THE ALLEN DENSE AIR ICE MACHINE.

The many advantages which the use of air presents in the working of ice machines have for a long time led inventors to seek a means of applying it without incurring the large losses which have heretofore accompanied its use. These losses were due primarily to the low specific heat of air compared with other cooling gases or vapors, and in consequence thereof the machinery required was large and wasteful of fuel, on account of the large volumes of air required to produce a given cooling effect. In the old form of machines the air was taken at ordinary pressure, compressed, cooled, and re-expanded to ordinary pressure, at which it circulated in the cooling pipes. It will be readily seen, however, that the greater the heat-absorbing power *per volume* of the cooling medium, the smaller will be the volume required to produce a certain amount of cooling effect, and consequently the smaller will be the machinery required to compress and circulate that volume. Since, however, the weight and consequent heat-absorbing capacity of a cubic foot of air at a tension of four atmospheres is four times that of a cubic foot at one atmosphere pressure, it follows that by circulating air at the former tension only one-fourth the volume will be required to do the same amount of cooling.

This latter fact is the basis of Mr. Leicester Allen's machine, for while heretofore air machines have circulated air at or near one atmosphere pressure, the former circulates air at a density of four atmospheres. This obviously gives the machine a great advantage over the older forms, and for the same work enables a machine to be used of only one-fourth the size of those in general use.

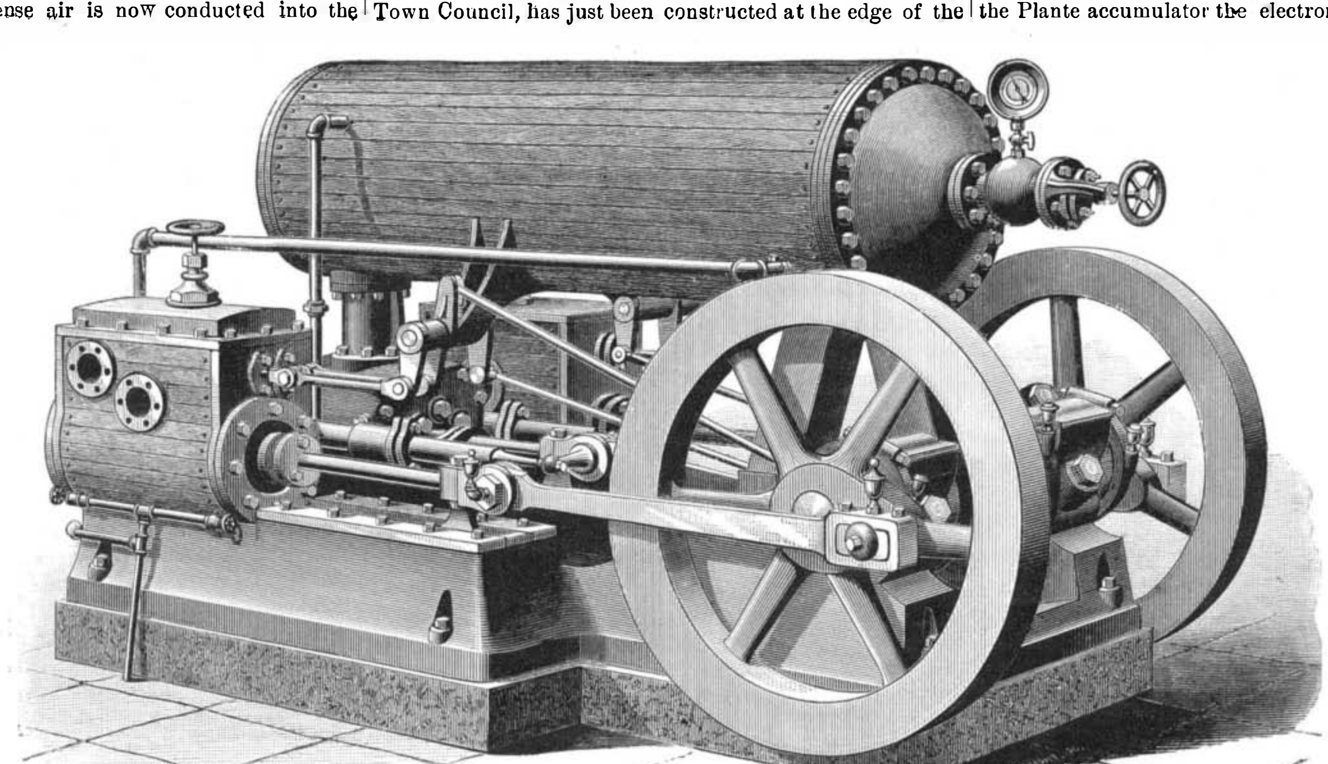
The accompanying illustration shows a perspective view of a four-ton machine. It will be seen to be mounted entirely on a single bed plate, thus greatly economizing space. On either side, at the rear, are situated cylinders, one being the steam cylinder, the other the expanding cylinder. Between these two the air compressor is placed, on both sides of which will be seen two small cylinders, the air and water pump, respectively. Above all these stands the large horizontal cylinder, through which water is circulated to cool the compressed air which passes through it in coils. The pistons of the compressor, pumps, and expander are directly connected with the crank shaft driven by the steam engine, as shown, thus giving them a positive motion.

The operation of the machine is as follows: We will assume that the pressure throughout the machine and cooling system is at ordinary atmospheric tension, and the steam engine started; immediately the small air pump at the side of the large compressor begins to force air into the system until a pressure of four atmospheres is reached, when a valve closes automatically and maintains the air in the system at that pressure. This dense air is now conducted into the compressor and compressed to 0·45 of its volume, or to a tension of twelve atmospheres. This heats it, and in order to lower its temperature it is led through coils into the large surface cooler, where the circulating water abstracts its heat and reduces the volume to one-third the initial volume. When cooled, the compressed air is led into the expanding cylinder, re-expanded to four atmospheres pressure, which lowers its temperature, and is then forced out into the circulating coils to cool surrounding objects. This process is a continuous one, and takes place in a closed cycle, no new air being admitted except to replace that lost by leakage, which amounts to an exceedingly small quantity. When it does occur, the valve of the air pump opens a trifle and admits just enough air to keep the pressure up to four atmospheres, when it again closes. By employing a closed cycle in operating the machine, several inconveniences and losses incident to air machines are avoided.

It is evident that while the power required to work a given weight of air between the limits of one and three atmospheres, as in the older systems, is the same as that required to work the same amount between four twelve atmospheres in the new machine, the *losses* avoided by using the latter are several. In the first place it allows of a reduction of the compressor and expander to one-fourth of their ordinary size. As a result, the surface losses within the cylinders, radiation, etc., are proportionally reduced; while the passive resistances, such as friction, are reduced very nearly in the same ratio. The machine, which we saw in operation requires no more care or attention than an ordinary etsam engine, and when once adjusted will run indefinitely without the necessity of watching.

During one hour of working the temperature of the air delivered at the exit pipe fell from 84° Fah. to —30° Fah., after passing through three-fourths of a mile of piping contained in an ice maker and cool room. It is claimed for the machine that it produces a cooling effect of somewhat over five pounds of ice melted per pound of coal consumed, which efficiency is more than double that of any other machine using air as a refrigerating medium, and the claim, though high, is well within the bounds of possibility.

One of these machines has been in practical use for over six months, and has required no repairs whatever, while two others will shortly be placed in the yachts of Mr. Wm. Astor and Mr. Elbridge T. Gerry. Further information can be obtained of the Allen Dense Air Ice Machine Co., Delamater Iron Works, West 13th Street, N. Y.

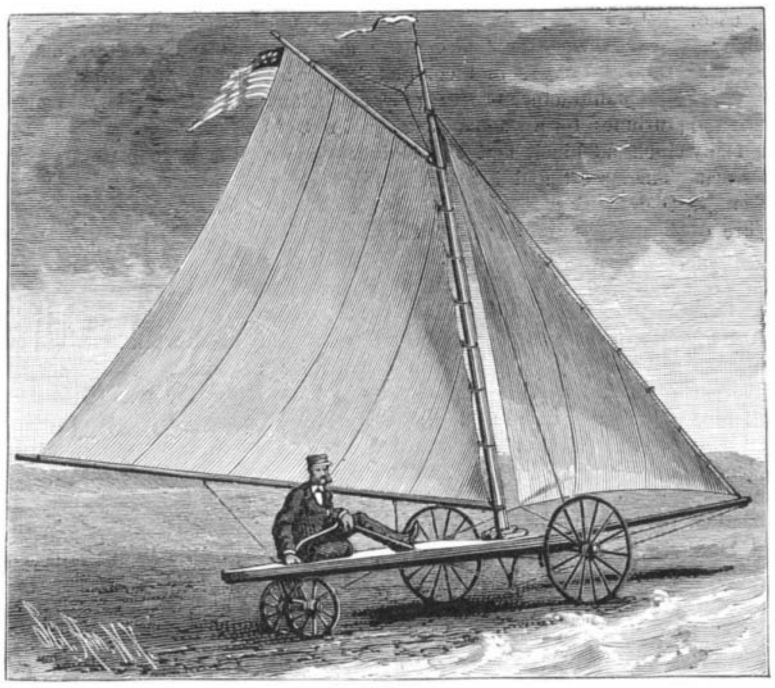


THE ALLEN DENSE AIR ICE MACHINE.

An Electric Railway at Brighton, England.

The first journeys were made April 7, on an electric railway about a mile long, which, with the sanction of the Town Council, has just been constructed at the edge of the beach, starting opposite the entrance to the Brighton Aquarium and running eastward. There is a single ornamental car, which will hold about a dozen persons, and the speed is limited to six or eight miles an hour, though a much higher rate can be attained. The scheme has met with a small but vigorous opposition, on the ground that it cuts off access to the beach and will not improve the residential character of the east end of the town. On the other hand, some of the most influential residents at that part have declared that it will be one of the greatest boons ever conferred on the district, as by means of a lift it will make access from the sea to the cliffs easy, and give pleasant communication with the center of the town. Approach to the beach is not stopped, as the line can be stepped across at any point. The car runs almost noiselessly, and is worked by a stationary engine, which sends a current along the metals.

SAIL WAGON.



ASPINWALL'S SAIL WAGON.

Across the wide forward end of the triangular frame extends an axle to which wheels are journaled. The short axle of the rear wheels is pivoted by a kingbolt to the narrow end of the frame. To the short axle is attached a gear wheel into which meshes a smaller wheel secured to the lower end of a vertical shaft journaled in bearings fastened to the frame. Upon the upper end of this shaft is a hand wheel or tiller, by means of which the wagon may be guided. The speed of the wagon is regulated by brakes upon the front wheels, connected with an upright lever pivoted in the middle part of the frame and provided at its upper end with a crosshead, so that it can be operated either with the hands or feet. A mast fastened to the middle forward part of the frame is provided with a sail and appliances for raising, lowering, and controlling the sail in the same manner as an ordinary sail boat.

With this construction the wagon can be driven at great speed by the wind, and can be driven with, on, or against the wind, where the beach or road is hard, with as much effect as can a sail boat on the water.

This invention has been patented by Mr. J. A. Aspinwall, of Bay Ridge, N. Y.

Accumulators.

M. Reynier, the well known electrician, has made experiments on three systems of secondary battery: (1) The Plante accumulator of reduced lead, peroxide of lead, and sulphuric acidulated water; (2) the copper accumulator of lead, copper, lead peroxide, acidulated solution of sulphate of copper; (3) the amalgamated zinc accumulator of zincked lead, lead peroxide, acidulated solution. His object was to test the electromotive forces of the combinations, and find their variations of sulphate of zinc. The accumulators were not completely formed. The electromotive forces were measured during charge and discharge by the method of equal deflection. His results confirm those formerly obtained by M. Gaston Plante, and are as follows:

(1) In the three systems of accumulators studied, the secondary electromotive force is notably more elevated during charge than during discharge. The ratio of the smallest of these values to the greatest may be called the *coefficient of fall*. It is a factor of loss which affects the efficiency of accumulators. (2) The fugitive superelevation of the electromotive force increases with the intensity of the charging current and the electromotive force of the source. (3) In the Plante accumulator the electromotive force is at least 1·95 volts during the charging, and at most 1·85 volts during the discharge. The coefficient of fall is therefore 0·95 under the most favorable conditions. (4) In the copper accumulator the electromotive force is at least 1·43 volts during charging, and at most 1·25 volts during discharge. The coefficient of fall is therefore 0·87 under the most favorable conditions. The copper accumulator is that which loses most. (5) In the amalgamated zinc accumulator the electromotive force is at least 2·4 volts during charging, and at most 2·36 volts during discharge. The coefficient of fall is 0 983 in the most favorable conditions. The amalgamated zinc accumulator is that which loses least. (6) In practice the losses due to variations of electromotive force will be greater than are indicated above, because the times of charging and discharging are generally more rapid than correspond to these experiments.

A FOREIGN contemporary says that a luminous waterproof paper, which may be of use in places not well adapted for the application of the so-called luminous paint, may be made from a mixture of 40 parts pulp, 10 parts phosphorescent powder, 1 part of gelatine, 1 part of potassium bichromate, and 10 parts of water.