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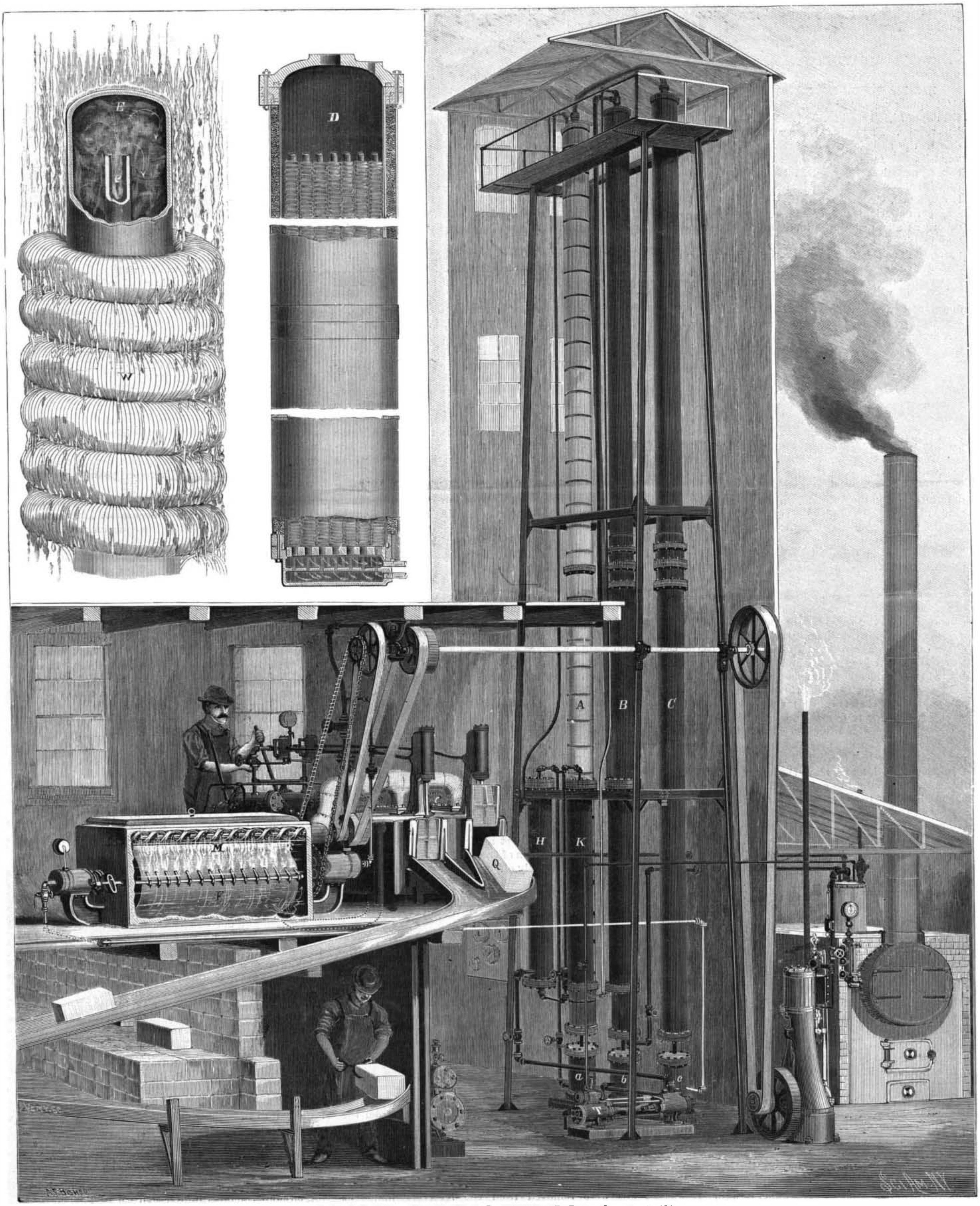

THE HOLDEN SYSTEM OF ICE MANUFACTURE.—[See page 151

ICE MANUFACTURE ON A NEW SYSTEM.

By the courtesy of Mr. D. L. Holden, who has been connected with the manufacture of artificial ice for over thirty years, and, by virtue of his early improvements, may justly be called the father of that industry in America, we were recently given an opportunity to inspect the remarkably interesting plant which is illustrated in the first page of this issue. Those of our readers who are acquainted with the systems commonly in use will see that, in introducing an entirely new method for making ice on a commercial scale, an important reduction has been made, both in the magnitude and first cost of the plant and in the cost of manufacture. Under the present methods, known as the "can" system, a plant capable of producing 100 tons of ice in twenty-four hours requires a house 100 feet by 150 feet square, and working under the best conditions the product costs from $1.65 to $1.85 per ton. A plant of equal capacity working on the new system will call for a house 25 feet by 50 feet, and the ice can be produced at 50 cents a ton, which is the actual cost per ton of operating the plant which forms the subject of this article.

The Ammonia System.—This is a combination of the compression and absorption systems, in which the inefficiencies and losses of both are reduced to a low point or removed altogether. It consists, in the plant in question, of three vertical pipes, 12 inches in diameter and 40 feet in height:—the still, *A*; the absorber, *B*; the condenser, *C*; two shorter pipes:—the interchanger, *H*; and the cooler, *K*, and the ammonia pump.

The still is a steam-jacketed wrought-iron pipe, 12 inches in diameter, whose interior is filled with about thirty-six 1-inch closed steam pipes, which are connected to the manifold at the base of the main pipe, and extend to within a few inches of the top (see Fig. D). Each steam pipe, *E*, is wound from top to bottom with a spiral coil of wire, *w*. The steam is introduced at the top of each 1-inch pipe by an internal ¼-inch pipe, *e*, which extends the full height of the pipe, as shown in the illustration. The Absorber is identical to the still in its construction, the pipes, *E*, being, however, in this case filled with circulating water in place of steam. The Condenser is also filled with a nest of vertical water pipes, but the encircling coils of wire are absent. At the bottom of *A*, *B*, and *C* are three short lengths of pipe, *a*, *b*, *c*, called Receivers, which serve to collect the liquid contents from the larger members above them. The Interchanger, *H*, and Cooler, *K*, are simply vertical 12-inch pipes containing coils through which the "weak liquor," or aqua ammonia of 16° to 18° B., circulates and is cooled.

We will now describe the continuous process by which the "strong liquor," or aqua ammonia of 32° B., is converted to pure anhydrous ammonia, ready for evaporation in the ice machine proper. The strong liquor is introduced at the top of the Still and allowed to drip over the wire coils and the pipes which they surround. Here it is broken up into myriad particles and the area of the liquid exposed to the heat is enormously increased. The wire coils, moreover, being in close contact with the steam pipes, are heated and serve to greatly increase the total heating surface. The ammonia gas separates freely from the liquor, as the latter trickles through the heated wire coils, and it passes off by a pipe from the top of the Still to the top of the Condenser, *C*. Here it is condensed upon the surface of vertical water pipes, similar to those in the Still, condensation taking place under its own pressure at the temperature of the cooling water. By this arrangement the distillation of the ammonia proceeds automatically and with great regularity; there is, moreover, a total absence of priming and practically no evaporation of the water; as is evident from the fact that the anhydrous ammonia which collects in the Receiver, *c*, below the Condenser is over 99 per cent pure. From this Receiver the liquid ammonia is conducted by a small pipe to the Freezing Cylinder, within which, as will be explained later, it serves by its evaporation to produce a layer of ice on the outer surface of the cylinder. The ammonia gas is then led out of the Cylinder through the opposite trunnion and conducted by a pipe to the top of the Absorber.

Returning now to the operation of the still, the hot, weak liquor, whose strength, as the result of the distillation, has been reduced to from 16° to 18° B., collects in the receiver, *a*. From this point it is forced under a pressure of 150 pounds to the square inch through a coil within the Interchanger, *H*, where it gives up its heat to the hot, strong liquor which is being pumped through the Interchanger on its way to the top of the Still. From the Interchanger the weak liquor passes through the Cooler, *K*, and thence to the top of the Absorber, *B*, where it meets the ammonia gas, which is being led direct to this point after having done its work in the Freezing Cylinder, *F*. The weak liquor is broken up on the wire coils, in the same way as the strong liquor in the still, and just as there these wires presented a large surface for distillation, so here they present an equally favorable condition for absorption, and by the time the liquor reaches the Receiver, *b*, it has absorbed the full amount of gas that it can hold under the pressure and temperature existing within the Absorber. The liquor, which now has a strength of 32° B., is then forced by the compression pump, *T*, through the Interchanger, *H*, where it absorbs the heat of the hot, weak liquor, which, as we have seen, is passing through the interchanger coil, and then it passes to the top of the Still to be again distilled and pass through the cycle of operations as above described.

From what has been said it will be seen that the troublesome back pressure, or accumulation of gas in the expansion or freezing cylinder, or in the expansion coils of other systems, is prevented, and it is possible to secure the proper fall of temperature due to a full expansion of the gas. On the occasion of our visit to the plant the back pressure, as registered at the pressure gage, was only 6 pounds per square inch.

The Manufacture of the Ice.—It is in the method of making the ice, however, that the greatest departure is made from existing methods as practiced in what is known as the "can" system. The ice machine, which in the plant under consideration has a capacity of 10 tons a day, consists of a tank of water 3½ feet in depth by 3½ feet in width and 7 feet long, within which rotates a hollow cylinder, *F*, which is journaled in the end walls of the tank by means of trunnions, upon which it rotates. The anhydrous ammonia is led into the cylinder through one of the trunnions in a sufficient quantity to keep the bottom of the cylinder filled to a depth of 2 or 3 inches. Since the cylinder is constantly rotating, the whole interior is kept constantly wet with a thin film of ammonia which rapidly evaporates; and as the boiling point of liquid ammonia is —32° F., it follows that there is a difference of 64° between the boiling ammonia and the water which is in immediate contact with the outside of the cylinder.

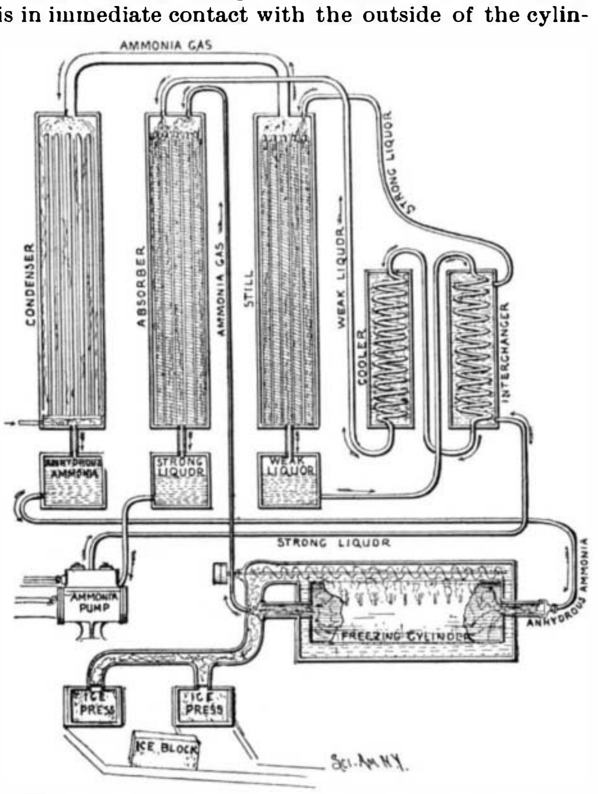

DIAGRAM OF THE AMMONIA AND ICE-MAKING PLANT.

Hence the water freezes to the cylinder with great rapidity, and would incrust it at the rate of a quarter of an inch per minute if provision were not made to remove it. As fast as it forms, however, it is cut away by means of a set of knives arranged on a shaft, which latter is oscillated by means of a yoke on the outside of the tank fed with a worm gear from the trunnions. The knives turn off the ice-crust as fast as it is formed, keeping it down to a thickness of about one sixty-fourth of an inch. The ice shavings or "spawls" rise to the surface of the water and collect within a hood which extends longitudinally across the top of the tank, where they are caught and carried out of the tank by the screw conveyor, *M*, and forced into a pipe which leads to the two hydraulic presses shown in the engraving. The ice scrapings or spawls carry with them a considerable amount of water, and the mixture has something of the appearance and consistency of ice slush. The pipe by which the spawls are carried off has a three-way valve, by means of which the constant stream of material may, as soon as one press is filled, be turned into the adjoining press. The sides of the presses are formed with channel ways and are lined with perforated brass, and under the working pressure of 325 pounds to the square inch the water and air are squeezed out through the perforations, and regelation sets in throughout the whole mass. The end door of the press is then opened, and there issues a block of compact ice which is absolutely free from air bubbles and is capable of cleavage in any desired direction. By the time a block has been compressed in one press the other press has been filled with spawls. The process of compression and regelation is, therefore, continuous, and in one and one-half hours from the time of starting, the plant is capable of turning out ice at the rate of 10 tons per day.

The advantages and economies of this system over the "can" system are many and obvious. In the first place the absorption of heat from the water takes place through the thin iron wall of the cylinder, whereas in the "can" system the absorption must take place not only through the sides of the can, but through the ever increasing wall of ice that forms within the can. The resistance of ice to the transfer of the heat of the water increases as the square of the thickness of the ice, and it is for this reason that the interior core of an ice block is so slow in freezing. In the cylinder process, on the other hand, the ice is never more than a sixty-fourth of an inch in thickness and the transfer of heat is immediate. Again, in the "can" system the ammonia is expanded in coils of pipe laid in a tank of circulating salt water, which contains the cans of water to be frozen. The whole contents of the tank must be reduced to freezing temperature before the contents of the can begin to freeze, and hence it is that it takes three days to set a "can" plant in motion, when one and a half hours suffices to start the smaller, simpler, and more direct system which we have described in this article.

We have already referred to the great economy in space effected by the combined system. This is well illustrated by the fact that while the freezing tank of a 10-ton plant under the present system has a capacity of only 85 cubic feet, a freezing tank of equal capacity under the "can" system would have a capacity of 1,800 cubic feet. It is this remarkable compactness that renders the combined system so valuable in cities, where, on the one hand, the high cost of land drives the ice plant to the outskirts, and on the other hand the question of meltage necessitates the plants being erected within a comparatively short hauling distance of the consumer. Another feature which will be welcomed by consumers of ice on a large scale, such as large hotels and packing establishments, is that the reasonable space required for the plant will enable them to become their own producers.

Firemen Killed by a Live Wire.

We have been favored by two correspondents with information and with Omaha papers containing an account of an extraordinary accident which recently occurred in that city.

On August 9, four firemen were killed and two painfully injured by an electric shock from a live wire while working at a fire. They were engaged in withdrawing an iron-bound ladder from a rear wall when the upper extension came in contact with one of the parallel wires in an alleyway. All the men had their hands on the cranks of the windlass and the current ran down the ladder, entered their bodies and threw them to the ground. The fire was extinguished and the ladder was being lowered when it came in contact with a bare spot in a number six wire that carried a 2,000 volt alternating current. The truck was so arranged that there were six cranks on winches to be used in lowering the water tower or ladder. One of our informants calls it a water tower and the other a ladder. When the ladder or tower struck the bare wire, the current followed the tower to the ground through the six men's bodies. Two of the men handling two of the wheels were pulled loose by bystanders, one of whom was knocked senseless. These two were very severely shocked, but four of the men were not loosened for several seconds, and when they were they fell writhing to the ground. One of them rose and walked two hundred feet, saying he felt all right, and then dropped dead. A heroic struggle was made to restore the men to life.

Accidents of this kind are most unfortunate and cannot, we suppose, always be avoided, but whenever possible, underground conduits will do away with much trouble of this kind.

Russian Caravan Tea.

A large part of the tea which comes from China into Europe is brought across the steppes of Siberia by caravans of sledges, which have for their destination one of the eastern towns of Russia. Although the caravans require at least a year to cross the vast extent of Siberia, this method of importation is the most economical, on account of the very heavy duty which is laid upon tea brought into any of the Russian sea ports. These caravans are usually made up of fifty to seventy sledges, and sometimes a caravan is seen which contains two or even three hundred. Each of the sledges carries on an average five bales of tea, packed in cow's skin and weighing from fifty to eighty kilogrammes each. The sleds are drawn by a single horse and are united in groups of five or six under one driver. Each sled carries in the rear a bundle of hay and a quantity of oats, which serves as a supply for the horse of the sled following. To provide for the first horse, the order of the sledges is changed from time to time. The caravans make halts of three or four hours in the villages, to give the drivers time to take care of the horses and to eat, but the drivers sleep only on the sledges, en route, in spite of the fact that the temperature in these regions falls as low as —60° C. The caravans finally reach the eastern part of Russia, from whence their cargoes are sent to Moscow, St. Petersburg, and other large centers of distribution.