

PATENT SPECIFICATION (11)

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO REFRIGERATION APPARATUS

(71) We, UNION CARBIDE CORPORATION, a corporation organised and existing under the laws of the State of New York, United States of America, of 270 Park Avenue, New York, State of New York, 10017, United States of America, (assignee of DAVID PAUL MAURER), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention pertains to a refrigeration apparatus for detachable mounting on shipping containers, particularly on shipping containers which are designed to be refrigerated using cold air which is introduced and removed from such containers by means of portholes provided therein.

New developments in the technology of shipping refrigerated products over land and sea have resulted in the rapid growth of containerized shipping. Containerization as applied to products which must be refrigerated has resulted in the development of numerous techniques for keeping such containers refrigerated. One such system employs the circulation of refrigerated air through shipping containers while they are in transit on shipboard. However, once such refrigerated containers reach their ports of destination some means of maintaining refrigeration therein is necessary to prevent spoilage of the contents. For a part-time or intermediate refrigeration system to be successful in use with such refrigerated shipping containers the refrigeration system must require a minimum of alteration of the container itself, must detachably mount on the outside of such container, must occupy a minimum of space, must be virtually free of maintenance requirements once installed, and must not require external power to perform the refrigeration function. In addition, the refrigeration system must be able to cool down the container very quickly, maintain uniform temperature control and require very little time to connect and disconnect

to the refrigerated shipping container. The use of mechanical refrigeration systems for part-time refrigeration of such containers has been found to be undesirable because such systems are expensive, lack quick cool-down capacity, uniform temperature control and have a high incidence of mechanical failure owing to the complexity of the equipment required for mechanical refrigeration.

To date, cryogenic in-transit refrigeration systems have been permanently attached to the product storage container. However, in view of the large number of refrigerated containers employed in container shipping and also because a given container may or may not be used to ship refrigerated product at all times, the cost both in terms of equipment required and space lost using permanently installed cryogenic refrigeration systems renders their use impractical.

The present invention sets out to provide a cryogenic refrigeration apparatus for use with thermally insulated shipping containers which apparatus requires a minimum of alteration to the container, attaches to the outside of said container, occupies extremely little space compared with its refrigeration capacity, is virtually maintenance-free, is self-contained and is capable of providing substantially uniform desired temperature within the shipping container.

The present invention relates in particular to an apparatus for refrigerating a stored product within a thermally insulated shipping container having at least one porthole therein, which includes a liquefied gas refrigerant storage tank connected to a flow control valve arranged for activation by a flow control means connected by an electrical cable to a temperature sensing means within the container, and a refrigerant discharge conduit leading from said flow control valve to refrigerant dispensing means within said container.

According to the invention, such apparatus is characterized in that the refrigerant storage tank and the flow control means together with the associated flow control

valve are mounted in a frame which is detachably secured to the exterior of said container, the porthole of the shipping container being sealed by a detachable closure provided with connection means to which internal and external portions of the electrical cable and refrigerant discharge conduit are separably attached.

In the accompanying drawings:

Figure 1 is a cross-sectional elevation of a thermally insulated container having a liquefied gas refrigeration system embodiment of this invention attached to the upper forward portion of the container.

Figure 2 is a perspective view of the apparatus shown in cross-section in Figure 1.

Figure 3 is an enlarged view, partly in cross-section, of the upper forward portion of the container with the attached liquefied gas refrigeration system.

Figures 1 and 2 show a typical thermally insulated shipping container 1 having access doors 2 and containing a refrigerated product 3. A liquefied gas refrigerant storage tank 4 and refrigerant flow control means 5 together with its associated flow control valve 24 are disposed within a detachable frame 6 which is secured to shipping container 1 by means of bolts 7. Shipping containers typically measure about 8 feet by 8 feet by 20 feet (2.4×2.4×6.1 metres) and the shipping containers preferred for use with this invention are those which have refrigerant air circulation portholes such as 8 and 9. A perforated refrigerant dispensing conduit 10 is installed in the upper portion of shipping container 1 and preferably is located quite near the ceiling to prevent interference with product storage within the container. A temperature sensing means 11 is removably attached to a mounting bracket 12 which is permanently attached to shipping container in the vicinity of the porthole 8. Porthole 9 which is not necessary to this invention is shown with a plug therein.

As shown in greater detail in Fig. 3, porthole 8 is sealed by a detachable closure 13 provided with a sealing gasket 15 and attachment locks 16. Affixed to the closure 13 is a gas pressure relief valve 14, such as a silicon rubber check valve, to relieve excessive pressures generated by evaporating liquefied refrigerant within the shipping container 1. The temperature sensing means 11 is connected to a connector 17 on the outside of porthole closure 13 by means of an electrical conductor 18. A refrigerant conduit 19 passing through porthole closure 13 is attached at one end to a fitting 20 on the outside of the porthole closure 13 and at the other end is removably attached to the perforated refrigerant dispensing conduit 10 by a coupling 21 within the container 1. An electrical conductor 22 from

the refrigerant flow control means 5 is detachably joined to the connector 17 thereby establishing a connection whereby the refrigerant flow control is responsive to the temperature sensed within shipping container 1 by temperature sensing means 11. A refrigerant conduit 23 includes the flow control valve 24 and is connected at one end to the refrigerant storage tank 4 and at the other end in detachable manner to the refrigerant fitting 20. The flow control means 5 is arranged to compare the temperature within the shipping container as sensed by the sensing means 11 with a predetermined desired temperature and to actuate the refrigerant flow control valve 24 in response to a difference between the shipping container temperature and the predetermined desired temperature.

The detachable frame 6 is preferably provided with built-in adaptive means for receiving a fork lift or crane-installing apparatus; in particular, fork lift channels 25 shown in Figure 3 may be provided perpendicular to the axis of the liquefied gas refrigeration storage tank 4 and at the bottom portion of the frame 6. Alternatively, one or more eye bolts 26 may be attached to the top portion of the frame 6 such that the latter may be raised into position adjacent porthole 8 by means of a crane.

A shipping container such as that depicted in Figures 1 and 2 can be quickly fitted with the detachable refrigeration apparatus of this invention. A workman reaches in through porthole 8 and inserts the temperature sensing means 11 into mounting bracket 12 which is rigidly attached to the inner wall or ceiling of shipping container 1, and attaches the refrigeration conduit 10 to coupling 21. Porthole closure 13 is then inserted into porthole 8 and locked into place by means of attachment locks 16. Thereafter, frame 6 is raised into position adjacent porthole closure 13 by means of a fork lift or crane and bolts 7 are engaged to securely attach the frame to the shipping container. Cable 22 from the flow control means 5 is then attached to connector 17 and refrigeration conduit 23 is attached to refrigeration fitting 20. At this point, flow control means 5 can be turned on to begin refrigeration of the shipping container 1.

It should be apparent from the foregoing disclosure that the electrical cable 22 and the refrigeration conduit 23 can alternatively be made so long that their disconnection from the porthole closure would not be required. Also, it should be clear that the cable 22 and the refrigeration conduit 23 can be rigidly connected to the porthole closure 13 at the connector 17 and fitting 20 and the connections to the flow control means 5 made detachable.

5 The perforated refrigerant dispensing conduit 10 may be permanently or removably installed or, if desired, it may be replaced by suitable substitutes such as spray nozzle means attached to the inside portion of the porthole closure. The temperature sensing means may comprise, for example, an electrical temperature sensor such as a precision wire wound resistance, a thermistor or a pneumatic temperature sensor. The temperature sensor may be mounted on the inside portion of the porthole closure as well as elsewhere within the storage container.

15 WHAT WE CLAIM IS:—

1. Apparatus for refrigerating a stored product within a thermally insulated shipping container having at least one porthole therein, including a liquefied gas refrigerant storage tank connected to a flow control valve arranged for activation by a flow control means connected by an electrical cable to a temperature sensing means within the container, and a refrigerant discharge conduit leading from said flow control valve to refrigerant dispensing means within said container, characterized in that the refrigerant storage tank and the flow control means together with the associated flow control valve are mounted in a frame which is detachably secured to the exterior of said container, the porthole of the shipping container being sealed by a detachable closure provided with connection means to which internal and external portions of the electri-

cal cable and refrigerant discharge conduit are separably attached.

2. Apparatus as claimed in claim 1, characterized in that the temperature sensing means is detachably secured to the shipping container.

3. Apparatus as claimed in claim 1 or 2, characterized in that the detachable porthole closure is provided with a pressure relief means.

4. Apparatus as claimed in claims 1, 2 or 3 characterized in that the internal portion of the refrigerant discharge conduit is connected to the refrigerant dispensing means by means of a separable coupling.

5. Apparatus for refrigerating a stored product within a thermally insulated shipping container and comprising a storage tank for liquefied gas refrigerant and apparatus for controlling the discharge of liquefied gas refrigerant from the storage tank through a connection connectable with a shipping container to be refrigerated, the storage tank and the apparatus for controlling discharge from the tank being mounted on a frame adapted to be detachably secured to a container to be refrigerated.

6. Apparatus for refrigerating a stored product within a thermally insulated shipping container having at least one porthole therein, substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings.

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15 WHAT WE CLAIM IS:—

1. Apparatus for refrigerating a stored product within a thermally insulated shipping container having at least one porthole therein, including a liquefied gas refrigerant
20 storage tank connected to a flow control valve arranged for activation by a flow control means connected by an electrical cable to a temperature sensing means within the container, and a refrigerant discharge
25 conduit leading from said flow control valve to refrigerant dispensing means within said container, characterized in that the refrigerant storage tank and the flow control means together with the associated flow control
30 valve are mounted in a frame which is detachably secured to the exterior of said container, the porthole of the shipping container being sealed by a detachable closure provided with connection means to which
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cal cable and refrigerant discharge conduit are separably attached.

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3. Apparatus as claimed in claim 1 or 2, characterized in that the detachable porthole closure is provided with a pressure relief means. 45

4. Apparatus as claimed in claims 1, 2 or 3 characterized in that the internal portion of the refrigerant discharge conduit is connected to the refrigerant dispensing means by means of a separable coupling. 50

5. Apparatus for refrigerating a stored product within a thermally insulated shipping container and comprising a storage tank for liquefied gas refrigerant and apparatus for controlling the discharge of liquefied gas refrigerant from the storage tank through a connection connectable with a shipping container to be refrigerated, the storage tank and the apparatus for controlling discharge from the tank being mounted
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6. Apparatus for refrigerating a stored product within a thermally insulated shipping container having at least one porthole therein, substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings. 65

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