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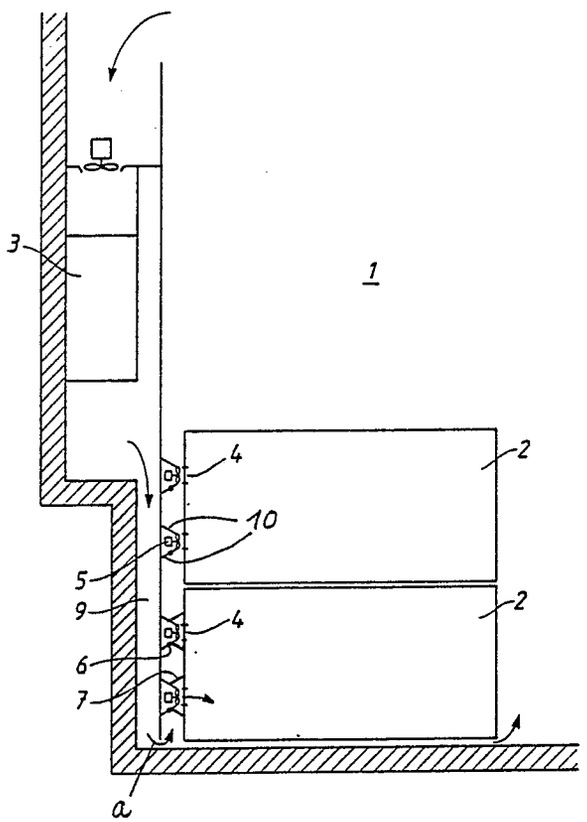
(54) Cooling system for container transportation.

(57) Cooling system for container transportation by ship in which containers, stacked on top of each other, are stored and cooled in the hold of the ship. With a centrally arranged refrigerating plant which supplies air coolers (3) with refrigerant in each hold (1), which is insulated, the ship can be made shorter. The air coolers (3) then supply a channel system (9) with cooling air to the holds and thus the containers. By arranging a fan (5) and a temperature sensor (6) in front of each opening (4) in the containers, the temperature level in each container can be individually controlled with the aid of a calculating unit to obtain good operation control of the container cargo.

FIG.1



EP 0 298 406 A1

Cooling system for container transportation

The present invention relates to a cooling system for container transportation according to the precharacterising part of Claim 1.

When transporting refrigerated cargo containers by ship, insulated containers are often used, which are stacked on top of each other, with several stacks positioned breadthways in the hold of the ship and which are being cooled while in the ship. A centrally arranged cooling system in the ship is connected to channel systems, arranged in each hold, for supplying cooling air to the containers. The channel systems in the holds are provided with connection openings, possibly with some type of movable connection part to fit different containers, each container being provided with corresponding connection openings for cooling air. Usually, the cooling system with its channels is insulated whereas the hold in the ship is not insulated. To be able to load and unload containers in a simple manner - also containers of varying sizes - a flexible as well as easily detachable connection must be provided between the channel system and the containers. SE-A-8502418-0 (DE-OS 36 15 570.5) provides an example of a flexible connection for use with cooling of con tainers. The connection part is there formed as a funnel-shaped and collapsible blocking member which, in dependence on the direction of flow, is expanded and open or folded and closed. SE-A-8700092-3 (EP-A-88 10 0209.1) gives an example of a connection part which can be turned by 180 degrees about a horizontal axis to adjust openings for cooling air in a centrally located channel system to openings for cooling air in containers of varying sizes.

The invention aims at developing a cooling system for container transportation of the above-mentioned kind, which allows effective cooling of the container contents in a relatively simple manner requiring less space than prior art cooling systems.

To achieve this aim the invention suggests a cooling system for container transportation according to the introductory part of Claim 1, which is characterized by the features of the characterizing part of Claim 1.

Further developments of the invention are characterized by the features of the additional claims.

According to the invention in ship transportation over large distances of large quantities of containers with the same or similar cargo contents which have to be cooled, the holds of the ship are insulated and cooled. Possibly, the holds can be divided into smaller insulated and cooled subspaces in order to obtain different temperature levels in the hold depending on the cargo. A central refrigerating plant supplies the air coolers arranged in the holds with refrigerant. Fans cause the air cooled by the air cooler to circulate through the hold which is filled with containers, each individual container being provided with connection holes for cooling air. During its circulation through the hold, the cooled air will flow around and through each container. In order to further improve the cooling of the containers, stationary circulating fans as well as temperature sensors may be provided, arranged in the ship and positioned in front of the two connection holes of each container. In addition to injecting cooling air into its associated container such a fan can also be used to remove ripening heat and carbon dioxide (if any). The air coming out of the container then blows out right in front of the temperature sensor associated to that fan which is not used at that time. With the temperature sensors connected to a central computer, which registers the ingoing and outgoing air temperature for each container, the time can be determined necessary for each fan to be in operation to obtain the desired temperature level in the container. The air temperature in the hold is adapted so that all containers in the hold will have its right temperature, in which case due account must also be taken of the vertical extension of the container stack.

With a fan placed in front of each connection hole in the container, one fan may constitute a standby fan for the other fan, or the fans may be used alternately to bring about an air circulation in the opposite direction in the container.

The cooling system for container transportation according to the invention requires little space and is not very expensive, which makes it possible to make the ship shorter. This entails additional savings, per se. With an insulated refrigerated hold, also refrigerated cargoes on platforms can be transported with the ship. With this type of cooling system for container transports, the drying up of the cargo and hence the weight reduction will be reduced.

Between the stacks of containers in the hold there is a guide system. By increasing the distance between the stacks of containers, a space wide enough for walking may be ob tained athwartships. For each level of containers there is then arranged a grating connected to the guide system. Connections for electricity supply and a connection for a possible measuring transducer are provided for each container position close to the guide system. In this way it will be possible to also transport containers with integrated refrigeration equipment in the hold of the ship. The air coolers with the fans in the hold then transport away transmission losses and condenser heat from the air-cooled condensers

of the refrigerated containers.

The invention will now be described in greater detail with reference to the accompanying drawings showing - by way of example - in

Figure 1 schematically a section through a hold of a ship in the longitudinal direction of the ship with refrigerated containers,

Figure 2 in perspective representation, a portion of the ship obtained by two sections perpendicular to the longitudinal axis of a ship comprising a hold for containers with integrated refrigeration with a guide system provided with gratings and connections.

Figure 1 shows the construction of an insulated hold 1 seen from the side of the ship, with a cooling system for containers 2 according to the invention. The holds are usually built up of cells, each cell accommodating two rows of stacked containers. In each cell the containers 2 are positioned in parallel with the longitudinal direction of the ship. A centrally located cooling plant (not shown) supplies one or more air coolers 3 adjacent to each cell with a refrigerant. In the transverse bulkhead of the hold there are arranged channels 9 via which the cooling air from the air cooler 3 is transported into the hold. In Figure 1 the cooled air enters the hold near the bottom of the hold as indicated by arrow a. It is, of course, also possible, to provide two or more such outlet openings for the cold air from the channel 9 into the hold at different vertical levels of the channel 9. The openings 4 of the containers are open and communicate with the surrounding space in the hold. In front of each opening 4 into a container, a fan 5 and a temperature sensor 6 may be arranged, displaceably connected to a transverse bulkhead, as symbolically indicated by the two lines 10. The fans 5 are adapted to adjustably control the flow of cooling air from the hold space in front of the containers into the respective container 2.

The temperature sensors 6 are adapted to supply a centrally arranged calculating unit or computer with measured values, which are processed in the unit/computer. The calculating unit or computer is then adapted to individually control the operation of the fans taking into account the individually measured temperature for maintaining a certain pre-determined temperature level in each individual container. A connection part 7 between the fan 5 and the connection opening 4 of the container 2 may be flexibly arranged to fit different types of containers. These connection parts 7 are preferably fixed to the fan structure or the bulkhead and do not prevent access of the surrounding cooling air to the fan.

With the temperature sensors 6 recording both the incoming and outgoing air temperature for each container 2, the computer can easily calculate for how long time each fan 5 has to be in operation to individually control the cooling air supplied to the respective container 2. The temperature of the air in the hold must also be adjusted such that all containers 2 in the hold 1 are given their required temperature level. Since in a hold 1 with, for example, seven containers 2 stacked on top of each other, the air temperature is nor mally higher in the upper part of the hold than in the lower part. This means that a so-called duty cycle (portion of time cooling air in blown into the container by the fan) for the bottom container is perhaps only 10% whereas for the top container it is 90%. One of the two fans 5 in front of the container 2 may be used as standby fan or to effect an opposite air circulation in the container 2 and hence a more uniform temperature inside the container.

Between the different stacked rows of containers 2 in the hold 1, there is usually arranged a guide system. The space for the guide system can be increased so that a space, wide enough for walking, can be arranged at least athwartships, as shown in Figure 2. By locating gratings 8 in the guide system between the containers 2, access can be provided, at each level and for each container 2, to electricity supply and measuring sensors arranged in the guide system. This makes it possible to also transport containers with an integrated refrigerating plant in the hold. When loading these containers into a ship's hold, the containers are turned such that their integrated refrigerating plants are facing each other. This makes it simple to connect the different plants to the connections in the guide system. The air coolers 3 arranged in the holds will then be used for transporting away transmission losses and condenser heat from all air cooled condensers of the integrated refrigerating plants.

With the individual measuring connections and the connections for electricity supply to the refrigerated containers, it will be possible individually to control the operating data of each refrigerated container.

The above-mentioned calculating unit/computer, besides being adapted to individually control the fans with respect to temperature, may also be adapted to individually control the operating data of each refrigerated container which is pro vided with a refrigerating plant of its own, in order to obtain the best operating conditions - seen as a whole - for the entire transport of refrigerated containers.

Besides controlling the temperature level, also the carbon dioxide concentration can be controlled centrally in order to attain a maximum storage time and the best quality of the products which are to be transported.

For both types of containers, it should be noted

that, within one insulated hold, only cargoes which "get on well" with one another from the point of view of smell can be transported, since fresh air is supplied to the containers from the air circulating in the hold, the concentration of CO_2 of the circulating air being centrally controlled for the respective hold.

Claims

1. Cooling system for container transportation by ship in which containers, stacked on top of each other, are stored and cooled in the hold of the ship,**characterized** in that the holds (1) are insulated and that at least one air cooler (3) is connected to each hold for the supply of cooled air to the hold and thus to the containers (2).

2. Cooling system according to Claim 1, **characterized** in that the outlet of the air cooler (3) is connected to a channel system (9) arranged in the wall of the hold, said channel system (9) supplying cooled air to the hold.

3. Cooling system according to Claim 2,**characterized** in that the release of cooled air from the channel system (9) into the hold is preferably arranged near the bottom of the hold.

4. Cooling system according to any of the preceding Claims, **characterized** in that a controllably operated fan (5) and a temperature sensor (6) are arranged near each opening (4) in the container (2) for supplying and removing cooling air to/from the container.

5. Cooling system according to Claim 4, **characterized** in that the corresponding measured values of the temperature sensors (6) are adapted to be utilized as input quantities to a calculating and control unit which, with respect to the input quantities and a pre-selected operating range, individually controls the operating condition of the fans (5).

6. Cooling system according to any of the preceding Claims, **characterized** in that between two rows of stacked containers (2) in a hold (1) there is arranged a grating system (8) which is wide enough for walking and which has connection possibilities for operation and monitoring of preferably containers with integrated cooling systems.

7. Cooling system according to Claim 6, **characterized** in that measured values from the monitoring are adapted to be used as input quantities to a calculating and control unit which, with respect to the input quantities and a pre-selected operating range, individually controls the operating condition of the containers with integrated cooling systems.

8. Cooling system according to Claims 5 and 7, **characterized** in that the corresponding measured values of the temperature sensors (6) and the measured values from the monitoring of containers with integrated cooling systems are adapted to be used, together with measured values from the carbon dioxide measurement, as input quantities to a calculating and control unit which, with respect to the input quantities and pre-selected operating ranges, individually controls the temperature level and carbon dioxide content of the containers.

FIG.1

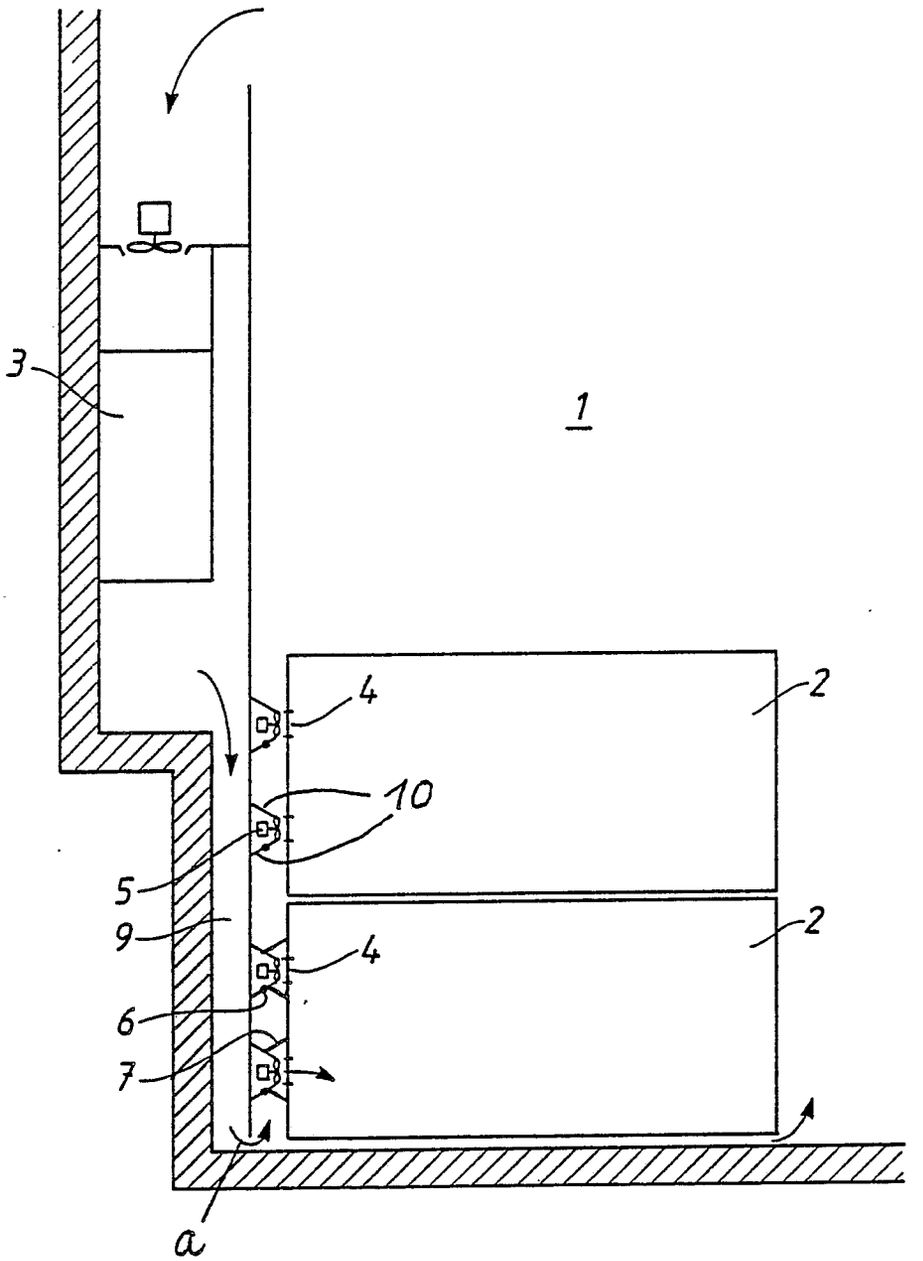
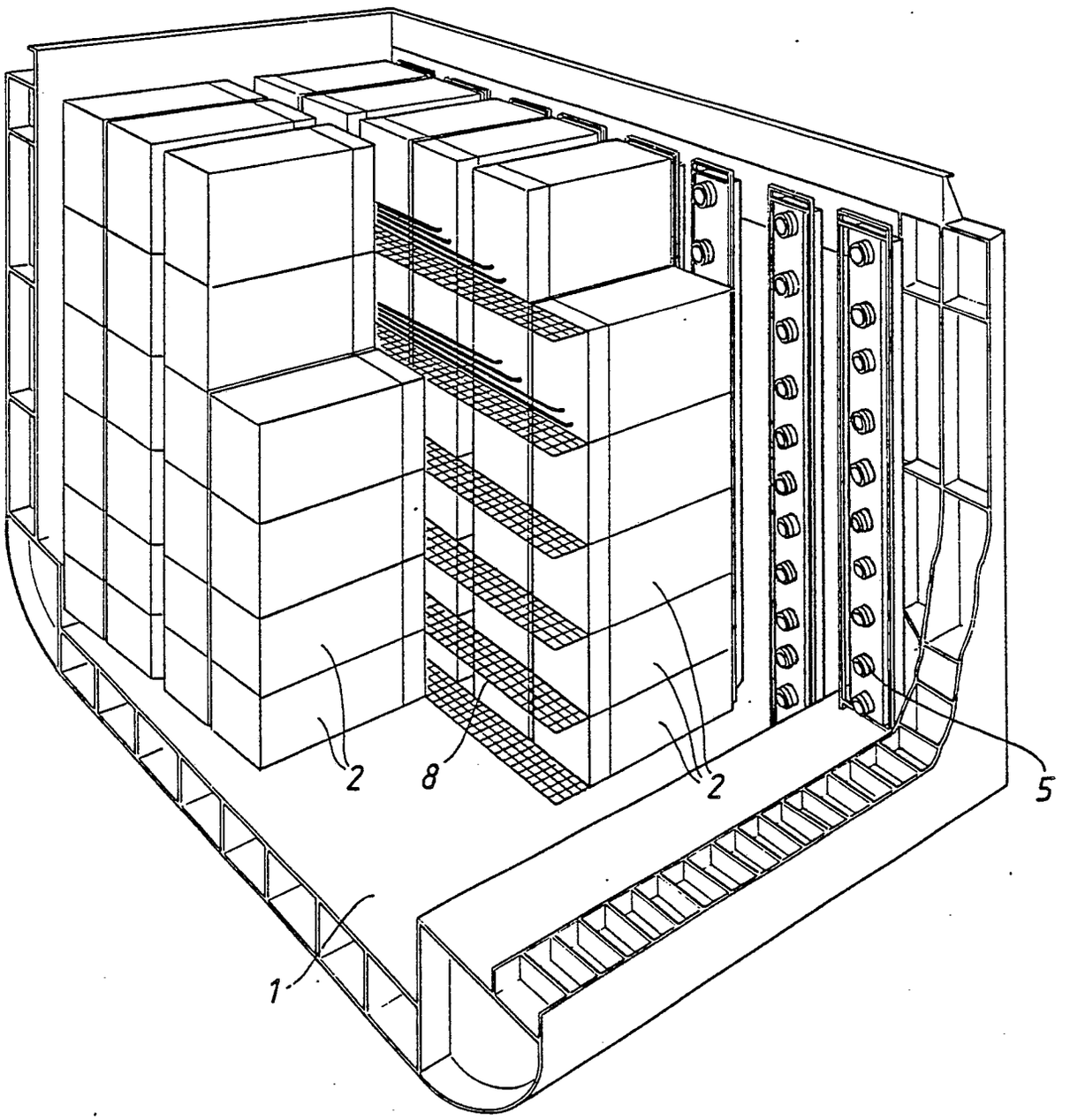


FIG. 2



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EUROPEAN SEARCH REPORT

Application number
88110644.7

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	SE-C-197 821 S.T.A.L. REFRIGERATION AB) * Column 1, lines 20-28; figure 1 *	1,2	B 63 J 2/12
Y	SE-B-416 928 SALÉN-REDERIERNA AB) * Figure 13 *	1,2	
A	SE-B-323 303 (O D COLVIN) * Figures 1,5; page 12, line 29 - page 14, line 21 *		
A	SE-C-181 618 (AB SVENSKA FLÄKTFABRIKEN OCH STAL REFRIGERATION AB)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 63 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	22-09-1988	SALÉN B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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