["ENGINEERING SERIES."]

A RECORD

OF

THE TRANSPORTATION EXHIBITS

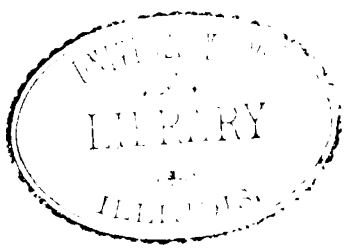
AT THE

WORLD'S COLUMBIAN EXPOSITION OF 1893.

BY

JAMES DREDGE.

Partly reprinted from "ENGINEERING."



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1894.

	dols.
Coal to produce steam for light	.87
Interest and depreciation at 10 per cent. per year on cost of train equipment	.87
Total	6.20
	cents.
Or, per car per day	88
,, ,, hour	6.3

The above estimate is figured on a seven-car train; if longer train were taken, the cost per car per hour would be correspondingly less. The allowance for attendance covers one-half the wages of two men, the other half being charged to care of baggage. This division is a fair one, as previously the same number of baggage men were run on these trains at the same wages. Two men are allowed per train on account of the length of run, which requires a double staff.

141.—THE EXHIBIT OF THE CINCINNATI, NEW ORLEANS, AND TEXAS PACIFIC RAILROAD.

Thirty-ton Fruit Car. (Plate CXV.)

The fruit car designed by Mr. J. Meehan, Superintendent of Motive Power, and illustrated on Plate CXV, is the standard type in use on the Cincinnati, New Orleans, and Texas Pacific Railroad. It is intended to carry a load of 60,000 lb., and measures 34 ft. in length by 8 ft. 6 in. wide, by 7 ft. ½ in. high, these being outside dimensions. The general system of framing is well shown in Figs. 1 to 3. The floor is supported on six beams, each measuring 5 in. by 8 in. These beams are trussed by iron rods, as shown in Figs. 1 and 3. Over these main beams comes a flooring course of 1¾-in. planking, and above this again a false floor, laid with open joints and raised 4 in. above the true floor. The side framing is carefully trussed, as shown in Fig. 1, and is covered with ⅞-in. planking on both outside and inside. The roof is also double, and its construction is shown in detail in Fig. 4. The car is provided with automatic couplers of the standard type. To successfully carry fruit good ventilation is essential, and to secure it, many steamships engaged in the fruit trade keep their hatches open. In the case of land transit, a practice of keeping open the doors might lead to a mysterious diminution in the quantity of fruit, and hence other means of ventilation have to be adopted. A reference to the figures will show this is done, mainly by openings protracted by louvre boards and gratings, details of which are given in Figs. 7 and 8. These openings are placed both at the top and bottom of the car, and at the ends there is also a flap, 4 ft. deep, which can be opened as indicated in Fig. 1, and thus insures a good draught through the vehicle. Roof ventilators are also fitted, as shown in Fig. 6. The planking shown in that figure over the centre of the roof forms a footboard intended for the use of the brakesmen.

142.—THE EXHIBIT OF THE EASTMAN CAR CO., BOSTON AND CHICAGO.

Automatic Heating and Ventilating Freight Car. (Plates CXVI and CXVII.)

Not only do many parts of the United States suffer from an extreme range of climate, varying from Arctic cold to tropical heat, but the country is so vast that a railway journey may begin in one extreme and end a few days later in the other. The passenger takes this as a matter of course; the human frame will bear very violent changes of temperature without much ill effect. But it is not the same with many varieties of food. Most perishable articles rapidly decay under excessive heat; and if they are to be transported for long distances in hot weather they must be artificially cooled. Hence there has arisen in America the refrigerator car, in which beef and fish can be carried for thousands of miles without suffering any injury. So perfect is the system that meat can be delivered in New York in better condition, if it be dressed in the Western plains, than if the beast be carried alive and slaughtered immediately at the journey's end. All this we in England can readily understand, although the necessity for refrigerator cars has not yet been sufficiently urgent here to lead to their introduction. But it will be news to many English readers that heated cars are provided in the States for certain products. Early fruits and vegetables grown in the warm climate of Florida cannot, as we have seen, bear exposure to the northern cold without injury. If they are packed in the ordinary way, and despatched by train, the chances are that they will be frozen and spoilt in transit, to the great detriment of their quality. To meet this difficulty, the Eastman Car Company, of Boston and Chicago, construct the automatic heating and ventilating freight cars, exhibited by them at the Columbian Exposition. As will be seen from Plates CXVI and CXVII, the heat is furnished by a stove (Fig. 2), fed with petroleum from a tank. This stove is below the level of the car floor (Fig. 4), and delivers its products of combustion into a stove pipe fitted between the frames, and finally rising above the car roof (Fig. 3), where it ends in a cowl. The stove pipe is inclosed within a second pipe, and the channel containing it is lined with asbestos and galvanised iron. The temperature is regulated by a thermostat comprising a Bourdon tube filled with kerosene oil. The whole car has double walls, separated by a space for hot air, and each wall is hollow, to prevent conduction of heat through it. At the end of the car there is a wide space for the distribution of the warm air. The car is carried on two four-wheel trucks, and has a capacity of 50,000 lb.

143.—Automatic Refrigerator Car. (Plate CXVIII.)

Another car shown by the Eastman Company is illustrated on Plate CXVIII and by Figs. 137 to 140 on page 449. Fig. 1 shows an elevation of the car, partly in section, giving the course of the air currents; Fig. 2 is a cross-section, and illustrates the great pains taken to isolate the contents of the car from accession of heat from the outside; Fig. 3 is a sectional plan of one corner; Fig. 4 is a section through a door in the roof by which the ice is introduced; Fig. 5 shows the junction of the roof and the side; Fig. 6 is a section through the door frame and sliding door.

The ice is introduced through the roof into the end compartments C, and gradually melting there, it absorbs the heat that leaks into the car. The water drips down, and flows on to the line through a trapped outlet. In the body of the car the air, as it becomes warmed, rises to the top, and the upper stratum overflows at B into the ice chamber. There it immediately parts with some of its heat, and begins to descend, drawing in more warmed air behind it. In falling it nearly attains to the

AUTOMATIC HEATING AND VENTILATING FREIGHT CAR.

EXHIBITED BY THE EASTMAN CAR COMPANY, BOSTON AND CHICAGO.

Fig. 1

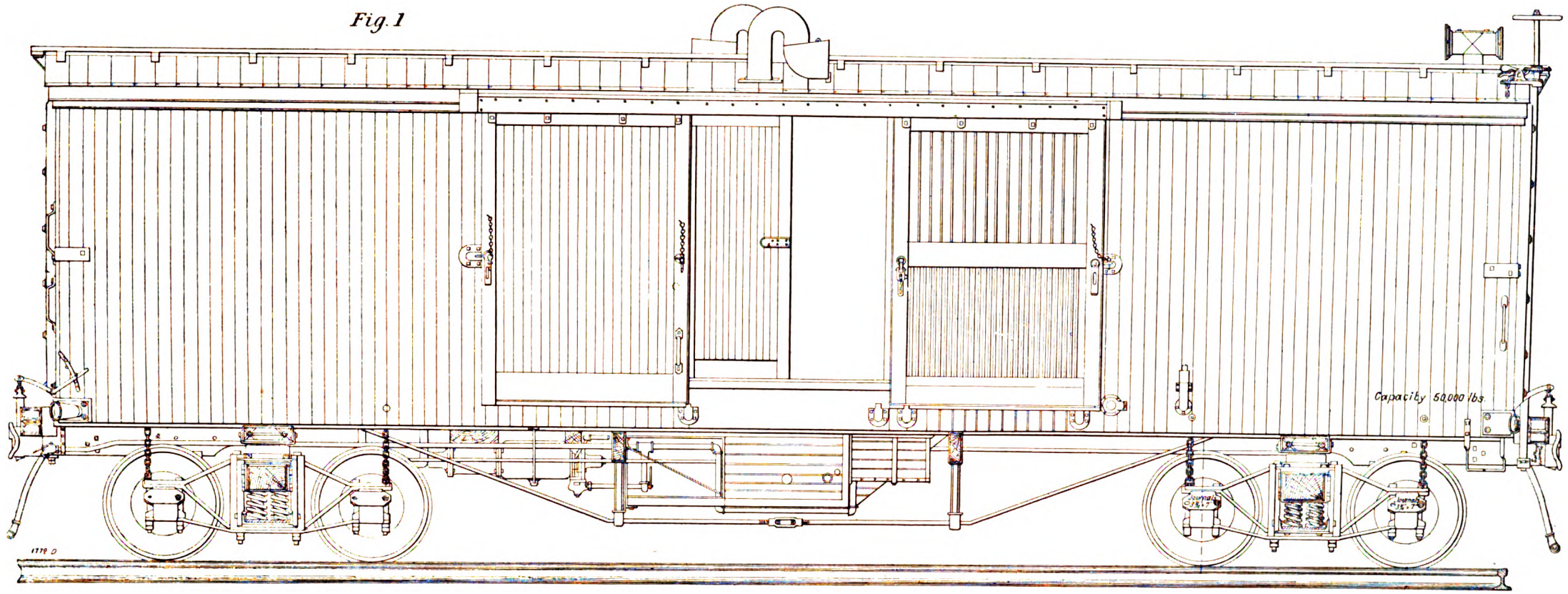
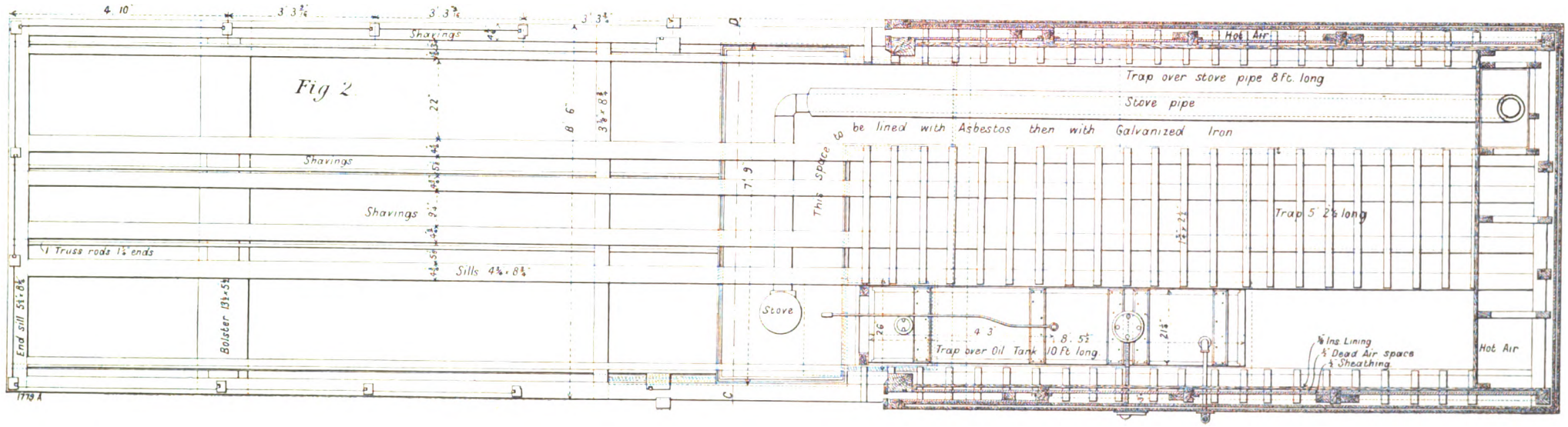


Fig 2



AUTOMATIC HEATING AND VENTILATING FREIGHT CAR.

EXHIBITED BY THE EASTMAN CAR COMPANY, BOSTON AND CHICAGO.

Fig. 3.

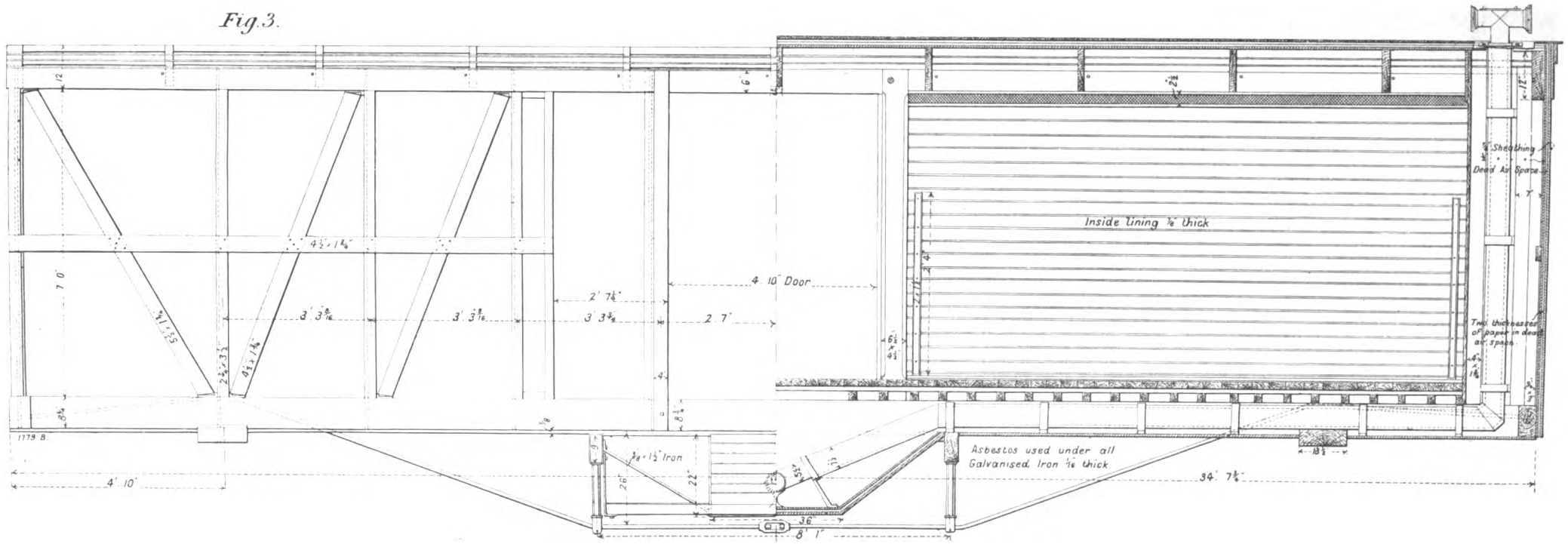
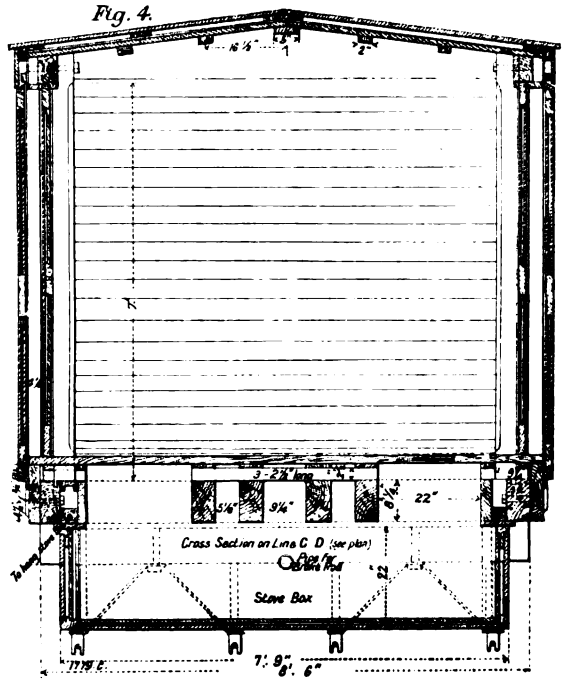


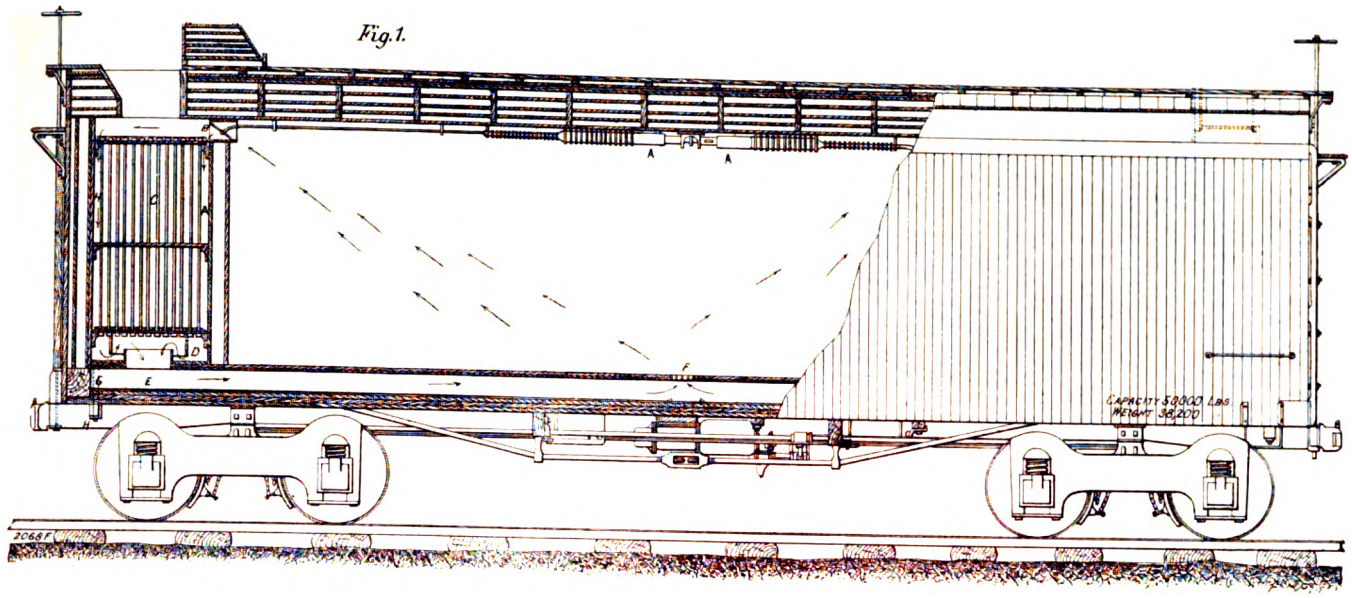
Fig. 4.



THE EASTMAN AUTOMATIC REFRIGERATOR CAR.

EXHIBITED BY THE EASTMAN CAR COMPANY, BOSTON AND CHICAGO.

Fig. 1.



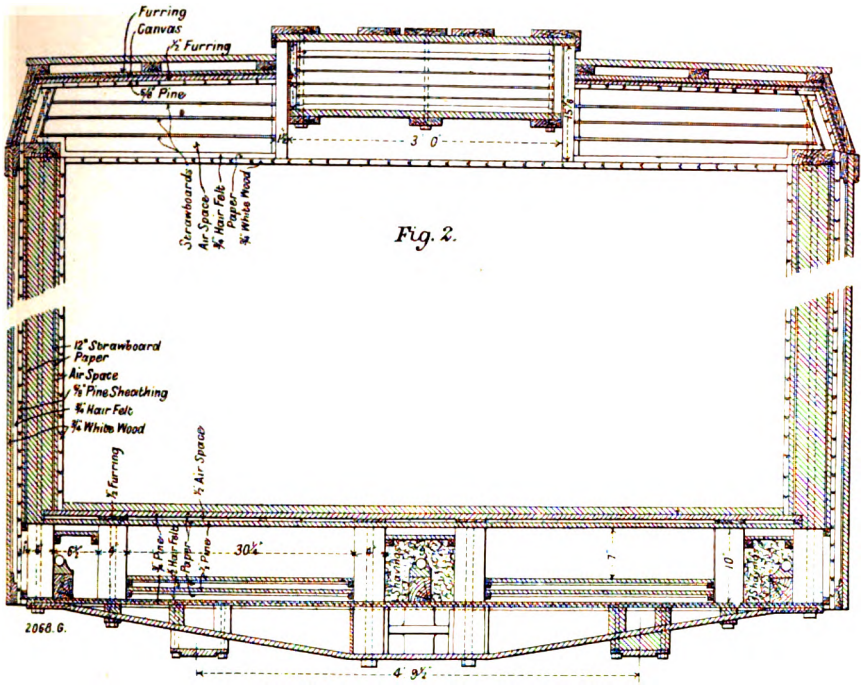


Fig. 2.

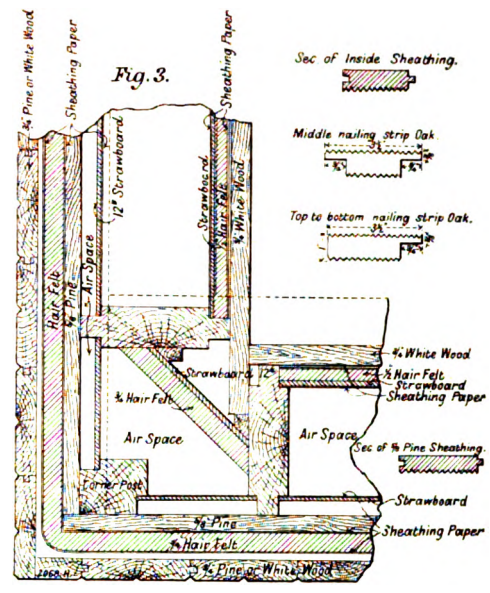


Fig. 3.

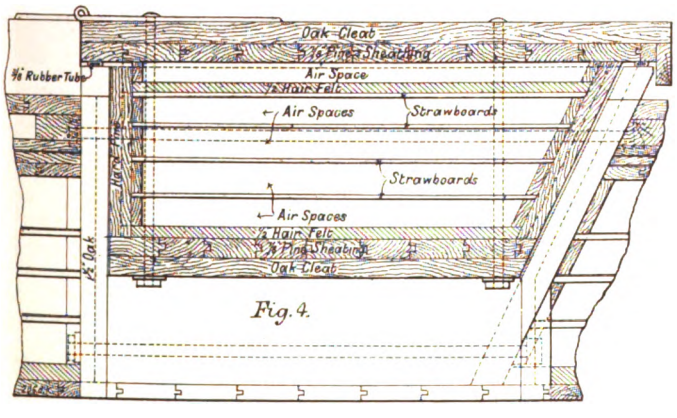


Fig. 4.

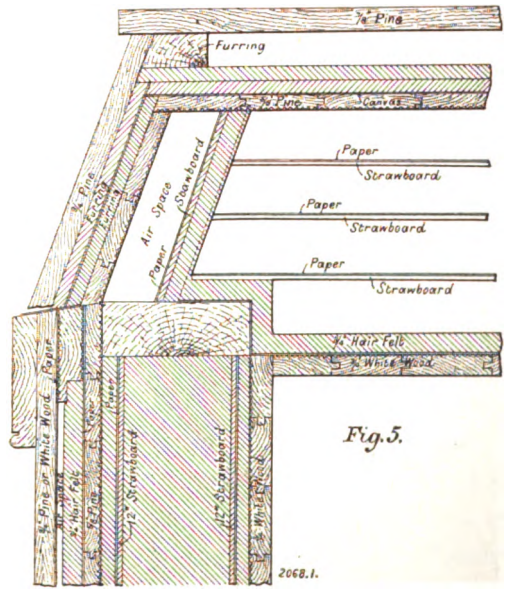


Fig. 5.

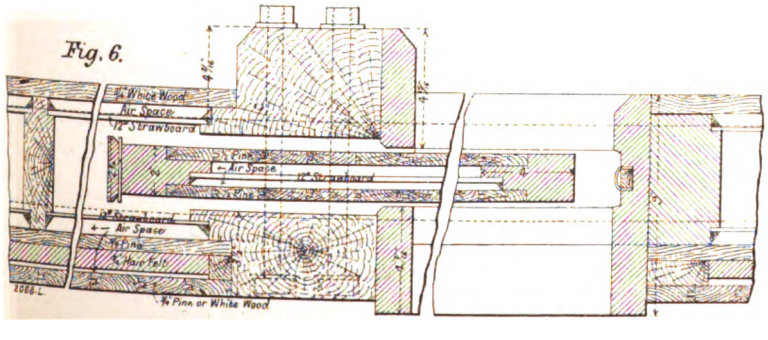
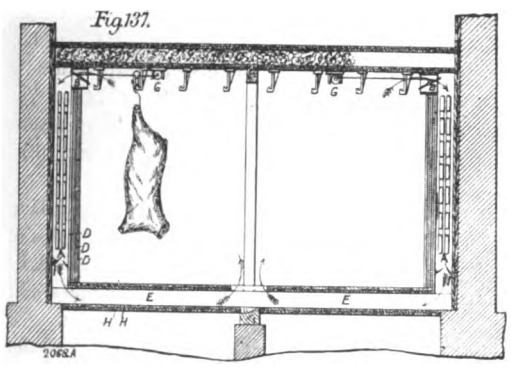
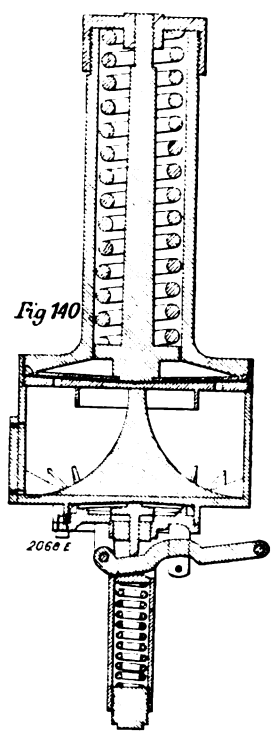


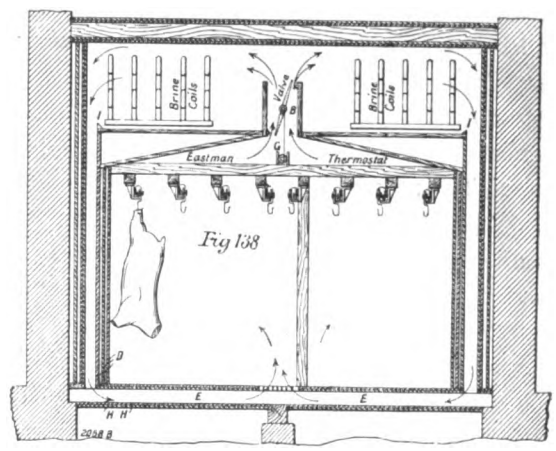
Fig. 6.

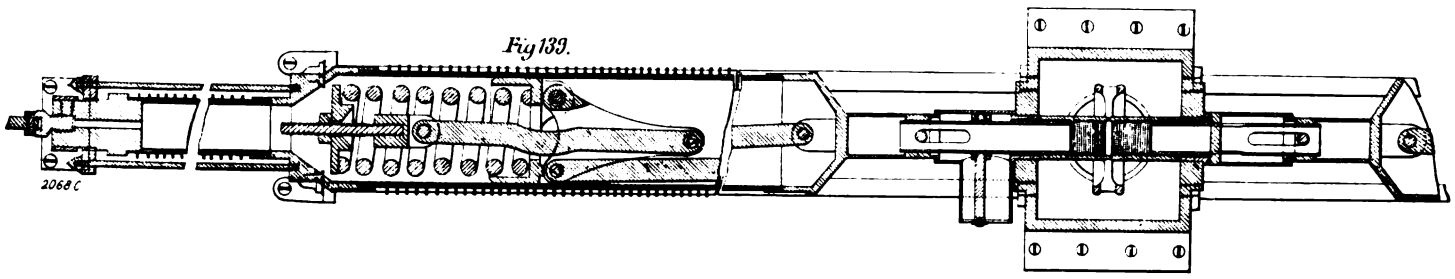
temperature of the ice, and in so doing it deposits all excess of moisture above that proper to zero temperature. From the ice chamber the air flows by the openings D and E into the main trunk formed below the bottom of the car, until it rises through the grid F. At this point it is at a lower temperature than anything in the car, and is therefore ready to absorb any moisture that may be given out by the cargo. The effect is that the contents are kept perfectly dry, and there is no deposit of slime on the walls or roof.

The Eastman cars make continuous trips from such points as Kansas City to Boston; Kansas City to New York City; Fort Worth, Texas, to New York City; Fort Worth, Texas, to Boston; Chicago to Boston; Chicago to New York City; Chicago to Baltimore; Sioux City to Amsterdam, N.Y.; and many others, of the difference in temperature. This surplus moisture, combining with the juices of the flesh, is the cause of the slime so objectionable to all meat buyers; and that which begins to take place as soon as the car is loaded, continues during the entire journey, because the temperature of the meat changes more slowly than the surrounding air. When at any time the air in the car becomes colder than the meat, evaporation more or less of condensed moisture occurs, making the meat alternately wet and dry. As these are the best conditions imaginable to defeat the very object in view, it becomes evident that moist air must be avoided to obtain the best results. It is, therefore, imperative that the air should enter at a temperature below that of the interior of the car, and that the moisture due to cooling should be deposited in a separate compartment.









THE EASTMAN SYSTEM OF REGULATING TEMPERATURE IN COLD STORES.

each trip being made in the ordinary schedule time. There is no re-icing during any of the trips, and block ice is used just as received, each block weighing from 100 lb. to 250 lb. As to the temperature of the cars, the company have tried almost every variation from 40 deg. to 46 deg., and obtained the best results when the bottom of the car was at 42 deg., and the top at about 45 deg. to 46 deg. In many cars the air is usually kept at about 35 deg. to 38 deg.; but with the dry air obtained by the Eastman condensation and expansion system, the absence of moisture is said to more than compensate for the higher temperature by the keeping qualities gained.

If meat from the chilling process at 35 deg. be put into a refrigerator car, in which the air is not dried as well as cooled, the first thing that happens, if the air in the car is in the least above 35 deg., is condensation of moisture on the meat, because

Figs. 137 and 138 show "Eastman" chill rooms for cooling and storing provisions before and after the railway journey.

A, A are the brine or the ammonia pipes, according to the system in use. I, I are drip receivers to catch water that may fall from the pipes when the frost is allowed to melt. These are provided that the cold air flues may be kept as dry as possible. E, E are cold air flues under the floor, made by boarding underneath the floor timbers, with a double course sheathing, H, H, using paper between to make the flues of air-tight and also to insulate them. D, D, D are three courses of sheathing, with a layer of paper between each, leaving two air spaces which give a partition that prevents back currents in the room, the insulation preventing deposition of moisture usual to those so made that they are colder than the room. B, B are valve boxes extending the entire length of the room, containing

valves of very thin and light wood balanced on ball bearings, so that a person could with a touch easily move the entire system. These valves are operated by an adjustable thermostat, which opens or closes to a greater or less extent the valves, according as the room tends to become too warm or too cold, thus increasing or decreasing the cold blasts to suit the requirements. To illustrate: Suppose it is desired to maintain in the room a temperature of, say, 35 deg. Fahr. The index is set with the pointer at 35 deg.; if hot meat is then put in the rooms, or if from any cause the tendency is for the rooms to rise in temperature above 35 deg., the valves will be automatically opened by the thermostat to an extent exactly corresponding to the speed and degree of the rise in temperature, thus increasing the cold blast; or, if the rooms begin to get too cold, the valves close correspondingly and partially diminish the circulation until they are finally adjusted, so that the draught just suffices to carry off the vapours and heat necessary to keep the rooms at the proper temperature.

It is evidently desirable that the rapidity of circulation of the air in the cars also should be adjusted to the needs of the trip. Under a blazing sun, it must be more active than in cloudy weather; and if the car be opened to take out a part of the freight at an intermediate station, there must be an increased circulation to withdraw the heat admitted through the open doors. To attain this regulation, there is employed a thermostat (Fig. 139), which opens and closes the valves at B (Fig. 138). This instrument is so sensitive that it responds to the slightest fluctuation of temperature, even far below the freezing point of water. The thermostat, once in place, requires no further attention. This instrument is a corrugated brass tube filled with kerosene oil, permanently and hermetically sealed. Oil is used because it will not freeze, and gives more volumetric expansion than any other available substance. There is obtained about $\frac{3}{8}$ in. lineal movement of the valve rod by a change of temperature of 8 deg., and as this is sufficient motion to entirely open or close the valves, it will be seen that the means of adjustment are ample. There is also a large expansion chamber provided, which takes up the additional expansion over and above that necessary to perform the work of operating the valves, so that if from any cause the car becomes warm, the thermostat will not become twisted out of shape or burst from internal pressure. In the centre of the thermostat there is a handwheel carrying a pointer over a thermometrically graduated scale, by means of which the thermostat can be set for any desired temperature to be maintained. Fig. 140 shows a modified arrangement.

The following report of a trip of an Eastman car, No. 997, from Chicago to Boston, will show the efficiency of the arrangements:—

TRIP OF EASTMAN AUTOMATIC REFRIGERATOR CAR, NO. 997, FROM CHICAGO TO BOSTON, LOADED WITH FRESH BEEF.

Car delivered at Armour and Co.'s shop, Union Stock Yards, Chicago, Ill., August 4th, 1891, to be iced; commenced icing at 11 o'clock A.M.; temperature inside of car at this time was 68 deg. at bottom and 70 deg. at top of car. Finished loading at 2 P.M., having put in 12,117 lb. of block ice and 1,000 lb. of crushed ice, the crushed ice being tamped in between the blocks, the entire quantity of ice put in being 13,117 lb. No salt was put in. When icing was finished the temperature in car had fallen to 54 deg. at bottom and 57 deg. at top. Ice tanks were locked with private locks, and at 9.30 A.M., August 5th, the car was placed at Armour and Co.'s beef house to be loaded; the inside temperature at this time was 42 deg. at the bottom and 44 deg. at the top of the car.

Twenty-five slaughtered cattle, weighing 20,156 lb., were put in, this beef coming from a cooling house, the temperature of the house being 35 deg. Finished loading at 10 A.M. Placed the indicator to maintain a temperature of 41 deg., and hung a thermometer 1 ft. from the floor of the car and one at 1 ft. below the meat rack; also placed a self-registering thermometer near the floor of the car. The doors of the car and also of the ice tanks were then locked with Yale locks, and the doors and ice tanks were also sealed by the Wabash Railroad car sealer, the number of the seals being 505.

The temperature of the car went up during loading, so, when ready to close the car, the inside temperature was 46 deg. at bottom and 48 deg. at top; the outside temperature at this time was 78 deg. in the shade and 90 deg. in the sun. The outside temperature at Chicago at noon the same day was 88 deg. in the shade and 110 deg. in the sun.

The car left Chicago at 7.20 P.M. billed *viâ* Canadian Pacific and Boston and Maine Railroad. At time of leaving, the outside temperature was 84 deg. August 6th, at noon, the outside temperature was 86 in the shade and 112 in the sun, and at 7 P.M. same day, 78.

Left Windsor, Ontario, at 5.30 A.M., August 7th, the car having been delayed 7 hours 45 minutes by another train on the line being off the rails. The outside temperature when leaving Windsor was 68; at 7 A.M., 77 in the shade and 86 in the sun; at 9 A.M., 83 and 95; at 11 A.M., 86 and 98; at 2 P.M., 94 and 110; at 4 P.M., 92 and 100. Arrived at Toronto at 7.30 P.M., outside temperature 89. Left Toronto at 8.30, temperature 88; at 10 P.M. temperature 78; at midnight 70. Arrived at Havelock at 3.30 A.M., August 8th; outside temperature 64. Left Havelock at 5.30 A.M., temperature 66; at 8 o'clock temperature 73, at 10 o'clock 84 in the shade and 100 in the sun, at noon 89 and 110, at 2 P.M. 92 and 115, at 4 P.M. 90 and 100. Arrived at St. Luc at 5.20 P.M.; left St. Luc at 5.45 P.M., outside temperature 86, at 8 P.M. 75. Arrived at Farnum at 9.15 P.M., and left at 10.30; temperature when leaving 62, at midnight 58; at 2 P.M., August 9th, 54, at 4 P.M. 50, at 6 A.M. 60. Arrived at Newport, Vt., at 7.15, left at 9.45; temperature 79 in the shade and 88 in the sun, at noon 78 and 80, and 2 P.M. 74 and 76. Arrived at White River Junction at 3.30 P.M., left at 5.30 P.M., temperature 76 and 80, at 8 P.M. 70, at 10 P.M. 70, at midnight 69, at 2 A.M., August 10th, 67, at 4, 66.

Car arrived in Boston at the Southern Division of the Boston and Maine Railroad at 9.10 A.M., August 10th, the outside temperature 85 in the shade. The Wabash seals were found intact, and the car was opened at 10.30 A.M. in the presence of Messrs. J. V. Fletcher and Sons, the consignees and representatives from the firms of Armour and Co. and Swift and Co.

The thermometer at the bottom of the car registered 41 deg., and the upper thermometer 43 deg.; the beef was in the best possible condition, and was so pronounced by all present. No meat odours whatever were noticeable, the floor of the car was absolutely dry, and the consignees stated that they never saw any beef come into Boston in finer condition. Upon examining the self-registering thermometer, it was found that the mercury dropped from 46 to 40 during the first ten hours after the car was loaded and sealed, and had not risen above 41 during the trip. The time between icing and opening the car was 5 days 20½ hours.

Upon examining the tanks a surprisingly small quantity of ice had apparently been consumed, estimated by those present at from 15 to 20 per cent. of the capacity of the tanks, or not exceeding 2,625 lb. There were no means at hand to weigh the ice, but it is absolutely safe to say that not over 3,000 lb. were consumed during the trip.

After taking out one load, as the weather was excessively warm and humid, Messrs. Fletcher and Sons concluded to let the remainder stay in the car until the following morning or later.

(Signed) N. L. NYE,
Superintendent of Tests.

Boston, August 10th, 1891.

144.—THE EXHIBIT OF THE ENSIGN MANUFACTURING CO., HUNTINGDON, WEST VA.

SLIDING-BOTTOM GONDOLA CAR. (PLATE CXIX.)

A special feature in this car (Plate CXIX) is the introduction of sliding doors, while at the same time all the elements of a plain gondola car are presented, for the transportation of lumber and other freight; the arrangement is specially intended to furnish a rapid means of discharging coal, ballast, or other materials through the bottom of the car, without in any way impairing its strength.

By this construction is accomplished the same result as is