April 26, 1932. E. G. ROWLEDGE 1,855,989

REFRIGERATOR CHAMBER, PARTICULARLY RAILWAY REFRIGERATOR VAN

Filed Nov. 3, 1930 3 Sheets-Sheet 1

Fig 2.

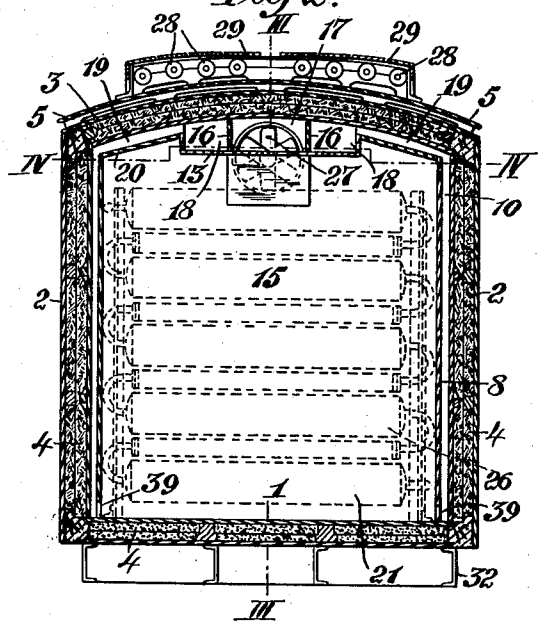
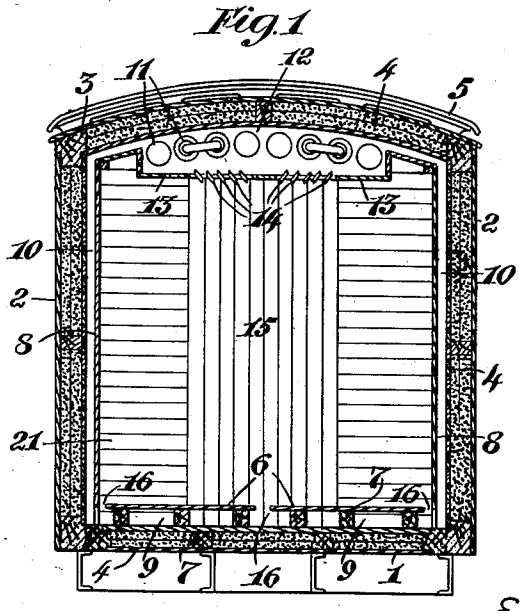


Fig. 1

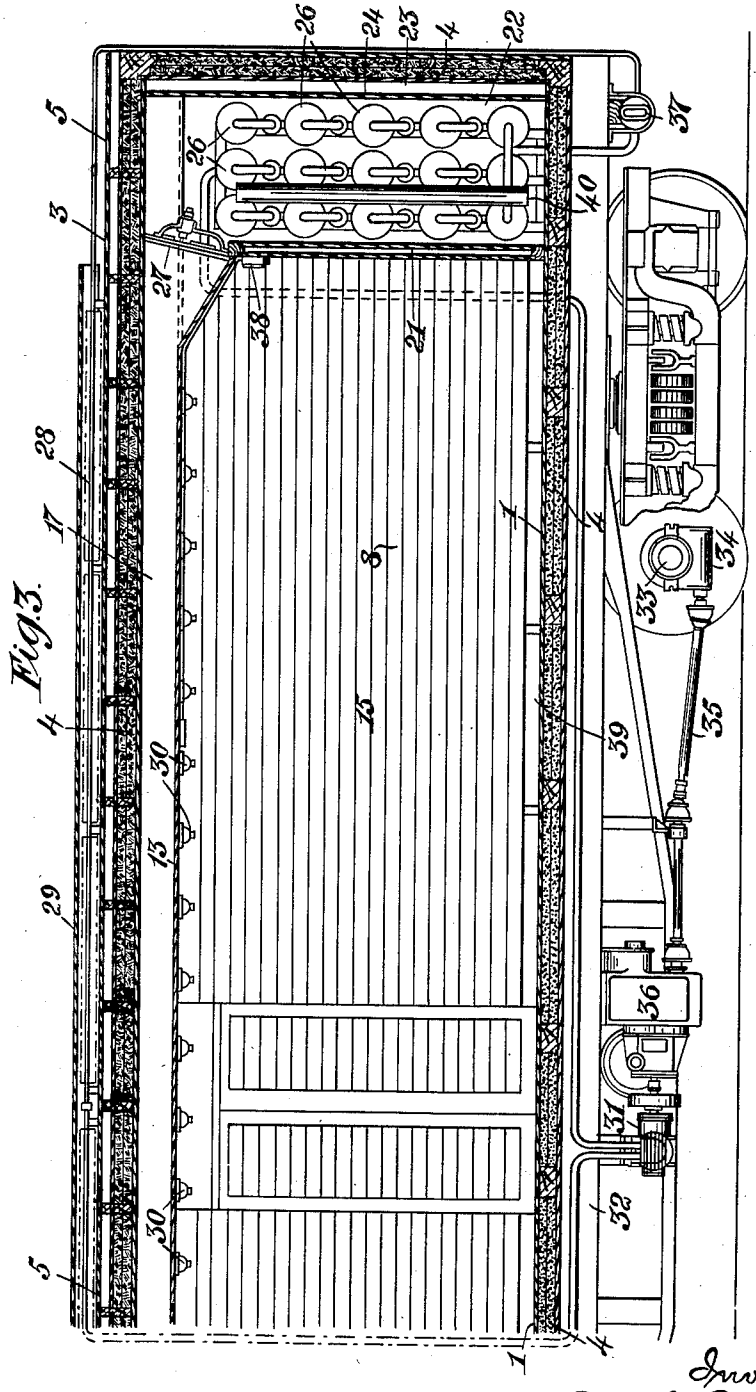


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REFRIGERATOR CHAMBER, PARTICULARLY RAILWAY REFRIGERATOR VAN

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REFRIGERATOR CHAMBER, PARTICULARLY RAILWAY REFRIGERATOR VAN

Filed Nov. 3, 1930 3 Sheets-Sheet 3

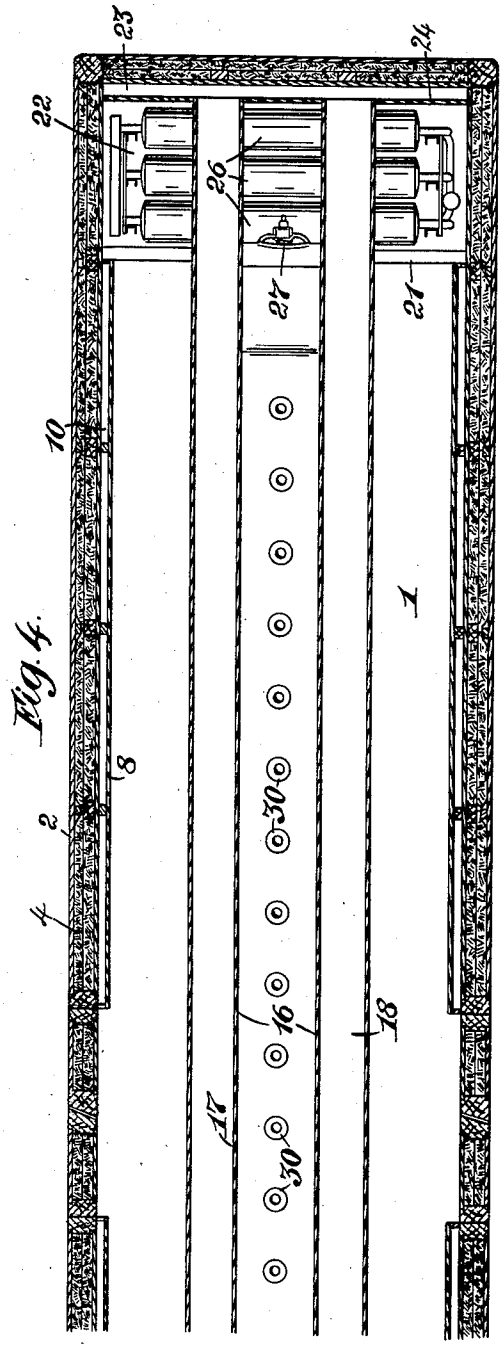


Fig. 4.

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UNITED STATES PATENT OFFICE

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REFRIGERATOR CHAMBER, PARTICULARLY RAILWAY REFRIGERATOR VAN

Application filed November 3, 1930, Serial No. 493,149, and in Great Britain November 20, 1929.

This invention comprises improvements in and connected with refrigerator chambers and is particularly concerned with railway refrigerator vans. The principal object of the invention is to provide an insulated refrigerator chamber adapted for the maintenance, within very close limits, of a given temperature uniformly throughout the lading space of the chamber and for the promotion of a brisk circulation of cold air over the whole of the goods contained within such space.

It is well-known that the greater part of the refrigeration duty required in a refrigerator van for maintaining the desired low temperature inside the van is due to the heat leakage into the van through the insulated walls caused by the thermal head across the wall thickness. In refrigerator vans as heretofore constructed and fitted with cooling apparatus in the roof, the cooled air descends from such cooling apparatus towards the floor and then ascends in contact with the walls of the car being warmed by such contact during the ascent. The amount of heat absorbed by the air during its ascent depends upon the efficiency of the insulated walls of the vehicle and upon the temperature gradient across the thickness of said walls and their insulation. In any event, however, the temperature near these walls and the roof is higher than elsewhere, so that the goods occupying the lading space are liable to be carried at different temperatures in different parts of such space. It is an object of this invention to overcome this defect.

According to this invention, a refrigerator chamber such as a refrigerator van or vehicle, constructed with an insulating shell, for example with an insulated floor, walls and roof, adapted for giving good protection against heat leakage, is fitted with false inner walls spaced a suitable short distance away from the shell so as to form a circulation space which encloses the lading space. Such portion of the roof as is not occupied by the cooling apparatus or cooling chamber is fitted with an inner roof part which is similarly spaced from the roof proper to form a continuation of the circulation space aforesaid.

In a modified form of the invention the cooling apparatus is disposed in a separate compartment and forcing means, such as a fan, is provided for delivering the cold air from such compartment to a cold air supply duct in the roof of the chamber. The cold air, discharged through appropriate openings or outlet devices in the duct, descends through the lading space, after which it ascends through circulation spaces in the walls and roof and passes through a return duct which delivers it to the separate cooling compartment for re-cooling.

The temperature within the lading space may be regulated by a thermostat which may be operative, for example, for putting the air forcing means into and out of action.

Two embodiments of the invention are illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a cross section of a simple arrangement particularly applicable to refrigerated railway vans.

Figure 2 is a cross section of an alternative arrangement also particularly applicable to refrigerated railway vans.

Figure 3 is a vertical longitudinal section on the line III—III of Figure 2, and

Figure 4 is a horizontal longitudinal section on the line IV—IV of Figure 2.

In the van construction illustrated in Figure 1, the floor 1, walls 2 and roof 3 are made double and packed with insulating material 4 according to standard practice, a sun shield 5 being fitted above the roof in the case of vans for service in hot countries. For some purposes a false floor made up of slats 6 may also be fitted, supported (as shown) a short distance above the floor 1 by bearers 7 of timber. False walls 8 are spaced from the walls 2 proper and may be built up of tongued and grooved boards secured at intervals to the side and end walls by vertical battens (not shown). The false side walls 8 stop short of the floor 4 so that the space 9 beneath the false floor 6 is in communication with the vertical duct spaces 10 covered in by the false walls. The cooling elements, which may con-

sist of evaporator pipes 11 (as shown) forming part of a thermo-dynamical cooling system or of ice tanks, are supported from the roof 3 and housed in a duct or shallow chamber 12 running longitudinally beneath said roof. Said chamber may have a substantial width, as illustrated, so that its sides are situated near to the side walls of the van. The chamber is formed by a false roof 13 and has free communication with the duct spaces 10 of the side walls. A comparatively large fraction of the area of the false roof 13 is composed of louvre boards or slats 14 which are manually adjustable or automatically controlled by an appropriate thermostat (not shown) which thus serves to control the descent of cold air from the cooling elements in the chamber 12 into the lading space 15, as described in the specification of our United States application Serial No. 376,651. If desired, the end walls and the van doors or movable wall parts may be fitted, similarly to the side walls 2, with false inner walls providing additional circulation spaces.

When the van has been loaded and the doors closed, the cold air in its descent passes freely over the goods in the lading space 15 and absorbs heat therefrom and then passes through openings 16 in the false floor 6 to the space 9 beneath the false floor 6 and so to the vertical spaces 10 between the false and outer walls 8, 2. In the floor and wall circulation spaces 9, 10, the air absorbs the heat which leaks through the insulation 4 of the floor and walls and the warmed air rising within the wall spaces 10 finally passes to the roof chamber 12 for re-cooling by the cooling elements 11. When the goods have been cooled to the appropriate temperature, the circulation is maintained principally by the warming of the air in the wall spaces 10, that is to say there is substantially no change in the temperature of the cold air during its descent from the cooling elements to the floor but a rise of temperature takes place during its ascent through the wall spaces. Any appreciable amount of heat leakage into the lading space 15 is rendered impossible by the low conductivity of the wood inner wall 8 and the low thermal head across such wall, due to the fact that the air rising by induced circulation in the ducts 10 between the walls is of a temperature but little higher than that in the lading space. Goods in all parts of the lading space are therefore maintained at an even temperature, warm or cold air pockets being prevented, and refrigeration by air circulation is evenly distributed throughout the entire lading space.

In the van construction illustrated in Figures 2–4, a longitudinal trunk extends along the middle of the insulated roof 4 and this trunk is divided by vertical partitions 16 into a central duct 17 and side ducts 18, the latter communicating with respective side wall circulation spaces 10, and a circulation space at the far end (not shown) of the van, through roof circulation spaces 19 provided by false roof portions 20. The circulation spaces improve the heat insulating properties of the van as heretofore explained. A double walled partition 21 is erected at a short distance from one end of the van to close off a refrigerator chamber 22 which communicates at the top with the central duct 17 of the trunk and at the bottom with a circulation space 23 formed by a false end wall 24. The side ducts 18 of the trunk communicate with the circulation space 23 of the end wall. A cold accumulator unit with quick cooling evaporator coils 26 is installed in the refrigerator chamber 22. An electric fan 27 is installed at the point of junction between the top of the refrigerator chamber 22 and the central duct 17 of the trunk. Upon the sun shield 5 is supported a wire wound air-cooled condenser 28 protected against the sun by sun shield slats 29. The central duct 17 of the trunk is formed with delivery apertures which may be fitted with directional nozzles 30 for delivering cold air down into the lading space 15. A compressor 31 of the opposed two-cylinder type fitted beneath the underframe 32 is conveniently driven from a running axle 33 by means of an insulated worm gear 34 at the axle, the drive being transmitted through a telescopic propeller shaft 35 and a gear box 36 comprising a governor controlled variable speed gear and clutch for automatically cutting out the drive at low speed, so that the compressor is free to be driven through other agencies when the van is standing. The underframe is also fitted with a receiver or reservoir 37 for liquid refrigerant, this reservoir being connected on the one hand with the condenser 28 and on the other hand with the evaporator 26. The operation of the van 27 is controlled by a thermostat 38 mounted on the partition 21 in the upper part of the lading space 15. The fan may be driven by a battery which is charged by an axle-driven dynamo (not shown). For some purposes a false floor may also be fitted, as in Figure 1, to give a circulation space below the lading space.

In the operation of the installation, the fan 27 lifts cold air from the refrigerator chamber 22 and delivers it to the central duct 17 of the trunk from which it passes through the apertures or directional nozzles 30 to all parts of the lading space 15. The descent of cold air in the lading space displaces the warm air which passes through the floor level openings 39 into the circulation spaces 10 of the two side walls and far end wall. The air rising in such wall spaces passes into the circulation spaces 19 within the roof and so into the side ducts 18 of the

trunk. The side ducts convey this air to the circulation space 23 of the other end wall and thus it is passed back into the bottom of the refrigerator chamber 22 wherein it is re-cooled and then re-circulated by the fan. This cooling operation can proceed whether the van is stationary or moving, so long as any cold remains in the refrigerator. When the van is travelling, and the clutch of the gear box 36 is closed, the compressor 31 is driven from the axle 33 and operates to remove refrigerant from the evaporator 26 and deliver it in a compressed condition to the condenser 28 wherein such refrigerant is liquefied. The reservoir 37 receives liquid refrigerant from the condenser 28 and delivers the same, under suitable control, for expansion in the evaporator coils. Auxiliary vertical containers 40 may be fitted within the refrigerator chamber 22 and in communication with the coils 26 thereof, such containers serving to receive and hold excess volume of refrigerant, when the van is standing and the compressor 36 is at rest. By this means, it is impossible for the compressor to become charged with liquid refrigerant when at rest, or to suck in liquid refrigerant when restarted after a period of rest.

I claim:—

1. Refrigerator chamber, comprising an insulating shell, false inner walls bounding a lading space and spaced away from said shell to form a circulation space enclosing said lading space, a separate compartment for cooling apparatus, an air supply duct arranged in the roof of the chamber and communicating between the cooling compartment and the lading space, an air return duct also arranged in said roof and communicating between the circulation space, which communicates with the lading space, and the cooling compartment, and air forcing means for circulating air around a circuit constituted by said compartment, supply duct, lading space, circulation space and return duct.

2. Refrigerator chamber, comprising an insulating shell, false inner walls bounding a lading space and spaced from said shell to form a circulation space enclosing said lading space, a separate compartment for cooling apparatus, an air trunk arranged in the roof of the chamber and divided into supply and return ducts communicating between said compartment and the lading space and between the circulation space and said compartment respectively, and air forcing means for circulating air around a circuit constituted by said compartment, circulaton space and return duct.

3. Refrigerator chamber, comprising an insulating shell, false inner side walls bounding a lading space and spaced from said shell to form a circulation space enclosing said lading space and communicating with the lower part thereof, a separate compartment for cooling apparatus having a double end wall bounding a circulation space communicating with the lower part of said compartment, an air supply duct communicating between the upper part of the cooling chamber and the upper part of the lading space, an air return duct communicating between the upper part of the side wall circulation space and the upper part of the end wall circulation space, and air forcing means for circulating air around a circuit constituted by said cooling compartment, supply duct, lading space, side wall circulation space, return duct and end wall circulation space.

4. Refrigerator van comprising a compartment containing cooling aparatus, a lading chamber consisting of an insulating shell which is lined with false inner walls separated from said shell by air-circulation spaces, connections between said compartment and the upper part of said chamber adapted for distributing cooled air downwardly throughout the latter, and connections between the lower part of said chamber and the lower parts of the inter-wall spaces and between the upper parts of the latter and said compartment, the last named connections providing the only communication from said chamber back to said compartment so that the air rising in said inter-wall spaces constitutes an insulating jacket enclosing said chamber.

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