Abstract:
The invention relates to areefer container for shipping goods placed onpallets, which container comprises aplurality ofsidewalls forming the sides, floor and ceiling in the container, a front end comprisingcooling and or ventilating means and a rear end comprising an opening to be closed by one or more doors, a reefer machine further comprising one or more evaporators and one or more fans for transporting cooling air into the container, an evaporator (3) is placed above a fan (2) in an air circulating system forcooling the air (4) in the container (14), where air circulating or passing through the reefer machine (1) and guided from the evaporator or (3) is divided into ducts (8) at both sides of the container (14). The invention further relates to a method of loading a reefer container (14) with pallets (15, 16).
INCREASED CARGOSPACE IN A CONTAINER

The invention relates to a reefer container for shipping goods placed on pallets, which container comprises:

- a plurality of sidewalls forming the sides, floor and ceiling in the container;
- a front end comprising cooling and or ventilating means and a rear end comprising an opening to be closed by one or more doors;
- a reefer machine further comprising one or more evaporators and one or more fans for transporting cooling air into the container;
- that an evaporator is placed above a fan in an air circulating system for cooling the air in the container.

The invention further relates to a method for loading a reefer container with pallets.

When constructing reefer containers for shipping goods it is common that a reefer machine for the reefer container have been manufactured and sold by different companies. The reefer machine has been installed in the front frame of the container by means of bolts or rivets or similar fastening means.

A frame for supporting the reefer machine in the container has usually been manufactured in aluminium, and the front frame of the container has been built in steel.

The reefer machines used for reefer containers have so far always been provided with a plenum for the cold air delivery on a back side of the reefer machine.

Once the reefer machine is installed in the container, there is a void on both sides of the machine.
These voids, commonly called lockers, have traditionally been used for storage of temperature sensors etc.

When manufacturing of both frame and machine, it is more convenient to integrate reefer machine and container, hence omitting the aluminium frame for the machine, which is then built into and integrated with the front end wall of the container. This offers obvious advantages like improved air tightness and insulation values.

Evaporator fans used in reefer machines has normally been powered by traditional asynchronous motors and the evaporator fans is normally placed in a plate above an evaporator, thereby pushing the air through the evaporator. The plate separates the intake air from the evaporator. Such a prior art arrangement is shown in figure 1.

A further disadvantage by using asynchronous motors is that they are producing too much heat due to their low efficiency. In order to compensate for this undesirable add-on heat, the evaporator needs to run at a lower temperature which will cause a lowering of the relative humidity in the supply air.

Regarding the products shipped in reefer containers it is for most produce important to keep the humidity level as high as possible in order to prevent dehumidification of the produce. Therefore it may be necessary to add humidity to the air within the container to ensure a sufficient humidity level to avoid the problem of dehumidification of the produce. Such adding of humidity to the air within the container will require additional equipment to each container or group of containers and will therefore be of great disadvantage.
SUMMARY OF THE INVENTION

The overall purpose of creating more space for cargo within the container can be obtained by redesigning the reefer machine.

Such redesigning opens up for utilizing the voids (lockers) on both sides of the machine.

In one embodiment the width of the evaporator is extended to full width or near full width of the interior of the container. This provides also the possibility of directing the airflow into side-channels instead of using the state of the art solution which would be to use a plenum on the back side of the machine.

Placing the evaporator above the fan or fans and thereby sucking the air through the evaporator instead of pushing it through, provides a better distribution of air through the evaporator.

A combination of the above mentioned features leads to an increased efficiency of the fan. This solution is possible in that the one or more evaporator fans are placed in one or more ducts and that the one or more fan motors can be controlled. When more fans and fan motors are used, each fan motor can be controlled together with the other fan motors within the container or independently.

By dividing the air guided from the evaporator into ducts at both sides of the container, it is possible to increase the internal cargo space.

This is further achieved by that the ducts are arranged between a central part of the reefer machine and a sidewall of the container.
Further the fan or fans being placed in one or more ducts raise the fan efficiency.

The overall aim of the invention is to gain more space within the reefer container to be able to make room for more goods.

Thereby the loading capability of a standard the container is increased.

If loading the container with goods on pallets, placement of a single more pallet within a standard large reefer container will increase the loading capability with approximately 5%.

The improved design makes it possible to design the reefer machine in a narrower layout than ordinary reefer machines. Further a redesign of the door or doors of the reefer container where also a narrower layout of doors are obtained, enough space are gained within the container to rearrange the positions of pallets within the container to arrange for at least one more of such pallets in the container.

Doors on reefer containers are traditionally constructed as a sandwich construction with an outer steel panel, an inner lining of aluminium or stainless steel and an insulating material in the core, often polyurethane foam. In order to provide the necessary strength, reinforcement profiles are added to the outer steel panel and extending into the foam. A door constructed after this known principle is shown in figure 10.

The internal reinforcement profiles make the construction more complicated due to extra components, whereby weight and cost is increased. Secondly these internal reinforcements protrude into the isolative core, reducing the insulation value of the door by forming a thermal bridge.
A typical thickness of a reefer door is 75 - 90mm. Additionally, a door locking gear is bolted onto this door sandwich, further increasing door thickness.

In a new door layout the internal door reinforcement profiles are removed and an outer corrugated door panel is provided instead. This simplifies the construction by reducing components, whereby weight and cost is reduced.

In an embodiment of a new door the thickness of the isolating foam layer corresponds to a distance from the inner lining of the door to a protruding end of the internal reinforcement profiles of a door according to prior art.

A corrugated door panel will allow the door locking gear to be placed between the corrugations, reducing the total thickness of the door. Placing locking gear on level with the outer door panel will protect them from impact and reduce the risk of damage.

As there are no longer protruding metal reinforcement profiles in the isolative core, the insulation value of the door sandwich is the same as a traditional door design, even though the door panel provided with depressions reduces sandwich thickness.

The thin door design will maintain same insulating value, while reducing overall thickness and protecting the locking gear.

In an embodiment of a door for a reefer container, where a panel forming the outer side of the door is provided with one or more depressions, which depressions extend in a substantially vertical direction.

In an embodiment the thickness of an isolating foam layer corresponds to a distance between the inner lining of a prior art door to a protruding end of the internal reinforcement profiles.
A door panel provided with depressions will allow a door locking gear to be placed in a depression, reducing the total thickness of the door. Placing locking gear on level with the outer door panel will protect them from impact and reduce the risk of damage.

As there are no longer protruding metal reinforcement profiles in the isolative core, the insulation value of the door sandwich is the same as a traditional door design, even though the door panel provided with depressions reduces sandwich thickness.

The thin door design will maintain same insulating value, while reducing overall thickness and protecting the locking gear.

In an embodiment the depressions in the door protrudes into the core of insulating material, which supports the strength and stability of the door.

In another embodiment the insulating material comprises polyurethane foam.

The door is provided with a locking gear placed in one or more depressions, which locking gear comprises a locking rod and a handle for operating the locking rod into a locked position by sliding the locking rod into a groove or hole in an upper and/or lower part of the container to be able to close the door or doors.

In another embodiment the locking gear is provided with one or more handles, which handles are placed within the depression in a locked position.

In another embodiment the outer side of the door comprises a panel made of steel.
The inner lining is placed in a frame forming the outer perimeter of the door. The lining can be fastened to the frame by screws, rivets, bolts, welding or by use of other mechanical means. The lining can be fastened to the frame by using adhesive components. The lining can also be fastened by the adhesive effect from foaming of the isolating material in the core of the door or a combination of both fastening methods.

The outer side of the door can be fastened to the frame in similar manner.

In another embodiment the inner side of the door comprises a lining of aluminium.

In another embodiment the inner side of the door comprises a lining of stainless steel.

In an alternative embodiment the inner side of the door comprises a lining of fibreglass.

In an alternative embodiment the inner side of the door comprises a lining of thermoplastics.

In an alternative embodiment the inner side of the door comprises a lining of thermosetting resin.

In an alternative embodiment the inner side of the door comprises a lining of thermosetting plastic.

In another embodiment the inner side of the door comprises a lining of fiber reinforced plastics.
In another embodiment one or more hinges is fastened to a depression of the door.

In an alternative embodiment one or more hinges are fastened to an internal side of the door through a slot in an edge portion of the door.

The invention is also achieved by a method for loading a reefer container with pallets, where at least eleven pallets of ISO 2 type or fourteen pallets of ISO 1 type are placed in the container with a longitudinal direction of the pallets going in a direction crosswise in direction of a longitudinal direction of the container and at least ten pallets of ISO 2 type or ten pallets of ISO 1 type are placed in the container with the longitudinal direction of the pallets going in a direction parallel with the longitudinal direction the container.

In an embodiment of the method the pallets of ISO 2 type are placed in two rows within the container, a first row comprising nine pallets placed in the container with a longitudinal direction of the pallets going in a direction crosswise in relation to a longitudinal direction of the container and two pallets placed in the container with the longitudinal direction of the pallets going in a direction parallel with the longitudinal direction the container and a second row comprising eight pallets placed in the container with the longitudinal direction of the pallets going in a direction parallel with the longitudinal direction the container and two pallets placed in the container with a longitudinal direction of the pallets going in a direction crosswise in relation to a longitudinal direction of the container.

A container according to the invention loaded with goods on pallets according to the above, can contain a pallet more than known containers.

By installing evaporator fan motors downstream from the evaporator, the fans are highly exposed to cold air, high air velocities and various humidity levels.
All combinations of the above may arise around the evaporator fan motors causing frost and ice to form on wings of the fan, on walls of air channels, on brackets etc. To prevent water from dripping directly or indirectly to areas close to the fan one or more water traps are placed below the evaporator.

Water from the water traps can be drained and discharged to the outside of the container or the water can be reintroduced into the environment in the container to maintain a certain humidity level. Furthermore, water from drain blockage, leftover water overflow from above placed water traps might contribute to the start of ice building in the air channels. To reduce accumulation of water and ice at unexpected places around the water trap, in the air channels, around the fan motors and at a bottom T-floor during long trips, the defrost function is further provided with heaters placed in the air channel surface near each evaporator fan motor.

These heaters can be energised along with the traditional evaporator heaters (placed just below the evaporator coil) or they can be energised separately, fully or in pulses, whichever is required in the situation.

Usually the evaporator fan motors are stopped during a defrost session to allow warm air and heat from the energised heaters to pass upwards through the ice blocked evaporator. Since the traditional transport container refrigeration system has evaporator motors placed above the evaporator, the ice issue around the fan wings and fan motors are not creating problems.

When the evaporator fans are installed below the evaporator, the possible water leaks and ice building around the fans could be thawed by the heaters, but if the fan motors are allowed to run slowly in either forward or reverse direction at the same time, heat distribution will increase in the air channels, below the evaporator and through the evaporator. However, the air flow should be kept at such a level that the heat does not enter the cargo space.
This is achieved by a defrost system where heating elements are provided in a duct at a perimeter of the fan, or at a rim surrounding the fan at its perimeter.

In an embodiment one or more evaporator heaters are placed below the evaporator coil or coils.

In an alternative embodiment the heating elements can be energised separately, fully or in pulses, adapted to the situation.

In an alternative embodiment hereof, the fan or fans are provided with heating elements in fan blades or wings.

In an alternative embodiment a hub of the fan can be provided with heating elements and heat from the hub is transferred to the blades or wings of the fan due to the heat transmission of the selected materials or heat transmitting materials provided within the blades or wings of the fan.

In an alternative embodiment the fan or fans are powered by permanent magnet motors.

In an alternative embodiment a protruding surface and an edge forming a trap for trapping liquid or ice is provided above the one or more fans.

In an alternative embodiment the edge has a rounded shape.

In an alternative embodiment the edge forms a groove or gutter for collection of water and ice.
In an alternative embodiment power draft of the one or more fan motors are monitored and an increase in power draft implies that the heating elements are following activated.

In an alternative embodiment the fan or fans are arranged together with a motor in a unit for removal or exchange during maintenance.

Ice forming can be reduced when fan motors are allowed to run slowly in either forward and/or reverse direction at the same time increasing the heat distribution in air channels or ducts, below the evaporator and through the evaporator, and keeping air flow at a sufficient low level ensuring that only little heat, preferably no heat enters a cargo space in the container.

In an embodiment of the method fan motors are run in such a way that the heated air is circulated within the refrigerating system by letting one fan blow heated air in one direction and let another fan blow heated air in the opposite direction.

Thereby is achieved that the heated air can circulate through the air channels or ducts and through the evaporator, without entering the cargo space.

In a further embodiment of the method the heating elements for heating the ducts in an area near to the fan are energised separately.

In an alternative embodiment the heating elements in the ducts can be energised separately from each other.

Hereby it is possible to energise one heating element or one group of heating elements situated close to one of the fans at a time.
In yet an embodiment of the method the heating elements are energised in pulses.

Fan wing ice block prevention is a feature used to protect the evaporator fan motors when starting in cold ambient temperatures or in other situations, which has consequences in terms of ice building on or near the evaporator fan wings. Torque and power consumption of the motors, when the evaporator fan motors are energised for the first time during a start-up procedure is measured and should be below predefined limits. If torque on a motor reaches a predefined limit and the power consumption at the same time is above a certain level, the fan blades or wings are most likely blocked by ice, which will then energise the heating elements incorporated in the walls of the air ducts and placed near the blades or wings and motors as a mean to thaw the ice and after a short while try to start the motor again.

One or more ducts can be provided with a guiding system in a maintenance or service opening in the duct for guiding and supporting a fan unit within the duct. The guiding system can be provided by a notch or groove in the perimeter of the duct and a corresponding ridge or spline provided at the rim of the fan unit or vice versa. Hereby it is obtained that the unit will be placed correct in the duct for example after removal due to maintenance and that the unit will not be able to dislocate during operation.

The fan unit is powered by electrical wires and a plug and socket can be provided within the service opening making it possible to disconnect the wire and to remove the fan and motor as a unit.

The wiring can be fastened to fastening elements by means of one or more struts or ribs fastening the fan motor to the rim or the wiring can be established through the one or more struts or ribs.
In an alternative embodiment the power can be provided to the fan motor through connectors (not shown) moulded into one or more struts or ribs connecting the fan motor to the rim.

To close the service opening and to ensure adequate performance of flow of air in the duct or ducts an insert is provided with an inner part having a shape corresponding to the duct in such a way that the insert forms part of the duct when inserted in the duct. The insert can be provided with a plate for giving the insert a plane outer surface which is substantially level with the outer surface of the reefer machine.

In traditional reefer machines the back plate of the air duct is installed by means of screws or rivets, why demounting the back plate is a complicated and time demanding process, which normally is done only in connection with repairs and not for e.g. cleaning purposes.

As there is a growing awareness of hygiene, also in connection with reefers, Accessibility to hidden areas is required.

By installing an openable hatch covering the evaporator, both the ducts and the evaporator is accessible for easy cleaning.

Further embodiments and advantages are disclosed below in the description and in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described more fully below, by way of example only, with reference to the accompanying drawings, in which:
Figure 1 shows schematically a prior art arrangement of a reefer machine for a reefer container;

Figure 2 shows schematically airflow through an arrangement of a reefer machine for a reefer container according to the invention;

Figure 3 shows schematically re-circulated airflow through an arrangement of a reefer machine for a reefer container according to an embodiment of the invention;

Figure 4 shows schematically a loading scheme for ISO 2 pallets in a container relating to prior art;

Figure 5 shows schematically an alternative loading scheme for ISO 2 pallets in a container relating to prior art:

Figure 6 shows schematically a loading scheme for ISO 1 pallets in a container relating to prior art:

Figure 7 shows schematically a loading scheme for ISO 2 pallets in a container according to the invention;

Figure 8 shows schematically a loading scheme for ISO 1 pallets in a container according to the invention;

Figure 9 shows schematically an embodiment of a loading scheme for ISO 1 pallets in a container according to the invention;

Figure 10 shows schematically another embodiment of a loading scheme for ISO 1 pallets in a container according to the invention;
Figure 11 shows a door for a reefer container relating to prior art;

Figure 12 shows a door for a reefer container according to the invention;

Figure 13 shows schematically the refrigeration system of a reefer container from figure 2, showing in detail an embodiment of a part of a labyrinth or water trap having a protruding surface with a rounded edge;

Figure 14 shows schematically the refrigeration system of a reefer container from figure 2, showing in detail an embodiment of a part of a labyrinth or water trap having an edge with a rounded shape;

Figure 15 shows a reefer machine to be placed in the front end of a reefer container, which reefer machine is provided with openings for insertion and removal of one or more fans; and

Figure 16 shows an enlarged view of an opening showed in figure 15.

DETAILED DESCRIPTION

Now convenient embodiments of the invention will be described.

A reefer machine 1 for a reefer container 14 according to prior art is schematically shown in figure 1. Evaporator fans 2 is normally placed in a plate (not shown) above an evaporator 3, thereby pushing air through the evaporator 3. The plate separates intake air from the evaporator 3. Such a prior art arrangement is shown in figure 1.

Air 4 (shown by arrows) pushed through the evaporator 3 by the fans 2 is lead downwards through a central portion or plenum 5 of the reefer machine 1 and to a lower part 7 of the reefer machine 1 from where the air 4 is lead
through a floor portion (not shown) of the container. The floor portion of the container 14 is normally made as a T-floor with a plurality of grooves between T-shaped protrusions standing on a base, which grooves runs in a lengthwise direction of the container 14 whereby the T-shaped protrusions, forms a distance between the base and cargo placed on pallets on the floor of the container 14.

At each side of the plenum 5 of the reefer machine 1 is a void called a locker 6. These voids or lockers 6 can for example be used for temperature sensors or the like. Generally the space in the lockers 6 is not utilised optimally.

According to the invention more space within the container 14 is provided hence making it possible to place at least one more pallet of ISO type 15 or one more pallet of EUR type 16 within the container 14.

The overall purpose of creating more space for cargo within the container 14 can be obtained by redesigning the reefer machine 1.

Such redesigning opens up for utilizing the voids or lockers 6 on both sides of the machine 1.

In one embodiment the width of the evaporator 3 is extended to full width or near full width of the interior of the container 14. This provides also the possibility of directing the airflow 4 into side-channels instead of using the state of the art solution which would be to use a plenum 5 on the back side of the machine 1.

Placing the evaporator 3 above the fan or fans 2 and thereby sucking the air 4 through the evaporator 3 instead of pushing it through, shows that a better distribution of air 4 through the evaporator 3 is obtained.
A combination of the above mentioned features leads to an increased efficiency of the fan 2. This solution is possible in that the one or more evaporator fans 2 are placed in one or more ducts 8 and that the one or more fan motors 19 can be controlled.

By dividing the air 4 guided from the evaporator 3 into ducts 8 at both sides of the container 14, it is possible to increase the internal cargo space. When the internal cargo space is increased, it is possible to load the container 14 with pallets 15, 16 in standard measures in different ways compared to loading schemes for use in containers according to prior art.

The ducts 8 are arranged between a central part 12 of the reefer machine 1 and a side or wall of the container 14 as shown in figure 2. Here the ducts 8 are arranged at both sides of the reefer machine 1.

The central part 12 of the reefer machine 1 comprises at its outer side components (not shown) for operation of the reefer machine 1.

Hereby it is possible for the reefer machine 1 to have an extension in longitudinal direction of the container 14, which is smaller than a reefer machine in a container according to prior art.

Further the fan or fans 2 being placed in one or more ducts 8 raise the fan efficiency.

The overall aim of the invention is to gain more space within the reefer container 14 to be able to make room for more pallets 15, 16.

Placement of one more pallet 15, 16 within a standard large reefer container will increase the loading capability with approximately 5%. 
The improved design makes it possible to design the reefer machine 1 in a narrower layout than ordinary reefer machines 1.

Further a redesign of a door or doors 25 of the reefer container 14, where also a narrower layout of doors 25 are obtained, enough space are gained within the container 14 to rearrange the positions of pallets 15, 16 within the container 14 to arrange for at least one more of such pallets 15, 16 in the container 14.

It is possible to load more pallets in a container by a method for loading a reefer container with pallets, where at least eleven pallets 15 of ISO 2 type (the standard size of such pallets should be approximately 1200 x 1000 mm) or fourteen pallets 16 of ISO 1 type corresponding to EUR type (the standard size of such pallets should be approximately 800 x 1200 mm) are placed in the container 14 with a longitudinal direction of the pallets 15, 16 going in a direction crosswise in relation to a longitudinal direction of the container 14 and at least ten pallets 15 of ISO 2 type or ten pallets 16 of ISO 1 type are placed in the container 14 with the longitudinal direction of the pallets 15, 16 going in a direction parallel with the longitudinal direction the container 14.

In an embodiment of the method the pallets 15 of ISO 2 type are placed in two rows within the container 14, a first row comprising nine pallets 15 placed in the container 14 with a longitudinal direction of the pallets 15 going in a direction crosswise in relation to a longitudinal direction of the container 14 and two pallets 15 placed in the container 14 with the longitudinal direction of the pallets 15 going in a direction parallel with the longitudinal direction the container 14 and a second row comprising eight pallets 15 placed in the container 14 with the longitudinal direction of the pallets 15 going in a direction parallel with the longitudinal direction the container 14 and two pallets 15 placed in the container 14 with a longitudinal direction of the pallets
going in a direction crosswise in relation to a longitudinal direction of the container 14.

Loading of a container with ISO 1 type pallets can be performed in three advantageous ways. If pallets 16 placed in the container 14 with a longitudinal direction of the pallets 16 going in a direction crosswise in relation to a longitudinal direction of the container 14 are given a reference A and pallets 16 placed in the container 14 with the longitudinal direction of the pallets 16 going in a direction parallel with the longitudinal direction the container are given a reference B, three advantageous loading schemes can be expressed as follows, when pallets are placed in two rows in the longitudinal direction of the container 14 as shown in figure 8 - 10:


Traditionally a door 25 for a reefer container 14 comprises a frame 33, an outer steel panel 31, an inner lining 32 of aluminium or stainless steel and a core 26. An often used insulating material in the core 26 is polyurethane foam. In order to provide necessary strength to the door 25, reinforcement profiles 27 are added to the outer steel panel 31 and extending into the foam of the core 26. Additionally a door locking gear in shape of one or more hinges 28, locking rods 29 and handles 30 are bolted onto the door 25, further increasing door thickness since hinges 28, locking rods 29 and handles 30 protrudes from an outer side of the door 25. If these elements are to be kept level with an end portion of the container, the door 25 will have a
certain protrusion into the container. A door constructed after this known principle is shown in figure 10.

A redesign of a door or doors 25 for a reefer container 14 (not shown in figures 9 and 10) with a more narrow layout of doors 25 is shown in figure 11. Such new doors are redesigned for providing enough space within the container to rearrange positioning of goods or goods placed on pallets 15, 16 within the container 14 to arrange for more goods or at least one more of such pallets 15, 16 in the container 14.

The aim of the invention is to be able to provide a door 25 which is narrower, having same isolating capacity and which is at least as stable as a traditional door 25.

Internal reinforcement profiles 27 make the construction more complicated due to extra components, whereby weight and cost is increased. Secondly these internal reinforcements 27 protrude into the isolative core 26, reducing the insulation value of the door 25 by forming a thermal bridge.

A typical thickness of a reefer door 25 is 75 - 90mm.

In a new door layout the internal door reinforcement profiles 27 are removed and an outer door panel 31 is provided with depressions 34 instead. This simplifies the construction by reducing components, whereby weight and cost is reduced.

In an embodiment the thickness of the isolating foam layer 26 corresponds to a distance between the inner lining of the door 25 to a protruding end of the internal reinforcement profiles 27 in the prior art doors 25.
In a new door 25 for a reefer container, the door comprises a frame 33 to which is fastened an outer panel 31 and an inner lining 32, a core 26 of insulating material, one or more hinges 28 and locking gear 29, 30, where the outer panel 31 of the door 25 is provided with one or more depressions 34, which depressions extends in a substantially vertical direction.

The inner lining 32 is placed in a frame 33 forming an outer perimeter of the door 25. The lining 32 can be fastened to the frame 33 by screws, rivets, bolts, clamping, welding or by using adhesive components. The lining 32 can also be fastened by an adhesive effect from foaming of the isolating material in the core 26 of the door 25 or a combination of the above fastening methods.

The outer panel 31 of the door 25 can be fastened to the frame 33 in similar manner.

In an embodiment the depressions 34 in the door 25 protrude into the core 26 of insulating material.

In an embodiment the insulating material comprises polyurethane foam.

In an embodiment the door 25 is provided with a locking gear 29, 30 placed in one or more depressions 34, which locking gear 29, 30 comprises a locking rod 29 and a handle 30 for operating the locking rod 29 into a locked position by sliding the locking rod 29 into a groove or hole in an upper and/or lower part of the container to be able to close the door or doors 25.

In an embodiment the locking gear 29, 30 is provided with one or more handles 30, which handles 30 are placed within the depression 34 in a locked position.
In an embodiment the outer side of the door 25 comprises a panel 31 made of steel or another strong material able to withstand rough handling during transport and during loading and unloading of the container.

Other examples of materials suitable for the outer side of the door can be aluminium or composite materials.

In an embodiment the inner side of the door 25 comprises a lining 32 of aluminium.

In an embodiment the inner side of the door 25 comprises a lining 32 of stainless steel.

In an embodiment one or more hinges 28 are fastened to a depression 34 of the door 25.

In an embodiment one or more hinges 28 are fastened to an internal side of the door 25 through a slot in an edge portion of the door 25 or in the frame 33.

A door panel 31 with one or more depressions 34 will allow the door locking gear 29, 30 to be placed in a depression 34, reducing the total thickness of the door 25. Placing locking gear 29, 30 in a depression 34 and thereby on level with the outer side of the door panel 31 will further protect them from impact and reduce the risk of damage.

The locking gear 29, 30 comprises a locking rod 29 and a handle 30 for operating the locking rod 29 into a locked position by sliding the locking rod 29 into a groove or hole in the upper and/or lower part of the container to be able to close the door or doors 25 in a secure manner. The locking rod 29
can be guided for sliding by commonly known sleeves, bushings or similar fittings 35.

One or more hinges 28 are placed on the door 25 at a place at an outer edge where the thickness of the door 25 is reduced, for example by means of a Depression 34. The hinge 28 could also be fastened to the door 25 by fastening the part of the hinge 28, which is fastened to the reduced thickness or depression of the door 25, on an internal side of the door 25 through a slot in an edge portion or the frame 33 of the door 25. Thereby the fastening part of the hinge will be adjacent to the core 26 of isolating material.

As there are no longer protruding metal parts 27 in the isolative core 26, the insulation value of the door sandwich is the same as a traditional door design, even though the door panel 31 provided with depressions 34 reduces sandwich thickness. Hereby is achieved that the door 25 will have a protrusion into the container, which is smaller than the protrusion of a conventional door design.

The thin door design will maintain same insulating value, while reducing overall thickness and protecting the locking gear 29, 30.

Placing the fans 2 below the evaporator 3 can generate a problem since water (ice) can drip or fall down on the fan 2 wings from the evaporator 3 or other surfaces placed above the fan 3. This can lead to blockage or imbalance of the fan 2.

By shaping an area above the duct 8 and below the evaporator 3 as a "labyrinth" or trap (see figures 2, 13 and 14), water is prevented from dripping directly down on the fan 2.
The trap can be provided by a surface 9 protruding into the reefer machine 1. Further a central part 12 of the reefer machine 1 is formed with its upper part having inclining sides 120 inclining from an area 121 substantially in the middle part of the central part 12 and downwards towards the ducts 8.

To prevent water or ice from dripping from the inclining sides and into the ducts 8 a slightly ascending portion is provided on an edge 119 of the surface 9 protruding into the reefer machine 1 and an edge 10 is provided in a transition area of the central part 12 where the downwards inclining side 120 goes into a more upwards direction and forms a part of the duct 8 or the ducts 8 adjoins the transition area of the inclining side 120.

In an embodiment the edge 119 has a rounded shape. The more an outer end of the edge is ascending and thereby forming a groove or gutter for collection of water and ice, the more it is able to hold back water or ice from falling from the evaporator 3 and into the duct 8.

The edge 10 prevents water or ice from entering the duct 8 and protruding surfaces 9 ensures that water or ice dripping from the evaporator 3 will be lead onto the inclining surfaces 120. A drain (not shown) is provided near the edge 10 to be able to lead the water and thawed ice into a reservoir (not shown) or to outside of the container.

In an embodiment the edge 10 has a rounded shape.

If the edge 10 is sharp, it is more convenient to stop and collect water in the trap, but the airflow in the system will be more turbulent. If the edge is rounded and thereby the edge 10 being less sharp, the airflow will be more laminar which will lead to a more optimal airflow. Therefore in situations where the airflow is more important than the water collection a rounded edge
10 is chosen, and in situations where water collection is more important than
the airflow, a more sharp edge 10 is chosen.

The same apply to the edge 119.

To reduce accumulation of water and ice at unexpected places around the
water trap 9, 10, in the air channels 80 or ducts 8, around the fan motors and
at a bottom T-floor (not shown) during long trips, the defrost function is
further provided with heaters placed in the air duct 8 surface 11 near each
evaporator fan motor.

If the above mentioned combinations of conditions of air and humidity should
cause ice forming in the duct 8, especially on the fan blades or wings or near
the fan 2, heating elements are provided for thawing the ice.

By building in one or more heating elements in the duct 8 at a perimeter 20 of
the fan, or at a rim 200 surrounding the fan 2 at its perimeter, any ice build-up
can effectively be removed by heating up the element. Typically this will
happen simultaneous with general defrosting of the evaporator 3.

If power draft of one or more fan motors 19 is monitored and an increase in
power draft is detected, the system can imply that heating elements are
activated. The activation can be initiated by detection of one or more of
following situations as an example: the fan 2 needs excessive power to run,
the fan 2 runs too slow in relation to the power input to the motor 19, the fan
2 is blocked, and/or the fan 2 is wobbling. These situations can be symptoms
of ice generated on or near the fan 2 or fan blades or wings. To avoid such
ice building in the duct or ducts 8, one or more heating elements 11 are
placed near the fan or fans 2 to be able to thaw the ice. This can also be
used as an alert that one or more motors 19 are too heavy loaded for some
reason (dirt or foreign objects blocking the fan 2).
If ice is formed in the duct or on fan blades or wings, one or more heating wires or heating elements provided in a duct or at a perimeter of the fan or at a rim surrounding the fan at its perimeter can be activated to heat the fan blades or wings or the area of the duct surrounding the fan or at the rim surrounding the fan at its perimeter and thereby thaw the ice.

In an embodiment one or more evaporator heaters are placed below the evaporator coil or coils.

In another embodiment the heating elements can be energised separately, fully or in pulses, adapted to the situation.

In a further embodiment the heating elements can be energised separately to heat a duct at a perimeter of the fan or at a rim surrounding the fan at its perimeter at a time.

In an alternative embodiment the fan or fans are powered by permanent magnet motors.

In yet an alternative embodiment, the fan can be provided with heating elements in the fan blades or wings. The energy can be transferred to the heating elements in the fan blades or wings by ordinary commutators or the energy can be transferred by induction.

In an alternative embodiment a protruding surface and an edge forming a trap for trapping liquid or ice is provided above the one or more fans.

In an alternative embodiment power draft of the one or more fan motors are monitored and an increase in power draft imply that the heating elements are following activated.
In an alternative embodiment fan or fans 2 are arranged together with a motor 19 in a unit 180 for removal or exchange during maintenance.

In certain situations the system can be put into defrosting mode. In an embodiment the defrosting mode is entered by letting a fan 2 direct the airflow 4 in one direction and another fan 2 direct the airflow 4 in another direction, thereby letting the airflow 4 circulate within the cooling engine. If one fan is blowing the air in a downwards direction, the other fan is set to blow the air in an upwards direction as shown in figure 3.

In conventional reefer machines defrosting mode is entered by heating the air 4 blown through the evaporator 3. This method can cause that heated air is blown into the cargo space thereby raising the temperature in the environment already cooled down.

According to the new method it is possible to circulate the heated air within the reefer machine 1 without having the heated air entering the cargo space. Hereby is achieved a more expedient way to enter defrosting mode of the reefer machine 1.

This is possible in that fan motors 19 are allowed to run slowly in either forward and/or reverse direction at the same time increasing the heat distribution in air channels 80 or ducts 8, below the evaporator 3 and through the evaporator 3, and keeping airflow 4 at a sufficient low level ensuring that only little heat, preferably no heat enters a cargo space in the container.

In an embodiment the fan motors 19 are run in such a way that the heated air is circulated within the refrigerating system 1 by letting one fan 2 blow heated air in one direction and let another fan 2 blow heated air in the opposite direction.
Thereby warm air will be circulated within the refrigerating system. This can be done for example by letting one fan 2 blow heated air in one direction and let another fan 2 blow heated air in the opposite direction. Thereby is achieved that the heated air can circulate through the air channels 80 or ducts 8 and through the evaporator 3, without entering the cargo space.

The heaters placed in the duct 8 at the perimeter 20 of the fan, or at the rim 200 surrounding the fan 2 at its perimeter, can be energised along with traditional evaporator heaters which is placed just below the evaporator coil (not shown) or they can be energised separately fully or in pulses, whichever is required in the situation.

In an embodiment the heating elements 11 in the ducts 8 can be energised separately from each other.

Thereby it is possible to only energise one heating element or group of heating elements 11 which relates to one duct 8, if this duct forms ice in the area close to the fan 2.

By installing the evaporator fans 2 below the evaporator 3, the possible water leaks and ice building around the fans 2 could be thawed by the heaters, but if the fan motors 19 are allowed to run slowly in either forward and/or reverse direction at the same time, heat distribution will increase in the air channels 80 or ducts 8, below the evaporator 3 and through the evaporator 3. However, the air flow 4 should be kept at such a level that the heat does not enter the cargo space.

One or more ducts 8 can be provided with a guiding system 21, 22 in a maintenance or service opening 18 in the duct 8 for guiding and supporting a fan unit 180 within the duct 8. The guiding system can be provided by a notch or groove 22 in the perimeter 20 of the duct 8 and a corresponding ridge or
spline 21 provided at the rim 200 of the fan unit 180. The notch or groove and ridge or spline can also be arranged the other way around. Hereby it is obtained that the unit will be placed correct in the duct for example after removal due to maintenance and that the unit will not be able to dislocate during operation.

The fan unit 180 is powered by electrical wires and a plug and socket can be provided within the service opening 18 making it possible to disconnect the wire and to remove the fan and motor as a unit.

The wiring can be fastened to fastening elements by means of one or more struts or ribs 191 fastening the fan motor 19 to the rim 200 or the wiring can be established through the one or more struts or ribs 191.

In an alternative embodiment the power can be provided to the fan motor 19 through connectors (not shown) moulded into one or more struts or ribs 191 connecting the fan motor 19 to the rim 200.

To close the service opening 18 and to ensure adequate performance of flow of air in the duct or ducts 8 an insert 23 is provided with an inner part having a shape corresponding to the duct 8 in such a way that the insert 23 forms part of the duct 8 when inserted in the duct 8. The insert 23 can be provided with a plate 24 for giving the insert 23 a plane outer surface which is substantially level with the outer surface of the reefer machine 1.

In traditional reefer machines the back plate of the air duct is installed by means of screws or rivets, why demounting the back plate is a complicated and time demanding process, which normally is done only in connection with repairs and not for e.g. cleaning purposes.
As there is a growing awareness of hygiene, also in connection with reefers, accessibility to hidden areas is required.

By installing an openable hatch (not shown) covering the evaporator, both the ducts and the evaporator is accessible for easy cleaning.
CLAIMS

1. A reefer container for shipping goods placed on pallets, which container comprises:

- a plurality of sidewalls forming the sides, floor and ceiling in the container;
- a front end comprising cooling and or ventilating means and a rear end comprising an opening to be closed by one or more doors;
- a reefer machine further comprising one or more evaporators and one or more fans for transporting cooling air into the container;
- that an evaporator (3) is placed above a fan (2) in an air circulating system for cooling the air (4) in the container (14);

characterised in that air circulating or passing through the reefer machine (1) and guided from the evaporator (3) is divided into ducts (8) at both sides of the container (14).

2. Container according to claim 1, characterised in that the ducts (8) are arranged between a central part (12) of the reefer machine (1) and a sidewall of the container (14).

3. Container according to claim 1 or 2, characterised in that one or more fans (2) are placed in one or more ducts (8), which ducts (8) leads from the evaporator (3) and further leading the cooled air (4) into cargo space of the container (14).

4. Container according to one or more of the preceding claims, characterised in that the fan or fans (2) are powered by permanent magnet motors (19).

5. Container according to one or more of the preceding claims, characterised in that a protruding surface (9) and an edge (10) forming a trap for trapping liquid or ice is provided above the one or more fans (8).
6. Container according to one or more of the preceding claims, characterised in that the one or more ducts (8) are provided with heating means (11) positioned at the fan perimeter (20, 200).

7. Container according to claim 6, characterised in that power draft of the one or more fan motors (19) are monitored and an increase in power draft imply that the heating elements are following activated.

8. Container according to one or more of the preceding claims, characterised in that the one or more ducts (8) are provided with a guiding system (21, 22) in a maintenance or service opening (18) in the duct (8) for guiding and supporting a fan unit (180) within the duct (8).

9. Container according to claim 8, characterised in that the fan or fans (2) are arranged together with a motor (19) in a unit (180) for removal or exchange during maintenance.

10. Method for loading a reefer container with pallets, characterised in that at least eleven pallets (15) of ISO 2 type or fourteen pallets (16) of ISO 1 type are placed in the container (14) with a longitudinal direction of the pallets (15, 16) going in a direction crosswise in relation to a longitudinal direction of the container (14) and at least ten pallets (15) of ISO 2 type or ten pallets (16) of ISO 1 type are placed in the container (14) with the longitudinal direction of the pallets (15, 16) going in a direction parallel with the longitudinal direction of the container (14).

11. Method according to claim 10, characterised in that the pallets (15) of ISO 2 type are placed in two rows within the container (14), a first row comprising nine pallets (15) placed in the container (14) with a longitudinal direction of the pallets (15) going in a direction crosswise in relation to a longitudinal direction of the container (14) and two pallets (15) placed in the
container (14) with the longitudinal direction of the pallets (15) going in a direction parallel with the longitudinal direction the container (14) and a second row comprising eight pallets (15) placed in the container (14) with the longitudinal direction of the pallets (15) going in a direction parallel with the longitudinal direction the container (14) and two pallets (15) placed in the container (14) with a longitudinal direction of the pallets going in a direction crosswise in relation to a longitudinal direction of the container (14).
**A. CLASSIFICATION OF SUBJECT MATTER**

INV. F25D11/00 F25D17/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

A* document defining the general state of the art which is not considered to be of particular relevance

E* earlier application or patent but published on or after the international filing date

L* document which may throw doubts on priority claim(s) one or which is cited to establish the publication date of another citation or other special reason (as specified)

O* document referring to an oral disclosure, use, exhibition or other means

P* document published prior to the international filing date but later than the priority date claimed

T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obiously to a person skilled in the art

A* document member of the same patent family

Date of the actual completion of the international search: 6 June 2014

Date of mailing of the international search report: 04/08/2014

Name and mailing address of the ISA:
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Fax: (+31-70) 340-3016

Authorized officer:
Jessen, Flemming

Form PCT/ISA/210 (second sheet) (April 2005)
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This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

  1-9

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9

   Reefer container with air ducts at both sides of the container
   
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2. claims: 10, 11

   Method for loading a reefer container with pallets.
   
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