(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 260 624**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **87113358.3**

(51) Int. Cl.[4]: **B63J 2/08**

(22) Date of filing: **12.09.87**

(30) Priority: **16.09.86 SE 8603893**

(43) Date of publication of application:
23.03.88 Bulletin 88/12

(84) Designated Contracting States:
BE DE ES FR GB IT NL

(71) Applicant: **STAL REFRIGERATION AB**

S-721 83 Västeras(SE)

(72) Inventor: **Ohlsson Sören**
Furuvägen 19
616 00 Aby(SE)

(74) Representative: **Boecker, Joachim, Dr.-Ing.**
Rathenauplatz 2-8
D-6000 Frankfurt a.M. 1(DE)

(54) **Fresh air supply system for holds in a ship.**

(57) Fresh air supply system for holds in a ship comprising means for automatic regulation and control of the concentration of a certain gas, for example carbon dioxide, in a hold by controlling the current of fresh air through a channel which is formed by a supply conduit (14,15) to the hold, the hold (5,6;7,8) itself, and an outlet conduit (12,13) from the hold. According to the invention at at least one location in said channel are arranged a regulating valve (18,19;22,23) provided with an operating device as well as a member (24) for sensing the concentration of carbon dioxide, the member (24) being adapted to deliver a control impulse to the operating device to bring about increased supply of fresh air in the case of a sensed increase in the carbon dioxide concentration.

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Fresh air supply system for holds in a ship

The invention relates to a fresh air supply system for holds in a ship, particularly for holds accommodating cargo refrigerating plants, according to the precharacterising part of Claim 1.

During the last thirty years most fresh air supply systems for cargo refrigerating plants in ships have been equipped with a high pressure system which was developed in the fifties when oil costs were less pronounced - or perhaps not given a though of at all. Today, the operating costs for a ship are considerable, which, among other things, calls for keeping the energy consumption as low as possible.

The reason for the need to ventilate the refrigerating plant is that fruit, berries and vegetables which are to be transported consume oxygen present in the air during the ripening process while at the same time giving off heat, CO_2 and water. Bananas also produce ethylene. The higher the temperature during the transportation of a cargo, the faster will be the ripening process. it is therefore desired always to transport the cargo at as low a temperature as possible without subjecting the cargo to freeze damage and without stopping the ripening process. If the ripening is stopped, it can never be revived. To achieve a maximum storage time and maximum quality of the products, it has been found that certain values of the CO_2 concentration in the air in the storage facilities of the refrigerating plant are suitable.

As examples the following can be mentioned:

Bananas 0.3 - 0.6% (per cent by weight)
Pears, apples 2 - 3% (per cent by weight)
Citrus fruits 0.1% (per cent by weight)

Of the above-mentioned fruits, bananas are by far the greatest carbon dioxide producer at the correct transport temperature. A few approximate standard values are given as follows:

Fruit	Transport temperature (°C)	Produced weight of CO_2 per ton of supplied fresh air and day
Bananas	11.5 - 14.5 °C	300 - 500 g
Pears	-1.5 - -0.5 °C	90 g
Apples	-1.0 - ±0 °C	100 g
Oranges	±0 - +1 °C	100 g

From these tables it is clear that the fresh air requirement varies most considerably depending on the kind of fruit that is transported.

The fresh air supply systems which are presently available must, of course, be able to fulfill the highest demands that may be placed on them although these extreme conditions very seldom occur in reality. Furthermore, it should be noted that each unnecessary cubic meter of fresh air supplied to the cargo space causes extra costs for oil for generator operation to produce the current necessary for operating the fans and, above all, for defrosting of the air coolers in the refrigerating spaces.

The instruments used at present for measuring the CO_2 concentration in the hold of a ship are self-calibrating precision instruments which enable a regulation of the CO_2 concentration around a mean value. Previously existing control devices have suffered from such great inherent uncertainties that many fresh air plants, in the case of fruit transportation, have been allowed to operate at full capacity during the whole voyage, irrespective of whether this was necessary or not, with resultant unnecessarily heavy operating costs.

The invention aims at the development of a fresh air supply system of the above-mentioned kind in which the carbon dioxide content in the hold is maintained on a favorable level.

To achieve this aim the invention suggests a fresh air supply system 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.

To bring about a particularly accurate control, automatically controllable, fully sealing valves are arranged in both the supply pipe and the outlet pipe.

Furthermore, since the fans arranged in holds do not always have sufficient capacity to effect the necessary change of air, additional fans can be arranged in both the supply conduit and the outlet conduit. The revolution rate of these fans is controlled by the member sensing the carbon dioxide content via, for example, a computer, whereby too high a carbon dioxide content leads to increased rotational speed of these fans.

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

Figure 1 a schematic cross-section of the cargo spaces of a ship,

figure 2 schematically a vertical cross-section through the cargo space shown in Figure 1.

Figure 1, shows the sides 1 of the ship and the insulated decks 2 in the ship. The insulated decks 2 divide the shown part of the ship into two separate refrigerating spaces. These, in turn, are divided by perforated decks 3 and 4 into two spaces so as to form a total of four holds, 5,6,7 and 8.

As will be clear from Figure 2, circulation fans 10 (producing about 350-500 Pa) and air coolers 11 can be arranged at a bulkhead 9 defining the holds.

The outlet conduit 12 for the holds 5,6 and the outlet conduit 13 for the holds 7,8 are connected onto the respective air-cooler units, between the fans 10 and the air cooler 11. These outlet conduits 12,13 run inside the supply conduits 14,15, that is to say, the conduits with the colder air run inside the conduits with warmer air, which means that the insulation of these conduits can be dispensed with. By the arrangement with pipes running inside each other, an additional advantage is gained, namely, that only half as many holes in the deck are needed, although the diameter of these holes will be somewhat greater than normal. At the outlets of the outlet conduits 12 and 13 there are arranged variable-speed controlled fans 16 and 17, respectively, and immediately inside of these there are arranged the motor-controlled valves 18 and 19, respectively, which are capable of closing the outlets completely. In similar manner, at the inlets of the supply conduits 14,15, there are arranged sim ilar fans 20 and 21, respectively, and controllable valves 22 and 23, respectively.

For controlling the controllable valves and fans, a member 24 is provided for monitoring the carbon dioxide content in the holds. This member 24, in turn, delivers control signals by means of a computer 25 to the above-mentioned valves and fans. The member 24 also communicates with a container 26 containing carbon dioxide of a known content for self-calibration of the sensing member 24.

The fans 10 operate both during intake and exhaust of air since - as will be clear from the figures - the outlet conduits 12,13 have been connected onto the air-cooler units between the fans 10 and the air cooler 11. The fans 10 are suitably allowed to run at full speed and control the air flow through the holds by means of the valves 18,19 and 22,23. If the fans 10 should not have sufficient capacity to keep the carbon dioxide content at the desired value, even with the valves fully open, the computer 25 is allowed to deliver a starting signal to the fans 16,17 and 20,21, which are controlled to run at a suitable speed. Otherwise, of course, numerous combinations of control are possible since both controllable valves and fans are available.

Claims

1. Fresh air supply system for holds in a ship comprising means for automatic regulation and control of the concentration of a certain gas, for example carbon dioxide, in a hold by controlling the current of fresh air through a channel which is formed by a supply conduit (14,15) to the hold, the hold (5,6;7,8) itself, and an outlet conduit (12,13) from the hold, **characterized** in that at least at one location in said channel there are arranged a regulating valve (18,19;22,23) provided with an operating device as well as a member (24) for sensing the concentration of carbon dioxide, the member (24) being adapted to deliver a control impulse to the operating device to bring about increased supply of fresh air in the case of a sensed increase in the carbon dioxide concentration.

2. Fresh air supply system according to Claim 1, **characterized** in that automatically controllable, fully sealing valves (18,19;22,23) are mounted in both the supply conduit and the outlet conduit.

3. Fresh air supply system according to any of Claims 1 or 2, **characterized** in that each hold is provided with separate circulation fans (10) and air coolers (11) and that outlet conduits (12,13) have been connected to the air cooler unit between fan and air cooler.

4. Fresh air supply system according to Claim 3, **characterized** in that additional fans (20,21;16,17) are arranged in both the supply conduit and the outlet conduit, said fans being controlled in dependence on control impulses received from the sensing member (24).

5. Fresh air supply system according to any of the preceding claims, **characterized** in that the sensing mem ber (24) for self-calibration includes a calibration tube (26) containing a known concentration of carbon dioxide.

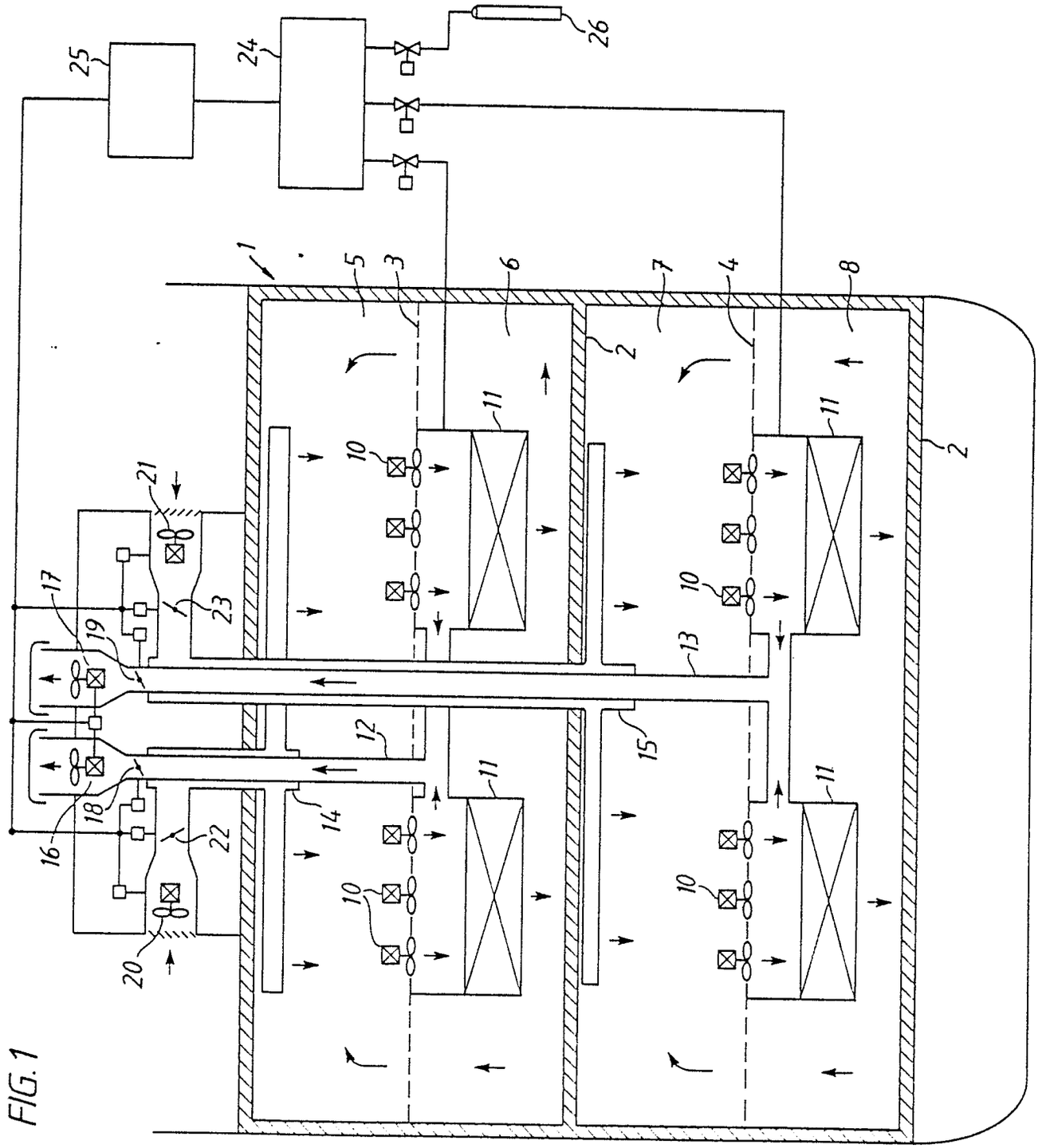
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FIG. 1

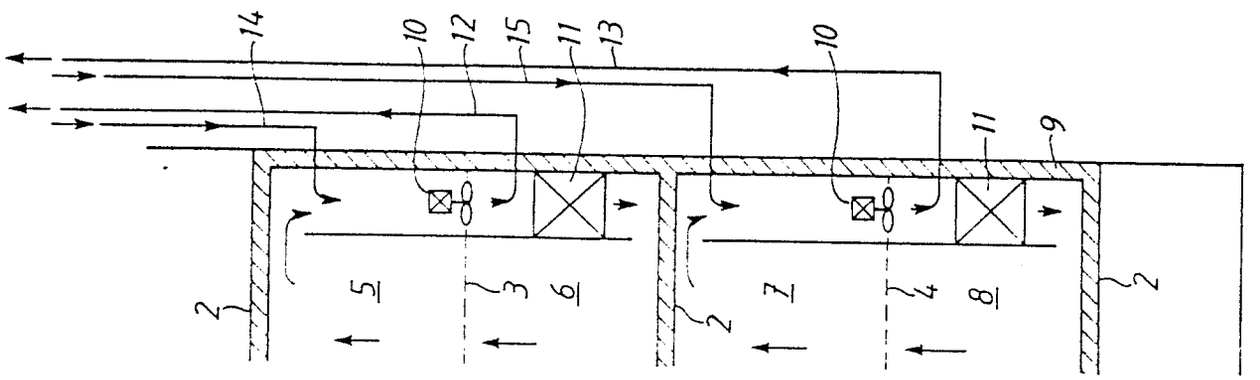
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FIG. 2

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EUROPEAN SEARCH REPORT

Application number

EP 87113358.3

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)
X,Y	SE-C- 181 618 (AB SVENSKA FLÄKT-FABRIKEN; STAL REFRIGERATION AB) * Column 2, line 37 - column 3, line 29 *	1-4	B 63 J 2/08
T	EP-A1-0 205 979 (MITSUBISHI DENKI KABUSHIKE KAISHA)	1, 4	
Y	EP-A3-0 136 042 (THE SHIPPING CORP. OF NEW ZEALAND LIMITED) * Abstract *	1, 4	
Y	US-A- 3 360 380 (K BEDROSIAN) * Claim 2 *	1, 4	

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

B 63 J
B 63 G
A 23 B
B 65 D
E 21 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	27-11-87	SALÉN B.

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
Y particularly relevant if combined with another document of the same category
A technological background
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T theory or principle underlying the invention
E earlier patent document, but published on, or after the filing date
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