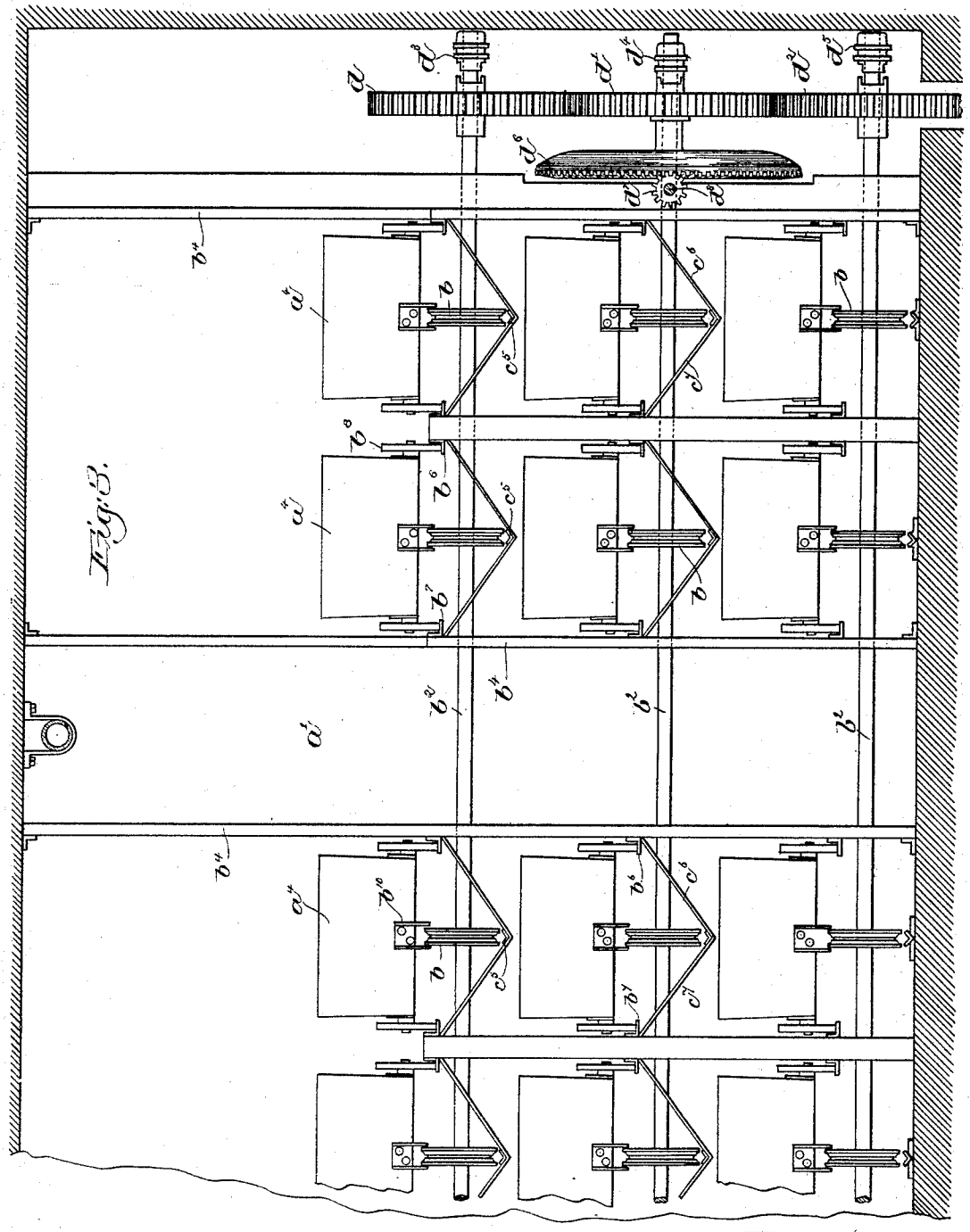


Fig. 3.

Witnesses
Howard F. Eaton.
Frederick L. Emery.

Inventor:
James Buckner,
by Lovejoy & Gregory
Attys.

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

(No Model.) 5 Sheets—Sheet 5.

J. BUCKNER.

APPARATUS FOR MANUFACTURING ICE.

No. 485,149. Patented Oct. 25, 1892.

Fig. 4.

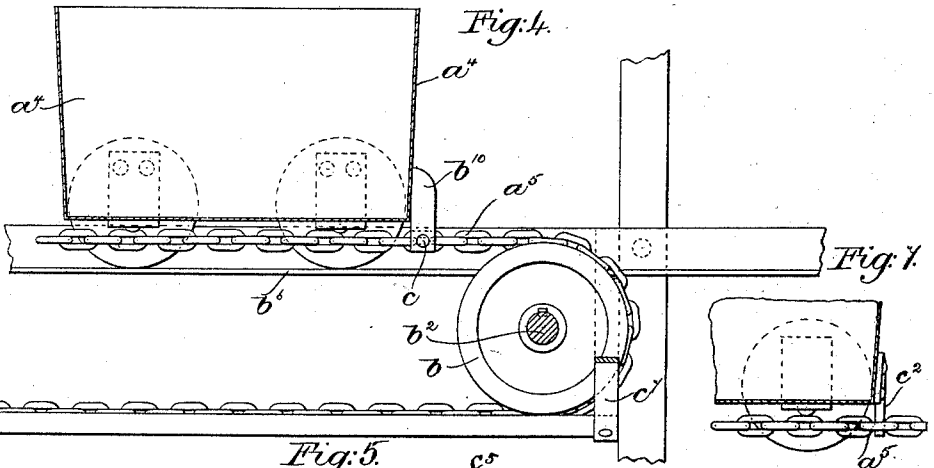


Fig. 7.

Fig. 5.

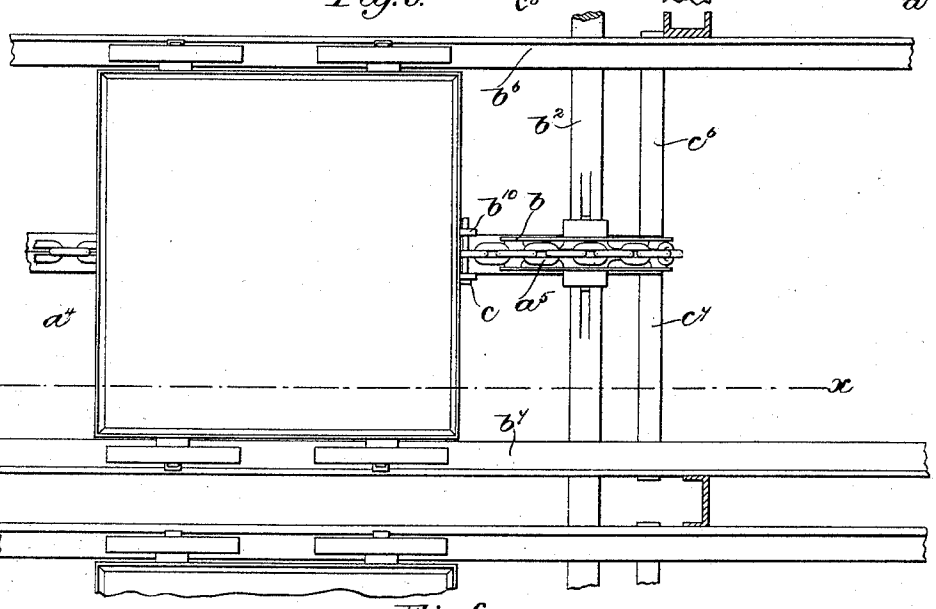
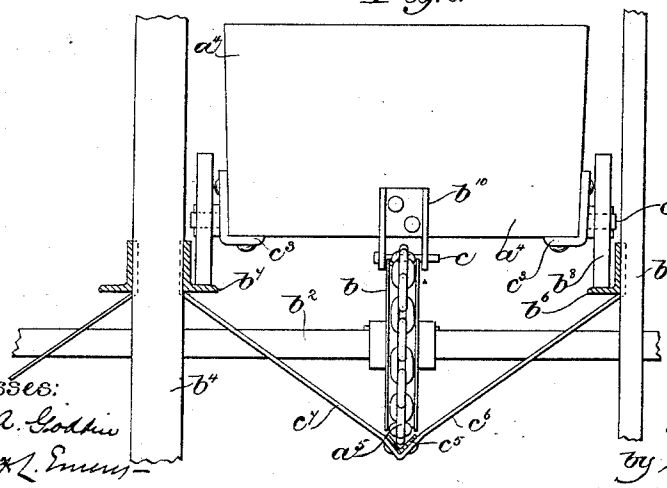


Fig. 6.



Witnesses:
Edgar A. Goddin
Frank L. Emmons

Inventor:
James Buckner,
by Lesoster & Gregory Attys.

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

UNITED STATES PATENT OFFICE.

JAMES BUCKNER, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO GEORGE W. HOLLIS, OF SAME PLACE.

APPARATUS FOR MANUFACTURING ICE.

SPECIFICATION forming part of Letters Patent No. 485,149, dated October 25, 1892.

Application filed July 25, 1889. Serial No. 318,657. (No model.)

To all whom it may concern:

Be it known that I, JAMES BUCKNER, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Apparatus for Manufacturing Ice, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object to provide a novel refrigerating apparatus for the manufacture of ice by means of artificial cold, preferably in cakes or blocks, ready for the market, my improved apparatus being especially adapted to be used in warm climates.

In accordance with my invention a chamber or room of a building, preferably the basement of the building, is provided with, preferably, a number of tiers of pans or receptacles, each tier consisting, preferably, of a number of independent rows of pans comprising a number of pans, which for the best results are detachably secured to an endless chain or carrier. The chamber or room referred to, which I shall hereinafter designate as the "refrigerating" or "ice" chamber, is maintained below the freezing-point of water by artificial cold, preferably produced by compressing and then expanding atmospheric air in an engine, which may be substantially such as shown and described in United States Patent to Haslam, No. 261,708, dated July 25, 1882, which engine may be located within the building or adjacent thereto. Each pan or receptacle is filled with water, which will preferably be distilled, and after being frozen, which takes about twelve hours, more or less, each pan is carried in turn toward one end of the refrigerating-chamber and discharged into a receiving-chamber, preferably containing a bath of warm water, into which the pan and its contained cake of ice are immersed to loosen the ice from the pan. The pan with the ice yet remaining therein is taken from the bath and carried by an elevator or otherwise into the store-room of the building, preferably the room above the refrigerating-room. The cake or block of ice is detached from its pan and the latter carried to the refrigerating-room and again attached to an endless carrier and filled with water to be frozen. The ice-chamber referred to has extended through it circulating-pipes connected to the water-jacket of the air-compressing cylinder of the cold-air engine and to suitable tanks or reservoirs, from one of which the water is drawn by a suitable pump and forced through the water-jacket into the other of the said tanks, whereby the cold in the refrigerating-room is utilized in cooling the water employed to absorb the heat generated by compressing the air in the compressing-cylinder. The circulating-pipes referred to may be provided with suitable valves, by which the water may be discharged into one tank as fast as it is drawn from the other, whereby the cooling-water may be used for substantially an indefinite time.

The particular features in which my invention consist will be pointed out in the claims at the end of this specification.

Figure 1 is a longitudinal section of the right-hand portion or end of the building provided with a refrigerating-chamber in accordance with my invention, one wall of the building being broken out to show the engine employed in the production of the cold, the section being supposed to be taken on line $x' x'$, Fig. 2. Fig. 1^a is a longitudinal section of the left-hand portion of the building, it being read in connection with Fig. 1 for the purpose of the drawings; Fig. 2, a top or plan view, partially broken out, of the refrigerating-chamber and its contained pans; Fig. 3, an end elevation, on an enlarged scale, partially broken out, of the refrigerating-chamber to more clearly show the arrangement of pans; Fig. 4, an enlarged sectional detail of one pan, showing the manner of attaching it to its endless chain, the section being supposed to be taken on line $x\,x$, Fig. 5; Fig. 5, a top or plan view of Fig. 4; Fig. 6, an end view looking toward the left of Fig. 5; Fig. 7, a modification to be referred to, and Fig. 8 a detail to be referred to.

Referring to Figs. 1 and 1^a, A represents a house or building, which may be of any usual construction suitable for the purpose. The building A is provided with a floor a, forming below it a chamber a' and a second chamber a^2, separated from the chamber a' by a vertical partition or wall a^3. The chambers a' a^2 preferably form the basement of the building

A, and the floor a and wall a^3 are preferably made non-heat conducting in any usual or well-known manner. The chamber a' forms the cold-room of the building, or what I shall hereinafter designate as the "refrigerating" or "ice" chamber. The ice-chamber a' is provided in accordance with my invention with a series of horizontal shafts b^2 b^3, supported by uprights b^4 b^5, located near opposite ends of the said chamber, the said shafts having mounted on them suitable wheels or pulleys b b', about which are passed a carrier, preferably and herein shown as endless chains a^5, to which pans or receptacles a^4 are detachably secured. The shafts b^2 at one end of the ice-chamber are arranged, as shown in Figs. 1 and 3, vertically over each other. The uprights b^4 b^5 have secured to them ledges b^6 b^7, preferably made as angle-irons, constituting tracks, upon which run wheels b^8, carrying the pans a^4. Each pan a^4 is detachably secured to the endless chain or carrier a^5, preferably by means of arms b^{10}, secured to the front end of the pan and made of sufficient length to pass down by the endless chain or carrier a^5, so as to embrace the same, the said arms being firmly secured to the said carrier, as shown in Figs. 4 and 5, by a pin c; but instead of the particular manner described for securing the pan to the endless carrier it may be secured in any other well-known or equivalent manner—as, for instance, by a rod c^2, extended down through a link of the chain a^5. (See Fig. 7.) The pans a^4 have secured to their sides angle-irons c^3, provided with a stud or arbor c^4, upon which the wheel b^8 is mounted.

To prevent the endless carrier from sagging to any considerable distance below the carrying-wheels, I have provided a guard, (shown as a trough-shaped bar c^5,) to which are secured rods c^6 c^7, fastened to the uprights b^4 b^5.

As shown in Fig. 2, the chamber a' is provided with ten rows of pans, and each row is made up of three tiers or lines of pans. The rows of pans referred to will preferably be made of unequal length, substantially as shown in Fig. 1^a, to enable each line of pans to be more easily filled with water.

The shafts b^2 are provided with loose gears d d' d^2, respectively, (see Fig. 3,) adapted to be engaged with the said shafts by clutch mechanisms d^3 d^4 d^5 of any usual construction. The gear d' on the shaft b^2 is firmly secured to the hub of a beveled gear-wheel d^6, in mesh with a pinion d^7 on a shaft or arbor d^8, adapted to be engaged by a key of ordinary construction, by which the said shaft may be turned to drive the beveled gear-wheel d^6 and produce rotation of the gears d' d^2, for a purpose as will be described.

The chamber a' has located in it, preferably, a series of branch pipes c^{50}, (see Figs. 1^a and 2,) provided with openings c^{60} and connected to a main pipe c^{70}, extended across the room near its front end, as herein shown, and connected by a pipe c^8 (see Fig. 1) to the discharge-orifice of an expansion-cylinder c^9 of a cold-air engine, which may be located within the building or in a room adjacent thereto.

The cold-air engine, which may be substantially such as shown in the patent referred to, comprises, essentially, an air-compressing cylinder provided with a water-jacket c^{10}, a condenser c^{12}, into which the compressed air from the compressing-cylinder is admitted by the pipe c^{13}, and a collector c^{14}, connected to the condenser and the air-expanding cylinder c^9, in which the compressed air is permitted to expand, the work done in the expansion of the air in the cylinder c^9 reducing the temperature of the said air to a substantially-low degree, which may be controlled by governing the speed of the engine.

In practice the speed of the engine will be maintained at such point as to reduce the temperature of the air below the freezing-point of water. The air expanded in the cylinder c^9 is forced from said cylinder into the refrigerating-room a' through the main pipe c^{70} and branch pipe c^{50}, and after performing its work is returned by the pipe c^{16} (see Fig. 2) to the air-compressing cylinder.

The wall a^3 is preferably provided with a series of openings or doors (see dotted lines, Fig. 1) substantially opposite each row of pans, and on the opposite side of the wall a^3, within the chamber a^2, I have provided an elevator d^{30}, normally maintained in its upper position by counterbalancing-weights d^{40}, attached to cords or ropes d^{50}, passed about pulleys d^{60}, secured near the top of the chamber a^2 to suitable uprights d^7.

In the operation of my improved apparatus each pan in its turn is secured to its endless carrier at the receiving or loading end of the chamber a', which is herein shown as the left-hand end of the said chamber, looking at Fig. 1^a. The pans of the lower row are attached to the carrier, and each pan in turn is filled with water, which will preferably be distilled water, in order to obtain as pure ice as possible, and after a pan has been attached to its chain the latter is moved forward sufficiently to enable a second pan to be attached to the carrier. In this way all the pans are attached to the lowermost carrier before a pan is attached to the second row of carriers, and so on.

In order that each pan may be filled with water without splashing or occasioning loss of water, a suitable supply-chamber e may be provided, it being shown as a box provided with a bottom having perforations e', which are normally covered by a valve e^2, (shown as a hinged flap-valve,) which is adapted to be raised by means of a crank e^3, attached to a handle e^4, a valve e^5 in the inlet-pipe being closed before the hinged valve e^2 is raised. The pans filled with water are permitted to remain in the refrigerating-room until the water has been frozen into a solid cake of ice, which may take about twelve hours, more or less. After the ice has been formed in pans each pan near the discharge end of the room

a' is removed in its turn, the endless carriers being rotated to bring the said pans in their turn toward the discharge end of the room.

In practice the uppermost row of pans may be detached from their carriers by workmen stationed at the discharge end of the chamber a' and passed through the doors or openings in the wall a^3 and placed upon an elevator d^{30}, the weight of the pans overcoming the counterbalancing-weight d^{40} and causing the elevator to descend. When the elevator has reached the bottom of the chamber a^2, a pan may be taken therefrom and slid into a bath f, containing warm water; or the said elevator may be tipped or canted when it strikes the bottom of the room a^2, so as to automatically discharge the pan into the bath. The warm water in the bath loosens the block of ice from its pan, and the pan still containing the block of ice is taken from the bath and carried into the store-room, which, for instance, may be the room f' above the chamber a^2, where the cake of ice is removed from the pan, the latter being then taken back into the room a' and again placed upon its carrier.

When it is desired to discharge the top row of pans without moving the remaining rows, the clutch d^3 is engaged with its gear d, while the clutch d^4 is disengaged from its gear d', so that when the pinion b^4 is rotated the gears d' d will be rotated and the uppermost endless carrier will be made to travel. After the pans have been detached from the uppermost row of endless carriers the pans attached to the next lower endless carrier may be fed forward independently of the others by disengaging all the clutches from their shafts, and thereafter the pans attached to the bottom or lowermost endless carrier may then be fed forward by engaging the clutch d^5 with its gear d^2. The endless carriers may be supported between the pulleys or wheels b b' by auxiliary wheels or friction-rollers f^5, supported by uprights f^6.

By the arrangement of gears and clutches as described it will be noticed that the travel of the endless carriers may be controlled by one workman operating the key employed to rotate the shaft d^8. The water-jacket c^{10} of the air-compressing cylinder has its inlet-port connected, as shown by pipe g, to the discharge-orifice of a pump g' of any usual or well-known construction. The pump g' has connected to its inlet-orifice a pipe g^2, preferably extended, as shown in Fig. 2, around the sides of the chamber a' and having its end communicating with a tank or reservoir g^8, preferably located in the chamber a^2. The outlet-orifice of the water-jacket c^{10} has connected to it a pipe g^4, extended about the room a', substantially side by side with the pipe g^2, and the pipe g^4 communicates with a second tank or reservoir g^5, located, as herein, on the opposite side of the chamber a^2. The pipe g^4 is provided, as herein shown, with a cock or valve g^6 and with a branch pipe g^7, communicating with the tank g^3 and provided with a cock or valve g^8. The pipe g^2 is provided with a cock g^9 and is connected to the tank g^5 by a branch pipe g^{10}, provided with a cock g^{12}.

The pump g' may be driven in any suitable manner, and in operation it draws water from one tank and forces it into the other. For instance, let it be supposed that the tank g^3 is full of water or other fluid and the tank g^5 substantially empty. The cocks g^9 g^6 are opened and the cocks g^8 g^{12} closed. The water is now drawn by the pump g' through the pipe g^2 and forced through the pipe g, water-jacket c^{10}, and pipe g^4 into the tank g^5. As the water passes through the ice-chamber it is cooled to a substantially-low degree, so that when it passes through the jacket c^{10} it absorbs a maximum amount of heat from the compressed air, and thereby renders the engine more effective for mking ice. The water heated in its passage through the water-jacket c^{10} is cooled again in its passage through the pipe g^4 and discharged into the tank g^5. After the water in the tank g^3 has been exhausted therefrom and discharged into the tank g^5 the cocks g^9 g^6 are closed and the cocks g^8 g^{12} opened, and the pump exhausts the water from the tank g^5 through the pipes g^{10} g^2 and forces it through the pipe g, water-jacket c^{10}, pipe g^4, and branch pipe g^7 into the tank g^3. It will thus be seen that the circulating-water is used over and over again and that the cold in the ice-chamber is utilized not only for making ice, but also for cooling the water circulating through the water-jacket, thereby more effectually absorbing heat from the compressed air.

I have specifically described my improved apparatus as employed in the manufacture of ice, but it is evident it may be used for congealing any other fluid.

I claim—

1. In an apparatus for the manufacture of ice, the combination, with a building provided with a refrigerating-room a' and a chamber a^2, separated therefrom by a wall a^3, provided with doors or openings, and a bath in the room a^2, of a cold-air engine connected to said refrigerating-room, a carrier in said room, and a plurality of pans or receptacles to contain water, secured to said carrier, substantially as described.

2. In an apparatus for the manufacture of ice, the combination, with a building provided with a refrigerating-room a' and a receiving-chamber a^2, separated therefrom by a wall a^3, provided with doors or openings, and a bath in the room a^2, of a cold-air engine connected to said refrigerating-room, a tier of endless carriers in said room, a plurality of independent pans or receptacles to contain water, secured to said carriers, and an elevator in the chamber a^2, adjacent to the separating-wall, substantially as described.

3. In an apparatus for the manufacture of ice, the combination, with a building provided with a refrigerating-room a' and a receiving-

chamber a^2, separated therefrom by a wall a^3, provided with doors or openings, and a bath in the room a^2, of a cold-air engine connected to said refrigerating-room, shafts b^2 b^3, arranged one above the other and supported upon uprights in the refrigerating-room, wheels mounted on said shafts, a series of parallel endless carriers passed about said wheels of each tier, the upper surface of said carriers being opposite the openings in the wall a^3, and a plurality of pans or receptacles to contain water, detachably connected to said carriers, substantially as described.

4. The combination, with a cold-air engine comprising an air-compressing cylinder having a water-jacket and an air-expanding cylinder, and a cold-air outlet-pipe leading from the said expanding-cylinder into a refrigerating-chamber, of circulation-pipes extended through the said chamber, stop-cocks in said pipes, a tank or reservoir with which each circulation-pipe communicates, a branch pipe connecting each circulation-pipe to the other tank, and a pump to exhaust fluid from one tank and force it through the water-jacket into the other tank through the circulation-pipes to cool the water in its passage through the refrigerating-room, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES BUCKNER.

Witnesses:
JAS. H. CHURCHILL,
EMMA J. BENNETT.