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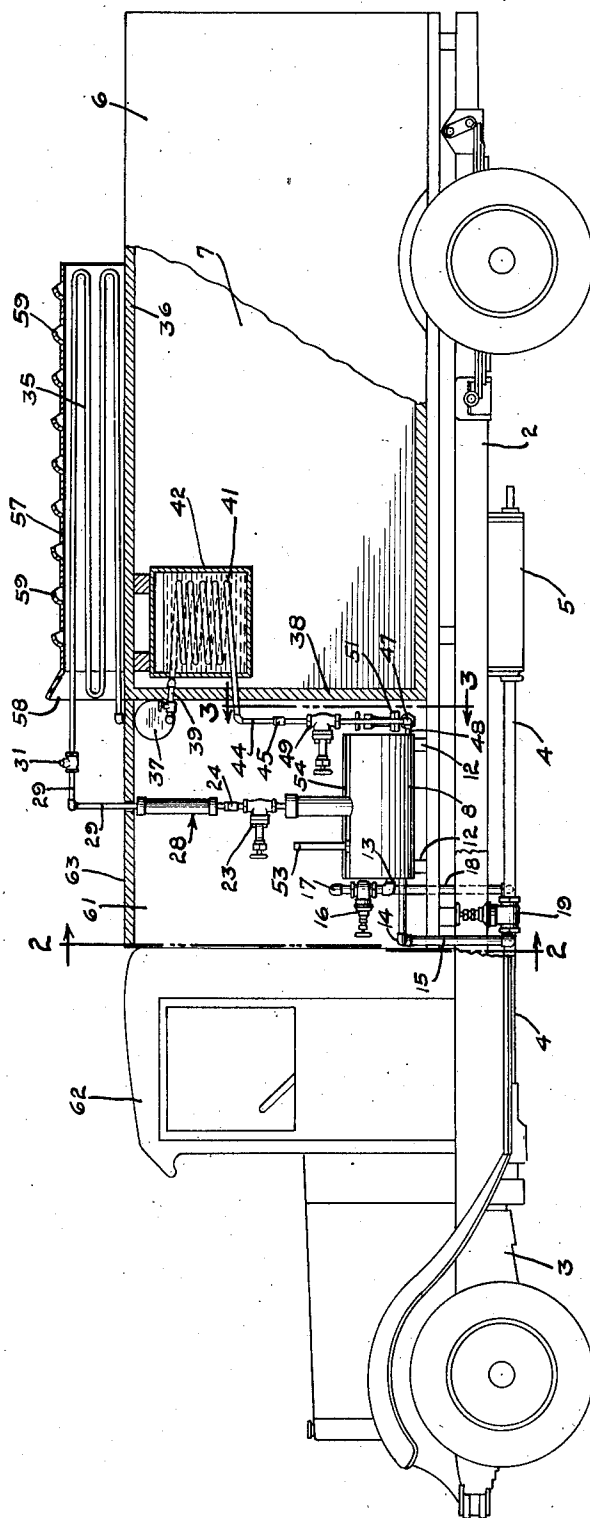
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1,923,451

REFRIGERATING APPARATUS

Filed Dec. 31, 1931

3 Sheets-Sheet 1



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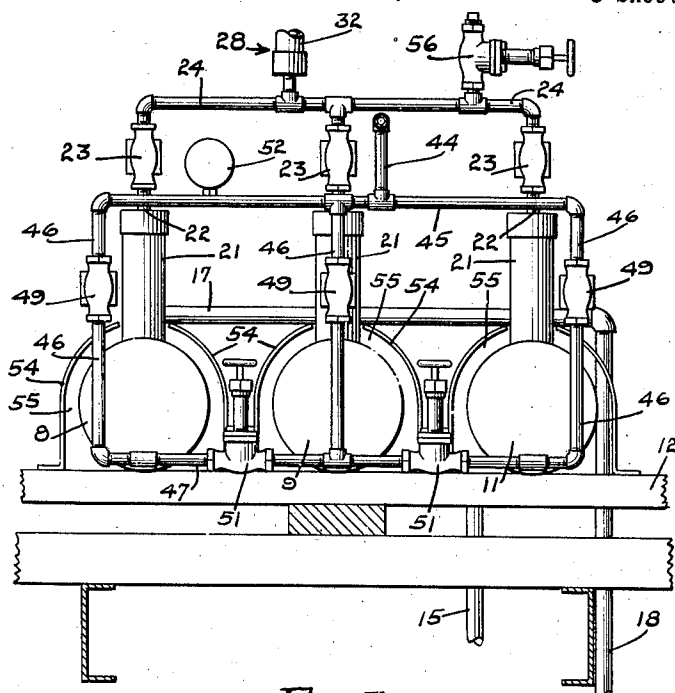


Fig. 3

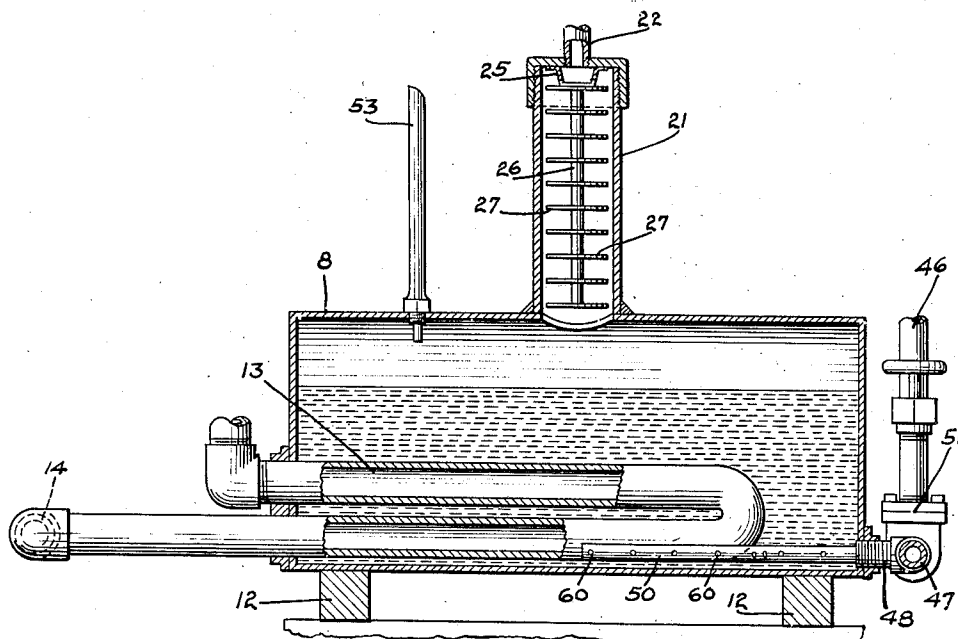


Fig. 4

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REFRIGERATING APPARATUS

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3 Claims. (Cl. 62—117)

This invention relates to new and useful improvements in refrigerating apparatus and more particularly relates to such an apparatus of the portable type adapted for use in connection with a vehicle body.

An object of the invention is to provide a refrigerating apparatus of simple and inexpensive construction and in which no movable parts or mechanisms are employed.

A further object is to provide a refrigerating apparatus comprising a still into which the expanded ammonia gas, after having exerted its refrigerating effect, is returned, and is absorbed by the liquid therein after which the ammonia gas is separated from the water in the still by the application of heat thereto, and means being provided whereby the exhaust gases from the engine of the vehicle may be utilized for heating the liquid in the still.

A further object is to provide a portable refrigerating apparatus of the absorption type, comprising a plurality of interconnected stills or tanks connected in the circulating system of the apparatus in such fashion that said stills or tanks may be used independently of one another, so that when one tank is being heated to separate the ammonia gas from the water therein, another tank may be cooling off so that the water therein will absorb the expanded ammonia gas returning thereto from the cooling coil, located within the food storage compartment of the apparatus, and said stills or tanks also being adapted for simultaneous operation.

Features of the invention reside in the arrangement of the stills and the means whereby they may be operated independently of each other, or successively; in the means provided in the circulating system of the apparatus for preventing the water in the stills from being carried into the cooling coil; in the means provided for cooling the condensing coil whereby the ammonia gas therein may be quickly liquefied; in the particular arrangement of the liquid ammonia receiving tank and the cooling coil; in the means provided for controlling the flow of liquid ammonia from the liquid ammonia tank into the cooling coil situated within the compartment to be cooled, and in the means provided for selectively controlling the circulation of the exhaust gases through the heating coils of the stills to control the heating of the water therein.

Other objects of the invention will appear from the following description and accompanying drawings and will be pointed out in the annexed claims.

In the accompanying drawings, there has been

disclosed a structure designed to carry out the various objects of the invention, but it is to be understood that the invention is not confined to the exact features shown as various changes may be made within the scope of the claims which follow.

In the drawings—

Figure 1 is a view showing a side elevation of a conventional type of vehicle, having a food storage compartment provided in the body thereof, and showing the invention embodied in the construction of the vehicle;

Figure 2 is a cross sectional view on the line 2—2 of Figure 1, showing the means provided for controlling the circulation of the hot waste gases from the vehicle engine through the heating coils of the stills, and also showing the liquid ammonia receiving tank;

Figure 3 is a cross sectional view on the line 3—3 of Figure 1 showing the means provided for controlling circulation of the ammonia gases through the stills;

Figure 4 is an enlarged detail sectional view on the line 4—4 of Figure 2 showing the interior construction of the stills; and

Figure 5 is a detail sectional view on the line 5—5 of Figure 2, showing the interior construction of the moisture or water trap provided in the pipe connecting the stills with the liquid ammonia receiving tank.

In the selected embodiment of the invention here shown, there is illustrated in Figure 1, a vehicle or commercial type of truck comprising the usual chassis 2, engine 3, exhaust pipe 4, leading from the engine to the usual muffler 5, and the body 6 which is shown provided with a food storage compartment 7.

In the transportation of perishable goods such as meats, vegetables, milk, ice cream, etc., it is necessary that means be provided for maintaining the temperature in the food storage compartment sufficiently low to preserve the goods so that they may readily be transported over long distances in hot weather, as from one town to another. Since the advent of the good roads, it has become very popular to transport food stuffs from one town to another by means of automobile trucks, and it has heretofore been customary to use ice, as a refrigerant, for maintaining the food compartments of such trucks sufficiently cool to preserve the foods while being transported. Ice is not a practical refrigerant for long hauls, principally because in real hot weather, it deteriorates very rapidly, and the length of time in which the goods may be preserved in an ice cooled com-

partment is therefore limited. Ice is also more or less unsatisfactory because of the water resulting from the ice when melting which usually makes it necessary to provide suitable drains in the body

5 to permit the escape of such water.

It is therefore desirable that an artificial refrigerating apparatus be provided which may be used in connection with vehicle bodies to maintain the storage compartments thereof at the proper temperature for the preservation of foods; which is inexpensive in construction and may be readily and conveniently operated when in use; and which may be operated at a very small cost; and it is the purpose of the present invention to provide such a refrigerating apparatus which meets all of the above mentioned requirements.

The novel refrigerating apparatus featured in this invention preferably comprises a plurality of stills 8, 9, and 11, in the form of large cylindrical tanks, and preferably arranged in spaced parallel relation, as shown in Figures 2 and 3. The stills may be supported upon suitable cross beams 12 secured to the chassis of the vehicle. The stills are adapted to contain a suitable liquid such as distilled water, as is customary in such apparatuses using the absorption process of refrigeration.

An important feature of this invention resides in the means provided for heating the water in the stills 8, 9, and 11, whereby the use of a compressor or circulating pump may be dispensed with. When the refrigerating apparatus is used in connection with an automobile truck body, as disclosed in Figure 1, the water in the stills may be heated by the exhaust gases from the engine 3, and suitable heating coils 13 are therefore shown positioned in the lower portions of said stills, as best shown in Figure 4, having their intakes connected with a header 14 which is connected with the exhaust pipe 4 by a suitable connection 15, shown in Figures 1 and 2.

The discharge ends of the coils 13 are connected with suitable control valves 16, which are shown connected to a horizontally disposed pipe 17, which in turn is connected by a pipe 18 to the exhaust pipe 4 rearwardly of the pipe connection 15. A control valve 19 is interposed in the exhaust pipe between the pipe connections 15 and 18, as best shown in Figure 1. By means of the valves 16 and 19, the exhaust gases may be caused to circulate through the heating coil of a selected still, or the gases may be caused to circulate simultaneously through the heating coils of all of the stills, whereby the water therein will be heated simultaneously. In ordinary practice, however, the stills are preferably heated successively, so that while the liquid in one still is being heated to separate the ammonia gas therefrom, another still may be cooling off to permit the liquid or water therein to absorb the expanded ammonia gas discharging from the cooling coil.

The valve 19 may be regulated so as to cause all or a portion of the exhaust gases to circulate through one or more of the heating coils, and when the apparatus is not functioning, the valve may be so positioned as to cause all of the exhaust gases to flow directly through the valve 19 and into the muffler, whereby none of the gases will circulate through the heating coils of the stills.

A suitable condenser 21 is provided on each still. These condensers have pipes 22 connecting them with suitable valves 23, connected with a header 24, as shown in Figure 2. The valves 23 will hereinafter be referred to as the discharge

valves. Each condenser 21 has a bracket 25 secured to the upper end thereof, as shown in Figure 4, to each of which a suitable rod 26 is secured. These rods depend into their respective condenser casings, as shown, and are provided with suitable condensing plates 27, arranged in spaced relation, and adapted to contact with the ammonia gas discharging from the stills into the circulating system of the apparatus. Any steam or water vapor rising into the condensers 21 will be condensed by contacting with the plates 27 thereof, and will be returned to the stills, while the ammonia gas will be discharged through the pipes 22 and into the header 24.

A moisture or water trap 28 has its lower end connected with the header 24 and its opposite end with a pipe 29, the opposite end of which is connected to a suitable check valve 31. The water trap 28 is shown comprising a cylindrical casing 32 having an upright pipe section 33 mounted therein, the lower end of which communicates with the header 24. The upper end of the pipe section 23 terminates short of the upper end of the casing 32, as shown in Figure 5. The ammonia gas rising into the pipe section 33 will discharge from the upper end thereof into the casing of the water trap as will readily be understood by reference to Figure 5. A series of small holes or apertures 34 are provided in the lower end of the pipe section 33 whereby any moisture or water carried upwardly into the trap, casing by the ammonia gas, will be precipitated to the bottom of the trap, from whence it will flow by gravity through the apertures 34 and into the connection between the trap and the header 24 to be returned to the stills.

A condensing coil 35 is shown mounted on the roof 36 of the vehicle body 6 and has one end connected with the check valve 31 and its opposite end to a liquid ammonia tank 37, mounted at the upper forward portion of the vehicle body 6, preferably exteriorly of the front wall 38 thereof. A pipe 39 connects the opposite end of the ammonia tank 37 with a cooling coil 41 mounted within the brine tank 42, preferably situated within the upper forward portion of the food storage compartment 7 of the vehicle body, as shown in Figure 1. A suitable valve 43, commonly termed an expansion valve, is interposed in the pipe 39, whereby the discharging of the liquid ammonia from the tank 37 into the cooling coil 41 may be accurately controlled. In the drawings, I have shown the valve 43 adapted for manual operation, but it is to be understood that, if desired, means may be provided for automatically controlling the discharging of the liquid gas from the tank 37, without departing from the scope of the invention.

The opposite end of the coil 41 is connected by a pipe 44 to a header 45 having pipes 46 connecting it with a second header 47 mounted at the lower rear portions of the stills 8, 9, and 11, as best shown in Figure 3. The lower header 47 is connected with the stills by suitable connections 48 shown in Figures 1 and 4. The connections 48 are shown having distribution pipes 50 secured thereto which project into their respective stills, and have a series of discharge apertures 60 provided in the walls thereof.

Valves 49 are provided in the pipe connections 46 for controlling circulation therethrough, and these valves will hereinafter be referred to as suction valves. Suitable valves 51 are also provided in the header 47 between adjacent stills to control circulation through the header 47 as best shown in Figure 3. A suitable pressure gauge 52

is provided on the header 45 to indicate the pressure of the ammonia gas in the coil 41.

operating to boil off the ammonia absorbed by the liquid therein and circulate it into the system, as hereinbefore described.

Each still is provided with a suitable thermometer 53, shown in Figures 1, 2, and 4, whereby the temperature of the liquid in the stills may be noted. It will also be noted that each still is enclosed within a casing member 54, which members are spaced from their respective stills to provide air-circulating passages 55. These casings are preferably open at their ends and tops to permit free circulation of air through the air chambers 55.

To start the apparatus after it has initially been charged with ammonia, the heat control valves 16 and 19 may be adjusted so as to cause the exhaust gases from the vehicle engine to circulate through heating coil 13 of still 8, whereby the water in said still will be heated to boil off the ammonia absorbed by the water therein. Upon starting, the expansion valve 43 of the liquid ammonia tank 37 is closed, and the discharge valve 23 of the still 8 is opened to permit the ammonia gas discharging from the still 8 to rise into its condenser 21 and into the header 24, from whence it flows upwardly through the water trap 28, pipe 29, check valve 31, and into the condensing coil 35, where the ammonia gas is cooled and liquefied so that it will discharge from the coil 35 into the tank 37 in a liquefied form. When still 8 has been heated to the proper temperature (about 220 to 230 degrees Fahrenheit), to separate the ammonia gas from the water therein, the supply of heat to coil 13 of still 8 is shut off by manipulation of its heat control valve 16, and the discharge valve 23 of said still is also closed. Suction valve 49 of still 8 is then opened, after which the expansion valve 43 is slightly opened to allow the proper amount of liquid ammonia to discharge from the liquid ammonia tank 37 and expand into the cooling coil 41. As the ammonia discharges from the tank 37 into the coil 41, it immediately gasifies, at which stage, the actual freezing operation begins, as is well known. The check valve 31 prevents the high pressure ammonia gas in condenser coil 35 from returning to still 8, when the heating means of said still is shut off.

A charging valve 56 is shown connected to the header 24, whereby the air within the circulating system of the apparatus may be withdrawn or pumped therefrom before the system is initially charged with ammonia. The ammonia is introduced into the system by connecting the ammonia supply tank to this valve.

It will also be noted by reference to Figures 1 and 2, that a small housing 57 is shown provided with a flared intake opening 58 adapted to direct air through said housing to cool the coil 35. The upper wall of the housing 57 may also be provided with suitable louvers 59 to increase air circulation through the housing. If desired, the housing 57 may be widened so as to be substantially equal to the width of the vehicle body whereby it may form, in effect, an arched roof for the body. The space 61 provided between the cab 62 of the vehicle and the front wall 38 of the vehicle body, is preferably enclosed by a suitable housing 63 provided with suitable door openings, not shown, whereby convenient access may be had to the interior thereof.

Operation

In the operation of this novel refrigerating apparatus, the stills 8, 9, and 11 are filled about three-fourths full of distilled water, after which a suitable pump is attached to the charging valve 56 and the air pumped from the circulating system of the apparatus to provide a vacuum therein. The valve 56 is then closed and an ammonia supply tank, of ordinary construction, is connected to the outlet of the valve 56 in lieu of the vacuum pump, and ammonia is then introduced into the system to about 60 to 70 pounds pressure, determined by the atmospheric temperature. As soon as the ammonia is initially introduced into the system, it expands in the form of gas and fills the pipe connections leading from the charging valve to the stills and also to the condenser coil 35 provided over the vehicle body. It is to be understood that when the system is being charged, the expansion valve 43 at the discharge end of the liquid ammonia tank 37 is closed. When the water in the stills is cold, the ammonia gas introduced into the system is quickly absorbed thereby, because of the inherent characteristic of the ammonia to liquefy when cooling.

When the system has thus been initially charged with ammonia, it is ready for operation, and the water in one or more of the stills 8, 9, and 11 is then heated to boil off or separate the ammonia absorbed by the water therein. When three stills are used, as illustrated in the accompanying drawings, the stills are preferably operated successively, that is, the ammonia in still 8 may be boiled off first, and when this tank has completed its distilling operation, still 9 is started, and the heating means of still 8 is shut off, permitting still 8 to cool. It will thus be seen that the apparatus may be so operated that while one still is cooling off, another one may be

As the ammonia gas flows through the cooling coil 41 in the brine tank 42, it absorbs the heat from the storage compartment 7 of the vehicle body, and slowly flows into the upper header 45 and through the open suction valve 49 of the still 8, and into the lower portion of said still. During the period that still 8 is operating, the suction valves 49 of stills 9 and 11 may be closed and the valves 51 between the stills are also closed so that the expanded ammonia gas flowing from the cooling coil 41 must return to the still 8, thereby completing one cycle of operation.

During the period that the liquid ammonia in the tank 37 is discharging therefrom into the cooling coil 41, the second still 9 may be operating to boil off or separate the ammonia gas from the water contained therein and, in like manner, still 11 may be caused to operate when the other tanks are cooling off. The valves 23, 49, and 51 thus provide means for controlling the operation of the stills so that when once the apparatus has been initially charged with ammonia, and is started, it may continue to operate indefinitely as long as the vehicle engine is operating to supply heat to the coils 13 of the stills.

In the drawings, I have shown the stills as being horizontally mounted in spaced relation and disposed lengthwise of the vehicle, but it is to be understood that, if desired, the stills may be vertically arranged without departing from the scope of the invention, the operation of the apparatus being substantially the same.

It is also to be noted that in the drawings, three stills are shown interconnected in such a manner as to permit them to be operated independently or successively. In some systems, it

may be found desirable to use but a single still, in which case the apparatus may be operated periodically only, for the reason that each time the still has been operated to separate the ammonia gas from the water therein, time must be allowed for the water in the tank to cool before said water will absorb the expanded ammonia discharging from the cooling coil 41. Two stills may also be used, when suitably connected together, but I have found that by connecting together three stills, as shown in the drawings, that the apparatus, when mounted upon an automobile truck, may be caused to operate continuously as long as the vehicle engine is functioning, which makes the apparatus particularly desirable for use in connection with automobile refrigerator bodies, used for transporting perishable goods over long distance as, for example, from one city to another.

It will also be noted that the apparatus is not dependent upon any movable parts or mechanisms for its operation. It operates entirely by gravity and by the waste heat from the vehicle engine. It will thus be seen that the cost of maintaining and operating this novel refrigerating apparatus, after once it has been installed, amounts to very little. The system being a closed one, there is very little loss in leakage or escape of the ammonia gas or water from the system, thereby providing such an apparatus which will require very little servicing.

It is further to be noted that by the provision of the casing 57 which encloses the condenser coil 35, said coil will be cooled by the circulation of air through said casing when the vehicle is traveling, thereby dispensing with the use of other cooling means such, for example, as water, which is now commonly used for cooling such condenser coils.

I claim as my invention:

1. A refrigerator truck comprising a frame having an engine mounted thereon and provided with an exhaust pipe, a driver's seat, a body spaced from said seat and having a food storage compartment, a refrigerating apparatus comprising a plurality of stills having ammonia-absorbing liquid therein, a refrigerator coil in said compartment, a condenser, pipes connecting said refrigerator coil and said condenser to said stills whereby they are in circuit therewith, a heating coil in each still connected to the engine exhaust pipe, control means convenient to the driver's seat for selectively controlling the operation of said heating coils whereby the stills may be successively operated to distill the ammonia from

the liquid therein and thereby maintain substantially a constant supply for the refrigerator coil, and other control means for selectively controlling fluid circulation between said stills and said refrigerator coil.

2. A refrigerator truck comprising a frame having an engine mounted thereon and provided with an exhaust pipe, a driver's seat, a body spaced from said seat and having a food storage compartment, a refrigerating apparatus between said seat and said body comprising a plurality of stills having ammonia-absorbing liquid therein, a heating coil in each still for heating the liquid therein, means connecting said heating coils to the engine exhaust pipe, means adjacent the driver's seat for selectively directing the exhaust gases of the engine through said heating coils, whereby said stills may be successively operated to distill the ammonia from the liquid therein, a refrigerator coil in the food storage compartment connected to said stills, means in the connections between said stills and said refrigerator coil for liquefying the ammonia distilled from said stills before it is delivered into the refrigerator coil, and means operable from the driver's seat for selectively controlling fluid circulation between said refrigerator coil and said stills.

3. A refrigerator truck comprising a frame having an engine mounted thereon and provided with an exhaust pipe, a driver's seat, a body spaced from said seat and having a food storage compartment therein, a refrigerating apparatus between said seat and said body comprising a plurality of stills having ammonia-absorbing liquid therein, a heating coil in each still for heating the liquid therein, means connecting said heating coils to the engine exhaust pipe, means adjacent the driver's seat for selectively directing the exhaust gases of the engine through said heating coils, whereby said stills may be successively operated to distill the ammonia from the liquid therein, a refrigerator coil in the food storage compartment connected to said stills, a condenser coil in series with said stills and said refrigerator coil for liquefying the ammonia distilled from said stills before it is delivered into the refrigerator coil, means operable from the driver's seat for selectively directing the ammonia gas discharging from said refrigerator coil into said stills, and a housing disposed on top of the truck body for supporting the condenser coil, said housing being arranged lengthwise of said truck body and open at both ends to permit free air circulation therethrough to cool the condenser coil.

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