### A LARGE REFRIGERATING MACHINE.

Engineers, journalists, and those specially interested in refrigeration and the manufacture of ice, through the courtesy of the De la Vergne Refrigerating Company, were recently enabled to visit the new and extensive works of the company, at the foot of East 138th Street, upon the East River, and to inspect a very large refrigerating machine just completed and ready for shipment to The Anheuser-Busch Brewing Association, of St. Louis, Mo., who will use it for the purpose of cooling beer. This machine has a cooling capacity equal to that resulting from the melting of 500 tons of ice in twenty-four hours, which is much greater than that of any machine heretofore constructed. The machine is not only the most modern and most powerful one of its kind, but it is also a splendid example of engineering skill, and a superb piece of mechanical execution.

Before describing the construction of the machine, it is perhaps well to outline the general principles upon which the machine operates.

The refrigerating agent employed in this engine is anhydrous ammonia. This agent is charged into the system, and afterward passed through the round of the three operations, which are as follows:

*First: Compression.*—The agent in gaseous form is compressed to a pressure varying in the case of ammonia from 125 to 175 pounds per square inch, and depending upon the temperature of the condensing water used, either mechanically or otherwise, in order to prepare it for the second operation. During the compression, heat is developed in proportion to the amount of pressure exerted upon the gas, or to the relative volume to which it has been reduced. Expressed popularly, heat is squeezed out of the gas, and can then be carried away by the condensing water.

*Second: Condensation.*—The heat developed in the above operation is withdrawn from the compressed gas by forcing it through coils of pipe while said coils are in contact with cold water; the heat being transferred to the water surrounding the coils. When this point is reached the gas is ready to assume the liquid condition, and in so doing it gives off additional heat to the surrounding water.

*Third: Expansion.*—The liquefied gas thus obtained is allowed to enter coils of pipe so placed that the substance to be cooled (air, water, brine, beer, etc.) can be brought into contact with them, the pressure in the interior of these coils being maintained at a lower point than that required for retaining the gas in the liquid state. The liquefied gas, upon entering said coils, re-expands, and extracts from the pipes and the substances surrounding the pipes the same quantity of heat that was previously given up by the gas to the water used during the period of condensation and liquefaction. The gas, having performed in this last operation its refrigerating work, is now ready to repeat the same cycle of operations.

From what has been said it will be readily understood that a refrigerating machine consists of three series of parts, each corresponding to one of the above operations:

1st. *A compression side*, in which the gas is compressed, either mechanically or otherwise.

2d. *A condensing side*, generally consisting of coils of pipe, in which the compressed air circulates, parts with its heat, and liquefies; and

3d. *An expansion side*, consisting also of coils of pipe, in which the gas re-expands 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 gas is drawn through the expansion coils by the pumps at a pressure varying from 10 to 30 pounds above that of the atmosphere, where ammonia is in use, and is then 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 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 expanding liquefied gas.

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. To maintain this cycle of operations powerful compressing pumps of peculiar construction are required.

Owing to the volatile nature of ammonia gas, the most perfectly constructed compressors, unless provided with some means for preventing the escape of gas, leak around the pistons and the piston rods. One of the important improvements in the machine made at these works is that of the injection of cold oil into the compressing cylinders along with the ammonia gas, the oil serving to seal the joints, prevent the escape of gas, and at the same time to increase the efficiency of the compressor by abolishing clearing spaces at the ends of the cylinder. By means of this improvement, it is made possible to use double-acting compressors, which greatly increase the capacity of the machine, without adding materially to the friction of the moving parts.

Although our engraving gives a good general idea of the dimensions of this machine, its size cannot be fully appreciated without the exact figures.

The double-acting compressing cylinders have a diameter of 24 inches and a stroke of 48 inches. The engine which drives the compressors is of the Corliss cross-compound condensing type, of 600 horse power; the high pressure steam cylinder is 32 inches in diameter, with a stroke of 48 inches: the low pressure cylinder is 64 inches in diameter, with the same stroke; the connecting rods are connected with the cranks on the engine shaft, which also receives the connecting rods of the compressors. The crank shaft is made of the best selected horseshoe scrap iron. It has a diameter of 15½ inches and weighs 20,820 pounds. On each of the crank cheeks is shrunk a band of wrought iron 2 inches thick. The crank shaft carries two fly wheels, each 14 feet 8 inches in diameter. The compressor connecting rods weigh 3,400 pounds each, and the steam connecting rods 3,800 pounds each. In the construction of this machine 4¼ tons of phosphor bronze were used in the connecting rods and bearings. The total weight of the machine in the rough was 390,000 pounds; the weight finished approximates 175 tons.

The anhydrous ammonia used in connection with these machines, and everything necessary for a complete plant for the manufacture of ice, is made here. The pipe fittings which are used in the construction of the coils and for connections, and which must necessarily be of special construction, are also made at these works.

### Height and Position of Mount St. Elias.

The geographic position of Mount St. Elias is of popular interest in connection with the boundaries of Alaska.

In the convention between Great Britain and Russia,* wherein the boundaries of Alaska are supposed to be defined, it is stated that the boundary, beginning at the south, after leaving Portland Channel, shall follow the summit of the mountains situated parallel to the coast as far as the 141st meridian, and from there northward the said meridian shall be the boundary to the Arctic Ocean. Whenever the summits of the mountains between Portland Channel and the 141st meridian "shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, above mentioned, shall be formed by a line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom."

As Mount St. Elias is approximately in longitude 140° 55′ 30″ west from Greenwich, as already shown, it is, therefore, only 4′ and 30″ of longitude, or 2½ statute miles, east of the boundary of the main portion of Alaska. Its distance from the nearest point on the coast is 33 statute miles. There is no coast range in southeastern Alaska parallel with the coast within the limits specified by the treaty, and the boundary must, therefore, be considered as a line parallel with the coast and ten marine leagues, or 34½ statute miles, inland. The mountain is thus 1½ miles south of the boundary and within the territory of the United States. Its position is so near the junction of the boundary separating southeastern Alaska from the northwest territory with the 141st meridian that it is practically a corner monument of our national domain.

The height of Mount St. Elias has been variously estimated. Prof. Russell, who was at the head of the government expedition which made a careful examination of the mountain last summer and reached the highest point yet attained by any one, estimates the height at 19,000 feet.

### The Simplon Tunnel.

From particulars given in the *Moniteur Industriel*, it appears that the tunnel will be about 19,731 meters (12¼ miles) long, exceeding considerably the length of the Gothard tunnel, which is 14,900 meters or about 9¼ miles. The tunnel will consist of practically two distinct sections of about equal lengths, the north section 9,900 meters long, which will begin near Brigue, and the south section, about 9,800 meters long, which will terminate within a short distance from the station Isella. As of special interest, it is mentioned that over part of the south section there will be in reality two tunnels, each accommodating a single line of tracks, while the remaining length will be in the shape of a single tunnel with double tracks.

The power required in building the tunnel, for tunneling proper, ventilation, transportation of material, etc., will be supplied by two large hydraulic plants, one at each tunnel end. At the north end the water will be taken from the Massa, an appreciable head being attainable, promising, it is thought, a total of 2,950 horse power. At the south end something like 4,250 horse power is counted on, the water to be taken from the River Cairasca. The total cost of the tunnel and accessories has been figured up to fall not far short of 80,000,000 francs, or about $16,000,000.

### Fireproof Doors.*

The danger from fire can be considerably lessened if passageways between buildings or through partitions be provided with doors that are as fireproof as possible. It used to be the fashion to provide iron sliding doors for such openings, but it was soon found that the iron door was faulty in construction and not much better than an ordinary wooden door would be. In a very few minutes the iron would become red-hot and warp out of shape so that a space of several inches would be opened around the door, letting fire have free entrance.

It has been found that covering a wooden door with tin proves more fireproof than an iron door; wood cannot burn unless exposed to the atmosphere. Placing a piece of wood in an air-tight tube, the tube may be heated almost red-hot without more than charring the outside of the wood.

To make a fireproof door, procure some sound, matched boards that fit closely together, free as possible from knots, many edges, or other imperfections. Make the door double, nailing the two thicknesses across each other, and fasten them tightly together by means of clinch nails put not over 6 inches apart in every direction. If the door be more than 4 feet wide or 7 feet high, better use three thicknesses of boards. Cover entire door with tin, locking the seams, not soldering them, and nailing each strip of tin firmly to the door. Do not drive nails through the tin to fasten it, but put a clip of tin into each seam lock, driving the nail through this clip, then lay on another strip of tin and another set of nailed clips, and so on entirely around the door.

Work right around the door from one side to the other, pressing over the edges, locking tightly and hammering all seams flat. Cover top and bottom of the door in the same manner, being particularly careful about top of door that the tin is locked perfectly. A small opening here will allow smoke and gas to issue, forming a draught between door and tin which will permit fresh air to draw in to the bottom of the door, and soon destroy the wood.

Be particular that no air spaces are left in the door. Therefore, never try to cover a panel door with tin, for such construction will not stand fire. It is better not to use hinges with such a fire door; put on sliding trucks or hang the door upon a track. Such a door should always fit into the rabbet in the door frame and come flush with the wall when practicable.

If the door slides, let it pass in behind a jaw which will press it snug, so as to tightly close the openings into either room.

No nails less than one inch long should be used in fastening the tin. The wood may be charred to a considerable depth, and if short nails are used they will become detached and allow the tin to bulge off, forming a bare place in the door, which may lead to its destruction.

Under these conditions the surface of the wood is converted into charcoal, which, being a non-conductor of heat, tends to retard further combustion of the wood; but if air get in in any manner, the charcoal is quickly burned, and then the door itself will be destroyed.

This shows how it does not pay to tin a door only on one side, for when this is done, as soon as the heat is sufficient to convert the surface of the wood under the tin into charcoal, oxygen reaches it from the other side of the door and the whole business is quickly in a blaze.

Several devices have been made to automatically close such fire doors, whenever the atmosphere reaches a certain degree. One method is to hold the door open by a thin wire of fusible metal which melts at 180 or 190 degrees. Another method is to use an electric device connected with any good automatic fire alarm system. Either of the methods has its advantages and faults. The advantages are that they work well when in good order, and the disadvantages are that they are hardly ever in good order. In a sawmill or woodworking shop in particular, a door that is kept open many days, weeks, and even months becomes so packed around with sawdust, to say nothing of chips and thin strips of wood, that a pair of mules could scarcely close the door, much less will it glide into place with its own weight when the time for action comes.

The best way to close fire doors is to make it some one's duty to see that they are kept shut, especially at night. When the mill is vacant it should be some one's duty to close them at the first alarm of fire, and the same man should see that the doors are in good condition and will work at all times.

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* Message from the President of the United States, transmitting report on the boundary line between Alaska and British Columbia; 50th Congress, 2d session, Ex. Doc. No. 146, Senate, 1889. I. C. Russell.

* James L. Hobart, in the *Industrial American*.