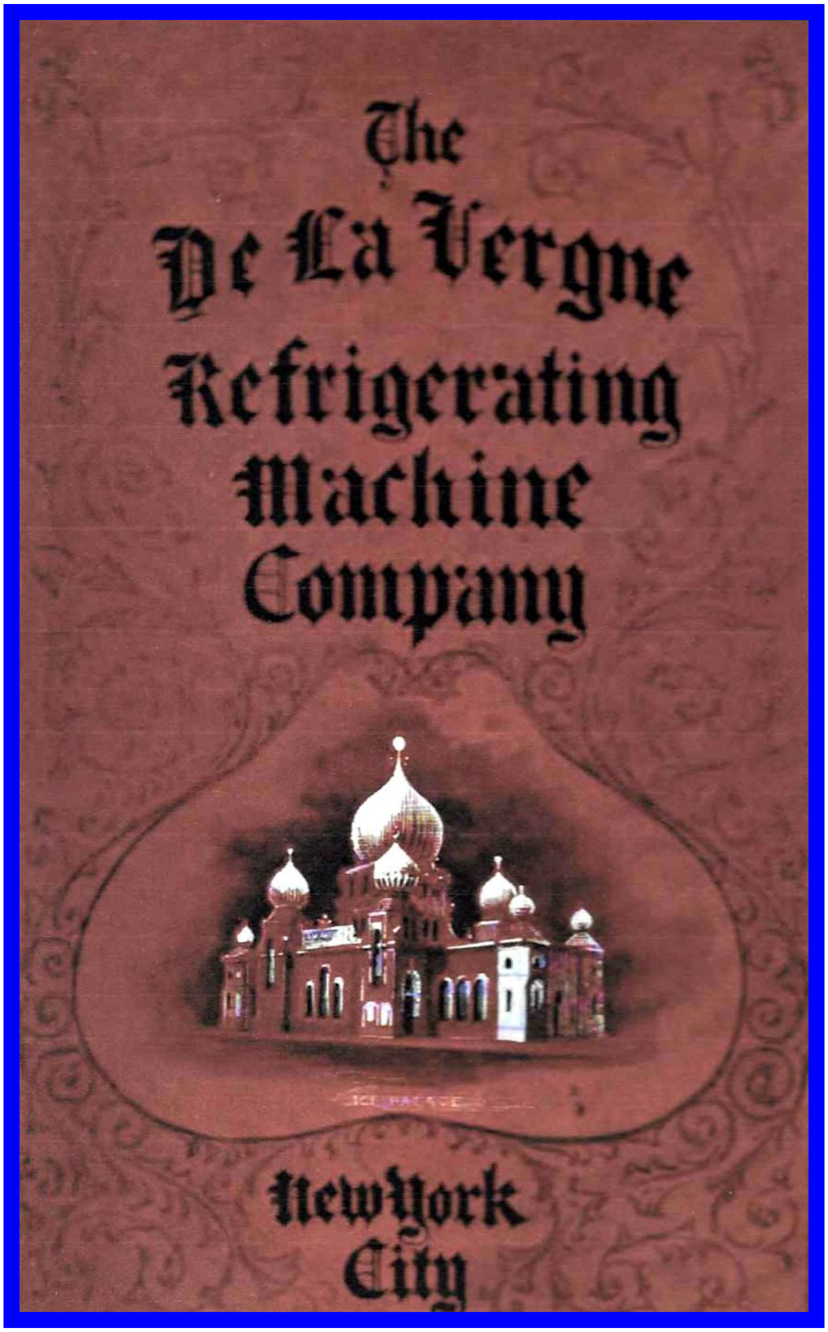
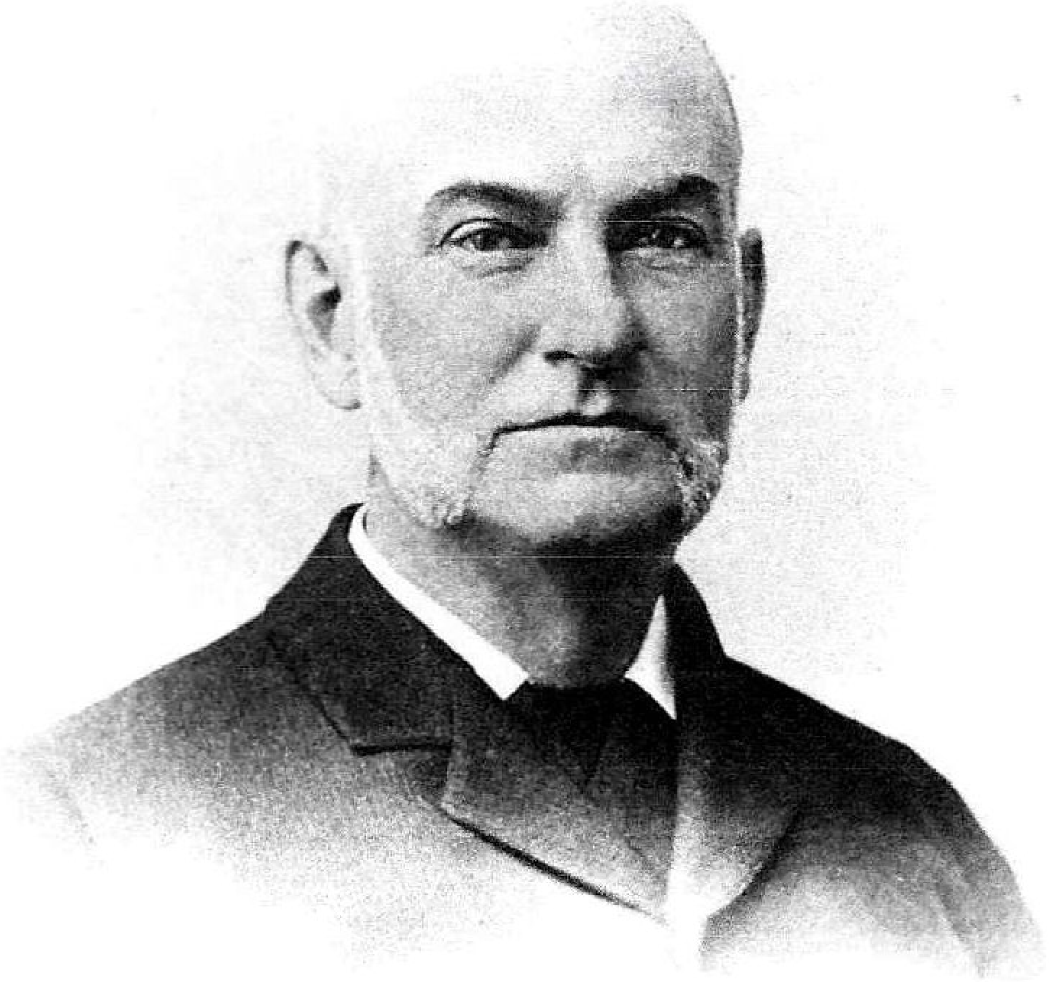
American Refrigeration
Cold Storage & Ice-Making 1875-1915

De La Vergne


The
De La Vergne
Refrigerating
Machine
Company

New York
City

Extract from CATALOGUE 1898



John C De La Vergne

FOUNDER AND PRESIDENT

OF

THE DE LA VERGNE REFRIGERATING MACHINE COMPANY

DIED MAY 12TH 1896.

Introduction.

IN issuing this the fifth edition of our catalogue it has been our aim to present to those interested in refrigerating and ice-making plants a clear and concise description of the machinery which we manufacture, and, at the same time, give information on matters closely allied to this class of machinery.

We have, up to this time, furnished over 700 refrigerating and ice-making machines, ranging in capacity from 1-5th of a ton to 500 tons, all of them together aggregating a refrigerating capacity equal to the melting of 37,000 tons of ice per 24 hours.

The results achieved by these machines have been highly satisfactory, and in many cases have been almost phenomenal. We have a record of machines running for years with practically no repairs at all, and a surprisingly small consumption of fuel and ammonia. In some instances the prime charge of ammonia put in when the plant was started has never required replenishing, in spite of the fact that the machines have been steadily operated for years.

The experience of many years, added to the extensive facilities we enjoy, justifies the assertion on our part that no other manufactory in the world is so well equipped to build and erect the very best that can be produced. Our reputation has been established by building the most reliable, durable and economical machines ever manufactured, and we shall continue to maintain the same high standard of workmanship.

We particularly call the attention of parties contemplating the purchase of refrigerating or ice-making plants to the importance of giving the most careful consideration to the probable durability and cost of operation of machines before determining which one to buy. There is a great tendency to purchase that which is the cheapest in the first cost, but which invariably proves the dearest at the end of a short period. It must always be borne in mind that machinery of this class is usually kept in continuous operation, day and night, and the additional expense of buying the best machinery in the beginning is of minor importance compared to the cost of maintenance and operation of an inferior plant. With poor machinery is involved, also, the risk of loss which might be occasioned by a breakdown or mishap, and when it is remembered that the preservation of products of great value depend upon the proper operation of the plant, the necessity for caution in the selection of a first-class apparatus will be more fully appreciated.

We invite a close perusal of these pages, followed by an inspection of a plant or plants in operation, in order to form an opinion as the merits of our machine.

Process of Mechanical Refrigeration.

THE process of Mechanical Refrigeration is simply that of removing heat, and mechanism is necessary because the rooms and articles from which the heat is to be removed are already as cold, or colder than, their surroundings, and consequently the natural tendency is for heat to flow into them instead of out of them.

The fact that a body is already *Cold* does not prevent the removal of more heat from it and making it still colder. The term cold describes a sensation and not a physical property of matter; the coldest bodies we commonly meet with are still possessed of a large quantity of heat, part of which, at least, can be abstracted by suitable means.

The only means by which heat can be removed from a body is to bring in contact with it a body colder than itself. This is the function that ammonia performs in mechanical refrigeration. It is so manipulated as to become colder than the body we wish to cool. The heat thus abstracted by it is got rid of by such further manipulation that (while still retaining the heat it has absorbed) it will be hotter than ordinary cold water and therefore part with its heat to it.

Ammonia thus acts like a sponge. It sops up the heat in one place and parts with it in another, the same ammonia constantly going backward and forward to fetch and discharge more heat.

The complete cycle of operation comprises three parts:

1st. **A Compression Side,** in which the gas is compressed.

2d. **A Condensing Side,** generally consisting of coils of pipe, in which the compressed gas circulates, parts with its heat, and liquefies.

3d. **An Expansion Side,** consisting also of coils of pipe, in which the liquefied gas re-expands into a gas, absorbs heat, and performs the refrigerating work.

In order to render the operation continuous, these three sides or parts are connected together, the gas passing through them in the order named.

The liquefied gas is allowed to flow into the expansion or evaporizing coils, where it vaporizes and expands under a pressure varying from 10 to 30 pounds above that of the atmosphere, when ammonia is the agent in use. The gas then passes into the compressor, is compressed and forced into the condensers, where a pressure of 125 to 175 pounds per square inch usually exists; here liquefaction takes place, and the resulting liquefied gas is allowed to flow to a stop-cock having a minute opening, which separates the compression from the expansion side of the plant.

The expansion side consists of coils of pipe similar to those of the condensing side, but used for the reverse operation, which is the absorption of heat by the vaporization of liquefied gas instead of the expulsion of heat from it, as in the former operation.

Heat is conducted through the expansion or cooling coils to, and is absorbed by, the vaporizing and expanding liquefied gas within such coils, for the reason that they are connected to the suction or low-pressure side of the apparatus from which the compressors are continually drawing the gas and thereby reducing the pressure in said coils, as already stated, to a pressure of 10 to 30 pounds above the atmosphere; it being kept in mind that liquefied ammonia, in again assuming a gaseous condition, has the power or capacity of reabsorbing, upon its expansion, a large quantity of heat. The liquefied gas entering these coils through the minute opening of the stop-cock above referred to is suddenly relieved of a pressure of 125 to 175 pounds, the amount requisite to maintain it in a liquid condition, when it begins to boil, and in so doing passes into the gaseous state. To do this it must have heat, which can be supplied only from the substances surrounding the pipes, such as air, brine, water, wort, etc. As a natural result the surrounding substances are reduced in temperature, or cooled. It is apparent, from the foregoing, that if the expansion coils are placed in an insulated room, that room will be refrigerated; also if brine or wort is brought in contact with the surface of the coils, they also will be reduced in temperature; and that brine so cooled can be used to refrigerate an insulated room by simply forcing it to circulate through pipes or gutters suspended in the same.

Either of the above methods can be applied to the refrigeration of breweries, packing-houses, etc., and for the manufacture of ice, the same gas being used over and over again to perform the same cycle of operations.

Our Patented System.

THE distinguishing characteristics of the De La Vergne System to which it owes its acknowledged superiority are :

ON THE COMPRESSION SIDE

The use of a cooling, sealing, and lubricating liquid.

ON THE CONDENSING SIDE

A scientific application of the laws governing the transfer of heat ; a prompt and regular separation of the liquid as fast as formed.

ON THE EXPANSION SIDE

The Direct Expansion System or expanding ammonia directly in coils placed in the rooms to be cooled instead of first cooling brine.

The justification of our claims as to the value of these features will be found in the following detailed description of our apparatus.

Natural Laws belong to all ; the utilization of them belongs to those who have the most perfect machinery.

Our Patented System

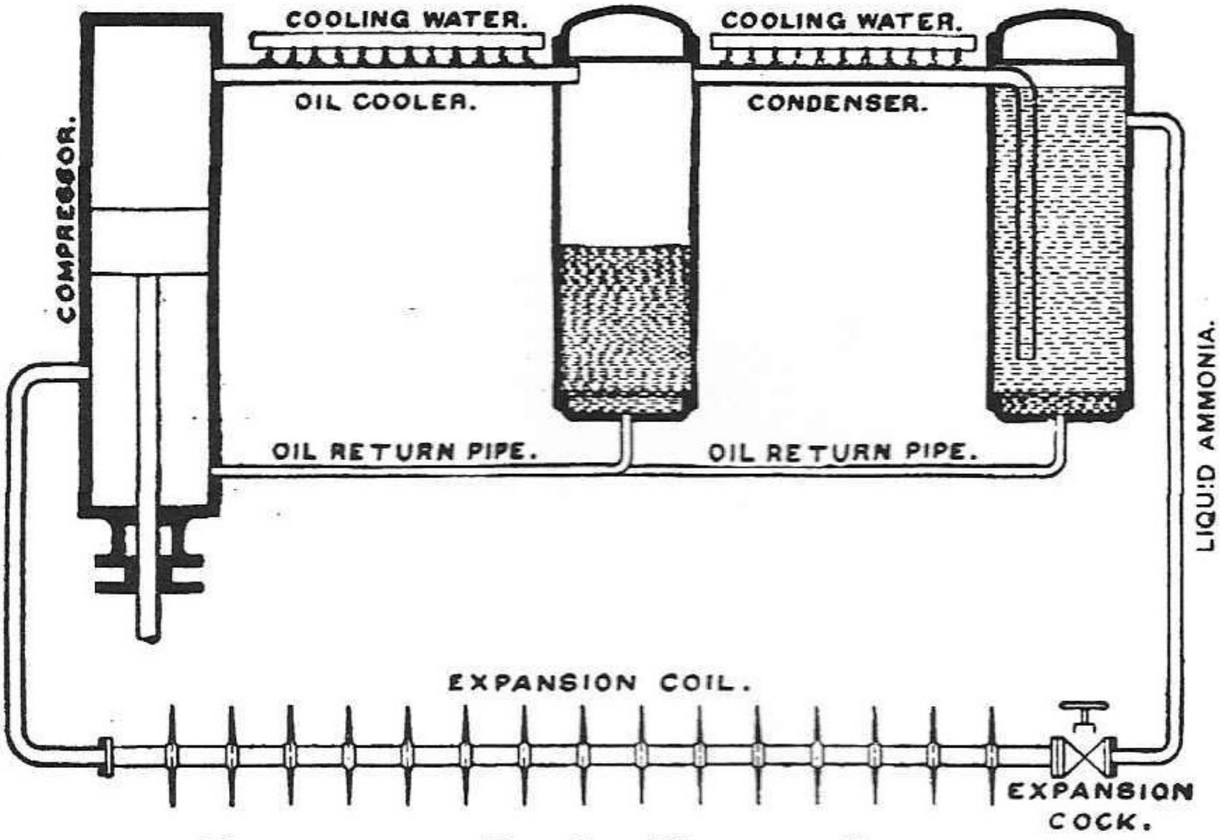


Diagram of De La Vergne System.

is seen to be extremely simple in conception; ammonia, gas, and oil are received into the compressor from which they are discharged together into the oil cooler. The cooled oil drops into the first tank while the gas continues into the condenser, where it is liquefied and collects in the second tank. The liquid ammonia is taken off from a point near the top of the second tank. If a little oil is taken over from the condenser it is conveyed by a pipe, as shown, to a point near the bottom of the second tank, where it remains, since it is heavier than liquid ammonia, and cannot rise to get into the liquid pipe of the ammonia supply.

The liquid ammonia is passed through the expansion cock into the expansion coil, where it boils into vapor which is drawn off into the compressor to pass around again in the order above described.

OUR LIQUID BASE :—

Ensures the expulsion of the entire volume of gas taken in at each stroke of the pump.

Effectually seals the suction valve, the piston, the stuffing-box, the piston-valve, and the discharge-valve—preventing all leakage.

Obviates the necessity of packing the stuffing-box tightly, and thoroughly lubricates the piston and piston-rod at every portion of the stroke, thus reducing the friction to a minimum.

Takes up a considerable amount of the heat developed in the gas during compression, thereby economizing largely the power required for compression.

Increases the life of the machine enormously ; a compressor after ten years running still shows the tool marks.

Does *not* reduce the capacity of the machine, as it is injected only after the compressor has been charged with its full complement of gas, and compression has begun.

Does *not* get into the expansion pipes, for, being a recognized feature of our system, adequate and effective means of separation are provided.

Compression.

THE difficulties previously encountered in pumping gas of the extreme tenuity of ammonia may be stated as threefold in number, and are as follows:

1. The Imperfect Discharge of the Gas from the Pump.

As a clearance must necessarily be left between the piston and the cylinder-head, only a portion of the compressed gas was expelled at each stroke; that remaining re-expanding with the reverse motion of the piston, produced a pressure against the incoming charge of gas, and resulted in a loss of power and efficiency.

2. Leaky Stuffing-Boxes, Pistons, and Valves.

In ordinary compressors the motion of the piston and rod, at each alternate stroke, would either introduce air into the pump, providing the internal pressure was less than that of the atmosphere, or force out and waste a volume of the refrigerating gas, and it was impossible to pack a pump piston and gland sufficiently tight to prevent these defects. In some cases where the attempt was made, the power required to overcome the friction of the stuffing-box thus tightened was found more than sufficient to do the entire work of compression. Again, working against constant pressures of 125 to 150 pounds necessitated the use of a tight piston, the least wear causing considerable leakage of gas past the piston into the adjoining pump chamber. Similar difficulties were also encountered with the valves, causing the gas to re-enter the pump past the discharge-valves, or to be returned to the suction side past its corresponding valves.

3. The Heat of Compression.

The mechanical energy which the compressor piston exerts upon the gas is converted into heat, which by expanding a tight packing of the piston causes friction; while on the other hand a loose packing of the piston, or its eventual wear, allows the gas to slip past.

The heat of compression expands the gas during compression, thereby increasing its volume, which necessitates an opening of the discharge valve prior to the time that it would open were the gas cooled during compression.

The work spent in effecting this prior discharge of the increased volume of gas is work lost.

To avoid these losses, and to obtain a higher efficiency in compressors other than ours, the device is resorted to of flooding the external portion of the cylinder with water, and in some cases also, of circulating a stream of water through the piston and piston-rod; but in such cases the thickness of metal required in the construction of the pumps and piston is so great that the cooling effect is only an approach to that which would effectually prevent such losses. In fact, this cooling only benefits the walls of the compressor, while the gas itself is practically not at all reduced in temperature.

Compression.

Our Standard Compressor.

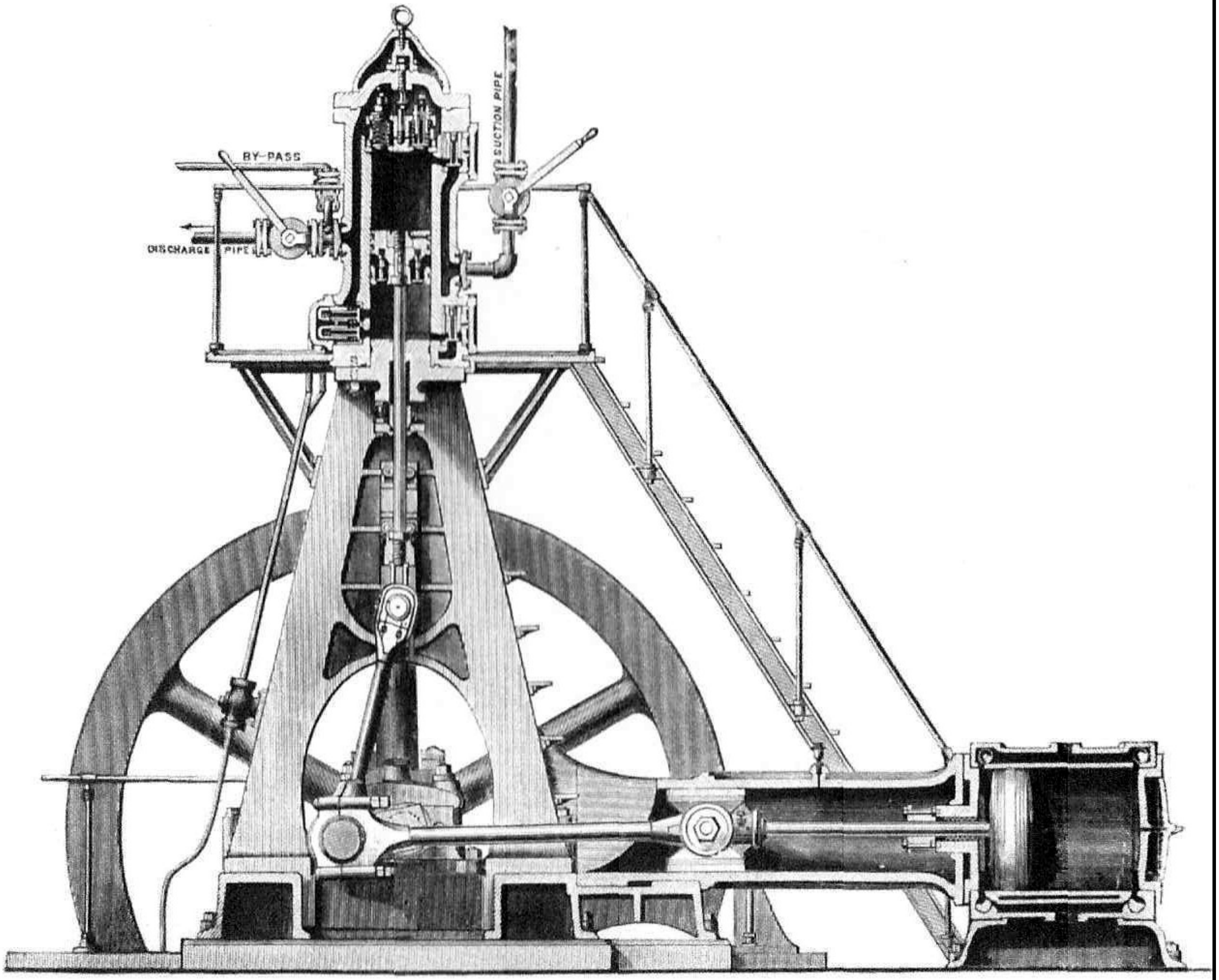
THIS represents our standard double-acting vertical compressor as arranged for use of oil as a sealing, lubricating, and cooling agent.

Two passages marked "*Suction*" and "*Discharge*" respectively, connect the compressor with the pipe system.

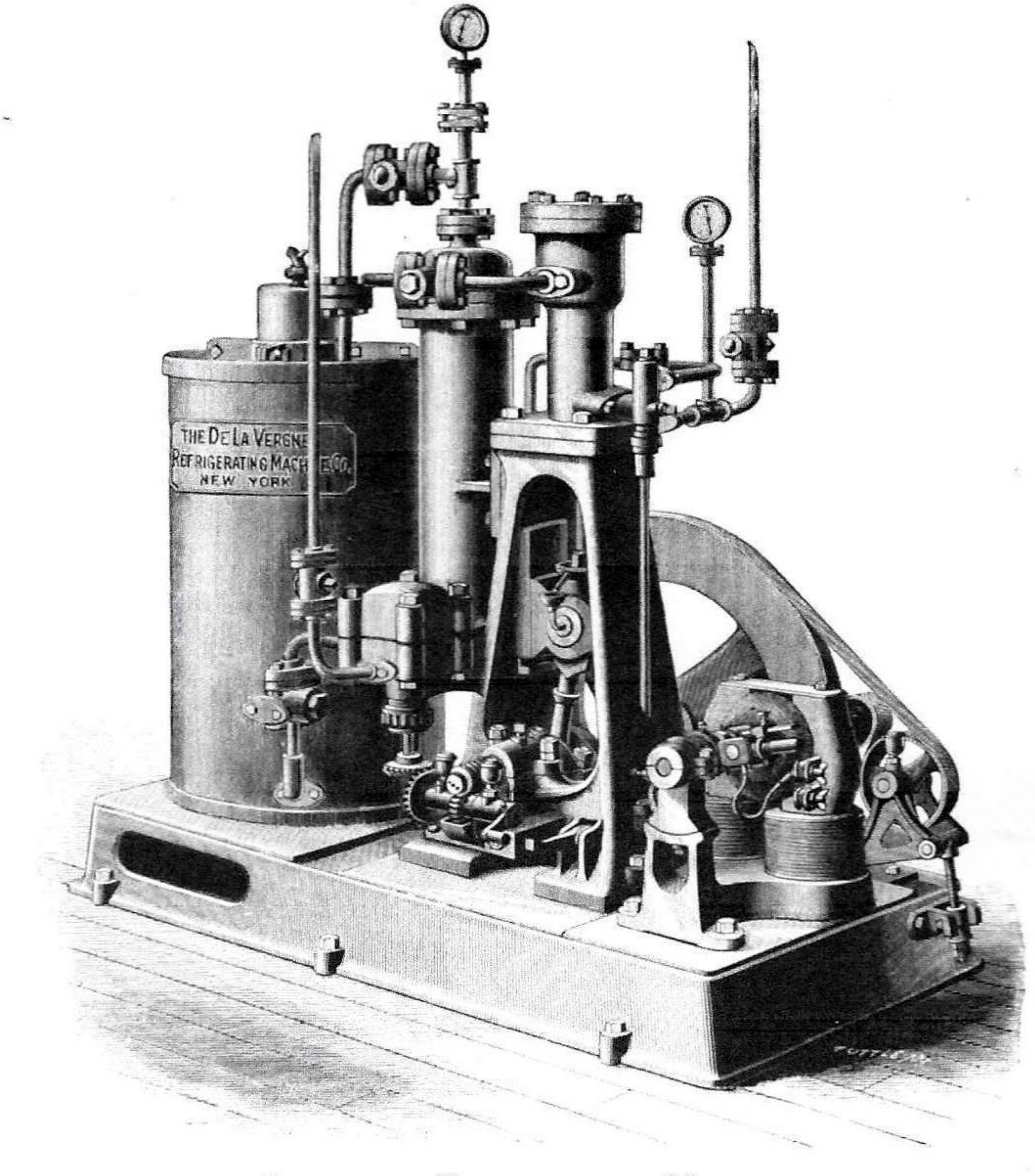
On the up stroke, gas flows through the lower suction valve into the space behind the moving piston, while the gas above the piston, after being compressed to the condenser pressure, is discharged through the upper valves (in the loose head) into the discharge passage.

On the down stroke, gas flows into the cylinder through the upper suction valve, and the gas below the piston is compressed and passes through the lower discharge valves into the discharge passage. The piston in its downward course closes successively the openings of these two discharge valves. When the lower is closed, however, the upper one communicates with the chamber in the piston, and the gas and oil still remaining below the piston are discharged through its valves into the chamber and out by the upper discharge valve.

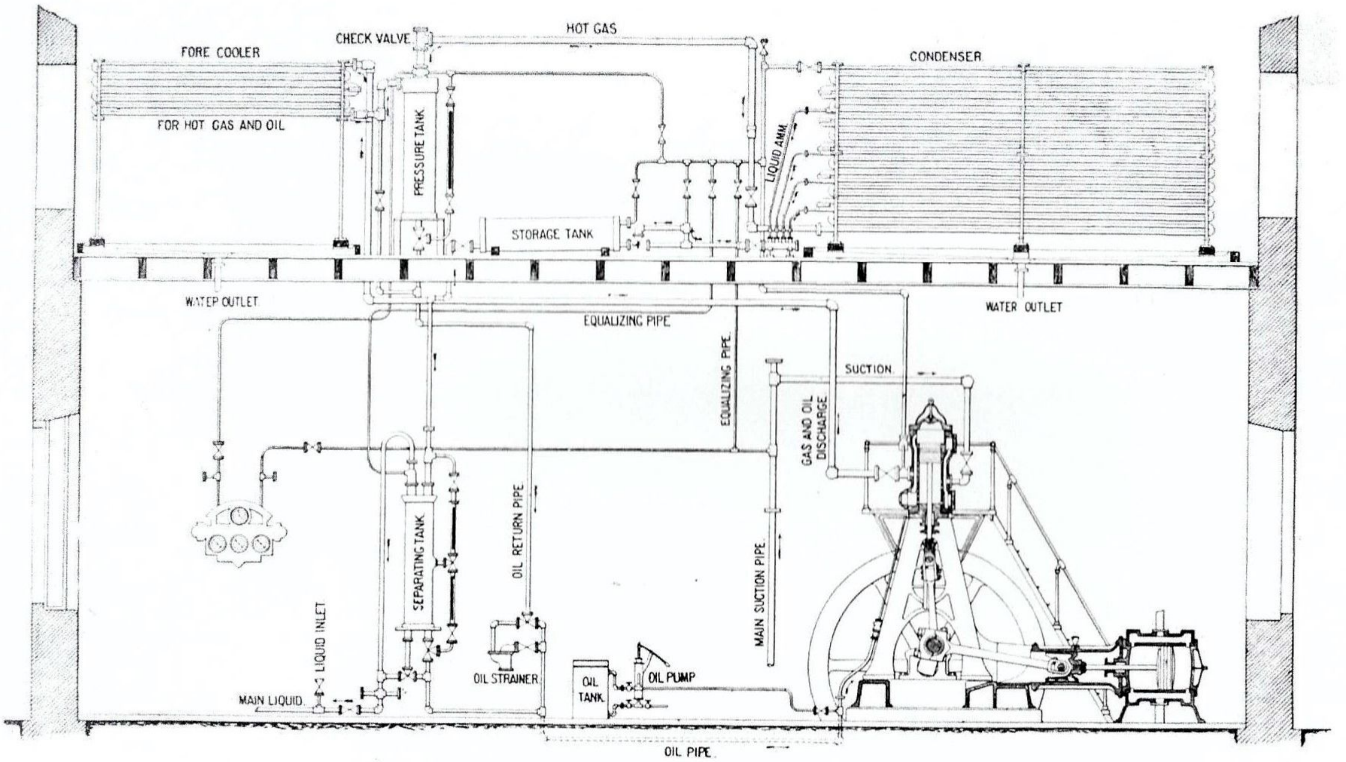
The oil being injected directly into the compressor after the compression of the full cylinder of gas has commenced *does not reduce the capacity of the machine.*



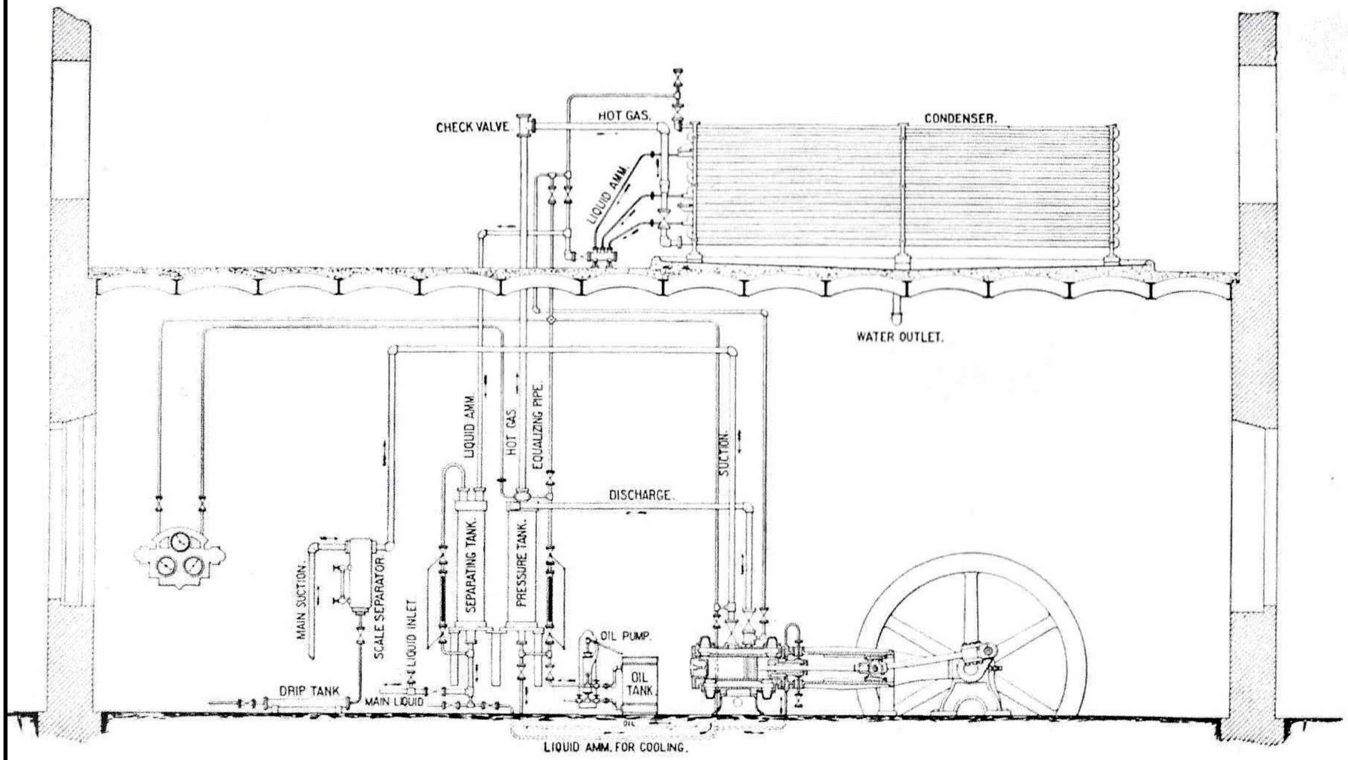
SECTIONAL VIEW OF OUR VERTICAL REFRIGERATING MACHINE.



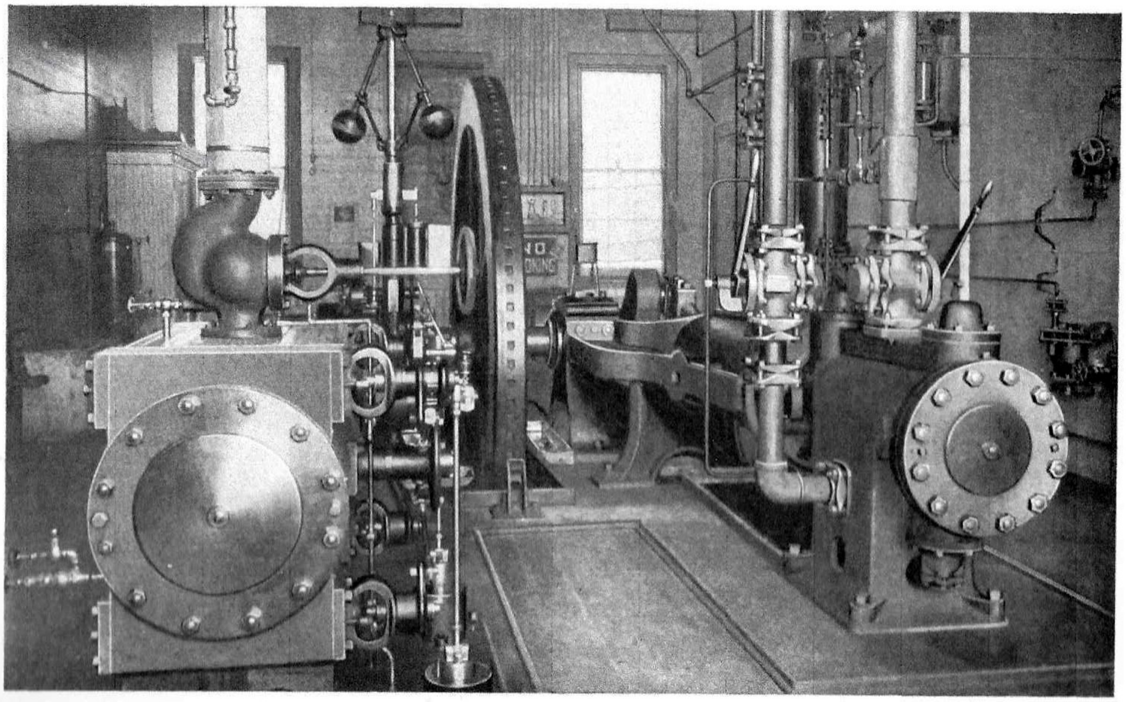
Automatic Refrigerating Machine.



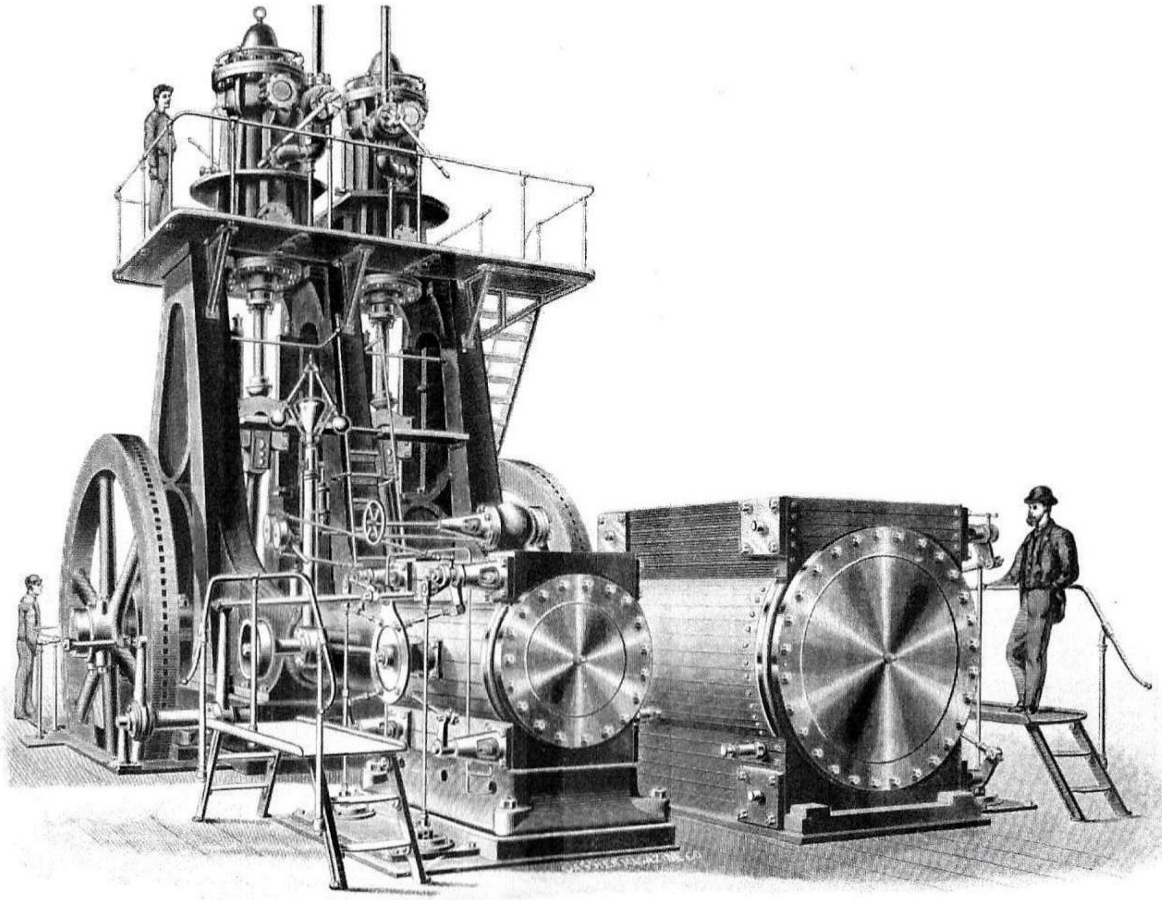
Refrigerating Plant, with our Vertical Compressor.



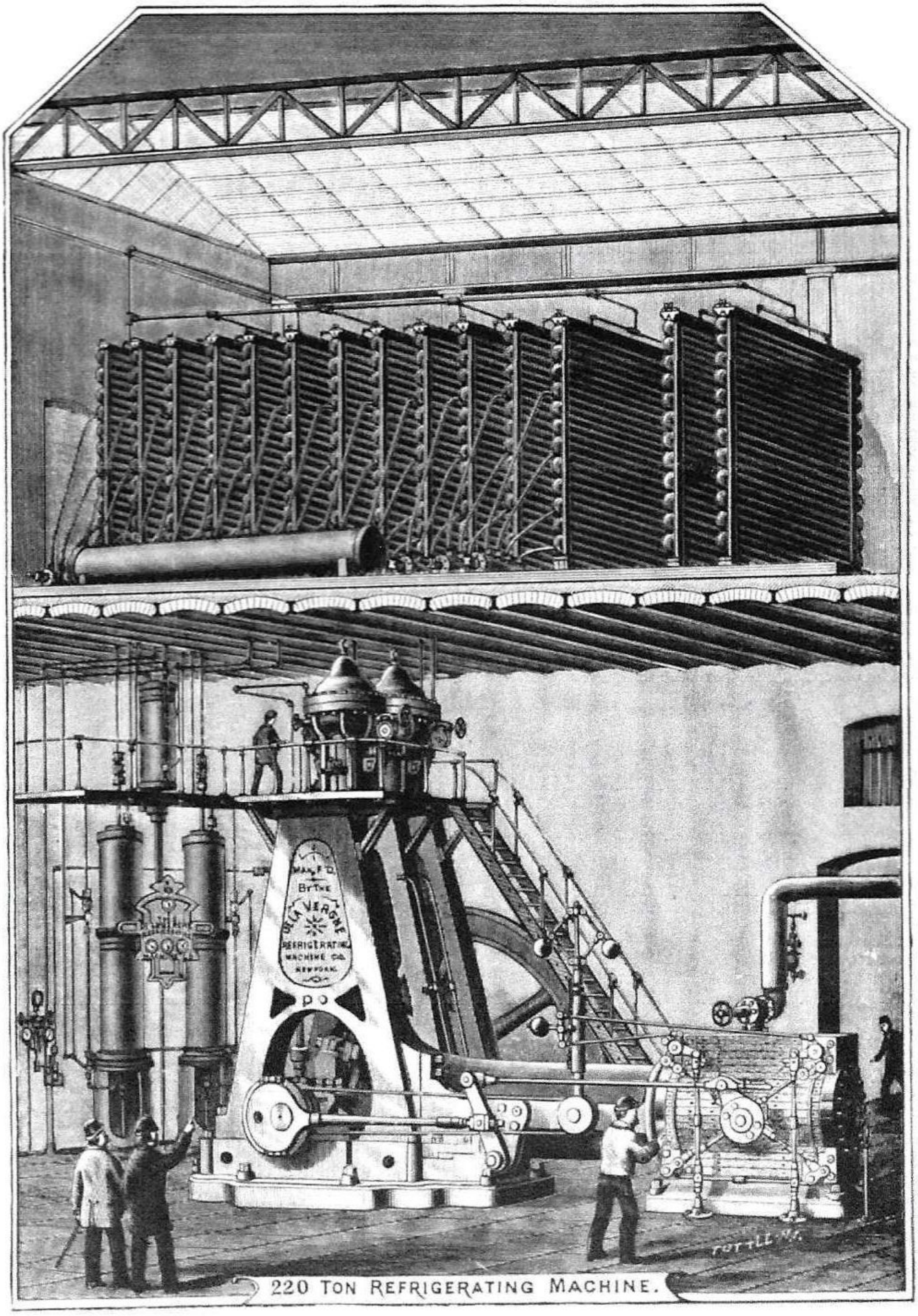
Refrigerating Plant, with Horizontal Compressor.



Double-Acting Horizontal Refrigerating Machine.



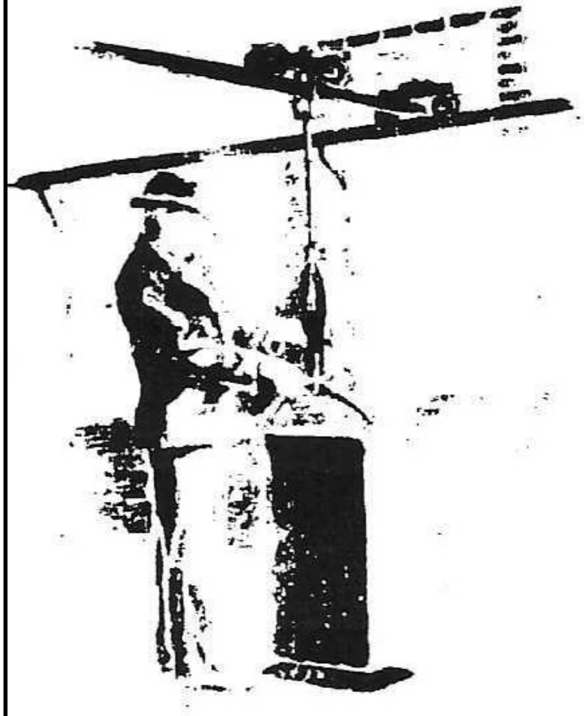
Cross-Compound 500-Ton Refrigerating Machine.



220 TON REFRIGERATING MACHINE.

Applications.

Ice Making.



THREE systems of Ice Making have survived the multitude of schemes, more or less impracticable, devised for this application of Artificial Refrigeration.

First, The system of removable cans.

Second, The plate system.

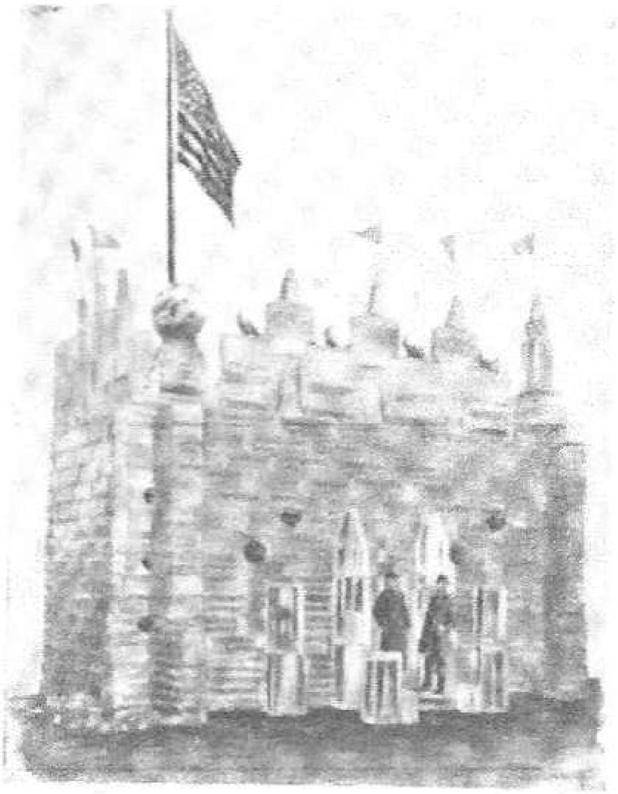
Third, The system of stationary cells.

The first is the one most in use the world over. In an iron or wooden tank, well insulated, a salt-brine is kept at a temperature considerably below the freezing-point of water by evaporating-coils, which are connected to the compressor of the refrigerating machine. In this brine galvanized iron cans are immersed. These cans contain the water to be frozen, and it is evident that in the course of time a coating of ice will form on the inside of the cans, and that after sufficient time has elapsed a solid block of ice will thus be produced in each can. One can after the other is now lifted out of the brine or freezing-tank, dipped into or sprinkled with tepid water, whereby the ice is loosened from the can, and the block slipped out, the can again filled with fresh water, and replaced in its position in the tank, where the freezing is again taken up. Thus a continuous process is established which permits of a regular output throughout the day and night.

In the plate system, which, as a rule, produces ice in pieces weighing one or more tons, a hollow plate of boiler-iron is formed and immersed in a tank containing fresh water to be frozen. This plate is filled with brine, which is kept below the freezing-point by evaporating-coils in a manner similar to those of the can system. The coils may be either in the plates or outside in a separate brine-tank, and the brine circulated through the plate. By thus keeping the plate at a sufficiently low temperature ice will form on both sides of it, and by and by two layers of ice will be built up on the two sides of the plate. In order to remove this ice, the cold brine is drawn from the plates, and in case the evaporating-coils are inside of the plates the circulation of ammonia in them is stopped. Now tepid brine is supplied to the hollow plates, and after a short while the ice is loosened from them, and can be hoisted out of the tank by means of cranes, and cut up into blocks of any desired size.

Plates are also made by bolting sheet iron against flat coils of pipes, inside of which ammonia is circulated; the loosening of the ice, when completely formed, is effected by passing hot ammonia gas through the coils. A number of plates are as a rule immersed into each tank, and a whole tank emptied at one time. In order to make the process continuous, more than one tank must be supplied, so that one at least is in continuous operation, while the other is being emptied and refilled and prepared again for work. But on larger plants even more than two tanks are necessary to permit of a daily drawing of ice. The freezing process going on from one side only, *i. e.*, a certain thickness of ice being formed by building up only on one side, the time of freezing is necessarily long. In a can ice is formed on two opposite sides, and the two surfaces growing together in the centre will ultimately make a solid block equal in thickness to the width of the can. If ice of such thickness is made on a plate, frozen only from one side, it takes about four times as long. Nevertheless the plate system has certain advantages, to which we will recur later on.

In the system using stationary cells the cold brine is pumped through the hollow walls of the cells, the latter being open at the top, and filled nearly brimful with the fresh water to be frozen. Ice will form in the cells the same as in the can system. After the blocks are finished in the cells, tepid brine is pumped in place of the cold brine, and thereby the ice loosened from the cells, and its removal becomes a matter of little time. It is self-evident that in this, as in the plate system, a whole tank has to be emptied at the same time, and, to make the plant continuous in its operation, more than one tank has to be employed. If the cells are made quite deep in proportion to their width, similar to the cans used in the can system, then of course the freezing-time is as fast as in the system first described. But if shallow cells, pan-shape, are used, the depth being small in proportion to length and width, then the freezing will practically be done mostly from the bottom, and for the same thickness of ice the time of freezing will be quadrupled as in the plate system. There is an object in using either the deep or the shallow cell, as will be shown later on.



Tower of Ice Blocks Made with Our Machines.

The De La Vergne Ice-Making Plant.

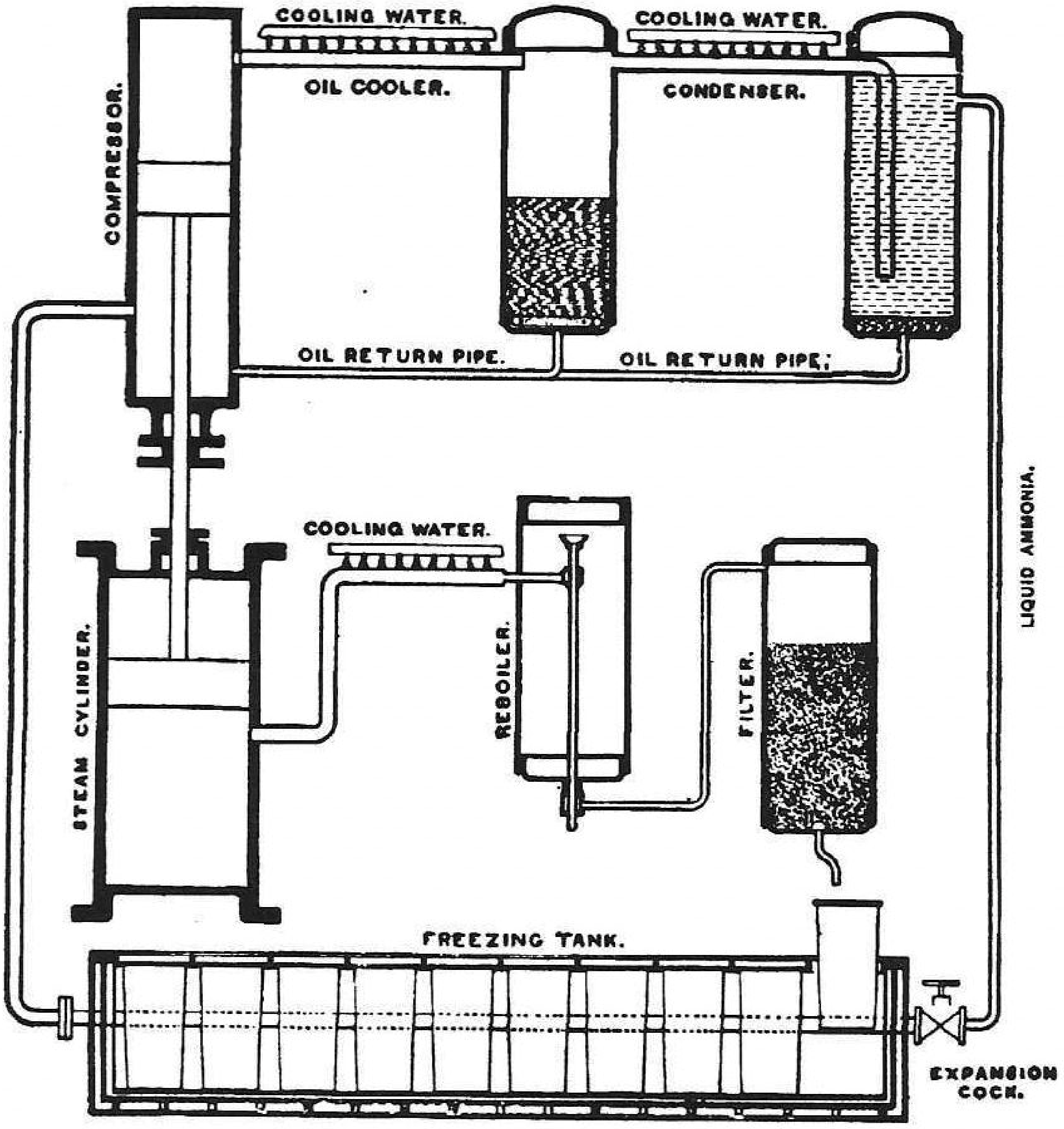
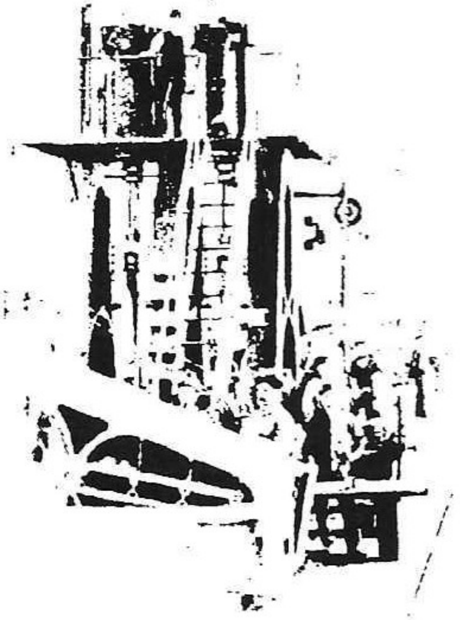


Diagram of the De La Vergne Ice-Making System.

Machines for Ice-Making.



We use our regular refrigerating machines for ice-making, but it must be remembered that a one hundred ton refrigerating machine will not make one hundred tons of ice.

Refrigerating machines are rated by the effect they produce equivalent to the melting of a corresponding amount of ice. Now the melting of one pound of ice is equivalent to the absorbing of 142 units of heat.

In making ice from water we have, however, to remove more than 142 heat units. We have first of all to reduce the water to 32° before we are ready to produce ice. If the water is at 82° this means the removal 50 heat units. Moreover, we cannot make ice with economy without going to a temperature much lower than 32°. The ice when formed may have a temperature of 18 degrees, and the specific heat of ice being 0.5, this means the removal of 7 more heat units. In other words, we have to remove 199 heat units instead of 142 to produce a ton of ice. Thus a 200-ton machine which would easily produce a refrigerating effect equal to the melting of 200 tons of ice would only produce 142 tons of actual ice. This proportion is still further reduced by the inevitable losses attending the use of large freezing tanks and the handling of the ice.