FERDINAND P E CARRE

By EurIng Brian Roberts, CIBSE Heritage Group

Ferdinand Philippe Edouard Carre, 1824-1900

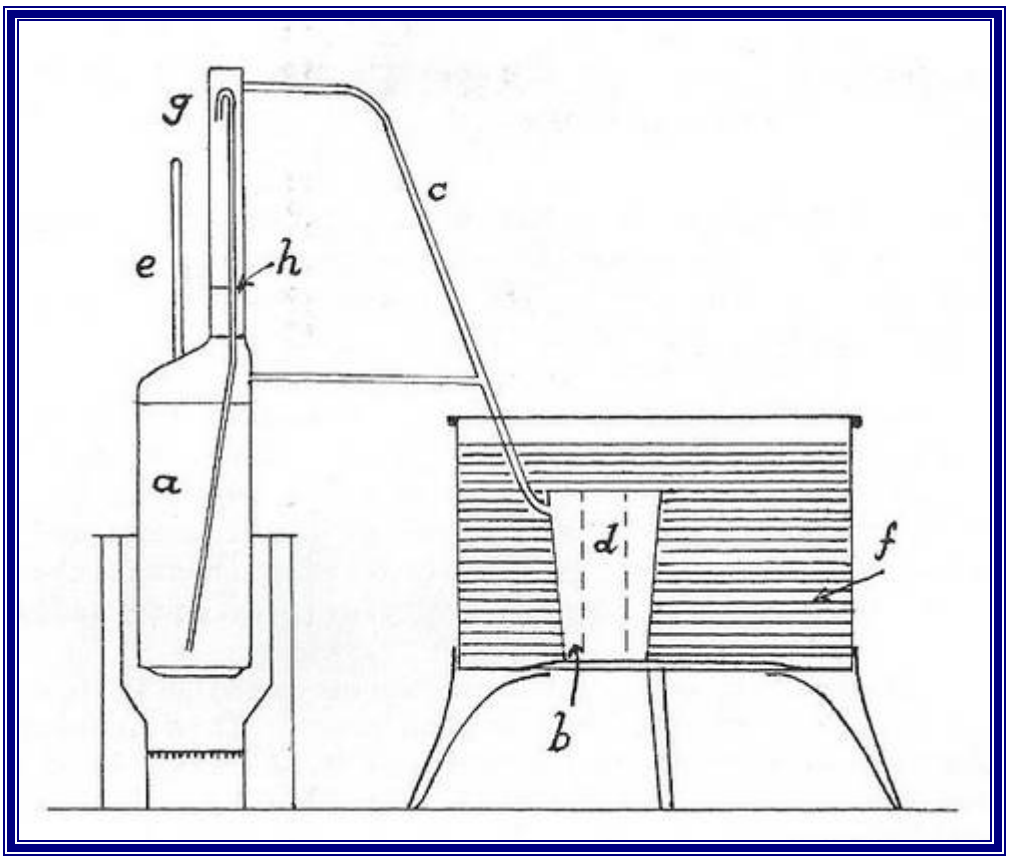
Ferdinand Carre was born on 11 March 1824 at Moislains, Somme, France. In 1850, his brother Edmond (1833-1894) developed an intermittent absorption refrigerating device using water and sulphuric acid, able to freeze water, which found use in Paris cafes. Ferdinand has been described as "a versatile engineer…interested in thermodynamics, mechanics, metallurgy and electrotechniques." From 1857, he studied refrigeration machines using ethyl ether and ammonia. He continued work on Edmond's process and in 1858 developed a machine which used ammonia as the refrigerant and water as the absorbent. This continuous absorption refrigerating machine was patented in France in 1859 and in the United States in 1860 (USP 30201 of 2 October). His machine was manufactured in 1861 by Mignon & Rouart of Paris. Carre exhibited his ice-making machine at the Universal London Exhibition of 1862, where it produced 200 kg of ice per hour.

Much of the commercial success of Carre's machine has been attributed to its use by the Confederate States in the American Civil War after the Union blocked shipments of natural ice from the north. Carre machines were smuggled through the Union blockade but did not operate satisfactorily until improved upon by Daniel Holden in New Orleans. Holden used steam coils to power the system and used distilled water to produce clean, demineralised ice.

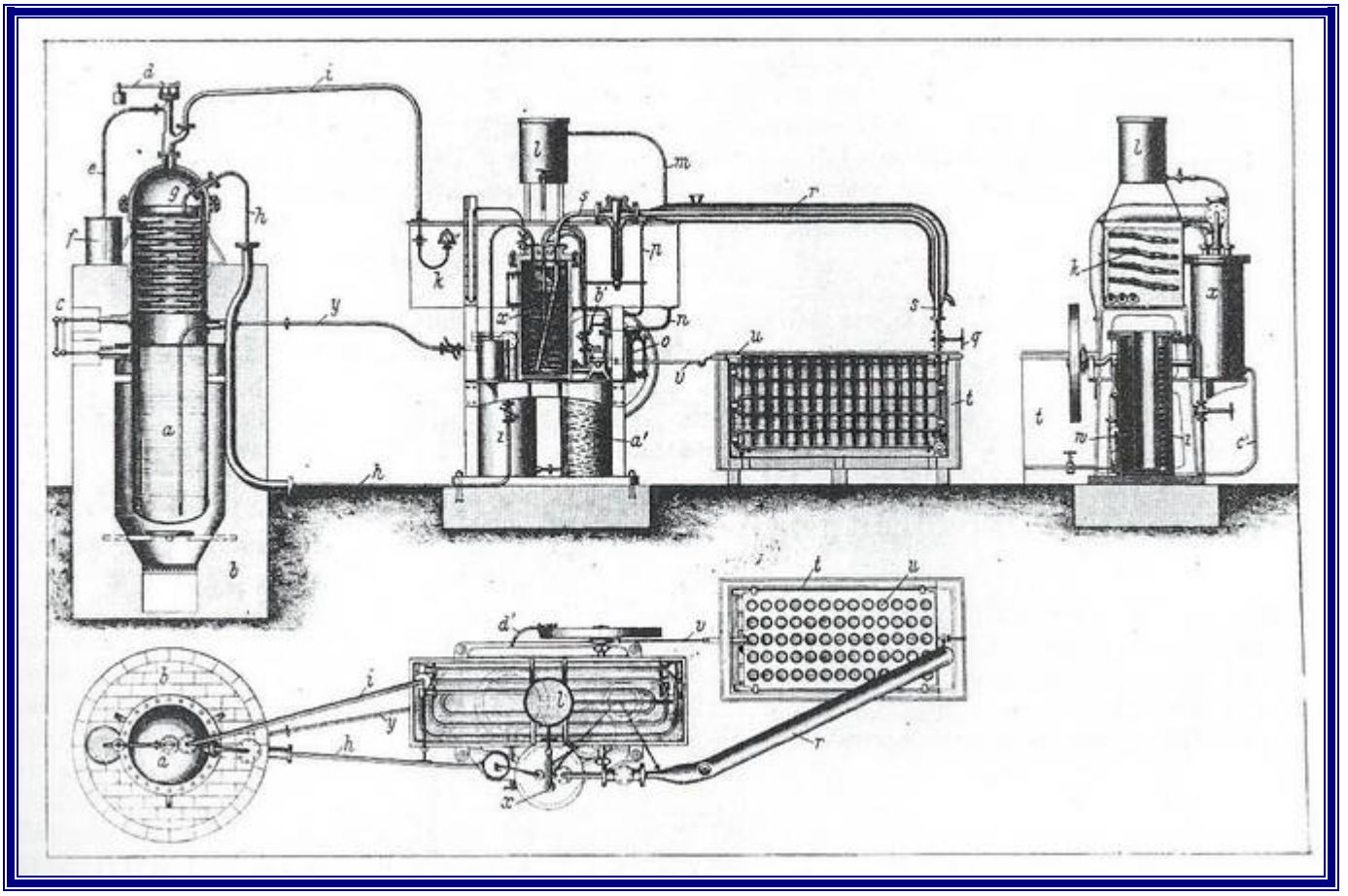
In 1876, Carre equipped the ship *Paraguay,* belonging to a Marseille company, with an absorption refrigerating system, enabling it to make the first intercontinental voyage carrying frozen meat in 1878 (from Buenos Aires to Le Havre).

He obtained more than 50 refrigeration patents and also carried out research in the field of electricity, inventing an electric light regulator and a high voltage electrostatic generator. He left no written records apart from his patents. Carre's absorption system continued in use through the early 1900's, after his death on 11 January 1900 at Pommeuse, Seine-et-Marne.

Carre absorption device (Smithsonian Institution, Division of Engineering & Industry)



Carre's intermittent household absorption refrigerator of 1859



Carre's continuous absorption refrigerating machine of 1859

6 Sheets—Sheet 1.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.

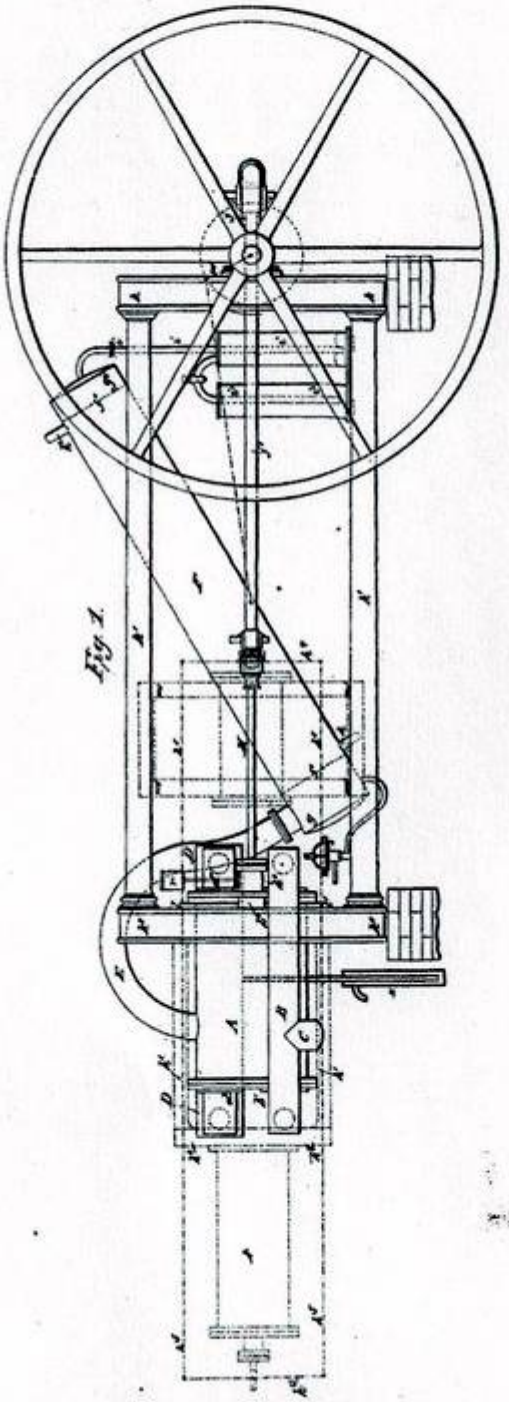


Fig 1.

Witnesses:

Inventor
F. P. E. Carrie by
A. Pollock Atty.

6 Sheets—Sheet 2.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.

Fig. 4.

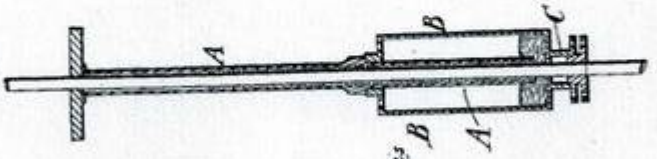


Fig. 3.

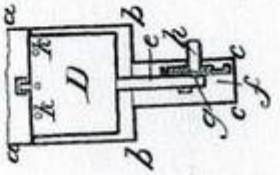
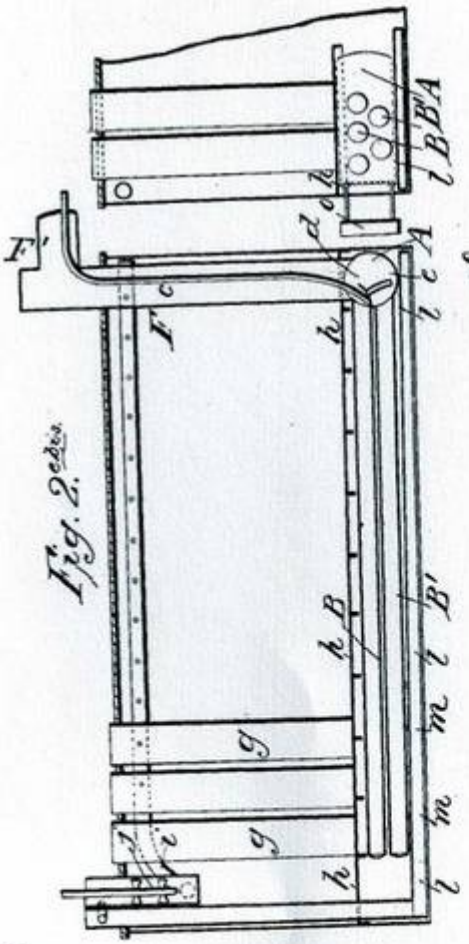
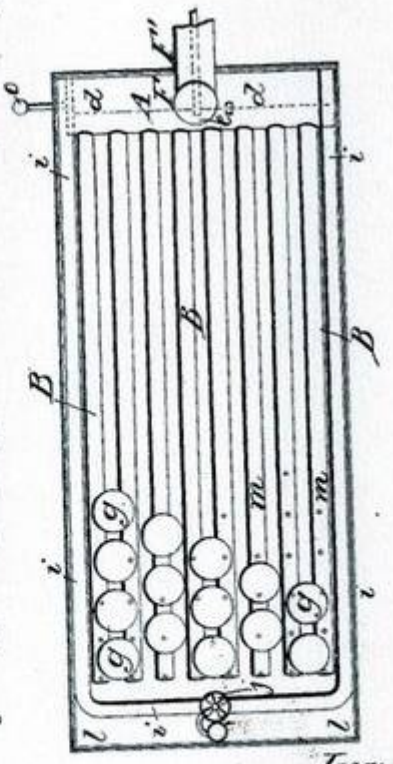


Fig. 2.





Witnesses:

Inventor:

F. P. E. Carrie by

A. Pollak his atty.

6 Sheets—Sheet 3.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.

Fig. 2.

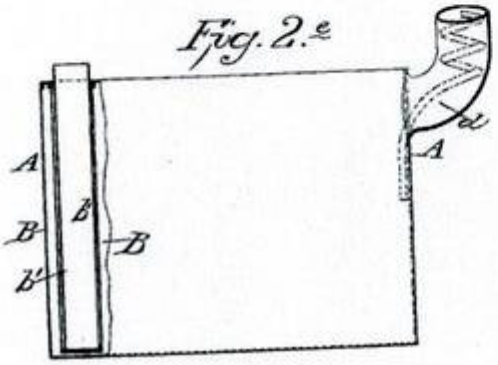


Fig. 6.

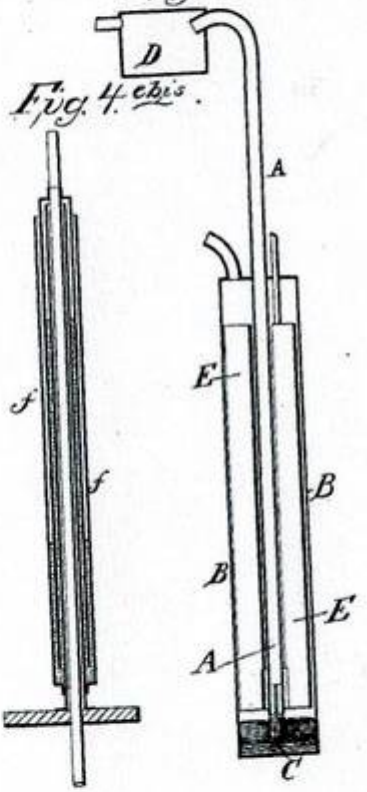


Fig. 4 ebis.

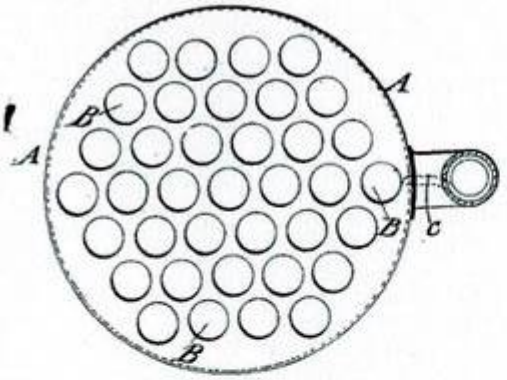


Fig. 5.

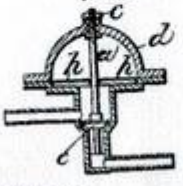
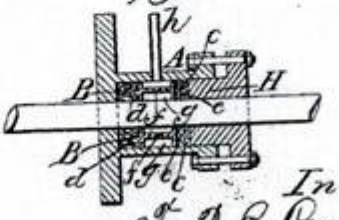


Fig. 3.



Witnesses:

Inventor:

F. P. E. Carrie by

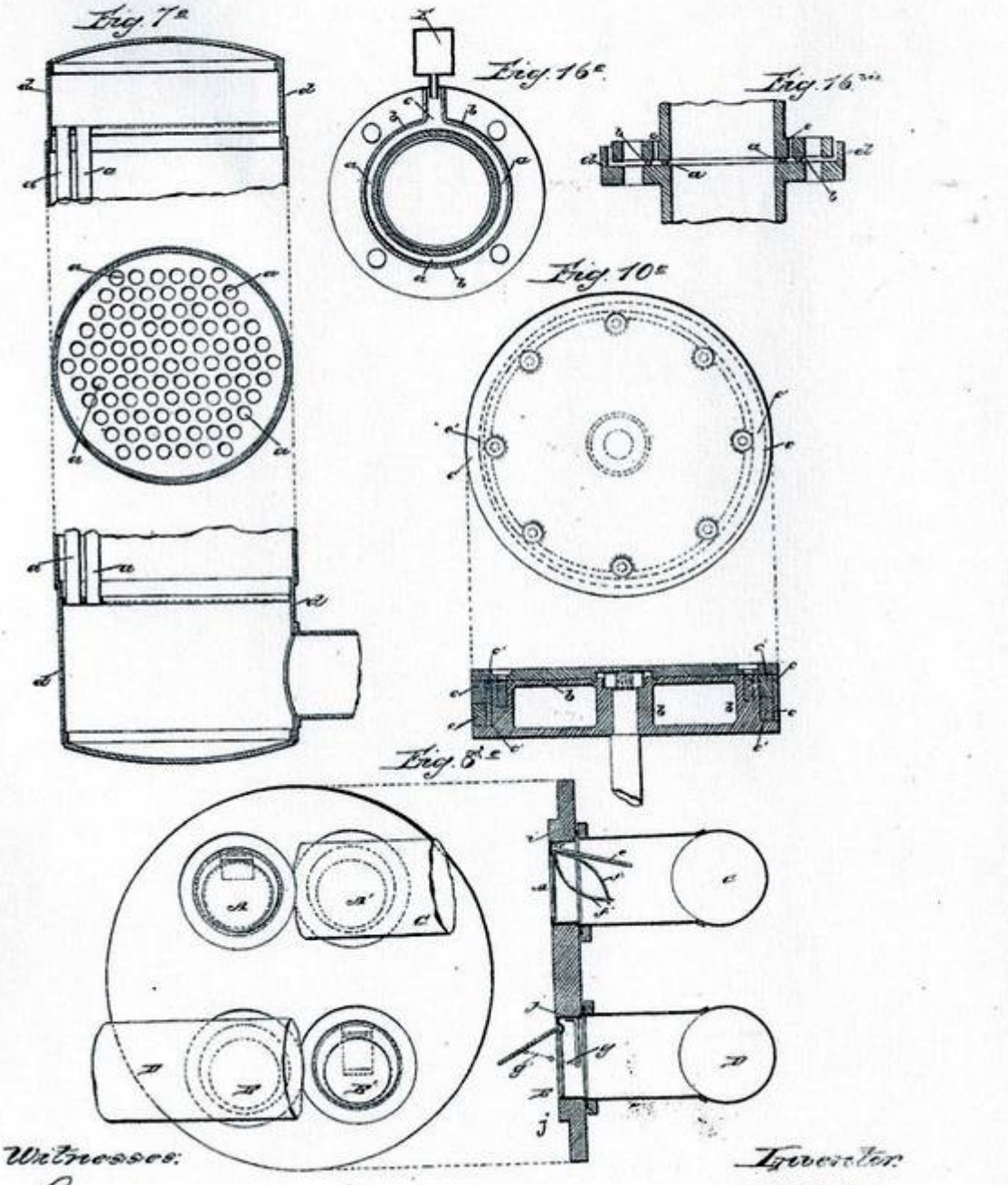
A. Pollak his atty.

6 Sheets—Sheet 4.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.

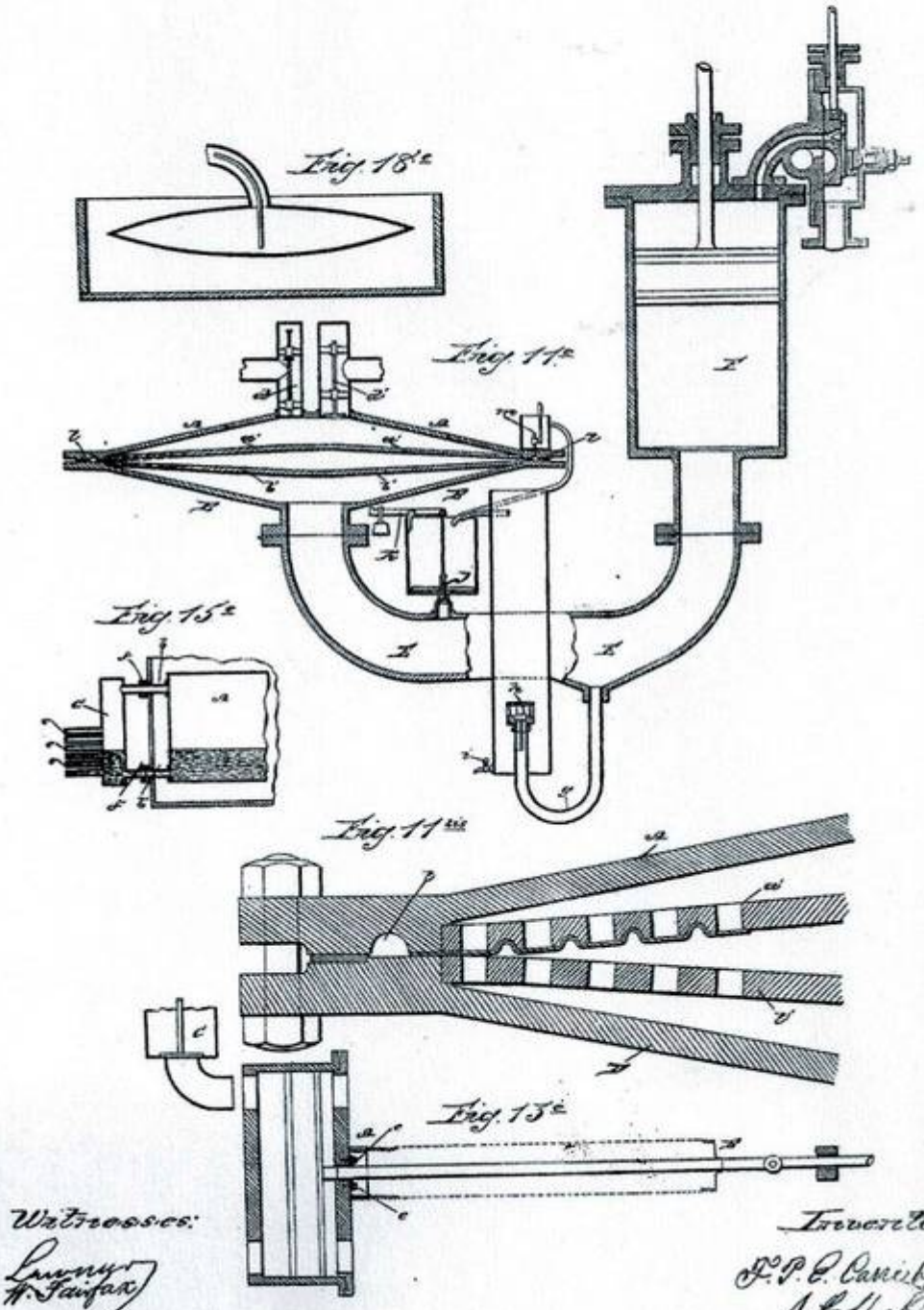


6 Sheets—Sheet 5.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.



Witnesses:

Lawny W. Fairfax

Inventor:

F. P. E. Carrie

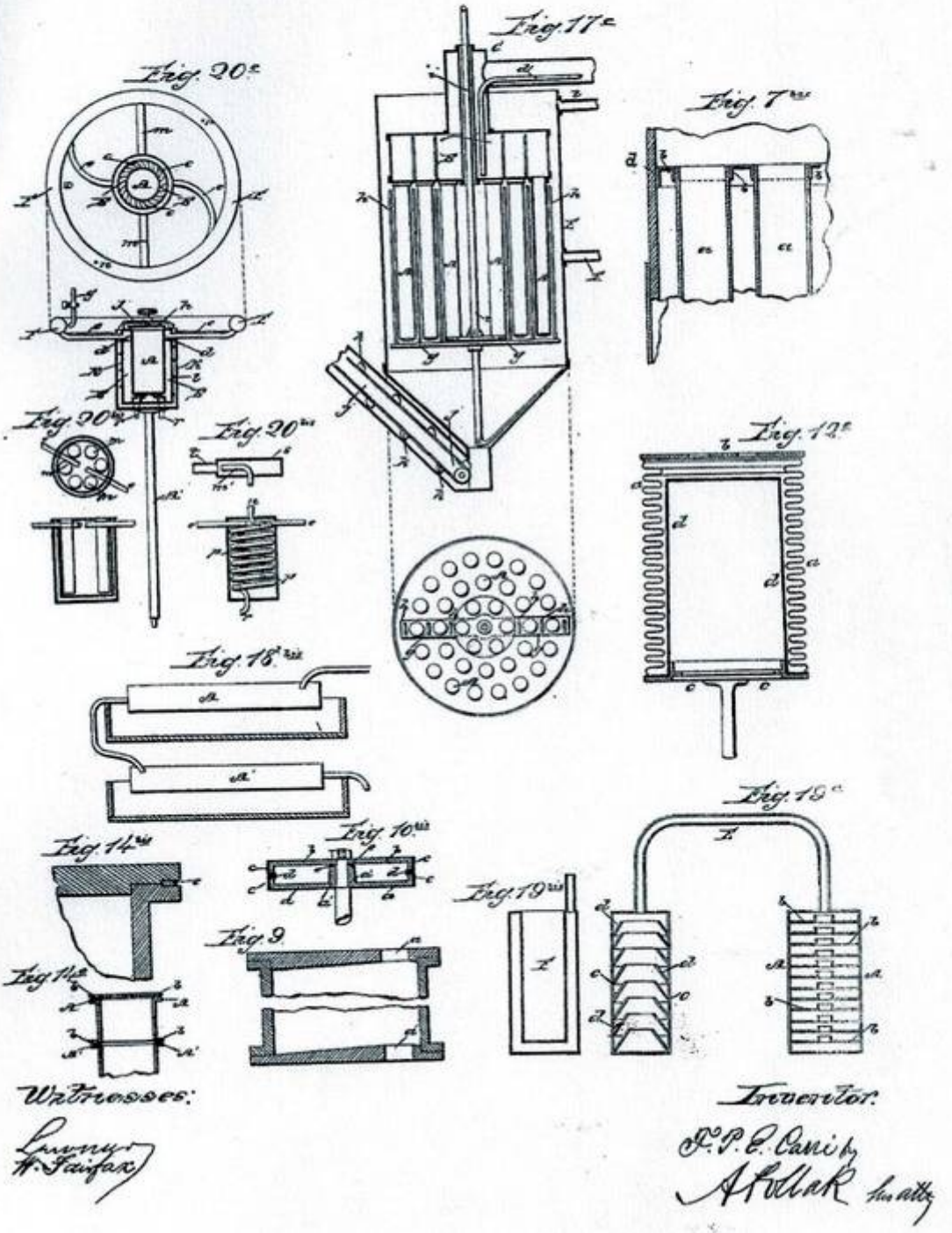
A. Pollak his atty

6 Sheets—Sheet 6.

F. P. E. CARRIE.

Manufacture of Ice.

No. 30,201. Patented Oct. 2, 1860.



Witnesses:

Geo. H. Fairfax

Inventor:

F. P. E. Carrie by A. Dallas his atty

UNITED STATES PATENT OFFICE.

F. P. E. CARRÉ, OF PARIS, FRANCE.

IMPROVEMENT IN APPARATUS FOR FREEZING LIQUIDS.

Specification forming part of Letters Patent No. **30,201**, dated October 2, 1860.

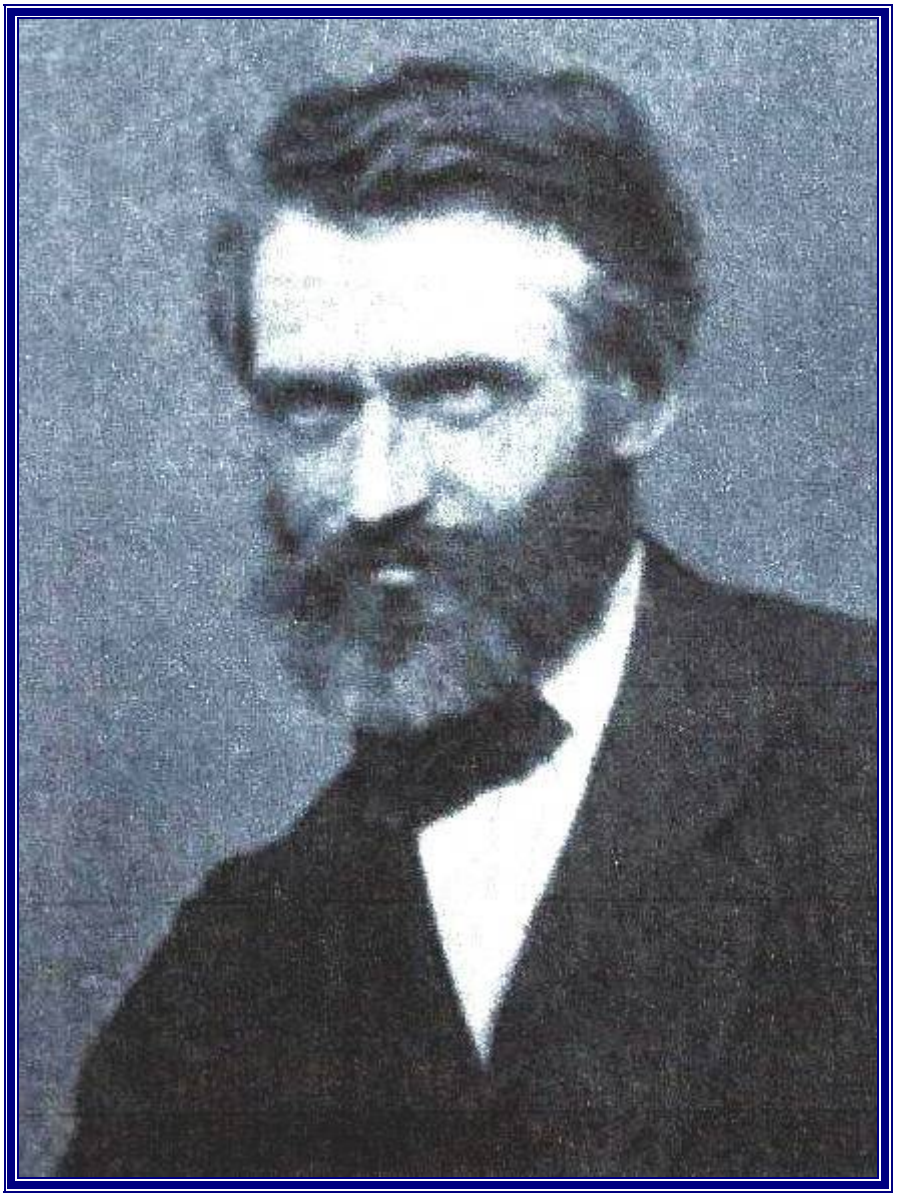
To all whom it may concern:

Be it known that I, FERDINAND PHILIP EDWARD CARRÉ, of Paris, France, have invented certain Improvements in Means for Producing Cold or Making Ice; and I declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The fact that by vaporization an enormous quantity of caloric is absorbed has led to the use of the vaporization of volatile fluids in the vacuum to produce cold artificially and to make ice. Liquids—such as ether, sulphuret of carbon, &c.—that reach the boiling-point at a low temperature, and the vapor of which possesses (even at the temperature of freezing water) a considerable degree of tension (5.5118 to 6.9055 inches of mercury) are eminently suitable to produce this result. For instance, if a recipient surrounded with water containing ether be put in communication with the exhaust-pipe of an air-pump, or if this pump be caused first to produce the vacuum in the recipient, when the said recipient is cleared of air, or nearly so, the ether will vaporize by virtue of its tension. We know that at 24.8° Fahrenheit it possesses a tension of about 6.9055 inches of mercury. Now at this temperature water freezes, and for that very reason the vaporization of a liquid cannot be effected without the absorption of a certain amount of caloric. Thus ether will absorb from the water surrounding the sides of the recipient its latent caloric, which (water) after having yielded all its latent caloric will be found converted into ice. If, on the other hand, the vapors of ether be forced into a worm, which we shall suppose thoroughly free from air and surrounded with cold water constantly renewed, so that it may be maintained at a uniform temperature of about 57.2° Fahrenheit, we find that at this temperature the tension of the vapor of ether to be about 12.5984 inches of mercury, or that as soon as, in consequence of the working of the pump, the vapors accumulated into the worm acquire a tension little beyond 12.5984 inches of mercury they will be condensed thereby, yielding their latent caloric of elasticity to the surrounding mass of water. Again, if the condensed ether in the worm be as soon as formed returned to the freezer, the latter will work continuously. In order that this series of phenomena may be produced in a constant and perfect manner, and allow of economy both as regards the motive power and the preservation of the liquids used, whose price is always comparatively high, it is necessary to make use of apparatus in which the vacuum once made is preserved indefinitely, or nearly so. Indeed, if air having a pressure of from 28 to 31 inches on all the openings and joints of the apparatus happen to get in it, it will require part of the motive power, besides checking the condensation, to be used for its own expulsion. By accumulating in the condenser the useful effect of the apparatus may be entirely annihilated, as its expulsion carries away considerable quantities of volatile liquid, and the operation under such conditions proves too onerous to be practicable. I avoid these inconveniences by means of the series of combinations hereafter expounded, whose efficiency has been tested by sufficient experiment, so that many of apparatuses used by me have kept for several months their initial or primitive vacuum, and consequently without losing an atom of ether. The special dispositions and arrangements of receivers, &c., I have found most efficient for the purpose of collecting the cold produced as well as for applying it are hereinafter fully explained.

The first sheet contains a drawing of the whole apparatus and several views necessary to make thoroughly comprehensive the application of the above-stated principles to an apparatus working by means of an ordinary air-pump.

In Figure 1, A is a double-acting air-pump; B, bifurcated tube, fixed by means of the branch tubes *b b'* upon the openings of the exhaust-valves; C, tube communicating with the freezer. D is a large bifurcated tube, whose branch tubes *d d'* are fitted on the openings of the forcing-valves; E, tube leading the vapors to the condenser; F, tubular condenser composed of small tubes soldered at their ends in the caps or partition on either end of the condenser, and composed of two plates, *f f'*, that are soldered on their periphery to the interior of the large tube inclosing the whole, thus form-



Ferdinand Carre

References

The History of Refrigeration: 220 Years of Mechanical and Chemical Cold: 1748-1968, Willis R Woolrich, ASHRAE Journal; July 1969

A History of Refrigeration, Roger Thevenot, International Institute of Refrigeration, Paris, 1979

Building Services Engineering: A Review of Its Development, Neville S Billington & Brian M Roberts, Pergamon Press, 1982

*Heat & Cold: Mastering the Great Indoors***,** Barry Donaldson & Bernard Nagengast, ASHRAE, 1994

The Comfort Makers, Brian Roberts, ASHRAE, 2004