2 Sheets—Sheet 1.

R. BURROWS.

Refrigerator Cars.

No. 196,967. **Patented Nov. 13, 1877.**

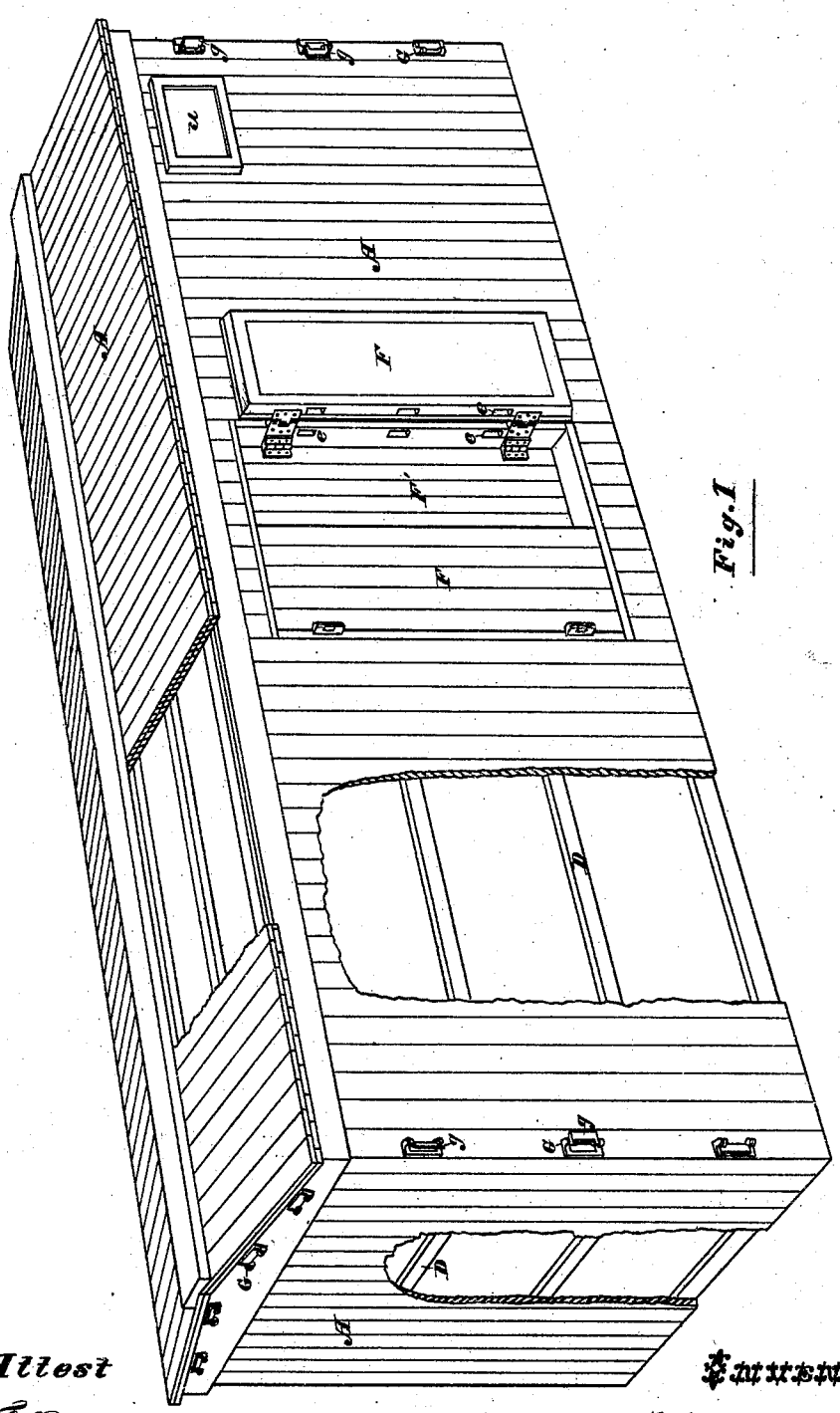

Fig. 1

Attest

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Charles D. Fox

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Robert Burrows,

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Atty.

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Fig. 2

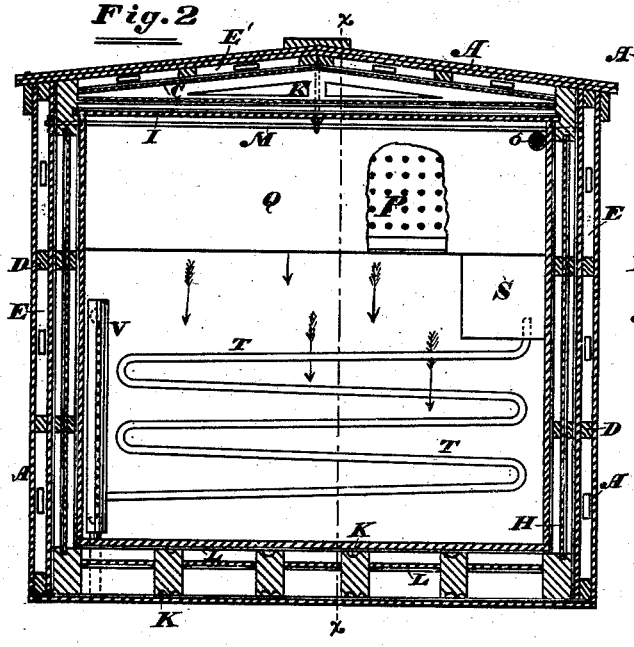


Fig. 3

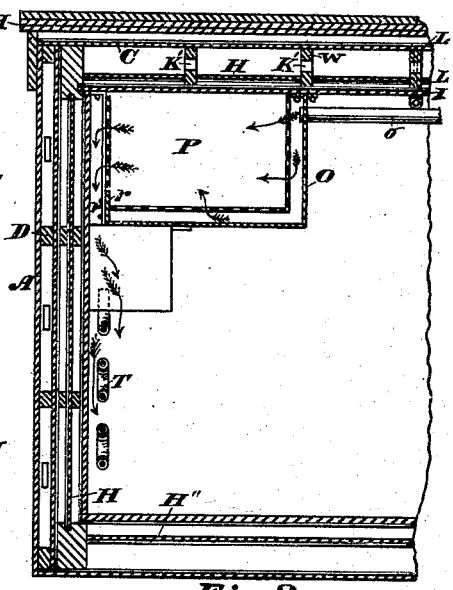


Fig. 4

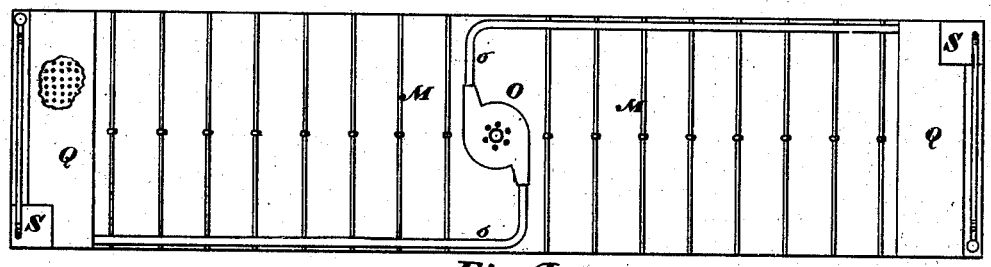


Fig. 5

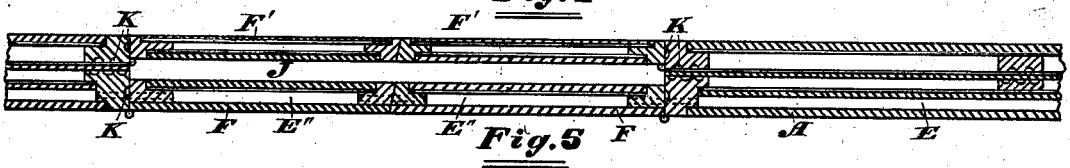
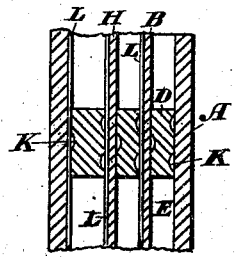


Fig. 6



Attest
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UNITED STATES PATENT OFFICE.

ROBERT BURROWS, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN REFRIGERATOR-CARS.

Specification forming part of Letters Patent No. **196,967**, dated November 13, 1877; application filed March 17, 1877.

To all whom it may concern:

Be it known that I, ROBERT BURROWS, of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Refrigerator-Cars; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention has for its object the production of a railway-car in which perishable materials may be transported long distances at all seasons of the year without suffering injury either from heat, cold, or other atmospheric conditions; and it relates most particularly to the construction of so-called "winter refrigerator-cars," for the reasons, first, that it is a well-known fact that greater difficulty is encountered in guarding against damage by frost than by heat; and, second, that a car which will satisfactorily perform its office in winter may—by the simple addition of an ice-chest at each or either end of the car, with means attached to force the air within the car to impinge against the ice in a continuous current, and circulate through the car, and, furthermore, of suitable means for creating a draft about the walls—be made correspondingly effective in summer.

The invention consists, first, in incasing the entire car, with the exception of the bottom, in a wooden jacket, separated from the roof and outer wall of the car proper by horizontal timbers only, whereby continuous air-spaces intervene; second, in constructing passages through the doors and door-posts wherever these serve as an obstruction to the said air-spaces between the jacket and the wall, thus permitting these air-spaces to extend uninterruptedly around the entire car; third, in providing these continuous air-spaces with ventilators capable of being opened when it is desirable that the air-spaces shall communicate with the exterior air, or closed when it is not, and capable, further, of regulation or adjustment when open, whereby the current through the air-spaces may be that incidental to the openings and movement of the car only, or of much greater force and volume, as desired; fourth, in having between the outer and inner shell of the entire car proper, and not in contact with either, an intermediate partition passing entirely through the door-posts, and limited only by the doorways, and which, in the walls and floor, is closely rabbeted into the sills and uprights; fifth, in channeling the studding, sills, door-posts, and other timbers lengthwise on both their outer and inner sides, as hereinafter particularly described, in order that they may, without sacrifice of strength, present as small a surface as practicable to the walls, &c., with which they come in contact, and afford additional air-cells to neutralize their heat-conducting properties; sixth, in the manner of constructing the doors and door-posts; seventh, in the manner of constructing the roof; eighth, in forming a truss-work of iron rods or bolts and tubing in the roof and upper portion of the car, for the twofold purpose of strengthening the structure and affording convenient means for suspending meat, &c., for transportation; ninth, in the manner of constructing the ice-chest, whereby the current of air from the fan is distributed to all parts of the ice-compartment; and, tenth, in certain attendant contrivances for utilizing and subsequently carrying off the waste-water, all as hereinafter more fully set forth.

In the accompanying drawings, Figure 1 is a perspective view of my refrigerator-car, with certain portions of the jacket broken away. Fig. 2 is a transverse sectional view, showing the refrigerating apparatus in elevation, with a portion of the outer casing of the ice-chest broken away. Fig. 3 is a broken longitudinal section taken on the line *x x*, Fig. 2. Fig. 4 is a plan view of the upper portion of the interior of the car inverted, with a part of the outer casing of one of the ice-chests broken away. Fig. 5 is a horizontal section of the side wall and doors; and Fig. 6 is an enlarged detail view, showing the grooves in the purlins.

A is a wooden case or jacket, separated from the outer wall B and roof C of the car proper by purlins D. Thus air-spaces E E intervene in the sides and ends, and others, E′ E′, in the top. F F are the doors of the

jacket A, and they are of greater thickness than the jacket and air-space E together, thus permitting air-spaces E″ E″, of equal depth with the spaces E E, to lie within them. *e e* are lateral passages through both edges of each door, and through the door-posts, connecting the spaces E and E″ when the doors are closed. Thus, it will be seen, when the doors are shut, air-spaces extend continuously around the entire car, there being no interruption even at the corners. The air-spaces E′ E′ in the top reach from end to end of the car.

In winter it is desirable that the air-spaces E E and E′ E′ be entirely closed; but if entirely closed in hot weather, the air within them soon becomes heated by conduction through the jacket to a temperature higher than that of the exterior air, when they become rather a detriment than a benefit; wherefore it is essential, for summer use, that suitable openings be made in the sides of the jacket, near each end of the car, leading into the spaces E E, and others at the ends leading into the spaces E′ E′. But in very hot weather it is not sufficient merely to have openings to the spaces E E, but, in addition thereto, it is necessary to force the currents into and out of the same; and at all times, of course, it is important to exclude sparks and cinders from the air-spaces. By means of the device shown in the drawings, and which I shall now briefly describe, I am enabled to fulfill all the above requirements.

G G are ventilators, provided with spring-valves *g g*, whereby they may be closed at will. When opened to about sixty degrees these valves will remain fixed. If opened somewhat less than this, they reclose by the action of a spring; but if opened a little beyond that point, they continue on by the action of the spring to one hundred and eighty degrees, where they are, of course, stopped. The valves at the sides open in a direction away from the nearest end of the car.

When it is desirable (as in very hot weather) that a very strong current shall flow through the air-spaces in the sides, the valves should be opened to sixty degrees. The air is then, when the car is in motion, gathered in, so to speak, at the forward end, and sucked out at the other, thus creating a very powerful draft. A wire-gauze screen within the port excludes all sparks and cinders from the air-space. When a less powerful draft is desired, the valve may be wholly opened. The openings at the ends, leading to the air-spaces in the top, are best either wholly open or wholly shut, according to the season.

As at present advised, I find the apparatus well known as the "Emerson Ventilator" to answer best all the above purposes, and therefore do not deem a fuller description necessary.

Between the outer and inner casing of the walls, roof, and bottom of the car proper, I place an intermediate partition, H H′ H″. This partition is rabbeted into the sills and uprights in the sides, ends, and bottom, and is cleated or rabbeted to the carlings in the roof. A course of studding and purlins is placed on each side of it in the sides and ends, and purlins above and below it in the floor. Thus dead-air spaces intervene on each side of it, limited by the purlins, studding, carlings, &c. It is, moreover, continued through or between the door-posts, terminating at the doorways, as shown in Fig. 5.

It is manifest that this additional wall must greatly enhance the non-conducting properties of the car.

K K are longitudinal channels or grooves cut into the outer and inner sides of the sills, purlins, studding, door-posts, &c., and they may sometimes be formed in three, or even all four, sides to advantage. They are best not directly opposite one another, however, so I prefer generally to have one more groove on one side than on the other, as shown. By means of these grooves air-cells are created, which greatly aid in preventing heat from passing in or out through the timbers, while the strength of the latter is not materially impaired.

I sometimes form grooves in the remaining sides, also, in order to intercept heat passing through at the edges.

L L represent sheathings of deodorized water-proof paper, constituting additional non-conducting media in the walls, roof, and floor. I employ as many layers as practicable, commonly three or four in each part of the car, securing them in position to the purlins, studding, carlings, and the several walls, &c., by means of the substance known as "inodorous pitch cement," and to be had in the trade. This particular kind of paper has peculiar advantages for this purpose, for it is not only one of the best non-conductors known, but it is also impervious to moisture, and, being perfectly odorless, it produces no bad effects upon the contents of the car, but, on the contrary, tends to preserve them in a pure state, while the particular kind of cement named not only serves to hold the paper securely in position, but has a tendency to preserve the wood, and is, like the paper, odorless.

A layer of this paper may likewise be used with advantage as a lining to the jacket A, and similarly cemented thereto.

The doors F F of the jacket, and F′ F′ of the car proper, are constructed each with an air-space, and are lined with the deodorized water-proof paper. When shut, an air-space, J, intervenes between the doors of the jacket and those of the car proper. The doors are constructed with beveled edges, which are faced with cotton flannel, in order that they may wedge closely and be air-tight. The edges which fit against the door-posts are not beveled; yet, by reason of the cotton flannel's pressing into the grooves K in the said door-posts when the doors are shut, all dust, cinders, &c., are completely excluded. The top of the door-frame consists of a solid wedge-shaped

door-cap, to which the beveled tops of the doors fit closely.

The inner faces of the doors should be protected by sheet-iron; and I generally, also, set an iron plate into the threshold, flush with the wood-work, to prevent wear in loading and unloading.

Each door-post consists of two parts, separated from each other by the wall H, and is formed with separate ledges or shoulders, as shown in Fig. 5, to give a suitable backing to the several walls.

I form the roof with a course of boards, C, above, and a course, I, below the carlings, with the partition H′ between, fastened, as hereinbefore stated, to the carlings W W, so that air-spaces intervene above and below it, and also with the several layers of paper, L L, as before stated; and I generally cut passages through the carlings above the partition H′, as shown at K′, Figs. 2 and 3, for the same reason that I groove the sills, &c.—viz., to prevent the conduction of heat to or from the interior of the car.

M M are lengths of common gas-pipe, reaching transversely across the interior of the car, near the top. The ends pass through the walls, and are held by nuts on the outside. N N are rods or bolts, hooked at their lower ends, for sustaining the tubes at their centers, their upper ends passing through the purlin, as shown in Fig. 2, and being held by nuts. The purpose of this truss-work has already been stated.

O is a fan or blower, placed against the center of the ceiling, and driven, in the ordinary manner, by gearing (not shown) connecting with one of the axles, for the purpose of forcing the air within the car to pass, by way of the pipe *o*, through the ice-chest P. By thus placing the fan a much more general atmospheric disturbance (which has a beneficial influence) is created than by placing it at or near the end, as has heretofore been done; also, a much more uniform temperature is maintained, for, the upward current being equally distant from both ice-chests, and comparatively near each, the air has not time to acquire an appreciable rise in temperature before it is again forced over the ice.

Even in winter, when no ice is used, this fan may be used with advantage, since the currents of air serve to keep the walls, &c., dry, and prevent the formation of frost thereon.

The ice-chests are placed against the ceiling, near the ends of the car, and are of sufficient length to reach from side to side. They are of peculiar construction, as follows: The ice-holder P is of perforated metal or wire mesh, properly strengthened and sustained. It is completely inclosed by the case Q on all sides, except that toward the end of the car, where the said case Q terminates, as shown at *r*, only a little above the bottom of the ice-holder, leaving the latter open on that side. At the side toward the fan, and at the bottom, the case Q is not in contact with the ice-holder; but everywhere else the two are tightly sealed together. Thus an air-chamber is formed between the two at the bottom and the side named, in which the air from the fan is cooled before passing through the perforated ice-holder, which latter constitutes the only outlet for the air. That side of the ice-holder which is toward the end of the car may consist of metallic strips or bars, if preferred, instead of perforated metal or wire mesh, like the rest, its only purpose being to prevent the ice from falling out. The air-duct *o*, leading from the fan, enters the case Q either at the end of the same, as shown, or midway of its length, or at any point between, terminating just within the case. Thus the current from the fan fills every part of it, finding an outlet only through the ice-compartment P by way of the perforations, so that it is distributed into every part of the ice-compartment, and being forced out at the opposite side in a chilled state, it descends and passes along the floor until it is again drawn up by the fan.

The bottom of the case Q serves as a pan to catch the drip as the ice melts, the incomplete side *r* being carried up to a height sufficient to prevent the water's running out at the uninclosed side of the ice-compartment. The chest is charged with ice through doors *u* in the walls of the car.

S S are salt-boxes, fixed into the corners of the car, one immediately below each ice-chest, and also charged through the doors *u*. The only outlet for the drip which collects in the bottom of the case Q is by way of an opening, or of several small openings, immediately above the salt-box, toward which it is best to have the said bottom slightly inclined. The drip, after trickling through the salt, enters the pipe T, which is coiled back and forth across the end of the car, penetrating the cylinder V near the bottom of the same. Within this cylinder is a globe-valve, arranged to discharge the salt-water from the car as fast as it collects in the pan after the coil T is full.

The economy of this arrangement is perfect, for the water in the pan or bottom of the case Q serves to absorb impurities in the air as the latter passes over it, and carry them out of the car; and the coil T, being intensely cold, condenses any moisture with which the air may be laden after leaving the ice-chest, since this current is then obliged to impinge against the coil. This moisture collects in the form of frost upon the coil; therefore a trough or pan should be placed below to catch the drip when the frost melts, with a suitable conduit attached to permit the water to pass out of the car.

It is obvious that in consequence of this thorough system of insulation an enormous saving of ice must be effected in summer; also, that, owing to the perfect circulation of air produced by my arrangement of the fan and ice-chests, a comparatively small quantity of ice will suffice to keep the temperature cool and regular.

My car is simple of construction, cheap,

and unusually strong, while at the same time it is much lighter than ordinary refrigerator-cars, since I wholly dispense with fillings between the walls.

Any ordinary box-car may be readily transformed into a refrigerator-car of my construction, thus effecting a considerable saving in the cost. To do this the outside casing of the sides and ends must first be removed to permit the grooving of the timbers and the placing of the paper in position. This done, the casing is replaced. The sides, ends, and roof are then incased, just as they are, in the supplementary wooden jacket, in the manner already described, the box-car itself constituting the car proper, hereinbefore referred to. The inside casing must be removed, and the partition H introduced in its place and rabbeted, in the manner described. Against this is placed the additional course of studding, to which the original inside casing is then fastened. The doors and door-posts, of course, require wholly new construction, and the remaining details also are the same as in a new car.

What I claim as new, and desire to secure by Letters Patent is—

1. The air-spaces E E E′ E′, communicating with the exterior air by means of openings at or near the ends of the car, which openings are provided with valves, by which they may be opened and closed at will, whereby the said air-spaces may be rendered either free or dead, as requirement shall dictate, substantially as described.

2. The continuous air-spaces E E, having openings to the exterior air, provided with ventilators capable of being opened and closed, and capable further of regulation or adjustment, whereby the draft through the said air-spaces may be either that incidental to the openings and movement of the car only, or of greater force and volume, substantially as specified.

3. The partition H, passing through the door-posts, and between the two courses of studding, and rabbeted into the sills and plates, substantially as described.

4. The sills, door-posts, studding, and the like, grooved or channeled longitudinally, so as to form air-cells between these timbers and the surfaces with which they come in contact, for the purpose of interrupting the passage of heat, substantially as described.

5. The grooved timbers, having those grooves which are on opposite sides of the same so placed that each groove on one side shall be opposite the ridge between two grooves on the other, in order that, with the smallest possible sacrifice of strength to the material, the heat which passes between the air-cells on one side shall be intercepted by air-cells on the other, substantially as specified.

6. The car-roof formed with the outer casing C, inner casing I, intervening partition H′, having dead-air spaces above and below it, layers of deodorized water-proof paper L L, and carlings W W, having through them the openings K K, substantially as described.

7. In combination with the walls and roof of a railway-car, the truss-work formed of lengths of iron tubing M M, reaching from side to side, and through the walls, and sustained at their centers by bolts N N, passing through the purlin in the roof, substantially as described, and for the purposes set forth.

8. The ice-chest consisting of the perforated ice-holder P, inclosed completely by the case Q on all sides except that nearest the end of the car, with an air-chamber intervening between the said ice-holder and case at the bottom and the side toward the fan, into which the air passes, finding an outlet only by way of the said ice-holder P, substantially as described.

9. The combination of the perforated ice-holder P, case Q, salt-box S, pipe T, and valve-cylinder V, substantially as described, and for the purposes set forth.

10. The door-posts provided, as shown, upon those faces that are contiguous to the doors with grooves *k*, into which the cushions on the edges of the doors press when the doors are shut, thus preventing air, dust, cinders, &c., from penetrating to the interior of the car, as set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

ROBERT BURROWS.

Witnesses:
ALFRED LINTON,
JOHN C. WALLIS.