(No Model.)

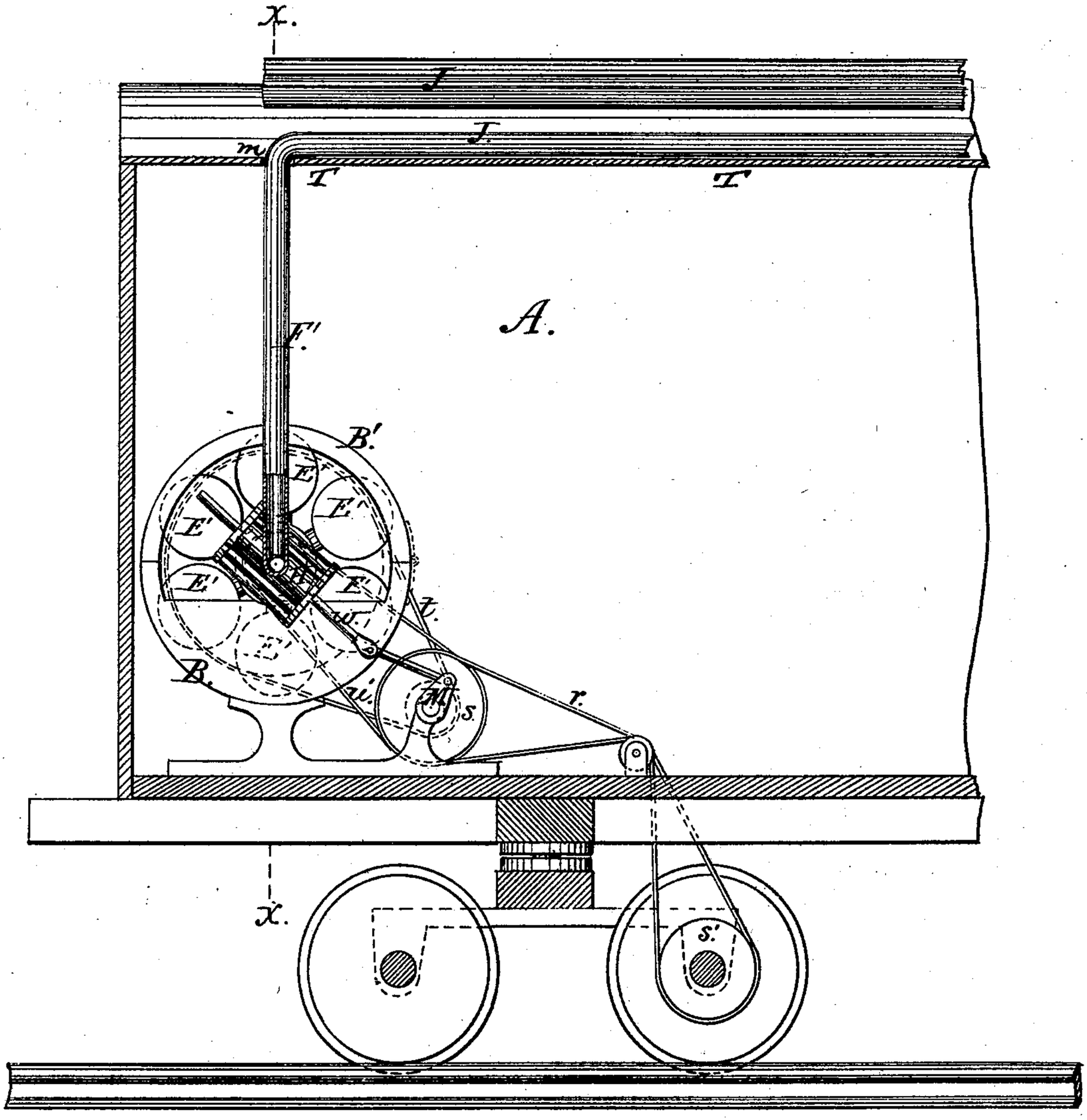
3 Sheets—Sheet 1.

C. W. COOPER.

Refrigerator Car.

No. 230,615. Patented Aug. 3, 1880.

Fig: 1.



Witnesses:
John C. Tunbridge.
Willy G. A. Schultz.

Inventor:
Chas. W. Cooper
by his attorney
A. V. Briesen.

(No Model.)

3 Sheets—Sheet 2.

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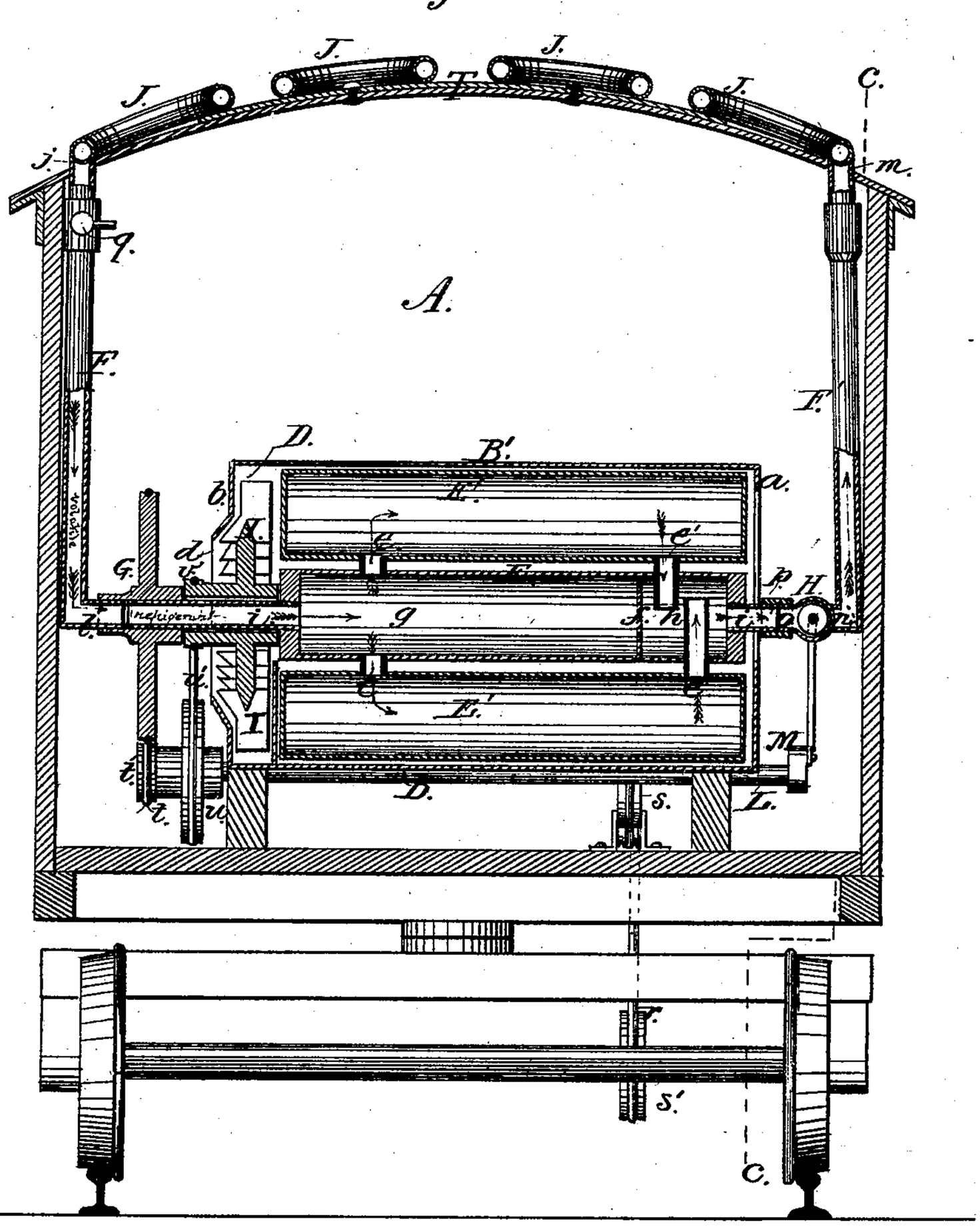
No. 230,615. Patented Aug. 3, 1880.

Fig: 2.



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(No Model.) 3 Sheets—Sheet 3.

C. W. COOPER.

Refrigerator Car.

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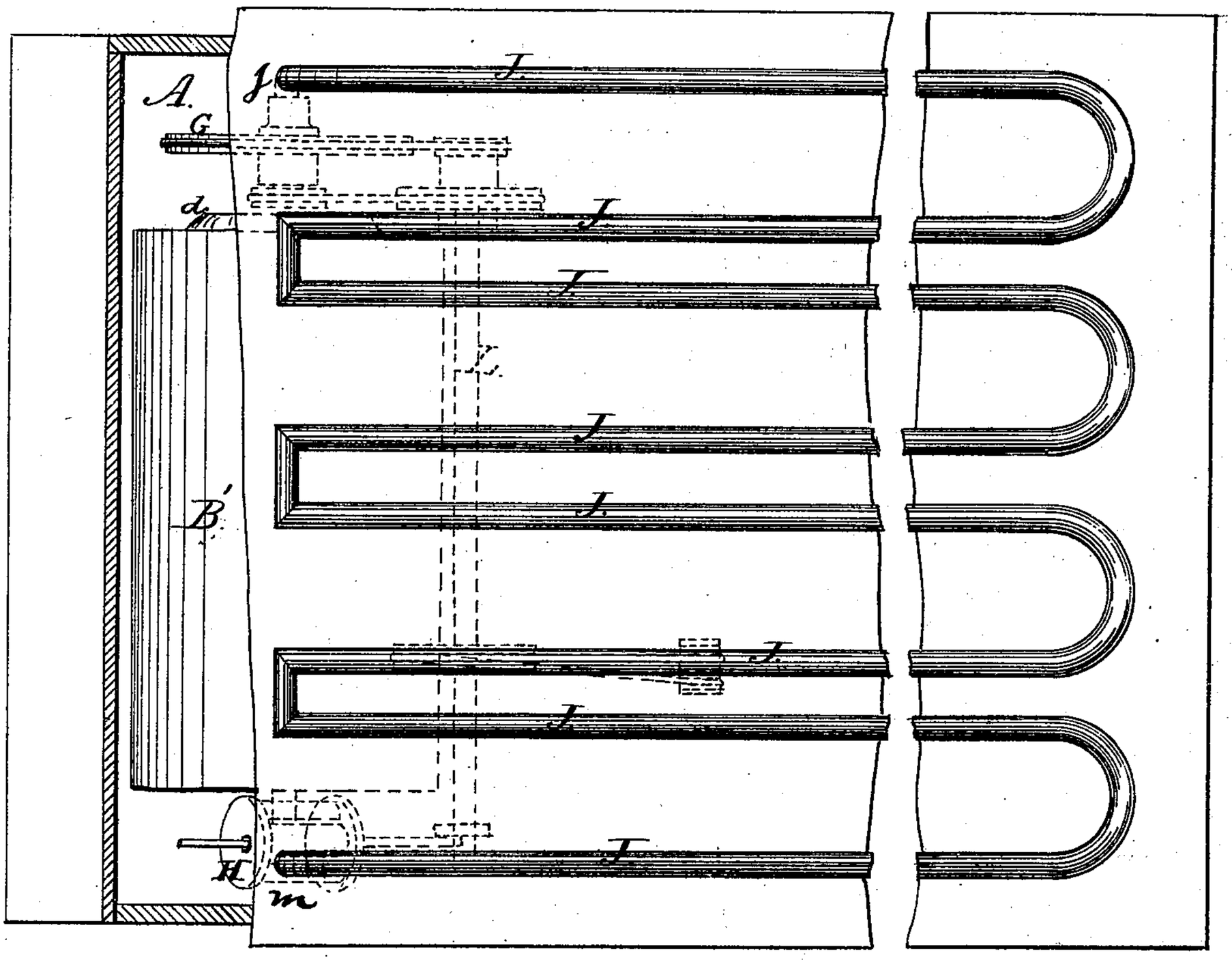
Fig: 3.



Witnesses:
John C. Tunbridge.
Willy G. A. Schultz.

Inventor:
Charles W. Cooper
by his attorney
A. v. Briesen

UNITED STATES PATENT OFFICE.

CHARLES W. COOPER, OF BROOKLYN, NEW YORK.

REFRIGERATOR-CAR.

SPECIFICATION forming part of Letters Patent No. 230,615, dated August 3, 1880.

Application filed March 13, 1880. (No model.)

To all whom it may concern:

Be it known that I, CHARLES WILLIAM COOPER, of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Refrigerator-Car, of which the following is a specification.

My invention relates to improvements in the construction and arrangement of refrigerating apparatus for railway-cars and other receptacles used in the transportation or retention of meat, vegetables, and other articles liable to damage by heat, by which apparatus the air of the car or receptacle can be kept cool during transit or otherwise without the use of ice.

For the purposes of my invention I avail myself of the principle used in many processes in the manufacture of artificial ice and for cooling stationary chambers, rooms, &c., viz., the alternate evaporation and condensation of some extremely volatile liquid. In these processes the liquid in evaporating becomes intensely cold, and in doing so it absorbs the heat from the surrounding air, and on being recondensed it parts with said heat, which is absorbed by a surrounding cooling medium, after which said liquid is again evaporated, and a further absorption of heat ensues, and so on continuously.

The object of my invention is to arrange an apparatus operating on the principle I have just stated, so that the evaporation of the liquid will take place within the refrigerating-chamber of the car, and the heat from the said chamber will be absorbed and the atmosphere of the said chamber thereby maintained at a low temperature, and the condensation of the liquid and the dispersion of the heat will take place outside of the refrigerating-chamber.

My invention consists, essentially, of a system of pipes arranged within the refrigerating-chamber, which pipes are connected with a system of pipes outside of said chamber by inlet and outlet pipes so arranged that the liquid in the inside pipes is in condensed form forced into the outside pipes, where it is cooled, and in the inlet-pipe is a contracted point or valve, which permits but a limited part of the liquid from the outside pipe to pass to the inside pipes, so that the two systems of pipes are divided at one side by the contracted space or valve and at the other side by a pump for condensing the liquid. A partial vacuum is maintained in the inside system of pipes, in which partial vacuum the evaporation of the liquid takes place.

The invention also consists of details of construction and arrangement, which will be fully and specifically described further on.

In the accompanying drawings, Figure 1 represents a sectional side elevation of a car provided with an inside and outside system of pipes to form a refrigerating apparatus operating on the principle of my invention, the line *c c*, Fig. 2, indicating the plane of section. Fig. 2 is a vertical cross-section of the car and apparatus, taken on line *x x*, Fig. 1. Fig. 3 is a partly sectional plan of the top of the car, showing the arrangement of the outside system of pipes.

Referring to the drawings, A represents a railway-car for the transportation and preservation of perishable articles.

Inside of the car, near one end, is placed transversely a semi-cylindrical tank, B, with partly closed ends to adapt it to hold a liquid. The cylinder of which the tank forms a part is completed by a semi-cylindrical cover, B′, which, when closed, forms with the tank B a cylindrical chamber, D, with a little more than the upper half of one end, *a*, open, while the opposite end, *b*, is provided with a central circular opening, *d*, as shown clearly in Fig. 2.

E represents a central drum, around which are arranged a number of other drums, E′, each of which is connected with the central drum, E, by two short tubes, *e e′*, near the ends, the tubes *e′* being longer than the tubes *e* to prevent a return flow. Between the two sets of connecting-tubes *e e′* the central drum is provided with a vertical partition or diaphragm, *f*, which divides the said drum into two chambers, *g h*, the former one being the inlet-chamber and the latter the outlet-chamber. The system of drums E′ E′ is placed within the cylindrical chamber D, where it is supported by the pipes *e e′*, or suitable braces on the central drum, E, so as to revolve freely together with the drum E.

In each head of the central drum, E, is placed axially a tube or pipe, *i*, which projects outside of the corresponding end of the said chamber D. On one side of the car (inside) is fixed

vertically a pipe or tube, F, the upper end, *j*, whereof projects through the car-roof, while the lower end is provided with a right-angular elbow, *l*, which aligns with the tube *i* projecting from the adjacent end of the drum. The end of the said tube *i* and the elbow *l* are made to communicate with each other through the hub or eye of a pulley-wheel, G, which wheel is fixed to the tube *i*, but turns freely in or on the end of the elbow *l*.

On the opposite side of the car is a vertical pipe or tube, F′, and having its upper end, *m*, carried through the roof of the car, and its lower end provided with an elbow, *n*, aligned with the pipe *i* projecting from the end or head of the drum E on this side.

The elbow *n* is entered into the side of a pump-barrel, H, so as to communicate with the interior of the said barrel, and from the opposite side of the pump-barrel a tube, *o*, projects, which is provided with a thimble, *p*, into which is entered the end of the pipe *i*, which is thus furnished with a bearing on this side.

The two pipes *i i* are thus both furnished with bearings, on which they are permitted to rotate freely, and with them the system of drums E E′ in the chamber D. At the same time communication from the pipe F to the interior of the drum E and drums E′, and from the chamber *h* of the drum E through the pump-barrel, and to the tube or pipe F′, is uninterrupted. The tube or pipe F forms the inlet-pipe for the drums E E′, and the pipe F′ is the outlet-pipe from the same.

On the inlet side a blower, I, is hung loose on the pipe *i*, within the casing of the chamber D, the purpose of which is to blow a current or currents of air through the chamber D, around the drums E E′, and out at the opposite end of chamber D.

On top of the car, outside, are a series of circulating-pipes, J, communicating with each other, and connecting on one side with the projecting end *m* of the outlet-pipe F′, and on the opposite side with the projecting end *j* of the inlet-pipe F, as shown in Figs. 2 and 3.

The inlet-pipe F is provided with a valve, *q*, to regulate the flow of liquid from the outside pipes J through the inlet-pipe F the purpose of which is to reduce the quantity of liquid flowing through the inlet-pipe F below the quantity which the capacity of the pipes J would otherwise supply to the said pipe F. This valve may be regulated by hand; but, instead of the valve, the pipe may be contracted at one part of its length to produce the same effect.

L is a shaft supported in suitable bearings, and rotated by a belt, *r*, or other connection with a wheel, *s′*, on one of the car-axles, so that when the car is in motion the said shaft L will be revolved, and will, in turn, rotate, through a belt, *t*, running over the pulleys *t′* and G, the system of drums E E′, and through the pulley *u*, belt *u′*, and pulley *v* on the hub of the blower I, rotating the said blower independently of the pipe *i*, on which the hub of said blower is loosely placed.

On the end of the shaft L is a crank, M, which is connected by means of a pitman with the piston-rod *w* of the pump H, for the purpose of operating the piston of the pump.

The operation of the improvement is as follows: The volatile cooling-liquid is placed in the circulating-pipes J, where, by means of the currents of air blowing over the said exposed pipes, the said currents being principally produced by the forward motion of the car, the liquid in the said pipes is made comparatively cool by the dispersion or radiation of the excess of heat which it contains. When the car is in motion the pump is worked and the system of drums E E′ is revolved in the chamber D, and the blower I is operated. Through the contracted portion of the inlet-pipe F, at the valve *q*, the liquid passes into the inlet-pipe, and thence through the pipe *i* into the drum E, where there is a partial vacuum produced by the action of the pump. In the partial vacuum the volatile liquid immediately vaporizes, and a certain proportion of the heat in the car is absorbed, whereby the atmosphere of the car is cooled. The blower I draws the air of the chamber through the opening *d* and drives it through the chamber D around the drums E E′, and expels it from the open end *a*, and thus the air around the drums is constantly changed and cooled. The vapor from the chamber *g* of the central drum, E, passes through the short tubes *e* into the surrounding drums E′, (the partition *f* prevents it from passing directly to the chamber *h*,) and the vapor is drawn by the action of the pump from the drums E′, through tubes *e′*, into the chamber *h*, and thence through the other pipe *i* into the pump-barrel, from which it is expelled by the action of the pump through the outlet-pipe F′ into the circulating-pipes J, the pumps serving also to condense the liquid, which, by the cooling action of the circulating outside air, parts with its excess of heat. Thence it passes over to the inlet-pipe F, as before described. The action of the pump is to maintain a partial vacuum in the drums E E′, and to condense the liquid in the pipe F′ and pipes J, also to keep up the proper circulation of said liquid, in the manner described.

In case the system of outside condensing-pipes and inside vaporizing pipes or drums be applied to a building or other stationary object for refrigerating purposes, artificially-produced currents of air produced by blowers or other such means must be employed to cool the liquid in the circulating-pipes J, and power must be supplied from an engine or other apparatus to operate the blower I and system of drums E E′ and the pumps.

To prevent ice from incrusting the exposed outside surfaces of the drums E E′, the tank B may be supplied with a liquid that freezes at a very low temperature, (glycerine for exam-

ple,) into which the drums E E′ will dip as they revolve and become lined with the said liquid.

The roof T of the car serves as a partition between the two sets of pipes, the one containing the condensed liquid from which the heat is to be removed by the action of the air-currents, while the other contains the expanded liquid which is to absorb the heat from the receptacle to be cooled.

As far as this branch of the invention is concerned, the interior pipes may be ordinary pipes placed under said roof T: but I prefer to use the drums E E′ dipping into the projecting liquid in the tank B, to prevent the injurious accumulation of ice on the outer side of said inner system of pipes.

I do not claim surrounding pipes which contain a cooling medium entirely with a liquid which is intended to prevent ice from forming on said pipes.

I claim—

1. The cooling-chamber A, containing the pipes F F′ and the connecting-pipes or drums, in combination with pipes J outside of said chamber, and with the pump H, all the parts being arranged within the chamber to be cooled except the pipes J, substantially as herein shown and described.

2. In combination with the wall T of a chamber, the drums or passages E E′, the inlet-pipe F, provided with the valve or contraction *q*, the outlet-pipe F′, and pump H, all on one side of said wall, and the outside circulating-pipes, J, on the opposite side of said wall, substantially as described.

3. In combination with the revolving drums E E′, the open-ended tank B and blower I, substantially as described.

4. The central drum, E, provided with the partition *f* and pipes *i i*, which connect on one side with the pump-barrel H and on the opposite side with the inlet-pipe F, in combination with the outside drums, E′, with which the drum E is connected by the tubes or pipes *e e′*, leading respectively from chamber *g* and into chamber *h*, substantially as described.

5. The combination of the system of drums E E′, connected with the pulley G, the blower I, provided with the pulley *v*, the pump H, and shaft L, having pulleys and crank M, with the car-axle and suitable connecting belts or devices, for the purpose of communicating motion from one of the car-axles to the drums, blower, and pump, substantially as described.

6. In a refrigerating apparatus, the roof or partition T of an inclosed chamber, which partition is interposed between the system of pipes that contain the heat-absorbing medium inclosed in one chamber and the system of pipes that contain the heat-discharging medium, the two systems of pipes communicating with each other, substantially as specified.

CHAS. W. COOPER.

Witnesses:
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