ICE MAKING AND REFRIGERATION.—THE PICTET PROCESS.

The Pictet process beautifully illustrates how a liquid in the act of volatilization absorbs heat, so as to freeze bodies with which it is in contact, and which, upon condensation, gives out the heat it had just taken up.

The artificial production of low temperatures is based upon the property of all bodies, whether solid or liquid, to absorb or take up heat while in the act of expanding; and the more volatile the body, the greater its power of accumulating heat and retaining it in a latent condition in itself. What such a body gains in heat, surrounding bodies lose. For instance, anhydrous sulphurous oxide, escaping in the air from its liquid state, produces a fall of temperature of 135° Fahr. A given quantity of the liquid will instantly freeze several times its own bulk of boiling water. While the physical law has long been known, the problem until recently has been to select the liquid and invent the machinery for its practical utilization. The liquid must volatilize spontaneously when allowed to expand; the machine must control the expansion, and reutilize the liquid, and the disadvantages of different liquids must be offset against their advantages.

It is claimed that the Pictet ice machine, which employs sulphurous anhydride, has attained a higher degree of excellence than any yet invented, its prominence in the market securing for it a more worthy distinction than even the prizes won for it at international expositions. As to the liquid, there has been a variety of liquids used for this class of machines in general, having different merits. Ammonia has high power or range of condensation and expansion, and was the element first used for the production of cold. Briefly, it is held in solution in water, and by the application of heat is vaporized or released from the water and passes into gas, takes up the heat surrounding it, and is brought again into contact with water, and returned into the retort to be revolatilized. The disadvantage of this machine is the great pressure to which the containing vessel is necessarily subjected, being 240 to 300 pounds per square inch, while that in the Pictet machine is only 35 pounds per square inch at its highest pressure. To this danger must be added the fact that the liquid is highly corrosive and gradually destroys the vessel designed to resist the already severe strain. Another recognized disadvantage is the use of heat to volatilize instead of the more efficient and controllable mechanical means used in the Pictet machine, and which could not be applied to the former.

Another objection to the use of these ammonia absorption machines is their intricacy and the absolute necessity of constant and watchful attention, it being unsafe to leave the apparatus for even ten minutes at a time, whereas the Pictet machines require only such casual attention as suffices in the running of any ordinary steam engine.

It must be borne in mind that in the construction of all machines, and in the use of materials, the advantages and disadvantages are to be contrasted.

The energy of the anhydrous sulphurous oxide is released by the simple removal of pressure which is controlled by mechanical appliances. Its economy is wonderful; it is very remarkable that a machine of this make has been known to run for six months with the loss of only 6½ pounds of the oxide.

The construction of the machine and the method of its operation are very simple. The liquid to be volatilized is put in a copper cylinder free from moisture and air. At this time it has no cooling effect. Part of it is now released by the action of the pump. This relief of pressure allows the liquid to expand and volatilize spontaneously, and, as has been explained, this volatilization enables it to absorb the heat contained in bodies in contact with the refrigerator, and hold it latent in the condition of latent heat. After absorbing the heat previously from the surrounding body, it is forced by the action of the pump into a condenser, where it is cooled to the temperature of running water, that is to say, a temperate degree of heat, when it liquefies, and then flows into the refrigerator to be volatilized by the removal of pressure, to repeat the cooling process.

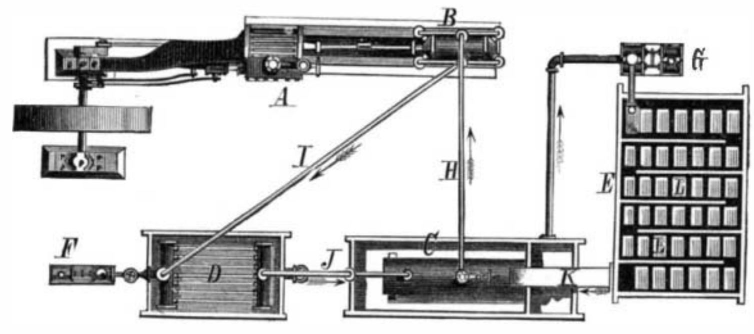

Fig. 4.—GENERAL PLAN OF ICE-MAKING MACHINE.

The accompanying cut, Fig. 4, serves to illustrate the principle and process.

A, horizontal engine; B, compression pump directly connected with the engine; C, refrigerator and tank; D, condenser and tank; E, freezing tank holding cans for ice blocks; F, pump for circulation of water; G, pump for circulation of brine; H, copper pipe for conducting gas to compression pump; I, copper pipe for conducting gas from compression pump to condenser; J, copper pipe connecting condenser and refrigerator; K, overflow from freezing tank to refrigerator tank; L, ice cans.

Refrigerator C is placed horizontally in the tank, through which an uncongealable liquid (chloride of magnesium) is circulated. The moulds or ice cans may either be placed in this refrigerator tank or in a separate tank as shown. The sulphurous oxide is volatilized in the refrigerator, C, by the pump, B, which draws the oxide from the refrigerator through the pipe, H, producing intense cold, which is communicated to the surrounding liquid, and the pump then forces the vapor through the pipe, I, into the condenser, D. The condenser is a series of copper tubes; a current of cold water is kept constantly flowing through the condenser tank and about the tubes, which abstracts the heat from the vapor and brings it back to a liquid form. The pipe, J, returns the liquid sulphurous oxide to the refrigerator to be revolatilized, while a stop-cock regulates the supply. The compression pump, B, used is double-acting, and of iron. The piston is of metal, without packing. Its action is very easy, owing to the lubricating nature of the oxide.

It will be readily seen that the water in the cans, L, is frozen into solid blocks of ice by the cold brine in the tank, which is several degrees below the freezing point, and that there are no chemicals or gases that can possibly affect the ice in color, taste, or smell. If the water is pure, the ice made from it will be equally pure, if not more so. The blocks of ice vary in size according to the different capacities of machines.

We present three illustrations of the machinery for practical application of the process. Fig. 1 is the manufacture of ice as a merchantable article. What nature affords precariously in the winter season is here systematically produced winter and summer in all climates. That which is produced in the tropics under a torrid sun is as real and as good ice as that which is produced by nature in the Alps. The illustration shows the cans or forms filled with pure water set in the uncongealable liquid in close proximity to the rapidly volatilizing anhydrous sulphurous oxide. The water in the cans gives up its heat to this powerful agent and congeals into ice. This cut is drawn from works at Louisville, Ky.

Another illustration (Fig. 2) is the "refrigerating" process. It is not here intended to freeze water, but only to cool the air of a room in which meat is preserved. And this can be brought to a sufficiently low temperature to freeze, if required. The pipes are suspended along the roof of the storeroom, and through them continuously flows a "brine" reduced to a temperature below 32° Fah. The chilled air, by reason of a well known law, descends, while the warm air rises to be cooled, and both establish circulation and ventilation. This method may be adapted to vessels for ocean transportation as well as for storehouses. The pipes overhead are covered with a beautiful crystallization of moisture in frost.

This cut represents the meat market in the establishment of Armour & Co., at the Union Stock Yards, Chicago, Ill. The firm mentioned say:

"We are *more than satisfied* with our Pictet refrigerating machines, and consider them *the best in the market.* We have two of the largest size in full operation.

"ARMOUR & Co."

The same process of refrigeration is applicable to breweries. The pipes are suspended from the ceiling in the vaults, and as shown in the illustration, Fig. 3, absorb the heat from the rooms and casks. Apart from the necessity of pure water in brewing, uniformity of temperature is of

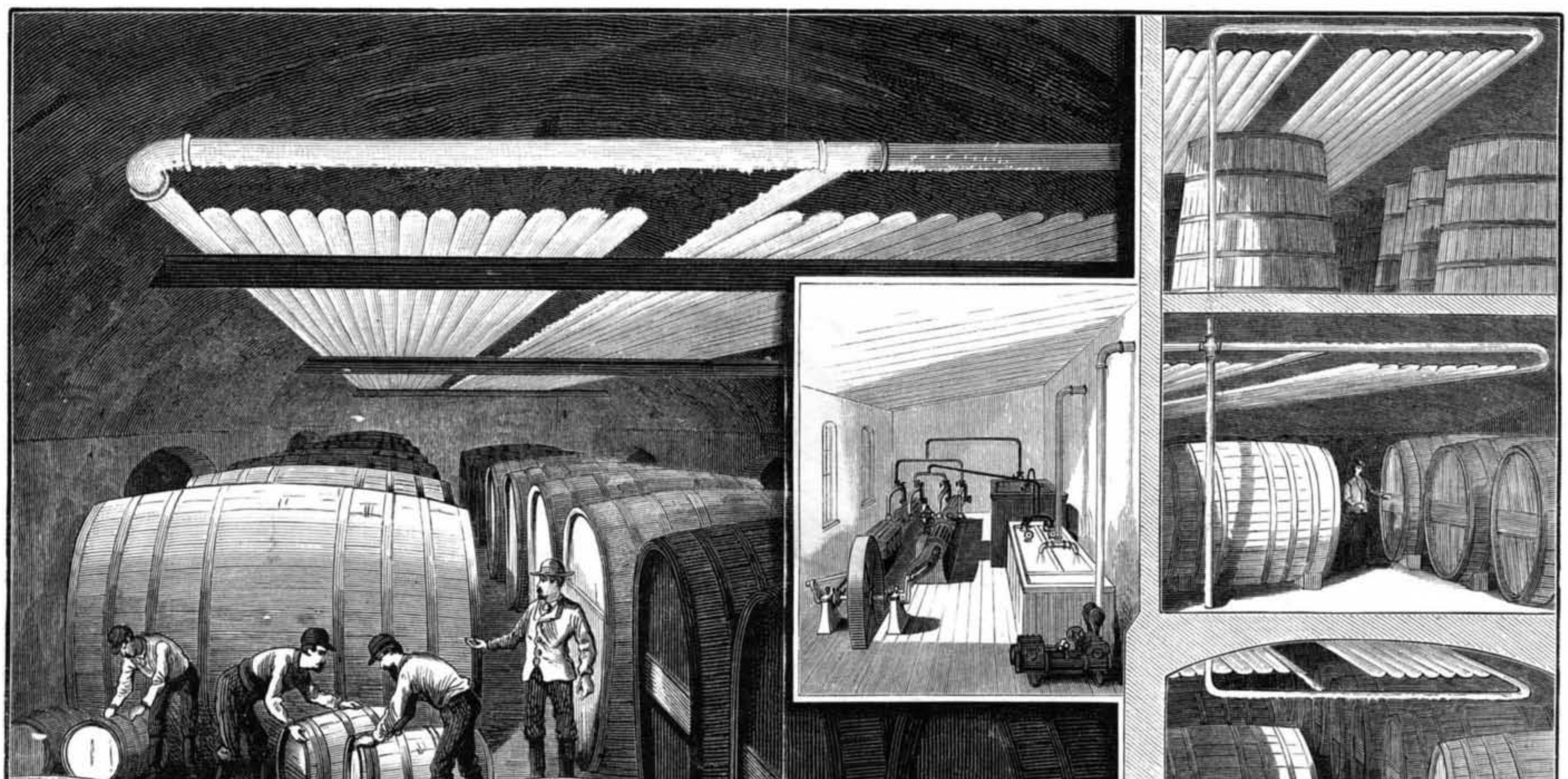

Fig. 3.—PICTET REFRIGERATION MACHINERY FOR COOLING BREWERIES.

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paramount importance, and that can be secured and controlled irrespective of climate or seasons. The process is used on a large scale by:

Armour & Co., Union Stock Yards. Chicago, Ill. (50 tons); New Orleans Refrigeration and Manufacturing Company; Rohe & Bro., New York; Roth, Meyer & Co., Cincinnati, O.; A. Merkle, Zanesville, O.; Charles Lang & Co., Covington, Ky.; Henderson Coal and Mining Company, Henderson, Ky.; J. O. Powlis, Louisville, Ky. (25 tons per diem); Brenham Ice Company, Brenham, Texas; Rio Grande Ice Company, Brownsville, Texas; C. H. Lawrence & Co., New Orleans, La.; Huse, Loomis & Co.. St. Louis, Mo.; Z. Wainwright & Co., Pittsburg, Pa.; Reymann Brewing Company, Wheeling, W. Va.; Russell H. Nevins, Lake Maitland, Fla.; S. H. Macrae, Granada, Nicaragua, C. A.; Rubsam & Horrmann, Staten Island, N. Y.; Peter Harley, Puenta Arenas, Costa Rica; L. Bon, Santiago, Cuba; and many others.

Anhydrous ammonia is also used, and vaporized and condensed by mechanical action of a pump upon the same principle as in the Pictet machine. But the resistance which ammonia offers to condensation is much greater than that by anhydrous sulphurous oxide, in round numbers about 600 per cent greater. For if we take a pump of say 11 inches in diameter, having a superficial area of 95 square inches, and multiply this by the Pictet pressure of 35 pounds per square inch, we have a resistance to be overcome at each stroke of the piston of 3,325 pounds, whereas if ammonia were used in this same sized cylinder with its pressure of 200 pounds the resistance would be 19,000 pounds to be overcome at each stroke of the piston. One great advantage in the use of anhydrous sulphurous oxide is that the machines using it can be built of any metal, as this gas has no effect upon any.

The Pictet machines, with the exception of the pump and engine, are built entirely of copper and are practically indestructible. Ammonia corrodes all metals, though it has less effect upon wrought iron than other metals. In a short time it will, owing to its high pressures, actually "honeycomb" cast iron plates an inch in thickness.

Furthermore, iron being used throughout, the entire apparatus, with the exception of the pump and engine, is exposed to water, the condenser to fresh water and the refrigerator to salt water, and so the more or less rapid oxidation finally destroys the machine.

Another serious trouble arises in the machines using anhydrous ammonia from the necessity of oiling the gas pumps. The oil combining with the ammonia forms a stiff soap, and this is carried into all parts of the apparatus, and soon chokes up the tubes of both refrigerator and condenser, necessitating the frequent stoppage of the machine for the purpose of taking it apart to cleanse the pipes.

This amounts almost to a rebuilding of the apparatus, takes a long time, and often becomes necessary during hot weather, causing a stoppage of the machine of several days' duration, when its work is most needed. Anhydrous sulphurous oxide being a lubricant in itself, the pump of the Pictet machine is never oiled, and consequently it never becomes necessary to cleanse the interior of the machine.

An ice making machine of 1½ tons capacity can be seen in operation at the warerooms of the Pictet Artificial Ice Company, Limited, 142 Greenwich street, New York. A personal examination of this machine gives a very good insight, not only into the Pictet system, but also into the process and *modus operandi* of the machinery, which is exceedingly simple, economical, and efficient. The company build ice making machines of different capacities varying from 1,200 pounds to 25 tons of ice in twenty-four hours; also air cooling machines especially constructed for cooling breweries, pork packing establishments, cold storage warehouses, hospitals, etc.

Further information may be had on application to the company whose address is given above, and whose advertisement may be found in another part of this paper.

THE new ship canal which is to connect the Baltic and the North Sea will save nearly 600 miles of the water journey now made around the Danish peninsula. The cut, as proposed, will be from Gluckstadt to Kiel, and the length will be about half that of the Suez Canal, or some fifty miles.

NOVEL ROAD VEHICLE.

The vehicle represented in the annexed engraving is a very novel and ingenious contrivance, as the reader will observe. Whether the invention is as useful as it is novel, is a matter of considerable doubt. It consists of a ring within which the seat of the rider is supported by a frame provided with three or more small grooved wheels resting against and running on the inner edge of the ring. The frame is provided with an axle carrying a balancing or staying wheel at each end, and with a mud guard and thills to which two hinged rings, provided with a saddle, are attached for hitching the horse to the thills. The vehicle is made entirely of iron, and is balanced by the side wheels and the thills. If the road is very narrow, the side wheels can be dispensed with. The vehicle is specially adapted for country roads and for the use of mail carriers, sportsmen, etc., it is claimed by the inventor, Mr. F. von Grubinski.—*Neueste Erfindungen und Erfahrungen.*

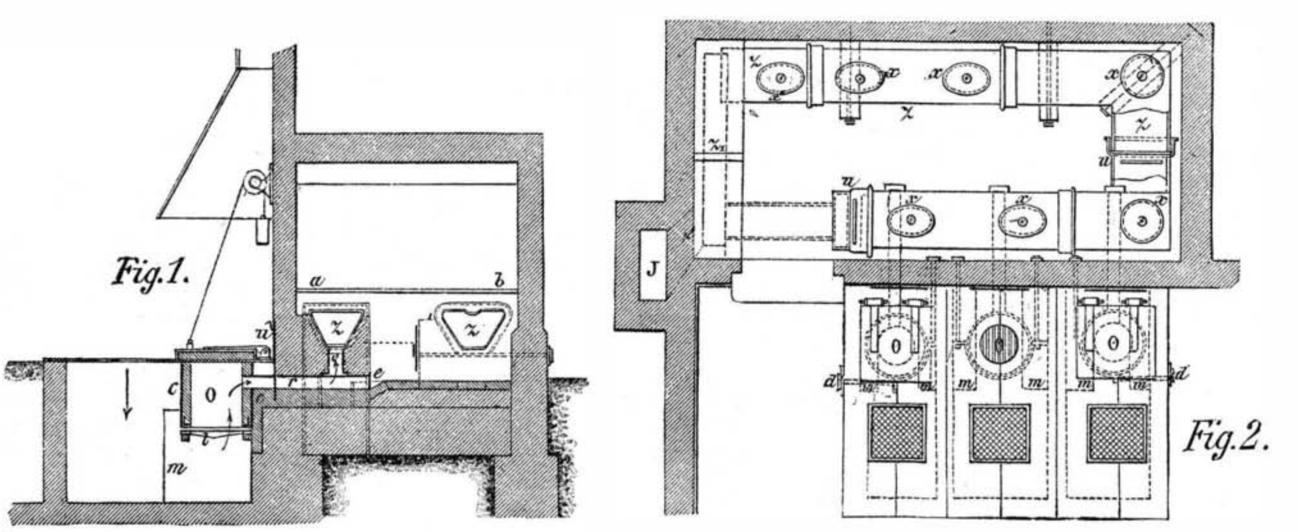
NOVEL ROAD VEHICLE.

OBERSTADT'S MELTING FURNACE WITH DRYING CHAMBER.

Generally, small furnaces in which metals are melted in the crucible are united closely to a chimney; and often there is added to the melting furnace a drying chamber for cores and small moulding frames, although it seems preferable to separate the drier from the furnace, since the long flat channels of these driers become easily choked up with ashes, and respond only imperfectly to the end in view.

The inconveniences attending the ordinary arrangement of these apparatus appear to be entirely got rid of in the furnace shown in Figs. 1 and 2, and described by Mr. Oberstadt in his work entitled "Die Technologie von Eisenbahnwerkstätten." Cast iron boxes constitute here heating flues which may be easily cleaned and freed from ashes, and which serve at the same time as tables for the frames to be dried.

The furnace consists of wrought iron cylinders, *c*, provided at their lower extremity with angle iron rings, upon which is arranged an inner lining of refractory bricks. The fireplaces rest on walls, *m*, which are also lined with firebricks, and are anchored by the rods, *d*, and carry the grates, *l*. Channels, *r*, with register at *e*, for convenience of cleaning, lead the gases due to combustion through small tubulures, *o*, into the horizontal iron smoke conduits, *z*, and from thence into the chimney, J. The upper wall of these conduits is arranged so that it may serve as a table for the cores and frames to be dried. The cleaning of the conduits, *z*, is effected through the apertures, *x*, which may be closed by covers. The extremity of these conduits are connected by a channel, z^1, which is covered by two cast iron plates, *a* and *b*, placed one alongside of the other, and which are likewise utilized as drying tables. Registers, *u*, permit of regulating the direction of the hot gases, and, consequently, the temperature of the drier.



MELTING FURNACE WITH DRYING CHAMBER.

Mother-of-Pearl.

This beautiful material, which is so much used in many kinds of artistic productions, is chiefly obtained from the pearl oysters (*Meleagrina margaritifera*) which are found in the Gulf of California, at Panama and Colagua, at Ceylon and Madagascar, at the Swan River in Manila, and at the Society Islands. The black lipped mussels from Manila bring the best prices. The Society Islands produce the silver lipped mussels, and Panama the so-called "Bullacks."

The peculiar and varied tints and colors exhibited by mother-of-pearl are due to the structure of the surface, which is covered with innumerable fine plates—often several thousand to the inch—which break up the rays of light falling on it, and reflect it in all different tints. The oyster pearl has a lamellar structure, and can actually be split off in scales, but they are very rarely divided in this way, as there is always danger of destroying it. In working mother-of-pearl, says Wieck's *Illustrated Art Journal*, the saw, file, and polishing stone play the principal parts. A mussel shell is selected that is covered with the peculiar pearly substance to such a thickness as is necessary for the work in hand.

The square or angular pieces are sawed out with a small saw, the piece being held in the hand or clamped in a vise. Buttons and similar round pieces are cut with a crown saw attached to a spindle. All the tools employed in working mother-of-pearl must be kept continually moist to prevent their sticking fast. The pieces are generally shaped on a polishing stone, the rim of which must be ribbed to avoid daubing and smearing. The stone, of course, must be kept wet while in use; a weak soapsuds works better than water alone. When the pieces have been brought to the proper shape on the stone, they are then polished with pumice and water. In many cases it is well to shape the piece of pumice so as to fit the form of the article to be polished, and then the latter can be fastened to a handle and rotated in a lathe. It is afterward polished with finely powdered pumice on a cork or wet rag, while the final polishing is done with English tripoli, moistened with dilute sulphuric acid. The acid brings out the structure of the pearl very beautifully. In many articles it is necessary to use emery before the tripoli is applied, and then employ oil instead of acid. Knife and razor handles have the holes bored in them after they are cut in the proper shape, and are then lightly riveted together, polished on the stone, and finished as before described.

In many workshops the polishing is performed on wheels covered with a wet cloth which holds the polishing material. For common work some pulverized chalk or Spanish white is substituted for the English tripoli.

Mother-of-pearl is frequently etched like copper. The design is put on with asphalt varnish, which protects the parts that are not to be etched, and the piece is then put in nitric acid. When the exposed portions have been sufficiently corroded by the acid, the article is rinsed with water, and the varnish dissolved off with turpentine or benzole.

Thin pieces of pearl which are to have the same shape are glued together, and all cut and bored at once like a single piece, and afterward separated by putting them in hot water.

In ordinary inlaid work of mother-of-pearl, scales or very thin pieces of pearl are fastened on iron or some foundation, usually made of papier mache, with Japanese varnish. The plate is first cleansed and dried, then coated with varnish; when the latter is nearly dry, cut pieces of mother-of-pearl are pressed into the varnish by the artist so as to adhere to it. The plate is then baked in an oven until the varnish hardens, when a second coating is put over the entire article, which is then polished again.

Besides the white and aurora-like mussels above mentioned, the sparkling green snail shells sometimes find use; these exhibit dark or light tints of green, yellow, or pink, or one shade passing into another.—*Deutsche Industrie Zeitung.*

MR. WAKE, engineer of the River Wear Commissioners, and Mr. Irish, manager of the Northern District Telephone Company, in England, have made some interesting experiments in the use of the telephone by divers. The length of the cable connecting the receiver in the diver's helmet with the transmitter above water was 600 yards. It was found that the diver could converse with ease, and ask for tools in any position in which his work might require him to place himself.

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