United States Patent [19]

Willis

[11] 3,792,595

[45] Feb. 19, 1974

[54] **TRANSPORTABLE REFRIGERATION APPARATUS FOR PRESERVING PERISHABLES**

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[73] Assignee: **Thermo King Corporation,** Minneapolis, Minn.

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[21] Appl. No.: **301,010**

[52] **U.S. Cl.** **62/414,** 62/239, 98/9, 98/20, 62/407, 62/89

[51] **Int. Cl.** **F25d 17/06**

[58] **Field of Search** 98/9, 20; 62/407, 413, 414, 62/415, 416, 418, 419, 89, 97

[56] **References Cited**

UNITED STATES PATENTS

1,027,740	5/1912	Leeming	98/20
1,973,022	9/1934	Strobell	62/419
2,780,923	2/1957	Jones	62/78
2,793,834	5/1957	Henney	62/419
1,296,968	3/1919	Klein	62/97

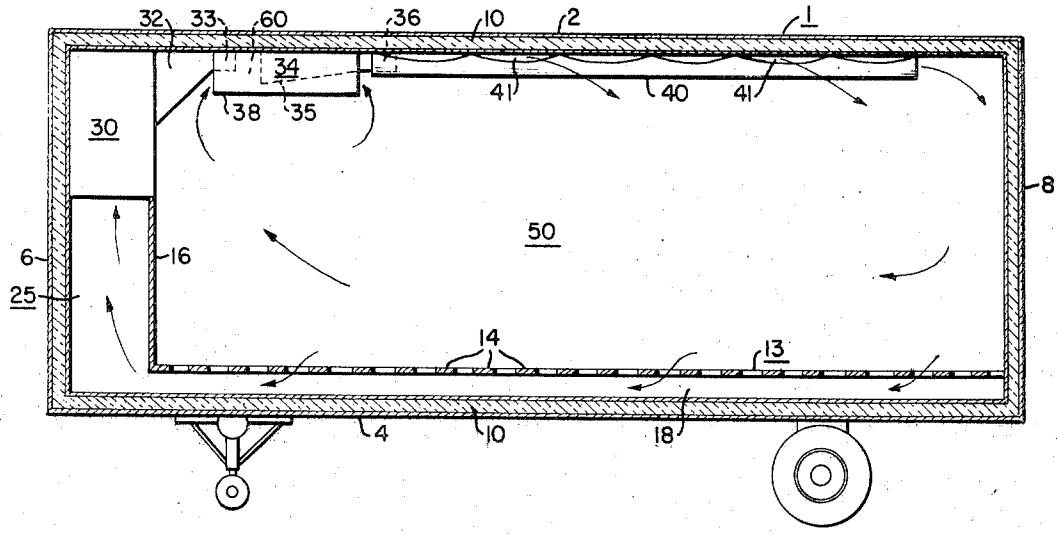
Primary Examiner—William J. Wye

Attorney, Agent, or Firm—F. H. Henson

[57] **ABSTRACT**

This invention relates to cooling apparatus used within a transportable refrigeration compartment for preserving perishables. The apparatus includes the combination of a heat exchanger having an exit nozzle for producing and discharging a gaseous cooling medium and a venturi-type conduit. The venturi conduit comprises an exit end and a flared inlet end which is aligned longitudinally apart from the heat exchanger exit nozzle and in a predetermined spaced relationship therewith. Gas ambient to the compartment and the cooling medium being ejected from the heat exchanger can be mixed within the flared end, with the tempered mixture being exhausted through the venturi conduit exit end and into the storage compartment. To provide an induced circulation of the tempered mixture throughout the compartment, the venturi conduit flared inlet end and the heat exchanger exit nozzle may be enclosed by a hollow duct having both the front and back walls removed so as to induce an aspiration effect therein.

5 Claims, 5 Drawing Figures



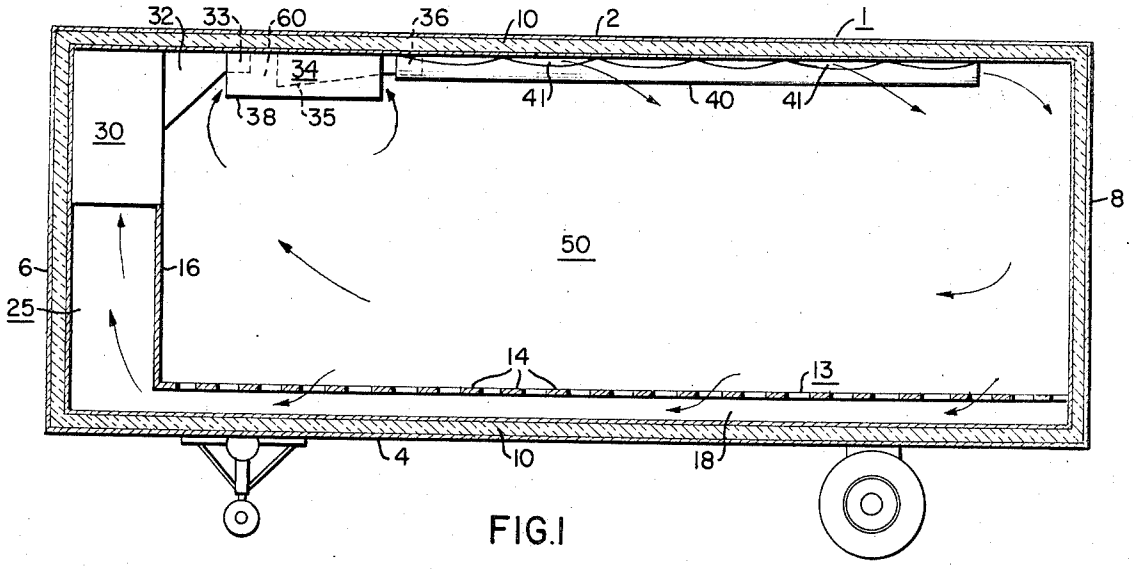

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FIG.1

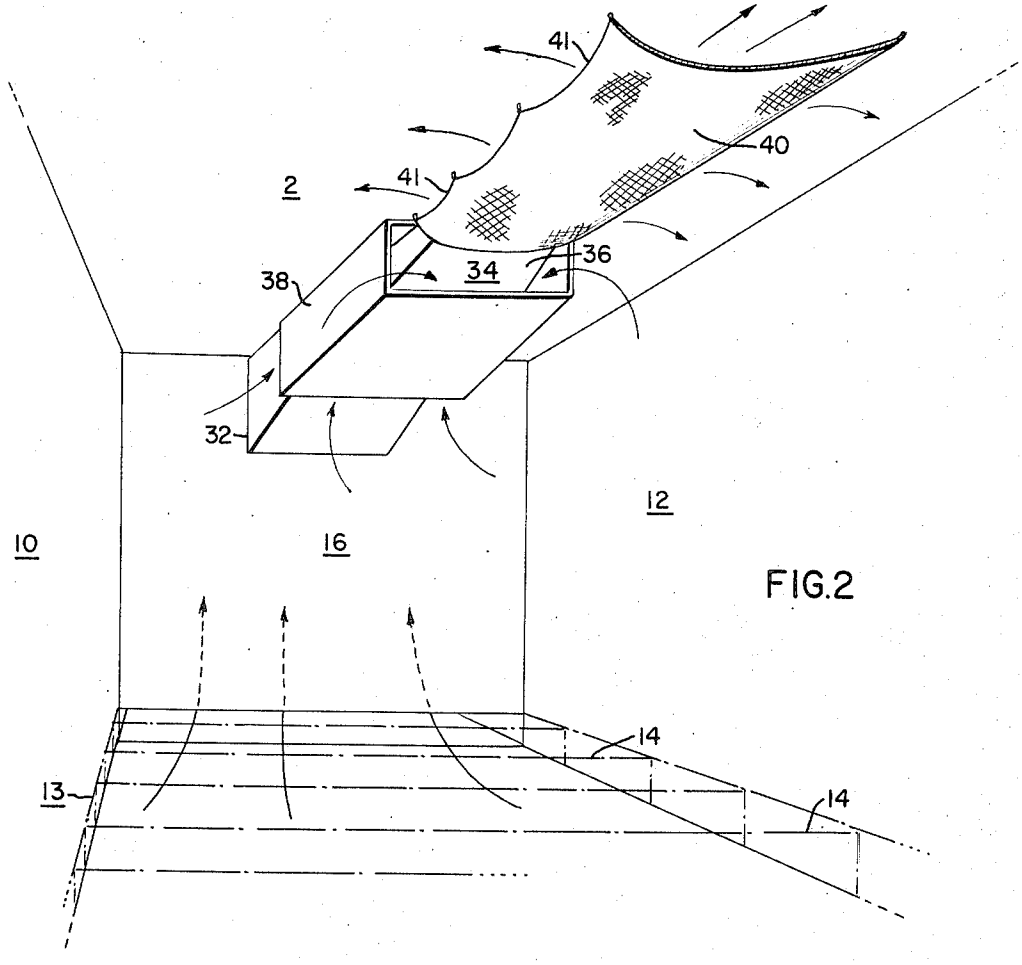
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FIG.2

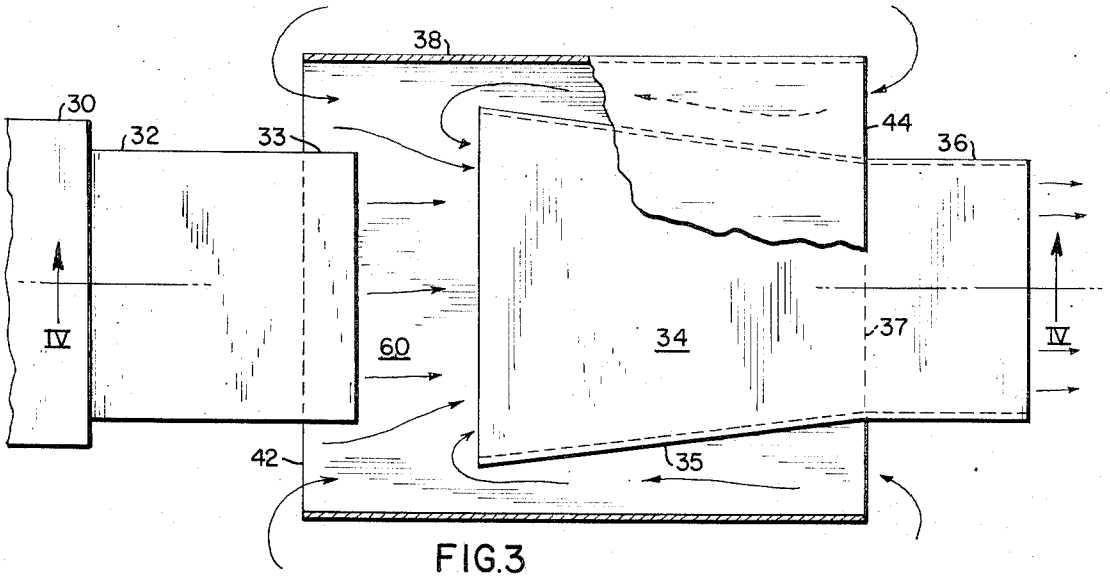

FIG.3

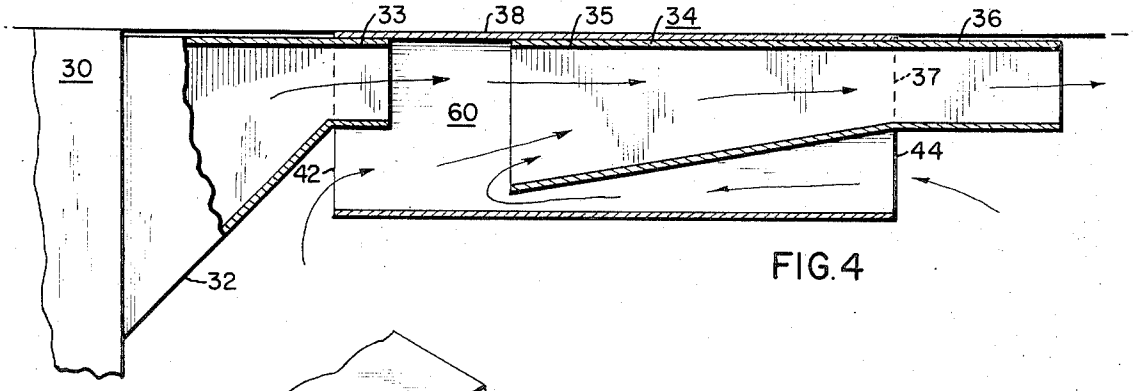

FIG.4

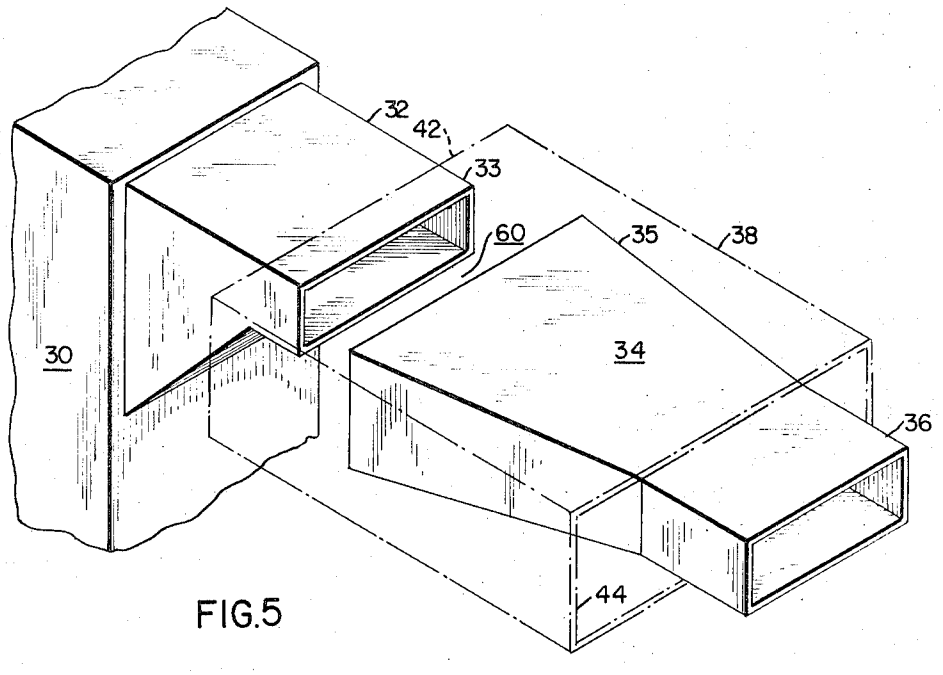

FIG.5

TRANSPORTABLE REFRIGERATION APPARATUS FOR PRESERVING PERISHABLES

CROSS REFERENCES TO RELATED APPLICATIONS

So far as known, this application is not related to any other pending patent applications.

BACKGROUND OF THE INVENTION

The problem of unevenly distributing a cooling gas to a cargo, which must be preserved by chilling during transit, has been known to exist in transportable refrigeration compartments of the type which are cooled by the circulation of refrigerated air. The temperature in the compartment has been held close to, but often above, the freezing point of a perishable commodity, such as fresh produce. Present attempts to correct this problem have included complex control units or bulky space consuming duct systems. Methods which provide refrigeration through the use of gases, such as Freon or carbon dioxide, have been found subject to maintenance and temperature control problems, while at the same time producing adverse temperature gradients.

It would therefore be desirable to employ standard refrigeration apparatus within a transportable cargo container to uniformly chill a product stored therein without the necessity of complex controls or complicated space consuming ductwork. It would also be desirable to reduce the possibility of maintenance and the need for highly complex temperature control, thereby helping to reduce cost to the user.

PRIOR ART

The following U.S. Pat. No. disclose examples of a transportable refrigeration unit and storage compartment for preserving perishables, wherein a venturi-type tube and an associated heat exchanger are combined to provide circulation of a temperature mixture of gases comprising a source of relatively low temperature coolant and the ambient air surrounding the perishables:

2,780,923	Jones	Feb. 1957
3,447,336	Grames	June 1969

However, none of the above patents discloses a venturi-type conduit having a flared inlet end portion which is aligned longitudinally apart from the respective exit nozzle of the heat exchanger and in a predetermined spaced relationship therewith.

SUMMARY OF THE INVENTION

A transportable refrigeration unit for preserving perishable goods is disclosed. The unit includes a compartment for storing the perishables and a suitable disposed heat exchange apparatus which is adapted to discharge a gaseous cooling medium through the discharge end of an exit nozzle and into the compartment at a relatively high velocity and low temperature. A venturi-type conduit is also provided comprising an exit end portion which communicates with the storage compartment and a flared inlet end portion converging to and connected with the exit end portion through a throat of reduced cross section.

In accordance with the instant invention, the flared inlet portion is aligned longitudinally apart from the exit nozzle discharge end and in a predetermined spaced relationship therewith, wherein gas of a relatively low velocity and high temperature, which is ambient to the perishables, and the gaseous cooling medium of relatively high velocity and low temperature may be mixed. The tempered mixture can then be exhausted through the venturi conduit exit end and in the storage compartment. To provide an induced circulation through the compartment and a more even distribution of the tempered air to the perishables, the heat exchange exit nozzle and the flared inlet end portion may be enclosed by a hollow duct in which the front and rear ends are open and exposed to the ambient air of the perishables so that an aspiration effect can be inducted therein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevation partly in section of the instant invention as employed within a transportable refrigeration unit;

FIG. 2 is an isometric view of the instant invention as employed within the cargo space of a transportable refrigeration unit;

FIGS. 3 and 4 are partially broken away cross-sectional views of the instant invention; and

FIG. 5 is a detailed isometric view of the instant invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2 of the drawings, a transportable refrigeration vehicle, intended primarily for the transportation of perishable foodstuffs, is generally represented by the numeral 1. The vehicle body consists of an outer shell having a top wall 2, a bottom wall 4, end walls 6 and 8, and side walls 10 and 12, each wall being provided with an intermediate layer of thermal insulation 10. Within the vehicle 1 is included a cargo chamber 50, wherein the perishables may be stored and preserved. Cargo chamber 50 has a floor rack 13 which is disposed above the vehicle body bottom wall 4 and is composed of a plurality of spaced members 14. A partition 16 separates chamber 50 from vehicle end wall 6. Partition 16 is suitably spaced from wall 6, so as to form a compartment or air space 25 therebetween which communicates with the channel 18, as formed between the raised floor rack 13 and bottom wall 4, and the space within cargo chamber 50. Within compartment 25 is a refrigerant evaporator or the heat exchange unit 30 of a mechanical refrigeration system.

The heat exchange unit 30 is suitably positioned within the compartment 25 and adapted to pass a gaseous cooling medium, such as chilled air, through the cargo chamber 50 at a relatively high velocity and low temperature. In communication with the heat exchange unit 30 is a tapering exit nozzle 32 having a truncated base and an associated discharge end 33 through which the cooling medium is discharged.

In accordance with the instant invention, a conduit 34 is also provided within chamber 50 and adapted to receive the cooling medium being discharged from exit nozzle discharge end 33. Conduit 34 (best illustrated in FIGS. 3 through 5) is of type similar to the conventional venturi tube and comprises an exit end portion 36, which communicates with the atmosphere of cargo chamber 50, and a flared inlet end portion 35, which converges with and is connected to the exit end portion 36 through an intermediate throat 37 of reduced cross section. Flared inlet end 35 is aligned longitudinally apart from the exit nozzle discharge end 33 in a prede-

termined spaced relationship so as to form a gap 60 between inlet end 35 and discharge end 33 in order that the cooling medium being discharged through discharge end 33 can be received by the inlet end portion 35. The advantages of maintaining the gap 60 between the exit nozzle discharge end 33 and the inlet portion 35 of conduit 34 will shortly become apparent.

It is desirable that flared inlet portion 35 be of a larger cross section than that of the exit nozzle discharge end 33. Thus, the proper dimensioning and spacing of discharge end 33 relative to inlet portion 35 will cause an aspiration effect within the area of the flared inlet portion, wherein the gaseous cooling medium, having a relatively high velocity and low temperature, and gas of a relatively lower velocity and higher temperature, which is ambient to the cargo chamber atmosphere and to the perishables contained therein, may be mixed and the temperatured mixture of gases through the exit end portion 36 of conduit 34 and into cargo chamber The tThe principle of an aspiration effect is well known and is described in greater detail in U.S. Pat. No. 3,447,336 to H. Gramse.

It has been found that by application of the apparatus as disclosed above within a transportable refrigeration unit, a gaseous cooling medium being discharged from the heat exchange unit 30 and having a temperature of about 51° F could be tempered to efect both a more moderate discharge cooling medium temperature and a more even distribution of the tempered mixture throughout vehicle cargo chamber 50. By way of example, with the cargo chamber ambient air having a temperature of about 68° F, a tempered mixture has been exhausted from duct end portion 36 with a resultant temperature of generally between 55° and 57° F. A further consequence of the aspiration effect is to more evenly distribute the tempered mixture by inducing a path of continuous circulation throughout cargo chamber 50 and down through the floor rack 13 (shown by FIG. 1) to the forward end of the chamber by way of channel 18 where the major portion of the air will flow upward through compartment 25 and into the heat exchange unit 30 for recirculation.

By aligning flared inlet end 35 longitudinally apart from the exit nozzle discharge end 33 and maintaining a predetermined space or gap 60 therebetween, the temperature and volume of the gases entering inlet end 35 can be regulated, depending upon the size of the gap, and accordingly, the temperature of the mixture being exhausted from conduit exit end 36 can be controlled, as desired, without the need of complex regulating equipment.

The tempered mixture of gases may be exhausted through conduit 34 and directly into the cargo chamber, as illustrated in FIGS. 3 through 5, or exit end portion 36 may be suitably modified as part of the conduit assembly. It is also within the scope of this invention for conduit exit end 36 to be longitudinally extended (not shown) across a portion of chamber 50 in order that the tempered mixture may be exhausted at a point near the vehicle end wall 8. Or, still another arrangement, as shown in FIGS. 1 and 2, would be to affix a separate, longitudinally extending and closely woven fabric 40 to exit end 36 which would enable the tempered mixture to escape from pockets 41 formed between neetting 40 and the vehicle top wall 2, thereby providing a wider distribution of the mixture throughout the cargo air space.

As an alternate embodiment of the instant invention, the flared inlet end portion 35 of conduit 34 and the discharge end 33 of the heat exchanger exit nozzle 32 may be enclosed by a hollow duct 38 having both its front and rear end walls 42 and 44 open and exposed to the cargo space which is ambient to the perishables. With the addition of a duct, such as that shown at 38, it has been found that an aspiration effect may occur, not only in the area of the conduit inlet end portion 35, as previously disclosed, but also at the front and rear ends 42 and 44 of the duct 38. Thus, a different supply of air ambient to the cargo space will be available for mixing with the chilled cooling medium at conduit inlet end 35, and consequently, a better circulation of the tempered mixture will be induced throughout the cargo storage space. The positioning of duct 38 relatively to gap 60 can also provide further means for regulating the resultant temperature of the tempered mixture being exhausted from conduit exit end 36 without the need of complex control equipment. Thus, the disclosed apparatus, which are relatively simple and inexpensive means for regulating the cooling of a transportable refrigeration cargo chamber to preserve perishables, will help to reduce the ultimate cost to the user.

Other modifications will occur to those skilled in the art.

I claim:

1. A transportable refrigeration unit for preserving perishables including a compartment for storing said perishables, heat exchange means suitably positioned in relation to said compartment and adapted to pass a gaseous cooling medium therethrough at a relatively high velocity and low temperature, an exit nozzle means in communication with said heat exchange means having an associated discharge end for discharging said cooling medium therefrom, and a conduit means, said conduit means comprising an exit end portion communicating with said storage compartment and a flared inlet end portion converging with and connected to the exit end portion, said flared inlet end being of sufficient dimension and aligned longitudinally apart from said exit nozzle discharge end in the direction of said coolant flow and in a predetermined spaced relationship therewith, whereby gas of relatively low velocity and high temperature and ambient to the perishables and said gaseous cooling medium of relatively high velocity and low temperature may be mixed in said flared portion to thereby enable the tempered mixture to be exhausted from said exit and into said storage compartment.

2. The invention of claim 1, wherein said flared inlet portion and the discharge end of said heat exchanger exit nozzle means are enclosed by hollow duct means, said duct means having both front and rear ends opened and exposed to said storage compartment.

3. The invention of claim 1, wherein a longitudinally extending means that is adapted to transport the tempered mixture is connected to said exit nozzle discharge end, said extending means having a plurality of spaced openings over a portion of its surface from which said tempered mixture may be exhausted and distributed throughout said storage compartment.

4. The invention of claim 1, wherein said flared conduit means inlet portion is of a larger cross section than that of the discharge end of said heat exchange means exit nozzle so as to induce an aspiration effect in the area of the flared portion.

5. The invention of claim 1, wherein said heat exchange means exit nozzle tapers towards its discharge end.

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