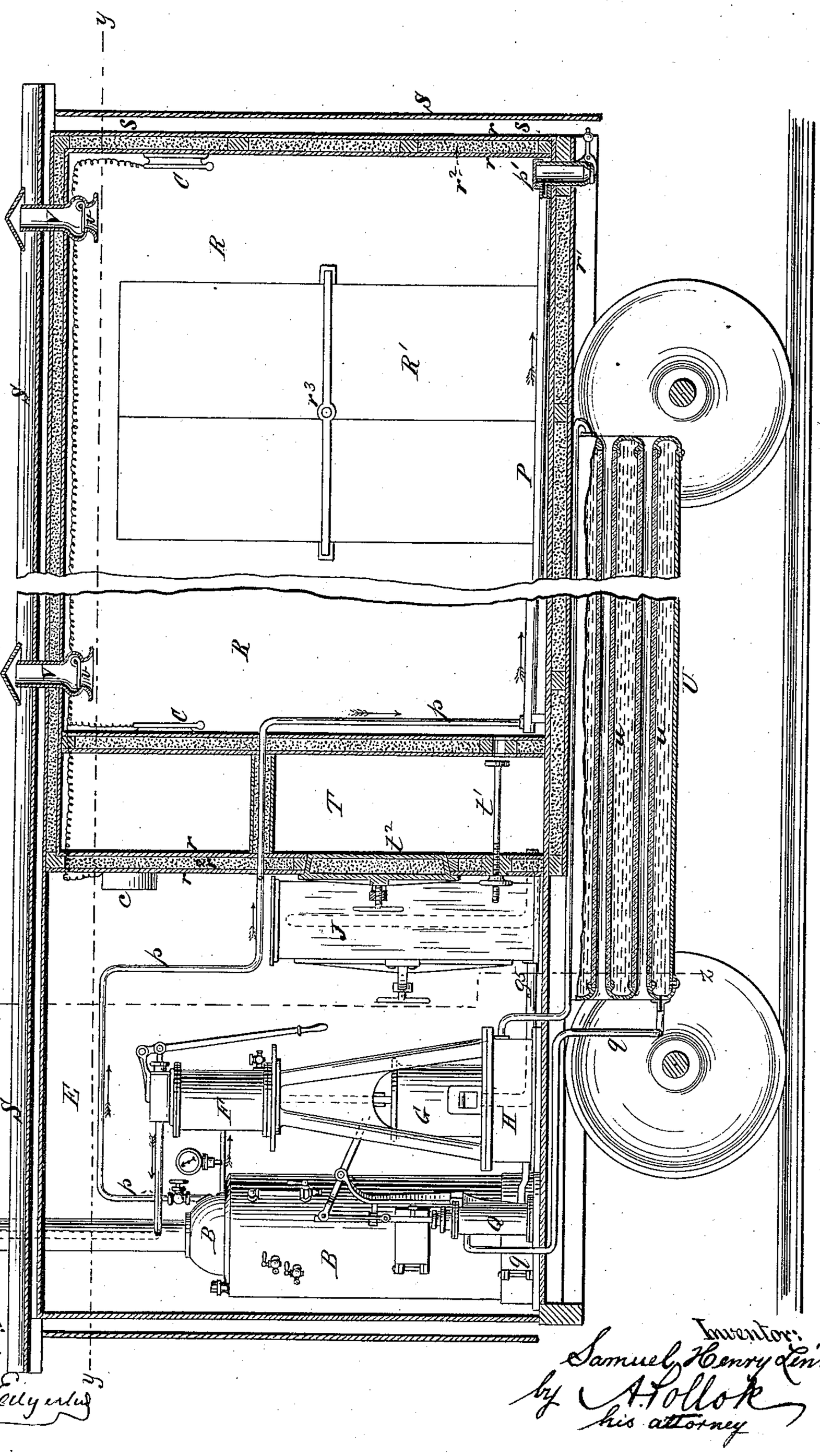
(No Model.) 4 Sheets—Sheet 1.

S. H. LINN.

METHOD OF AND APPARATUS FOR PRESERVING AND TRANSPORTING FOOD.

No. 291,914. Patented Jan. 15, 1884.

Figure 1.



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(No Model.) 4 Sheets—Sheet 2.

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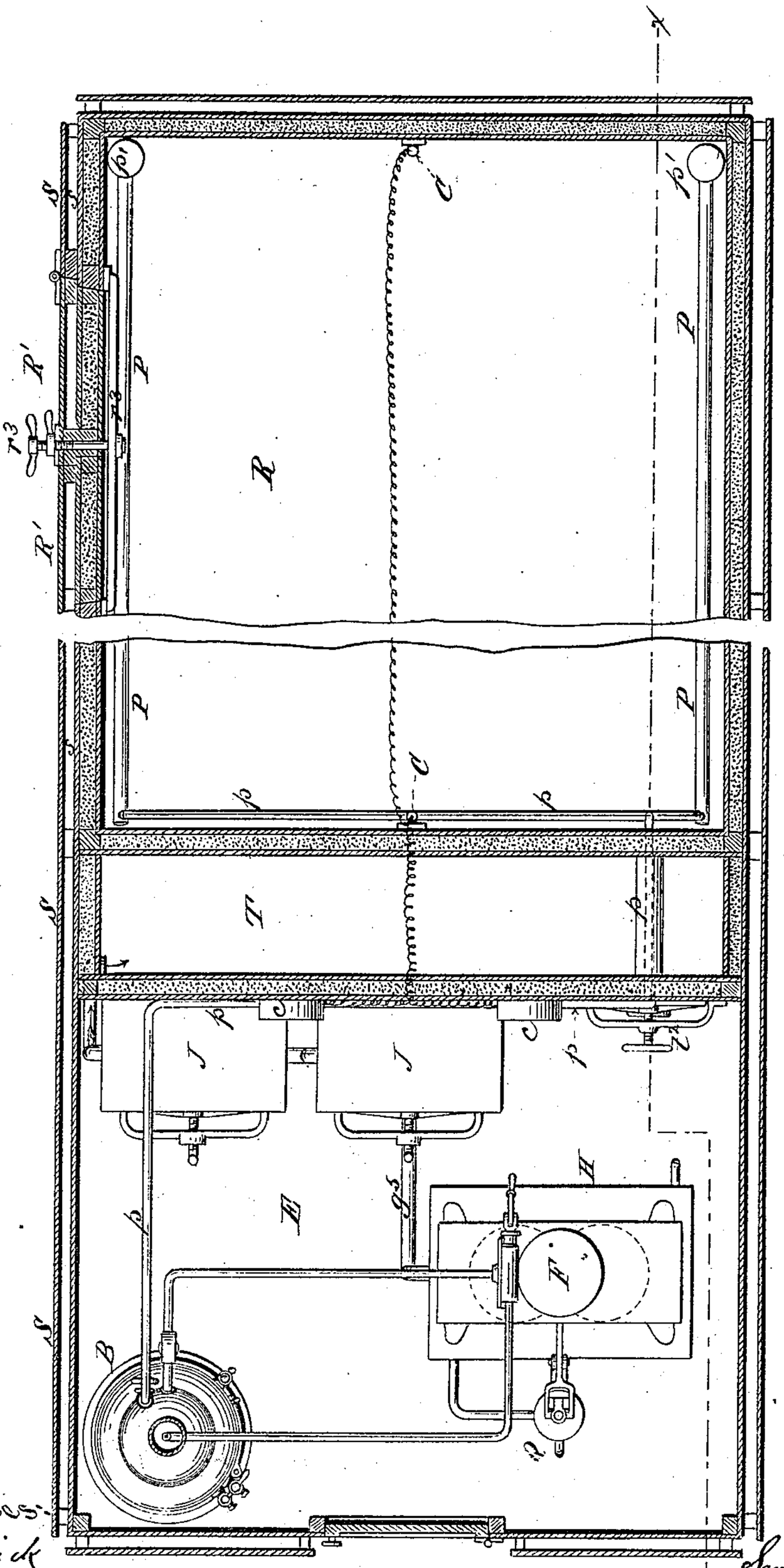
Figure 2.



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(No Model.) 4 Sheets—Sheet 3.

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Figure 4.

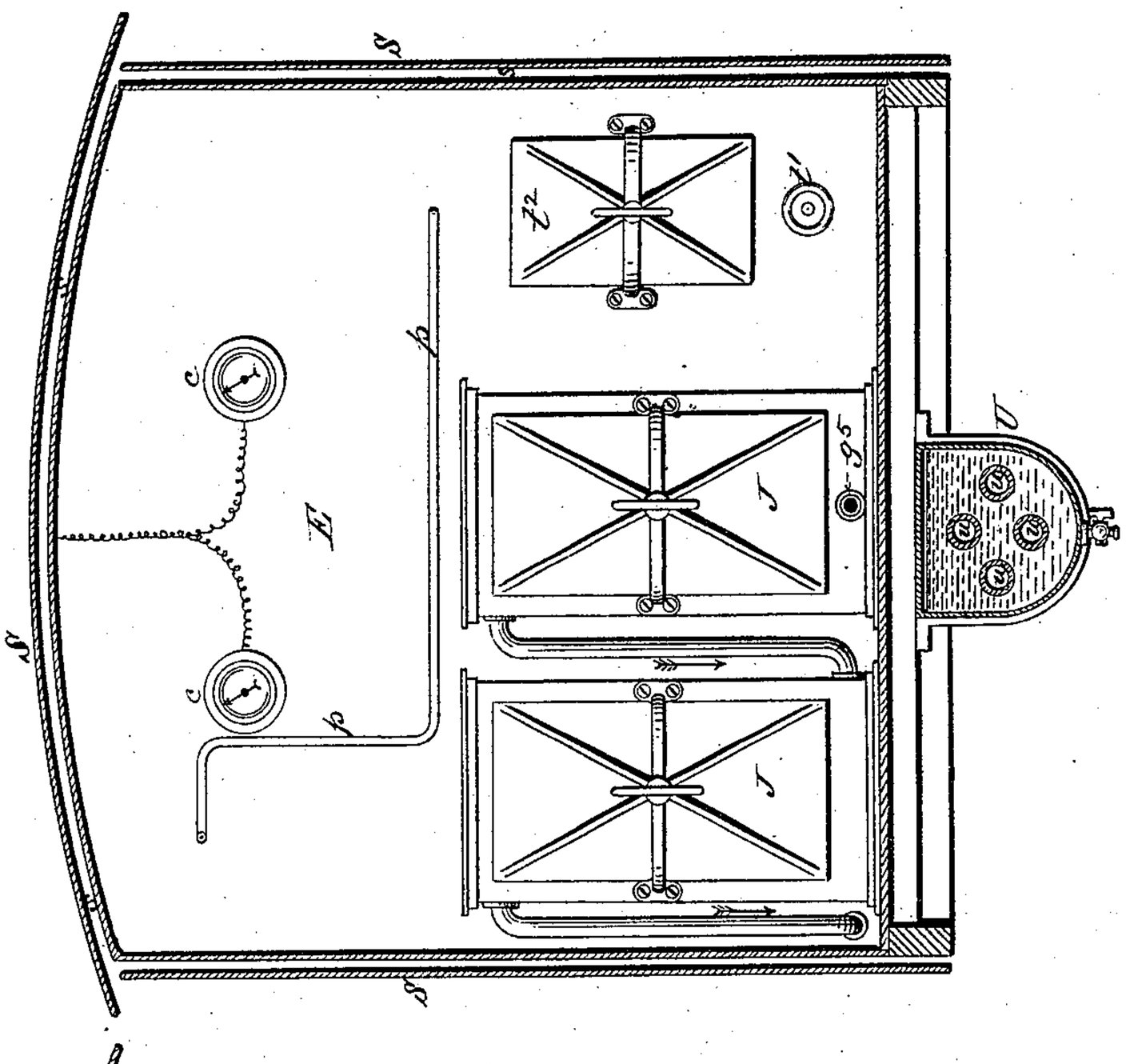
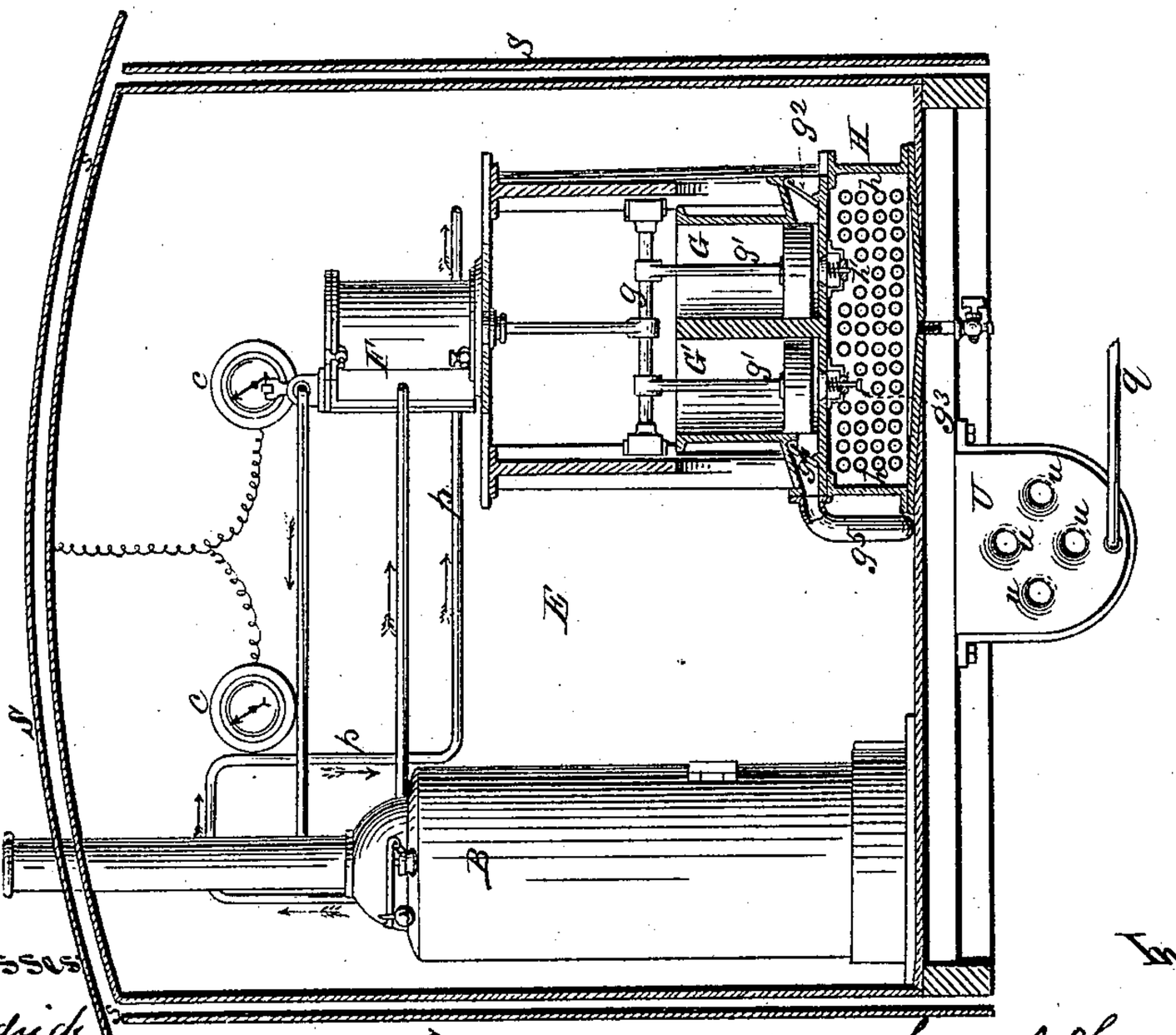


Figure 3.



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(No Model.) 4 Sheets—Sheet 4.

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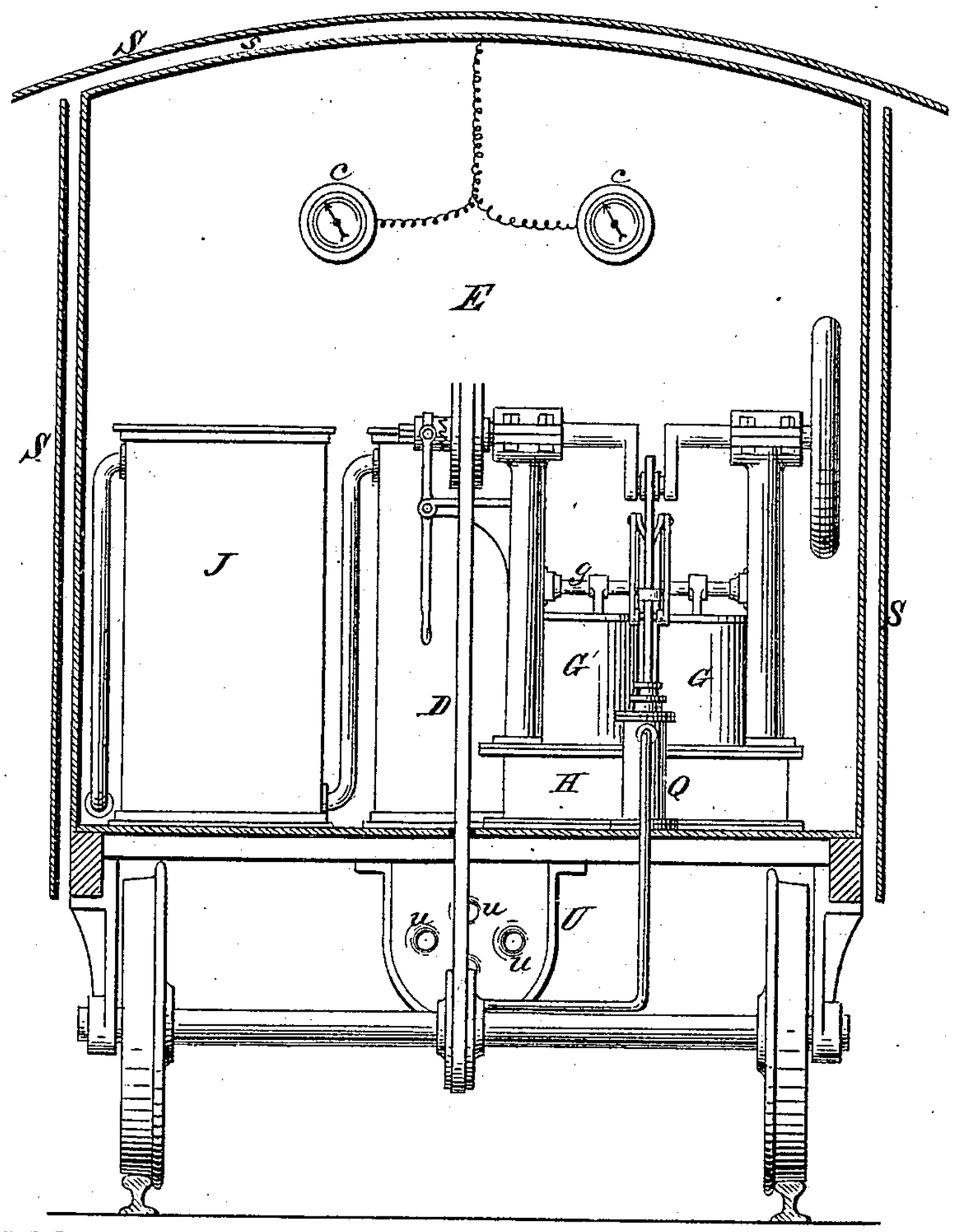
Figure 5.



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UNITED STATES PATENT OFFICE.

SAMUEL HENRY LINN, OF NEW YORK, N. Y.

METHOD OF AND APPARATUS FOR PRESERVING AND TRANSPORTING FOOD.

SPECIFICATION forming part of Letters Patent No. 291,914, dated January 15, 1884.

Application filed September 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL HENRY LINN, of the city, county, and State of New York, have invented a new and useful Improvement in Methods of and Apparatus for Preserving and Transporting Food, which improvement is fully set forth in the following specification.

The present invention has reference to the preservation of meats and vegetables and other perishable articles of consumption in store-rooms or during transportation in railway-cars, vessels, and other vehicles by maintaining in the provision-chamber a supply of cold dry air of uniform temperature and impregnated with a preservative agent.

In my Patent No. 270,549, dated January 9, 1883, I have described methods of and apparatus for treating air, so as to cool the same, free it from moisture and impurities, and charge it with a preservative agent, preparatory to supplying it to the provision-chamber.

The present invention may be considered an improvement upon that set forth in the aforesaid patent.

It consists, first, in the methods and means, hereinafter set forth, for compressing and expanding the air and cooling the same mechanically without the use of ice; secondly, in the employment of a condenser or air-cooling chamber containing a system of pipes through which is maintained a forced circulation of a suitably-cooled liquid; thirdly, in the particular construction and arrangement of the reservoir containing the cooling-liquid; fourthly, in utilizing the motion of the railway-car to operate the air compressing, expanding, and cooling mechanism; and, fifthly, in the particular construction and arrangement of the refrigerating-chamber and the several devices connected therewith, and in certain combinations of parts, as hereinafter fully set forth.

The necessary apparatus for cooling, compressing, expanding, drying, and impregnating the air is preferably arranged, in the case of a railway-car at least, in a separate compartment or operating-room. The style and construction of such apparatus may be varied more or less according to circumstances. The air is cooled mechanically without the use of ice. It is then preferably further deprived of moisture and impurities, for which purpose chloride of calcium or lime and other suitable substances may be used, and it is then preferably charged with a preservative agent, such as salicylic acid. When steam furnishes the motive force for the said apparatus, an ordinary steam-cylinder is employed, by means of which the air compressing and expanding pistons are reciprocated. Where the motion of the car is utilized to operate said apparatus, the power may be communicated from one of the car-axles to a shaft operating the pistons through an endless belt, or by a train of gears, or in other suitable way. The cooling-liquid may be water kept at a low temperature in any suitable way. As herein described, the tank containing the liquid is provided, in part, at least, with walls of porous earthenware, or other material which will allow the liquid to percolate through very slowly. The moisture thus standing on the outside of the tank is rapidly evaporated, and thereby cools the liquid in said tank. In the case of a railway-car the tank is supported underneath the car, where it is exposed to a constant and strong current of air, and to still further increase the evaporation it is or may be provided with longitudinal flues or air-tubes of porous terra-cotta or like material.

In the accompanying drawings the improvements are, for convenience of illustration, shown as adapted to a railway refrigerating-car, although they may with equal facility be utilized in connection with any other form of refrigerating-compartment, either stationary or movable.

Figure 1 is a vertical longitudinal section on line *x x*, Fig. 2, of a railway-car provided with apparatus for carrying the invention into effect, the tank or reservoir below the car being partly broken away. Fig. 2 is a horizontal section on line *y y*, Fig. 1. Fig. 3 is a transverse vertical section through the compartment containing the compressing, expanding, and cooling apparatus. Fig. 4 is a similar view on line *z z*, Fig. 1; and Fig. 5 is a transverse section of said compartment, showing means for operating said apparatus by the motion of the car.

The refrigerating-chamber R is surrounded on all sides by double walls *r r'*, the space between which is filled with "mineral wool" or other suitable non-conducting material, r^2; or

the said walls may be constructed in accordance with my aforesaid patent. Outside of the non-conducting wall thus formed is arranged upon the top and sides of the chamber a shield, S, the several plates constituting which are secured to the body of the car in such manner as to leave air spaces or passages *s* between the inner sides of the plates and the outer surface of the double wall. These spaces *s* are preferably left open at the extremities and top and bottom of the car or chamber, so as to allow free access and circulation of air between the shields and the walls of the compartment, for the purpose of removing by connection a greater portion of the heat received by the shields S, thereby largely reducing the amount of heat to which the walls proper, *r*, are subjected from exterior sources. This arrangement is specially advantageous when used in connection with a railway-car, since the motion of the latter insures a rapid circulation and change of air under the shield-plates, thereby effectually preventing any excess of heat.

Access is had to chamber R through suitable doors, R′, which are constructed to correspond and coincide with the double wall *r r′* and shield S, and are provided with suitable tightening mechanism, r^3, by which they may be secured hermetically. Although thus hermetically closed, the chamber R is not, in the strict sense of the word, a closed chamber, since provision is made by ventilators V, provided with outwardly-opening valves *v*, for the escape of surplus air to compensate for that freshly admitted to the compartment.

The proper refrigeration of the compartment R is effected by the admission into it from a suitable reservoir, T, of more or less dry, cool, purified, and compressed air impregnated with a suitable preservative agent. The reservoir T, containing this prepared air, is preferably situated between the refrigerating-compartment R and the engine or operating-room E, and is provided with a hand-valve, *t′*, by which the escape of the air into the refrigerating-chamber R may be controlled from the said operating-room E.

Provision is made for elevating the temperature of the refrigerating-compartment or chill-room R, when necessary, by means of steam pipes or radiators P P, which are connected with the steam-dome of boiler B by means of pipe *p*, and are provided with drip-traps *p′*, for the collection and automatic discharge of the water of condensation.

A suitable number of thermometers, C C, are situated in the refrigerating-compartment or chill-room R, and are electrically connected with indicators *c c* in the operating-room E; or other appropriate means are employed to indicate externally the temperature within, and guard against any undue variation. This may be accomplished automatically, if desired, by any suitable and well-known means connecting directly with the steam and air valves, respectively.

Provision is made for access to the reservoir T, when required, by a suitable man-hole, t^2, capable of being hermetically closed.

The apparatus for compressing, cooling, expanding, drying, and impregnating the air to be supplied to the refrigerating-compartment R is arranged, as shown, in a separate compartment or operating-room E. As shown in Figs. 1, 2, and 3, the necessary power for effecting these operations is obtained by the use of a steam-boiler, B, situated in the working-compartment E. The steam cylinder or engine F is mounted directly above the compressing and expanding cylinders G G′, its piston-rod operating a cross-head, *g*, to which the piston-rods *g′ g′* of the compression and expansion cylinders are attached.

Immediately underneath the cylinders G G′, and communicating with the latter by suitable spring-valves, *h′ g³*, is the condensing and cooling chamber H, containing a coil or series of pipes, *h*, through which a forced circulation of a suitably-cooled liquid is maintained. This circulation is effected by a pump, Q, which is or may be operated directly by suitable levers connected with the reciprocating cross-head *g*, as shown in Fig. 1, one end of the coil *h* connecting with the pump Q and the other with a reservoir or tank, U, which is in turn connected with pump Q by the supply-pipe *q*.

The tank or reservoir U is situated upon the exterior of the car or chamber, preferably upon its under side, so as to be exposed to the atmosphere, for the purpose of allowing the latter readily to remove any excess of heat which the cooling-liquid may acquire while circulating through the condenser H. In order to facilitate this action of the atmosphere, the reservoir or tank U is provided with several longitudinal pipes or flues, *u u*, so as to augment the extent of radiating-surface exposed to the air. The tubes *u u* and the tank itself, if desired, are or may be made of a slightly porous material—such as unglazed or porous terra-cotta, or similar substance—through which a portion of the liquid will percolate slowly, and by evaporation lower the temperature of the tank and its contents. This construction is especially effective when used in connection with refrigerator-cars, or under other circumstances in which the tank or flues will be exposed to a current of fresh air.

Situated in the operating-compartment E, and connected with and interposed between the compressing, expanding, and condensing apparatus and the air-reservoir T, are a series of air-tight receptacles, J J, which communicate with each other, for storing proper quantities of purifying, moisture-absorbing, and antiseptic materials. This part of the apparatus may be constructed and arranged as described in my aforesaid Patent No. 270,549.

Where the invention is used for a refrigerator-car, the power for operating the air compressing, expanding, and cooling mechanism may be supplied by the motion of the car, as shown in Fig. 5, in which motion is commu-

nicated from the car-axle through belt D to shaft D′, which is connected with and reciprocates the cross-head *g* through a crank and connecting-rod.

The operation is as follows: It being desired to maintain as nearly as possible a uniform temperature in the refrigerating-chamber R, as well as a continuous change of atmosphere therein, the compressing, expanding, and condensing apparatus are designed to be kept in operation continuously, and any decline below the required degree of temperature to be compensated for by the admission of more or less steam into the radiators P P. As the pistons *g g′* in cylinders G G′ are raised simultaneously, they respectively draw in a supply of air in the first cylinder, G, from the atmosphere through the valve g^2, and into the cylinder G′ from the condenser H through the valve g^3. The descent of the pistons closes the inlet-valve g^2 in the first cylinder, and forces the air contained in it through the spring-valve *h′* into the condenser H and into contact with the coil of cooling-pipes *h*, which absorb a large proportion of the heat set free by the compression of the air and condense a portion of the moisture contained in the latter, while at the same time the valve h^2 in the other cylinder, G′, is closed, and the air just withdrawn from the condenser H is forced through the valve g^4 into the pipe g^5, and thence to the first of the series of air-tight compartments J J. Simultaneous with the action here described, the reciprocation of the cross-head *g* has operated the pump Q and caused it to change the refrigerating-liquid in the coil *h* of the condenser H. The air thus compressed and cooled is dried and purified, and finally impregnated with salicylic acid or other suitable antiseptic as it passes through the receptacles J J upon its way to the reservoir T, from which latter its passage into the refrigerating-chamber or chill-room R is regulated by means of the hand-valve *t′*, as before stated. In cases where the compressing, expanding, and cooling mechanism receives its power from the motion of the car, as in Fig. 5, it may be necessary or desirable to prevent too great elevation in the temperature of chamber R, in case of an accident or prolonged stoppage, by providing means for temporarily cooling the apparatus U by throwing into the pipes any known or suitable refrigerating material.

It is obvious that modifications may be made in the details of construction without departing from the spirit of the invention, and that parts thereof can be used without the others. For example, other suitable means for mechanically cooling the air may be used with the other parts of the invention, instead of those described.

Having now fully described my said invention and the manner of carrying the same into effect, what I claim is—

1. In the art of preserving articles of food during transportation, the improvement consisting in cooling the air to be supplied to the provision-chamber by a circulation of water or similar liquid from a tank or reservoir on the outside of the vehicle, having walls which permit a portion of said liquid to percolate through, so as to be evaporated by the current of air to which the said reservoir is exposed when the vehicle is in motion, substantially as and for the purpose described.

2. The combination of the air-cooling chamber, the air expansion and compression cylinders, their pistons and means for operating the same, the coil of pipe in said chamber, connected at both ends with a tank or reservoir containing a cooling-liquid, and mechanism for maintaining a constant circulation of said liquid from said reservoir through said coil, substantially as described.

3. The combination, in a refrigerator-car, of the air-cooling chamber, the air expansion and compression mechanism, the coil of pipe in said chamber, the reservoir for the cooling-liquid, supported on the outside of said car, and means for maintaining a circulation of the cooling-liquid from said reservoir through said coil, substantially as described.

4. In a refrigerator-car, the combination of the air-chamber, the air compression and expansion cylinders, their pistons, the coil of pipe in said chamber, communicating with a reservoir containing a cooled liquid, the pump, and connections for operating said pump and said pistons from the car-axle, substantially as described.

5. In a vehicle for transporting perishable articles of food, the tank for the cooling-liquid, supported outside the car, and having air-tubes extending through it in the direction of motion of said vehicle, substantially as described.

6. In a refrigerator-car or other vehicle, the tank for the cooling-liquid, supported outside the vehicle, and having its walls formed wholly or in part of porous earthenware, substantially as described.

7. In a refrigerator-car or other vehicle, the tank for the cooling-liquid, supported outside the car or vehicle, and air-flues of porous material extending through it in the direction of motion of said vehicle, substantially as described.

8. The combination, with the air-cooling chamber of a refrigerator-car, of the tank or reservoir containing cooling-liquid, supported outside the car, and provided with longitudinal air-tubes of porous earthenware or similar material, a coil of pipe in said chamber, connected with said tank or reservoir, and a pump for maintaining a circulation of the liquid in said coil, substantially as described.

9. In a refrigerator car or chamber, the following devices in combination: a condenser or cooling-chamber, a coil or system of pipes therein, a reservoir or tank connected with said pipes and having air-tubes of porous material, air compressing and expanding cylinders communicating by valves with said con-

denser or cooling-chamber, pistons working in said cylinders, means for operating the same, and a pipe leading from said condenser to the provision-chamber through vessels containing moisture-absorbing, purifying, and preservative substances, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

SAMUEL HENRY LINN.

Witnesses:
JOHN MCCLURE,
MARTEL DREW.