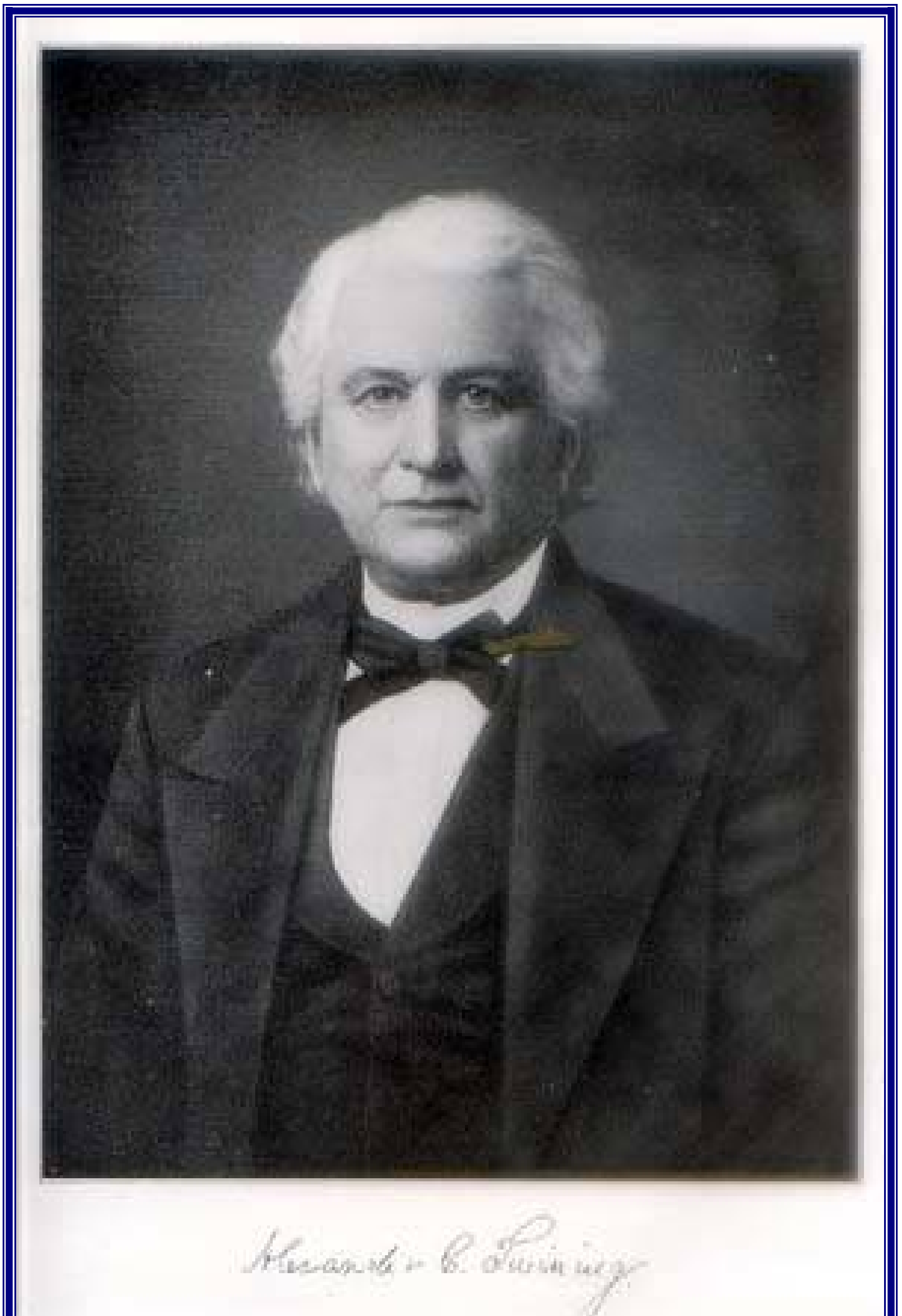
ALEXANDER TWINING

By EurIng Brian Roberts, CIBSE Heritage Group



Alexander Catlin Twining, 1801-1884

Alexander Catlin Twining was born on 5 July, 1801, in New Haven, Connecticut, into a prominent family claiming roots back to William the Conqueror, and having come to America before 1641. He attended Hopkins Grammar School before entering Yale University where he gained his Masters Degree in 1820. He then entered a Seminary to prepare for the Ministry but abandoned this project, instead becoming a tutor at Yale from 1823 to 1825.

Twining then went to West Point in New York State where he pursued a private course in civil engineering, then taking it up as his intended profession. He surveyed a possible route for a railway line between New York and New Haven though it was not adopted at the time. He continued to practice as a civil engineer until 1839 when he accepted the Chair of Mathematics, Civil Engineering & Astronomy at Middlebury College in Vermont, where he remained in post for the next ten years. Returning to New Haven he again became involved in civil engineering projects, particularly the construction of railways and canals.

Twining's other interests included refrigeration and ice-making and it is for his work in this field that he is now best well known. He began experiments in 1848 using ether as the refrigerant and was so confident of success that he filed a caveat with the US Patent Office in November 1849, before securing US Patent No. 10,221 on 8 November, 1853. In the meantime, he obtained British Patent No. 13,167 of 3 July, 1850, in which he claimed "invention of the vapour-compression refrigeration itself, a claim that proved to be insupportable." (The US Patent covered only the use of mechanical refrigeration for ice-making). In 1851, he published a booklet *Manufacture of Ice on a Commercial Scale*.

One of his machines was constructed at the Cuyahoga Steam Furnace Company in Cleveland, Ohio, with freezing trials beginning in February, 1855, producing ice for the next two years. Twining then attempted, without success, to interest financial backers in the construction of an ice-making plant in New Orleans. Unfortunately, the American Civil War prevented the progress of this venture. He also failed in his plans for an improved system at the Morgan Iron Works of New York City in 1863.

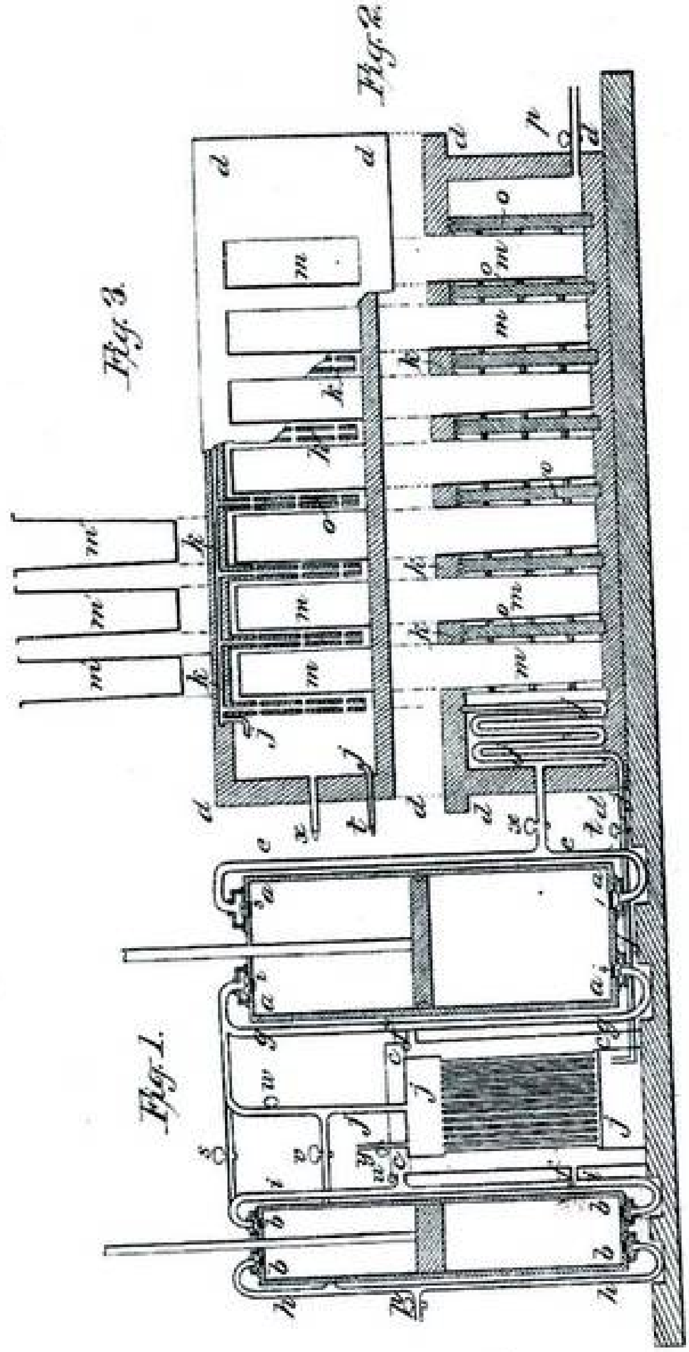
The Civil War not only prevented Twining setting up his ice-making plant in the South, but led to his claims that he felt this gave the opportunity to others, notably Ferdinand Carre and James Harrison, to steal his ideas. Twining's appeal to Congress to extend his 1853 patent failed. However, his "ice-can" method of making ice came into common use and his Cleveland plant was the earliest using the vapour-compression refrigerating system to manufacture ice in commercial quantities. Elements of his patent were incorporated in the first commercial ice plant operated by the Louisiana Ice Manufacturing Company in 1862.

Professor Alexander Catlin Twining died in New Haven on 22 November, 1884 and he was laid to rest in Grove Street Cemetery.

A. C. TWINING.

Manufacture of Ice.

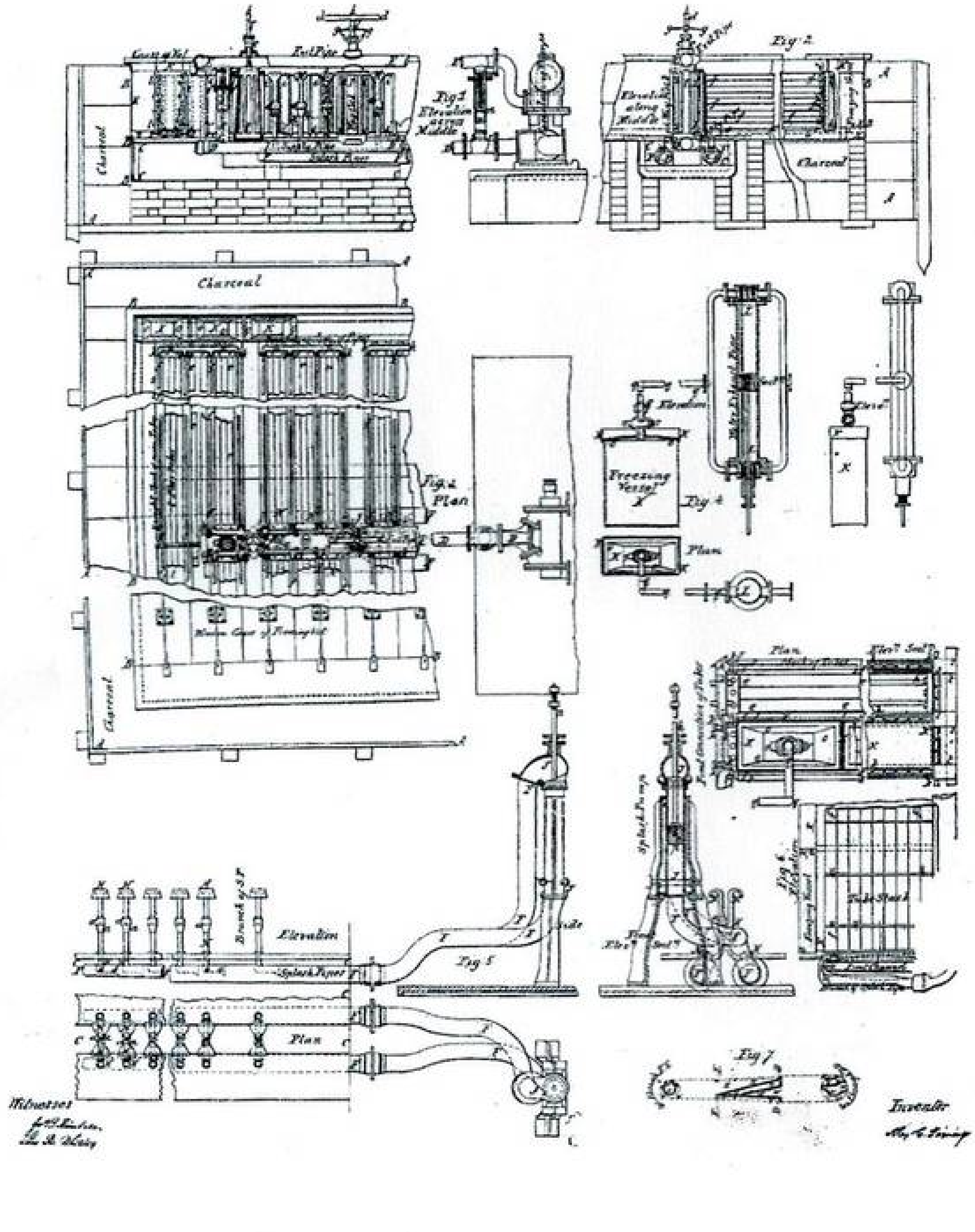
No. 10,221. Patented Nov. 8, 1853.



A. C. TWINING.

APPARATUS FOR COOKING AND FREEZING.

No. 34,018. Patented Dec. 24, 1861.

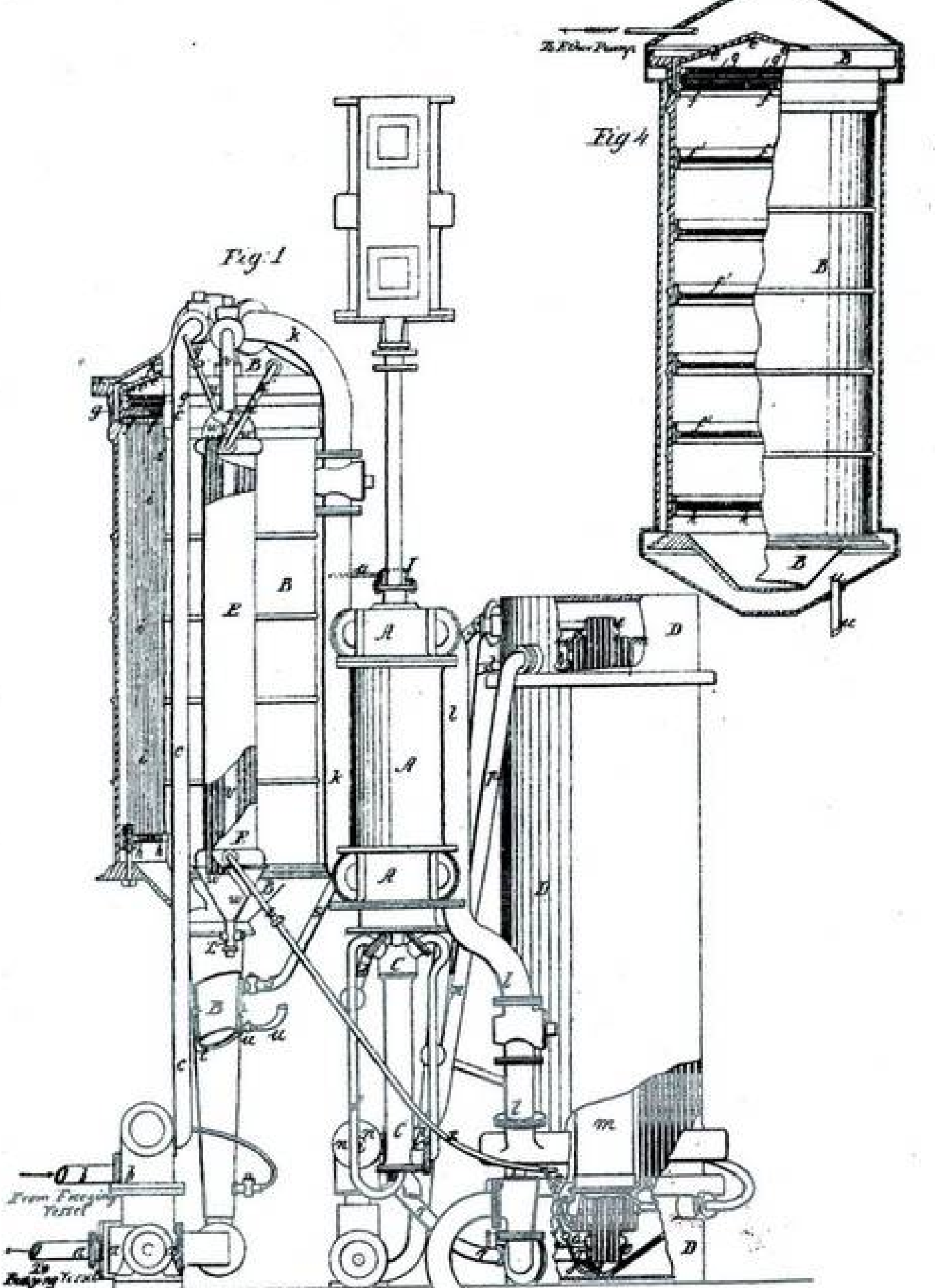


A. C. Twining.

Sheet 1-2 Sheets.

Refrigerating Apparatus.

Nº 35,051. Patented Apr. 22, 1862.



Witnesses

Inventor.

Sheet 2-2 Sheets.

A. C. Twining.

Refrigerating Apparatus.

No. 35,051. Patented Apr. 22, 1862.

Fig: 2

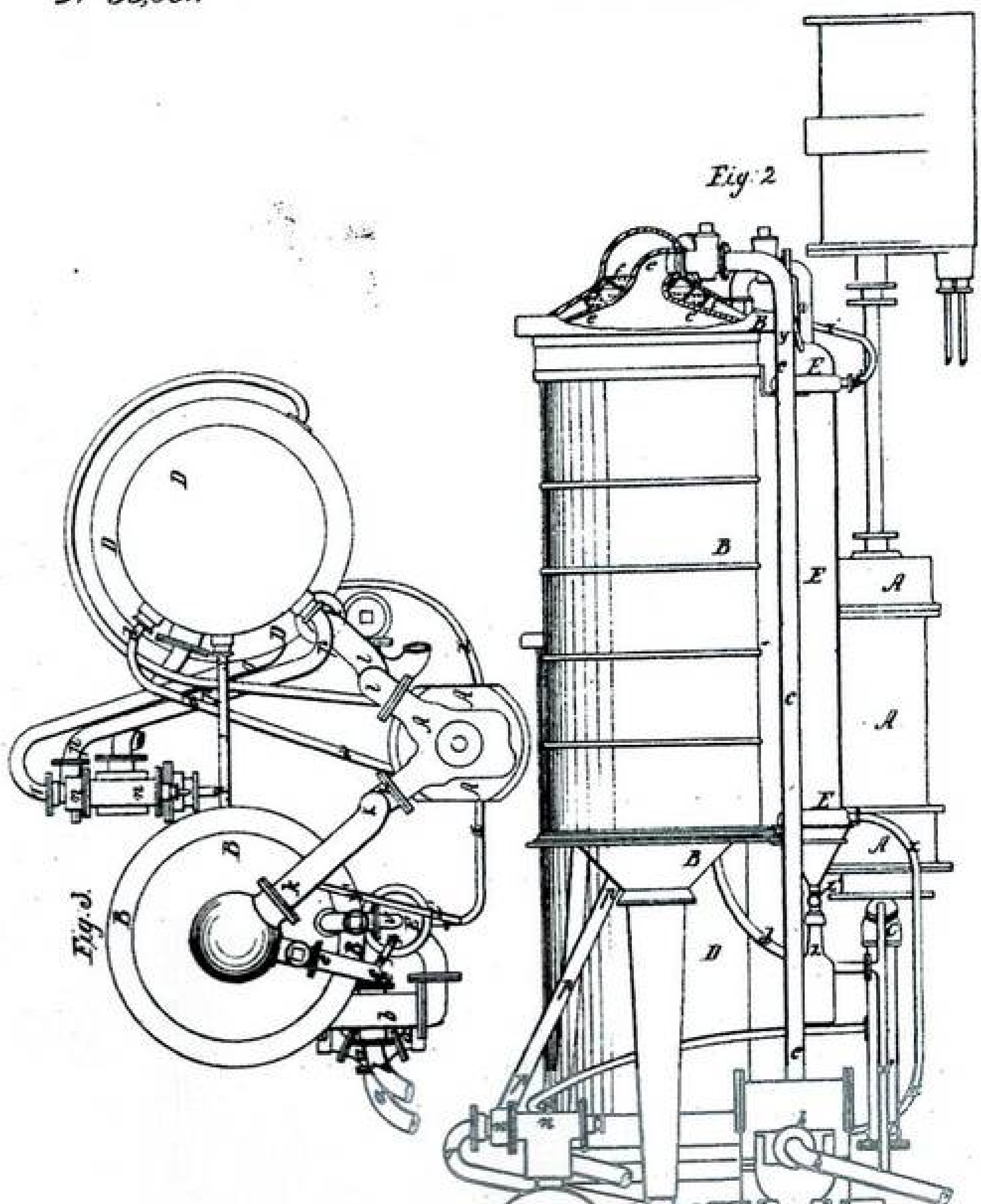


Fig. 3.

Witnesses

Inventor

UNITED STATES PATENT OFFICE.

ALEXANDER C. TWINING, OF NEW HAVEN, CONNECTICUT.

IMPROVEMENT IN APPARATUS FOR COOLING AND FREEZING.

Specification forming part of Letters Patent No. 35,051, dated April 22, 1862.

To all whom it may concern:

Be it known that I, ALEXANDER C. TWINING, of the city of New Haven, county of New Haven, and State of Connecticut, have invented a new and useful Improvement in Fixtures, &c., for Refrigeration and Congelation; and I declare that the following is a full description of my invention, of which—

Figure I of the accompanying drawings shows a front view; Fig. II, a side view; Fig. III, a plan or ground view, and Fig. IV an elevation and side view of certain details and modifications.

In a former patent I have described the general process which is employed.

In the drawings, A A A is the exhaust-pump for evaporation of a volatile liquid, and B B B B is the exhaust or vacuum vessel, in which the above pump keeps up a partial vacuum, and into which ether (making that the type of any volatile liquid) is introduced to be evaporated in part, and consequently cooled. In this present construction the cooled ether is drawn out of the vessel by the lower circulating-pump, *a a a*, and is forced by the same into the freezing-cisterns or refrigerating-vessels (not shown in drawings) through the circulating-pipe *a a* and back through *b b*. The temperature of the cold ether is raised in the act or process of freezing the water, &c., exposed to its action, and it is returned (by the aid of a second circulating-pump, if desired) through the upper circulating-pipe, *c c c*, into the top of the vacuum-vessel. This last pipe expands into the funnel-shaped distributing-cavity *e e e*, which has its bottom pierced with holes to discharge the ether in a shower upon the grating F F. For more complete distribution of the ether upon the grating an auxiliary plate, *g g*, is interposed and is pierced with holes more numerous and of smaller size than in the funnel-plate above mentioned. The ether now falls in drops upon the middle of the upper grate-bars, around which there pass cloths *i i i* down to and around the bars of a lower grating, which is suspended by them. Straining-screws pass through the vacuum-vessel's under side into lugs cast upon the ring of the grating *h h*, by which the cloths are strained taut. These cloths offer a very extended surface for the ether to run down upon and so be exposed to evaporation in the vacuum. Metallic plates without the gratings and other thin diaphragm would constitute an equivalent arrangement, although less advantageous. Moreover, the metallic plates might be placed horizontally with rims around and holes pierced through them, forming colanders one below another in a series, showering the ether through successively, as shown in Fig. IV of the drawings. The ether or other vapor passes between the funnel *e e e* and upper head of the vacuum-vessel, and is drawn to the exhaust-pump through the discharge-pipe *k k k* and its controlling-cock; but this passing vapor strikes open diaphragms *f f*, &c., of metal, cloth, or other suitable material, arranged between the funnel and the upper head to catch small drops or mist of liquid which the vapor may bear along in its current, and discharge them in drops or vesicles down the diaphragms. The vapor, however, turns into the spaces or slits left in or between the diaphragms, and meets other diaphragms overlapping these spaces, but with a distance between, all as in the drawings. This may be susceptible of still other application. The vapor pumped out of the vacuum-vessel is thrown by the ether-pump A A A at its return-strokes into the restorer D D D, through the pipe *l l l* and its controlling-cock. Here it is reconverted into liquid, according to the operation described in my patent dating from July, 1850; but during the process a little air becomes mixed with the vapor, and this air would accumulate in the restorer and impede or destroy continuous condensation if not removed. To remove this air without serious loss of vapor is the object of my condensation-pump *c c* and condenser *m m m*, also of the gas-pump *n n* and precipitating-vessel *o o o o*. The condensing-pump may be worked, as in the drawing, by the piston-rod of the ether or exhaust pump continued through, or by a separate rod. It draws mixed vapor and air from the upper part of the restorer D D D through the pipe *d d d* and its controlling-cock, and it throws the mixture into the condenser, where most of its vapor is condensed under the augmented pressure on the outside of the pipes, which have water running through them, just as in the restorer. The gas-pump now draws the air, with a little vapor still in it, from the condenser through the pipe *p p p* and its controlling-cock, and throws it through *r r r* with as high compression as practicable into the precipitating-vessel *o o o*, which acts by its pipes like the condenser and restorer; but the precipitating-vessel embraces, by means of the connecting-pipe *s s s s* and its controlling-cock, the narrow cavity *t t t* around the lower part of the vacuum-vessel, which lower part I call the "cold-ether reservoir." This reservoir is of sheet-copper, and by the important assistance of its low temperature precipitates from the compressed air nearly all its small residue of vapor. The air may then escape through the small orifice or cock and escape-pipe *u u*. This escape-pipe may be enlarged and partially filled with water, alcohol, sponge, cotton, or other absorbents to catch any remaining ether, small as its quantity will be. This operation will be aided by making the escaping air expand in a small working-pump on its way to the escape. The absorbed or liquid ether may be returned through a pipe leading from its containing substance and vessel to the vacuum-vessel, taking care to close the escape-pipe from air for the time being. It is obvious that I may employ any part of either the vacuum-vessel's surface or of the circulating or the vapor pipes for precipitation, just as I have described for the cold-ether reservoir.

Again, if any part of the apparatus is liable to concealed leakage, it may be inclosed by a casing, as the vacuum-vessel in Fig. IV, or by a chamber, as the stuffing-box of the main piston-rod at I, and the cavity or chamber may be kept filled with water, or the escape-pipe *u u* may be introduced into those cavities. By these means the leakage will carry back the ether vapor which the escape air would otherwise waste, or will itself be avoided. Thus, also, gas leaking out from one part may leak in at another by embracing both in the same cavity or inclosure.

It will be understood that pipes, cocks, and channels are provided to conduct the respective precipitations of ether back to the main body or current, and, again, that non-conducting wrappers or coverings are provided for the vacuum-vessel and for all pipes or parts exposed to injurious radiation.

The returned liquid from the restorer will hold oils and other impurities derived from the ether-pump or leakage of water, &c. These I propose to work out by the clarifier E E E. This is a hollow cylinder with tight heads, which are capped both above and below by cavities of convenient shape, *w w w w*. Pipes run through both heads tightly. The pipes open by a very contracted bore in each into the upper cavity, and by their full bore they open into the under cavity. This last opens into the vacuum-vessel through a large central pipe, *v v*, and its controlling-cock, which, like some of the other cocks, is closed at bottom and has a stuffing for its stem. The discharge-pipe *x x* of the restorer opens into the hollow cylinder and fills it around the pipes with warm restored ether, which discharges into the vacuum-vessel through the pipe *x' x'* and its controlling-cock, or, if preferred, a self-acting valve which opens and shuts or contracts by flotation in the liquid itself. The upper cavity opens upward by the pipe and cock *y y* into the return ether-pipe *c c c*.

The operation is as follows: The pipe and cock *y y* allow a regulated stream of the return ether to run from the circulating current into *w w* and into the small upper orifices of the pipes, which terminate in a horizontal plane. The ether spreads along the inner surfaces and is evaporated by the warm liquid around the pipes, cooling the latter. The vapor flies down the pipes and up through the central pipe into the vacuum, while impurities run down and may be drawn off into a bottle screwed upon *z'* by first opening and then closing the cock at *z'*.

What I claim in the above, and desire to secure by Letters Patent, is embodied in the following:

1. The condensing-pump and condenser, in combination with the restorer, whether with or without the gas-pump and precipitating-vessel between them and the escape-pipe, the gas-pump and precipitating-vessel, in combination with the restorer, whether with or without the condensing-pump and condenser intervening, and the employment of any cold surface of the vacuum-vessel or of the circulating-pipes or the vapor-pipe as part of a precipitating-vessel, or of a condenser in any way substantially the same as above.

2. The use of cloths as above, or other plates equivalent thereto, in combination with a distributing-funnel or any distributing plate or arrangement for the liquid, also the use of the colanders in a series, all substantially as above and in combination with a restorer.

3. The above diaphragm arrangement for arresting mist or vesicles from vapor, in combination with an evaporating apparatus.

4. The clarifier, in combination either with the circulating cold current or the reconducted liquid from the restorer.

5. The combination of a vacuum-vessel and a liquid cooled therein with a pump or pumps to draw out from the vacuum-vessel and throw back in a continuous circulation that freezing or refrigerating liquid.

6. The connection of the escape-pipe *u u*, or of any escape or leak outward, with a cavity surrounding any part leaking inward, to obviate loss of ether, as above.

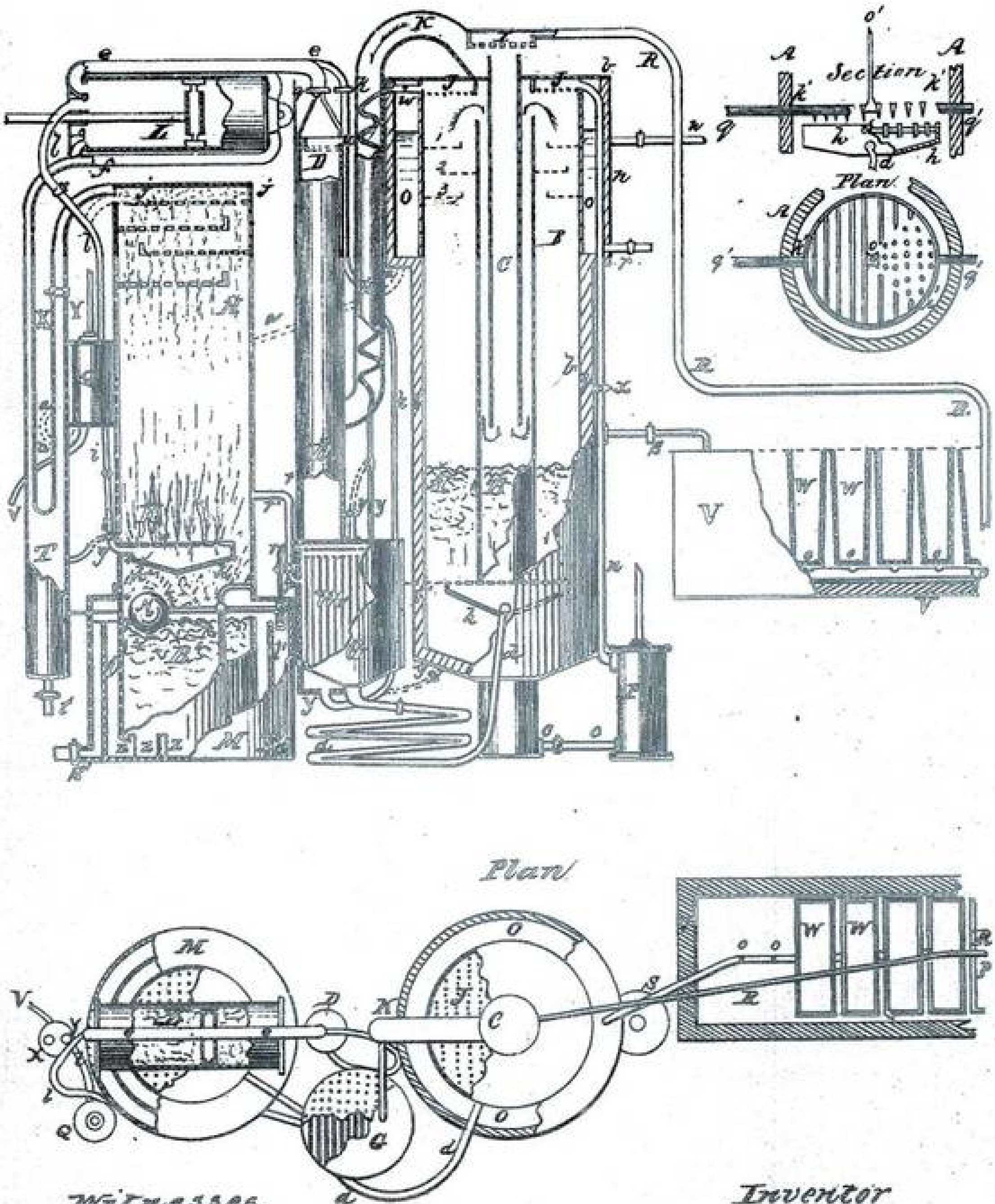
ALEXR. C. TWINING.

Witnesses:
EDWARD C. HERRICK,
CHAUNCEY A. DICKERMAN.

A. C. TWINING.

Methods of Freezing and Cooling.

No. 146,620. Patented Jan. 20, 1874.



Witnesses.

Inventor

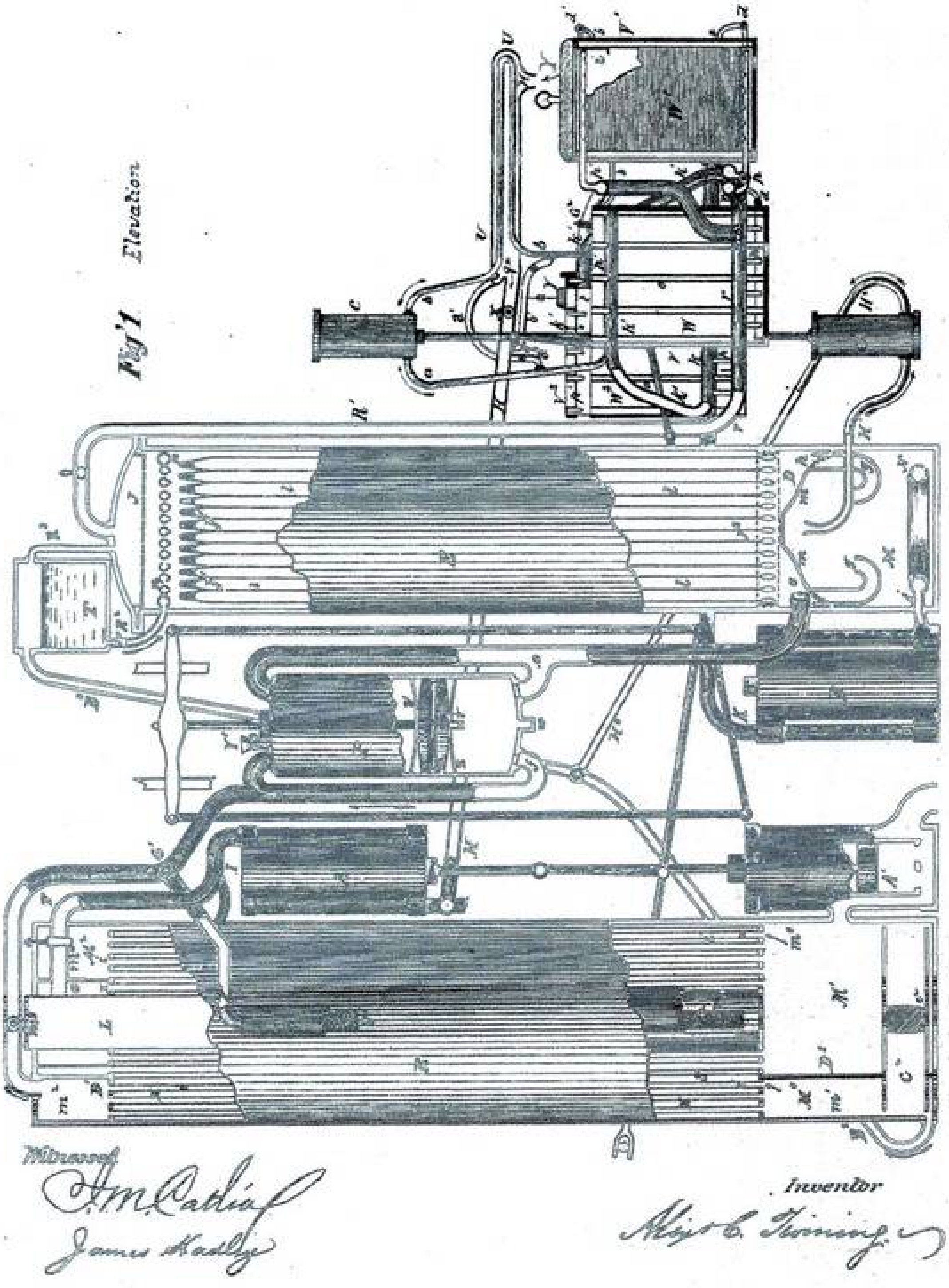
Alex^r C. Twining

2 Sheets--Sheet 1.

A. C. TWINING.

Ice-Machines.

No. 146,621. Patented Jan. 20, 1874.



2 Sheets--Sheet 2.

A. C. TWINING.

Ice-Machines.

No. 146,621.

Patented Jan. 20, 1874.

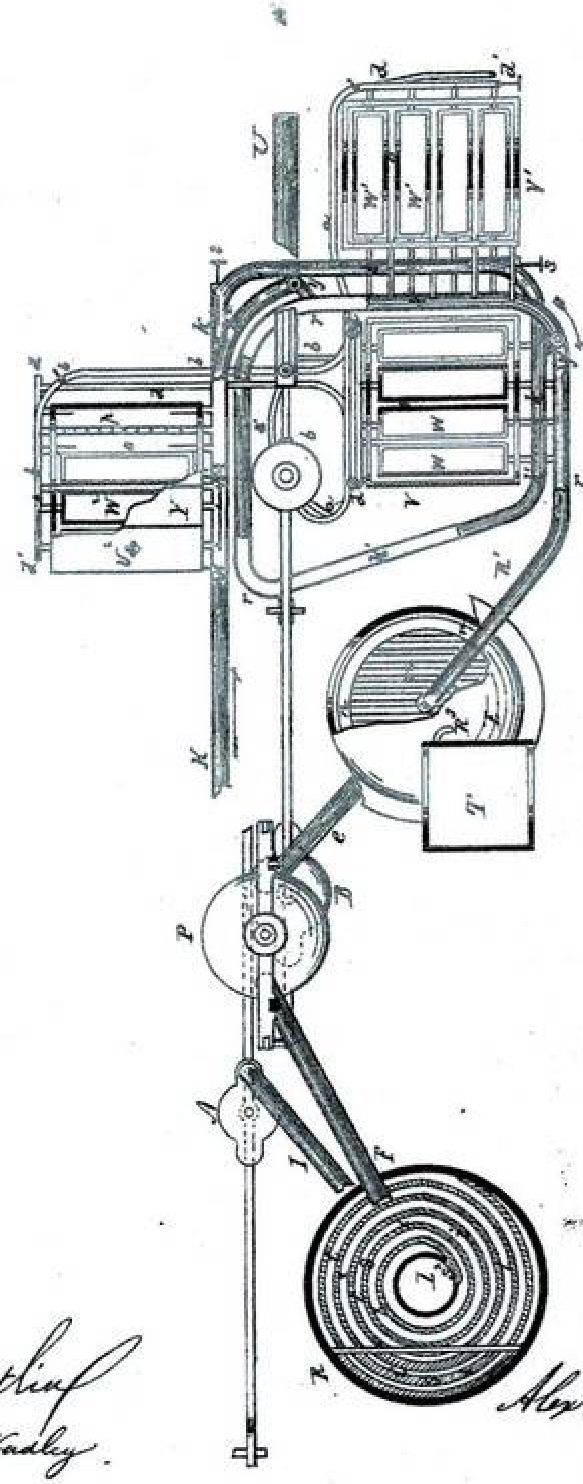


fig. 2 Ground Plan

Witnesses

J. M. Catlin

James Hadley

Inventor

Alexr C. Twining

UNITED STATES PATENT OFFICE.

ALEXANDER C. TWINING, OF NEW HAVEN, CONNECTICUT.

IMPROVEMENT IN ICE-MACHINES.

Specification forming part of Letters Patent No. **146,621**, dated January 20, 1874; application filed June 6, 1872.

To all whom it may concern:

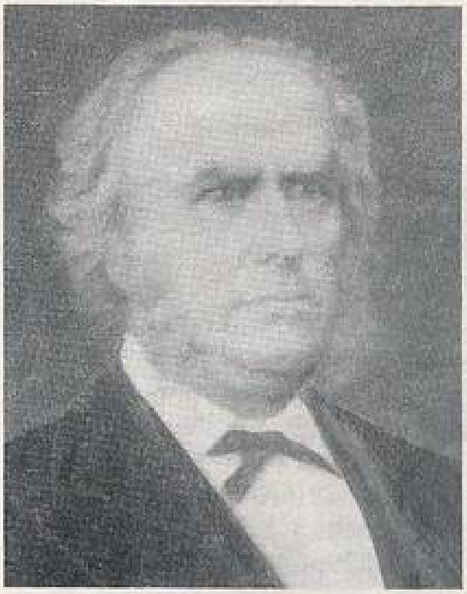
Be it known that I, ALEXANDER CATLIN TWINING, of the city and county of New Haven and State of Connecticut, have invented a new and Improved Ice-Machine; and I hereby declare that the following is a full and exact description of my said improvement and invention, to wit:

The machine will produce the cold by the evaporation and recondensation of a volatile liquid, insoluble or but sparingly soluble in water, during mixture or contact of the same with salt-water, or other solution or medium, which last is cooled by contact with the first during the evaporation. Then the salt-water or medium so cooled, is made to circulate around receptacles or water-chambers containing water to be frozen, and is to be returned to the cooling-vessel to be cooled anew, all essentially, in this respect, as explained in an application for a patent heretofore made by me, and also as further explained herein. The foregoing word "medium" is and will be herein used exclusively to signify the liquid or solution, of whatever description, that is cooled in an evaporating vessel or process, and circulated as above described. But my improvement herein consists in the particular way, means, or parts for the operation and freezing effect thus generally above referred to.

Figure 1 is a view of the parts in elevation, and Fig. 2 is a ground plan of the same.

The cooling-vessel or refrigerator, in which the evaporation of the volatile liquid goes on, is E. The evaporation is effected by a double-action pump, P, which draws or receives vapor out of E, through the inlet-pipe and valves *e e*, and forces the vapor out through the exit-pipe and valves *f f*. Compression of the vapor, received as above, goes on alternately above and below the piston of the pump; and in order to prevent, as effectively as possible, any escape of the compressed vapor between the piston and the inner surface of the pump, and also to reduce friction between the same parts to the least possible, a channel, space, or spaces, *c*, all around the piston, is made to contain oil, glycerine, water, brine, or other liquid or solution for packing or lubrication, which liquid will fill any minute space or leak between the piston and the surface specified. But, because this liquid will in part escape or be forced into the chamber of the pump beneath the piston, the lower pump-head is made hollowing downward, and a small cylindric chamber, *w*, is provided in the middle to receive this escaped liquid flowing or delivered down into it. To make the flow or delivery the more complete and speedy, the flexible metallic or other plate *z* is fixed at its middle to the piston and beneath it, and has a less or a reversed curvature, compared with the interior surface of the pump-head which it comes upon, so that the rim of *z* will close first upon the exterior circle or part of the head, and then progressively close from the exterior to the middle, and force the liquid into *w*. The plunger *v* projects down from the middle of the piston, and fits snugly into the receptacle *w*, and so, in the latter part of the piston's descent, drives back the contained liquid into the groove *c* through the perforation which leads along the middle of *v*, as shown. If there should be an excess of liquid it escapes to the upper surface of the piston through a conduit or channel, shown by the dotted lines near and above *c*. This upper conduit should or may conduct to the rim or edge of the piston's upper surface, where a small depression may run around, and contain liquid of this same description and use. Regurgitation from *c* is prevented beneath by a small stop-valve in the conduit through *v*, and the same is prevented from above into *c*, if desired, by a stop-valve in the above-described conduit, leading upward; but it may be prudent, and it will be easily practicable, to make both these valves yielding to any force much greater than the compressive force of the vapor, so that an excess of liquid, if any, accumulated above the piston may be driven back by the gradual closing of the plate *z′* above the piston upon the upper hollowing surfaces of the latter. For it will be observed that, while *z* or *z′*, whether above or below, closes from rim to center upon the pump-head, they close from center to rim upon the piston's surfaces. As this lubrication liquid may waste a little through the inlet and outlet valves, a cup and cock, Y′, should be provided to introduce a supply, as needed, into the upper chamber of the pump.

Twining vs. Harrison: A Refrigeration Debate



James Harrison

Editor's note: With the publication of ASHRAE's book on the history of the industry, titled Heat and Cold: Mastering the Great Indoors, *Mr. Luscombe, the historian for The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH), takes issue with the book's portrayal of the major players' roles in the development of refrigeration. Mr. Luscombe expressed his concerns in a letter (published below) to ASHRAE. Bernard Nagengast, a co-author of* Heat and Cold *provides the reply.*

I am writing in reference to your recent publication, *Heat & Cold: Mastering the Great Indoors* and protest in the strongest terms at the alleged stealing of Twining's ideas by Ferdinand Carré and James Harrison (refer page 126).

Twining's petition to the U.S. Congress to have his 1853 patent extended because of the influence of the civil war (1861-65) was not allowed, and this should be stated to portray the true situation and clear the charge of dishonesty against workers in this field, who were not caught up in the conflict. As published, only part of the story is told and both Carré and Harrison are defamed. I believe it is the duty of ASHRAE to clarify this situation with hard evidence of theft, or issue an apology.

James Harrison lived in Geelong, then a frontier town in colonial Victoria, Australia. He applied for his first patent in 1854, for his third machine he obtained patent V25/55 in 1855, London patents for improved machines followed, 747 of 1856 and 2363 of 1857. Machines to this later patent being sold to the breweries of Truman Hanbury and Buxton and Huggins and Co. in that year. By 1860, the shipping line P&O had installed Harrison machines in their major ports of call around the world.

It is outrageous to suggest that the U.S. civil war (1861-65) gave Harrison the opportunity to steal Twining's ideas. As far as Harrison is concerned, he had "stolen the scene" before the civil war began.

Having discussed this matter with AIRAH, it is our considered opinion that an erratum note be appended to the book and we request that this letter be published in your Journal.

Geoff Luscombe
AIRAH Historian

Reply to Mr. Luscombe
by Mr. Bernard Nagengast
Heat & Cold: Mastering the Great

Indoors contains the following statement on page 126: Not only did the Civil War physically prevent (Alexander) Twining's efforts to make ice in the South, but Twining also felt that it gave others, particularly Ferdinand Carré and James Harrison, the opportunity to steal his ideas for their own use."

The statement presents Twining's feelings, but is not intended to represent that Carré or Harrison had in fact copied Twining's ideas, only that Twining thought that they did.

The best representation of Twining's assumption can be found in the petition before Congress to extend his 1853 patent. There, the argument is presented that all of the refrigeration ideas which appeared after Twining, particularly Carré's, were natural consequences of Twining's ideas. With reference to James Harrison, the petition states: "It (Harrison's patent) adopted and described, as its general principle, the plan made known in the eighth paragraph of Twining's patent." Later in the petition, Harrison's patent is mentioned again with the conclusion: "Freezing in this manner is also clearly described in Twining's patent."

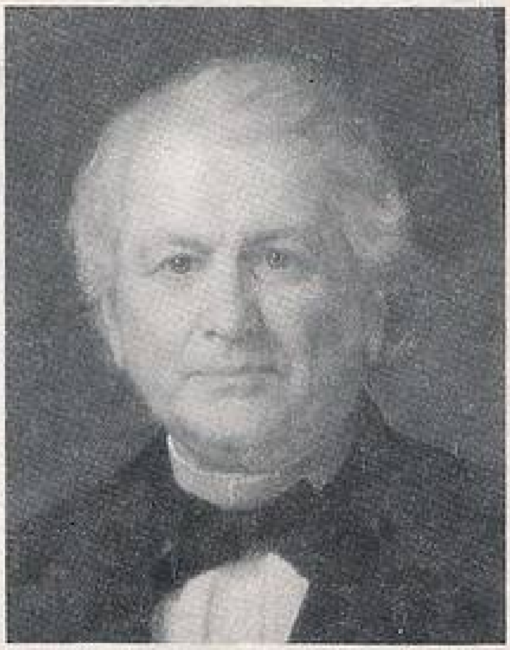
In fact, the ideas of both Carré and Harrison were, in a broad sense, similar to Twining's, however it is safe to conclude that all three arrived at the same destination independently. Carré had apparently begun working with refrigeration before either Twining or Harrison, and concentrated his efforts on absorption type systems. Since Twining's patent predates Carré's patent, it is possible that Carré knew of Twining's work, but this does not really matter since two different types of refrigeration systems were being proposed.

Harrison was also working independently. Mr. Luscombe, in a letter to me, has concluded, rightly in my opinion, "...it is difficult to see how Harrison in a frontier town in Australia, who applied for a patent in 1854, could have gained anything from (Twining)."

Alexander Twining based his whole argument on the assertion that he was the first to propose refrigeration and ice making by mechanical means, and therefore those that followed him had copied his ideas. In fact, it could be argued that Twining's refrigeration ideas were not new either! Two previous patents, Jacob Perkins' (1834) and John Gorrie (1850), present ideas for refrigeration and ice making.

Thus we must conclude that Alexander Twining was wrong. Neither Ferdinand Carré, James Harrison, nor anyone else stole the idea that refrigeration could produce ice. And who actually emerges the victor in all this? Ultimately the triumph belongs not to those who merely conceive an idea and experiment with it, but to those who can transform the idea to practical reality and usefulness.

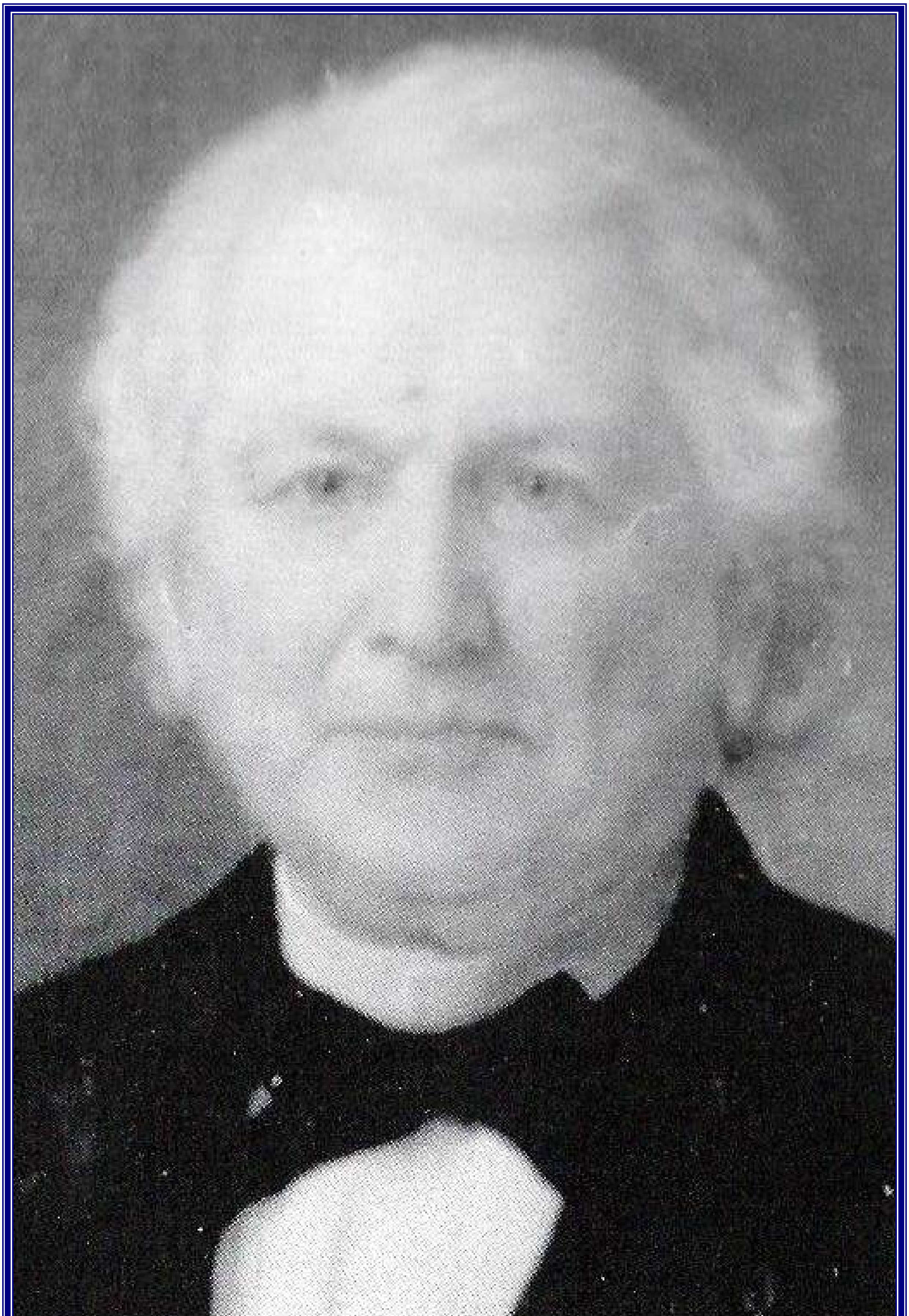
Alexander Twining did have a good idea, with successful experiments culminating in a commercially operating ice making plant. And his experiments were successful at an earlier date than Carré's or Harrison's. But fate intervened, and the U.S. War Between the States prevented any further devel-



Alexander Twining

opment. *Heat and Cold* concludes: "It was his contemporary, James Harrison of Australia, who would succeed where Twining failed." James Harrison, through the industrialist Daniel Siebe, was able to make that crucial transformation from the experimental to practical usefulness. Ferdinand Carré was also able to arrange for commercial development of his absorption refrigeration system.

By 1870, the date of Twining's lament to the U.S. Congress, Harrison and Carré systems were already being used in many places throughout the world. They had won the race honestly, and Alexander Twining was wrong to conclude otherwise. But it is a fact of history that Twining did have these feelings. It is also a fact of history that James Harrison of Australia invented the first commercially successful vapor compression refrigeration system which saw widespread use, and upon which many subsequent systems were based.



Alexander Catlin Twining

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