

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 200146120 B2
(10) Patent No. 780894

(54) Title
Fan intended in particular to equip a tunnel for refrigeration of products such as food products and tunnel equipped with a set of these fans

(51)⁷ International Patent Classification(s)
F25D 017/08 F25D 013/06
F24F 013/08 F25D 017/06

(21) Application No: **200146120**

(22) Application Date: **2001.05.18**

(30) Priority Data

(31) Number	(32) Date	(33) Country
2000/06558	2000.05.23	FR

(43) Publication Date : **2001.11.29**

(43) Publication Journal Date : **2001.11.29**

(44) Accepted Journal Date : **2005.04.21**

(71) Applicant(s)
L'Air Liquide, Societe Anonyme pour l'Etude et l'Exploitation des Procedes Georges Claude

(72) Inventor(s)
Robert Taylor

(74) Agent/Attorney
PHILLIPS ORMONDE and FITZPATRICK, 367 Collins Street, MELBOURNE VIC 3000

(56) Related Art
US 2765748
US 3260443
GB 212123

ABSTRACT

Fan intended in particular for equipping a tunnel for refrigeration of products such as food products, this tunnel having a gaseous current flowing through it, characterised in that it comprises at least one pair of funnels (1) fixed onto one face of a support (2) mounted so that it can rotate about a vertical axis (XX) and connected to a means of driving rotation; these funnels have their entrance apertures (4) arranged radially so as to allow the gaseous current to penetrate into them and to emerge from them at an accelerated speed via their exit aperture (5). One or several fans according to the invention can be arranged at appropriate places in the tunnel, their rotation speed being chosen so that the exit gas currents from the funnels ensure a high degree of heat transport while reducing the risk of undesirable movement of products passing by on a conveyor placed below the fans.

AUSTRALIA

Patents Act

**COMPLETE SPECIFICATION
(ORIGINAL)**

Class Int. Class

Application Number:
Lodged:

Complete Specification Lodged:
Accepted:
Published:

Priority

Related Art:

Name of Applicant:

L'Air Liquide, Societe Anonyme pour l'Etude et l'Exploitation des Procedes Georges Claude

Actual Inventor(s):

Robert Taylor

Address for Service:

PHILLIPS ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne 3000 AUSTRALIA

Invention Title:

FAN INTENDED IN PARTICULAR TO EQUIP A TUNNEL FOR REFRIGERATION OF
PRODUCTS SUCH AS FOOD PRODUCTS AND TUNNEL EQUIPPED WITH A SET OF THESE
FANS

Our Ref : 643173
POF Code: 1290/43509

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

It would be desirable to provide a fan intended in particular for equipping a tunnel for refrigeration of products such as food products, and also the tunnel equipped with such a set of fans.

5 It is known that in cryogenic tunnels for refrigeration of food products a cold gaseous current is circulated which ensures heat transfer by convection between the cold gas and the food product to be refrigerated. The aim is to ensure high levels of heat transfer without damaging or moving the products on the belt of the conveyor, while minimising the energy
10 dissipated inside the cryogenic tunnel.

This type of tunnel has been used for more than thirty years with a wide variety of fans and of devices to ensure the necessary gas movement. The most common fans act axially and are fitted so as to blow downwards
15 in the direction of the food product. Centrifugal fans which push the gas transversely to the products are also used. The heat transfer coefficients of such systems normally lie between 45 and 90 W/m²/°C. Tunnels optimised for treatment of products that are in principle thin such as small hamburger rounds use
20 gaseous vortices whose heat transfer coefficient is about 120 W/m²/°C or which produce gaseous jets impinging on the products with a heat transfer coefficient greater than 200 W/m²/°C.

The gaseous vortices normally require that the gas
25 flows away through zones not covered by the belt of the conveyor, which limits their application to products which do not completely cover the belt of the conveyor, an upper limit of 65% for the coverage of the belt being usual.

30 The gaseous impact systems are normally based on fans which create an overpressure in a relatively large volume of the tunnel. The gaseous jet impacts are produced by a gas which is expelled from a high pressure volume through a plurality of holes, or of channels. So that these impact systems can be used in cryogenic tunnels, they must be easy to clean, and

special characteristics are required to maintain their performance owing to the potential presence of snow and of ice formed in the holes and tubes or the channels.

5 In many cases, problems arise in connection with excessive transverse air currents or suction towards the fans which can cause movement of light products on the conveyor. For most products which could be moved, such movement is unacceptable as it can damage or modify the shape of the product or make it come out of
10 alignment with the other products, even when that alignment is intended to allow a subsequent process such as automatic packing.

For products which are not particularly fine, the highest heat transfer coefficients do not contribute
15 major advantages in terms of treatment speed, as the thermal diffusion capability of the products limits the rate of heat transfer from the products.

The discussion of documents, acts, materials, devices, articles and the like is included in this specification solely for the purpose of providing a context for the present
20 invention. It is not suggested or represented that any or all of these matters formed part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed in Australia before the priority date of each claim of this application.

Throughout the description and claims of this specification, the word "comprise" and variations of the word, such as "comprising" and "comprises", is not intended to
25 exclude other additives, components, integers or steps.

It would therefore be desirable to provide a fan designed to remedy these disadvantages.

The fan concerned in the invention is intended in particular to equip a tunnel for refrigeration of
30 products such as food products, this tunnel having a cold gaseous refrigerating current flowing through it.

According to the invention, this fan comprises at least one pair of funnels fixed onto one face of a support mounted so that it can rotate about a vertical axis and connected to a means of driving rotation, and these funnels have their entrance apertures arranged radially so as to allow the gaseous current to penetrate into them and to emerge from them at an accelerated speed via their exit aperture.

A set of these fans can be appropriately arranged inside the tunnel, and the funnels of each fan can be profiled to generate a gaseous jet moving for example at a speed of 20 to 30 m/sec and which impinges on the product to be refrigerated. The high speed of the gaseous jet emerging from the fans provides high levels of heat transfer as the boundary layer around the product is very thin. The action of the fan does not

create high suction flows nor zones of very low pressure, which makes it possible advantageously to minimise any movement of the products.

5 The cryogenic tunnel also concerned in the invention is equipped with a set of these fans, arranged to direct cold gaseous currents locally at an accelerated speed onto predetermined zones of the conveyor.

10 Other features and advantages of the invention will become apparent in the course of the following description, given with reference to the appended diagram and which illustrates one form of implementation as a non-limiting example.

15 The single figure is a simplified perspective view of one form of implementation of a fan according to the invention, intended to equip for example a cryogenic tunnel.

20 The fan shown in the appended figure is intended in particular to equip a tunnel for refrigeration of products such as food products.

25 It comprises at least one pair of funnels 1 fixed onto one face of a support 2 mounted so that it can rotate about a vertical axis XX and connected to a means of driving rotation not shown, such as an electric motor. The support 2 can for example consist of a disc equipped axially with a spindle 3 suitable for receiving an output shaft from the drive motor.

30 The two funnels 1 and 2 are fixed diametrically opposite on a lower face of the disc 2 arranged in an approximately horizontal plane. Their entrance apertures 4 can have any outline, for example rectangular as shown, and are preferably situated approximately in a same diametric plane of the disc 2. The funnels 1 are curved downwards in the direction
35 opposite to the direction of rotation R of the disc 2. The cross-section of the body of each funnel decreases gradually along the curvature thereof until an exit aperture 5 of small diameter.

Thus when the disc 2 is set in rotation around the vertical axis XX, the cold gas current is taken into the entrances 4 and flows within the funnels 1 as shown by the set of arrows F, at an accelerated speed. After
5 passing through the exit apertures 5, the gas currents impinge on the products to be refrigerated, not shown, arranged below the disc 2 on the band of a passing conveyor, which is not shown.

A set of such fans can be arranged in well defined
10 zones of the tunnel, in which a high degree of heat transfer by convection has to be ensured. These fans are thus situated where they are considered most advantageous for the functioning of the tunnel. For example they can be arranged at the entrance, where the
15 surface of the products can be refrigerated while minimising their dehydration and creating an abrupt temperature gradient within the product. It can also be placed close to a cryogenic injection point, where there is a very large temperature difference between
20 the gas and the product to be refrigerated.

The rotation speed of the fan can vary widely to optimise its performance depending on the products to be refrigerated. Cryogenic injection into the path of these funnel fans can be exploited to control the
25 formation of frosting or to increase the heat transfer of the injection zone. The structure of these funnel fans is optimised to produce efficient gas movement and to allow easy cleaning. These fans reduce the risk of movement of light products while ensuring a high degree
30 of heat transfer by convection.

When fans according to the invention are used in the liquid nitrogen injection zone (cryogenic injection zone), a ring can be vaporised around the fan to effect an atomisation towards the axis of the fan. The funnel
35 fan collects the aerosol and directs a combination of cold gas and droplets of liquid nitrogen entrained thereby directly onto the product at high speed. The aerosol of liquid nitrogen provides an additional advantage by cleaning off any formation of snow or

frost before it can diminish the aerodynamic performance of the funnel fan. The latter has been found effective at low temperatures but can also be used at high temperatures, for example for continuous
5 cooking systems.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Fan intended in particular for equipping a tunnel for refrigeration of products such as food products, this tunnel
5 having a gaseous current flowing through it, wherein the fan includes at least one pair of funnels fixed onto one face of a support mounted so that it can rotate about a vertical axis and connected to a means of driving rotation, and in that these funnels have their entrance apertures arranged radially so as to
10 allow the gaseous current to penetrate into them and to emerge from them at an accelerated speed via their exit aperture.

2. Fan according to claim 1, wherein the support is a disc on one face of which the funnels are fixed diametrically opposite
15 with their entrance apertures situated approximately in a same diametric plane, and these funnels are curved downward and in the direction opposite to the direction of rotation (R) of the disc.

3. Cryogenic tunnel for refrigeration of products, for example food products passing by on a conveyor and wherein a cold gas current can circulate, wherein it is equipped with a set of fans according to claim 1 or 2 arranged to direct cold
20 gaseous currents locally at an accelerated speed onto predetermined zones of the conveyor.

4. A fan according to claim 1 substantially as hereinbefore described with reference to the drawing.

30

Date: 18 February, 2005

Phillips Ormonde & Fitzpatrick
Attorneys For:

David B. Fitzpatrick

L'Air Liquide, Societe Anonyme pour l'Etude et l'Exploitation
35 des Procédes Georges Claude

10 05 01 40120

