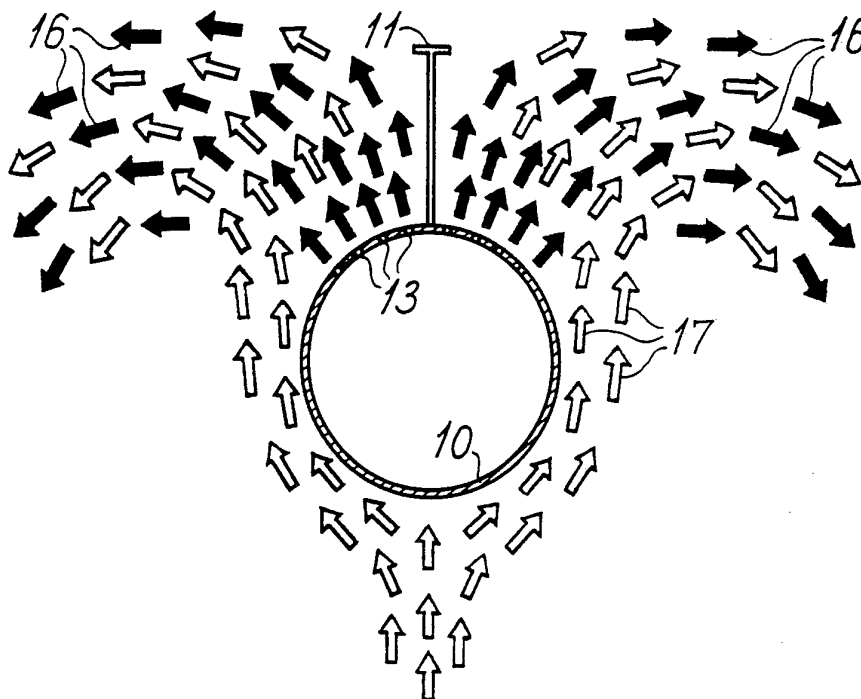


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(21) International Application Number: PCT/DK93/00037 (22) International Filing Date: 2 February 1993 (02.02.93) (30) Priority data: 0127/92 3 February 1992 (03.02.92) DK (71) Applicant (for all designated States except US): KE-BURGMAN A/S [DK/DK]; Park Allé 34, DK-6600 Vejen (DK). (72) Inventors; and (75) Inventors/Applicants (for US only) : DANIELSEN, Frede [DK/DK]; Baunborgvej 1, DK-6600 Vejen (DK). JESPERSEN, Carsten [DK/DK]; Priorgade 4 st.th., DK-9000 Aalborg (DK). (74) Agent: PLOUGMANN & VINGTOFT A/S; Sankt Annæ Plads 11, DK-1250 Copenhagen K (DK).		(81) Designated States: AU, BB, BG, BR, CA, CZ, DE (Utility model), DK (Utility model), ES (Utility model), FI, HU, JP, KP, KR, LK, MG, MN, MW, NO, NZ, PL, RO, RU, SD, SK, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: AN AIR INJECTION TUBE AND A METHOD FOR AIR INJECTION



(57) Abstract

An air injection tube (10) for injecting ventilating, cooling and/or heating air may be installed in a room. The tube (10) has a plurality of small, mutually spaced air injecting openings (13) defined in its peripheral wall along at least one longitudinally extending wall zone of the tube. These air injection openings (13) are arranged in groups or patterns (15) each comprising at least two peripherally spaced rows or openings. The groups or patterns of openings are mutually spaced along the length of the zone, and the longitudinal spacing (d) of adjacent groups or patterns (15) substantially exceeds the mutual longitudinal spacing of the openings (13) in each group or pattern (15) of openings. The maximum angular spacing of the openings (13) in peripherally adjacent rows of each group or pattern is 45° and preferably 35°.

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AN AIR INJECTION TUBE AND A METHOD FOR AIR INJECTION

The present invention relates to an air injection tube for injecting ventilating, cooling and/or heating air into a room in which the tube is installed. Such tubes, which may be made
5 from an air-impervious, flexible material, comprise a great plurality of uniformly mutually spaced small openings defined in a peripheral zone extending along the length of the tube.

Tubes of this known type may be used for blowing fresh and/or heated air into a large room or hall, such as factory
10 buildings, gymnasiums, etc.

An air injection tube of this type may, for example, be mounted in the upper part of the room or hall so that the air injection openings are directed upwardly and/or sidewise. For special applications the openings may also be directed
15 downwardly. When ventilating and/or heating air is fed into the tube at a certain pressure above that of the atmosphere a high-velocity flow of primary air is directed outwardly through each of the air injection openings of the tube. Each such high-velocity air flow generates a surrounding zone with
20 a subatmospheric pressure, which in turn induces an inflow of secondary air from the room towards the injection tube. The velocity of the primary air flows is reduced in response to the inflow of secondary air from the room in which the injection tube is installed.

25 GB-A-846,472 and GB-A-929,285 disclose an injection tube or air duct of the above type, wherein the openings defined in the tube are arranged in a pair of diametrically opposite rows. The tube may be divided into axial sections, and the mutual spacing of the openings in each row of openings may be
30 smaller in sections adjacent to a closed end of the tube than in sections adjacent to an air inlet end of the tube.

It is desired to obtain the best possible mixing of the injected primary air with the air present in the room without inducing uncomfortable draught therein.

The mixing of the primary air supplied through the injection tube and the air present in the room may be improved by increasing the pressure of the primary air supplied to the injection tube and, consequently, also the velocity of the primary air flows. However, this in turn increases the uncomfortable draught in the room.

10 The present invention provides an injection tube of the above type by means of which the mixing of primary air supplied through the injection tube may be substantially improved without increasing the uncomfortable draught in the room in which the injection tube is installed.

15 Thus, the present invention provides an air injection tube for injecting ventilating and/or heating air into a room in which the tube is installed, a plurality of small, mutually spaced air injection openings being defined in the peripheral wall of the tube along at least one longitudinally extending wall zone of the tube and being arranged in at least two peripherally spaced rows of openings, and the air injection tube according to the invention is characterized in that the air injection openings are arranged in groups or patterns, which are mutually spaced along the length of the zone, the longitudinal spacing of adjacent groups or patterns substantially exceeding the mutual longitudinal spacing of the openings in each group or patterns of openings, the maximum angular spacing of the openings in peripherally adjacent rows of each group or pattern being 45°.

30 It has been found that the flows of secondary room air directed towards the air injection tube and induced by the primary air flows through the axially spaced groups or patterns of air injection openings are substantially in-

creased compared with an air injection tube, in which the air injection openings are not arranged in such axially spaced groups or patterns. It is believed that the increase in the secondary air flow is obtained because the axial spacing of the groups or patterns of injection openings induces a three dimensional secondary air flow rather than the two dimensional secondary air flow - in planes at right angle to the longitudinal axis of the air injection tube - induced when the known air injection tubes are used.

10 The increased volume of secondary air flowing to the air injection tube according to the invention causes a substantial reduction of the velocity of the primary air flowing outwardly from the tube through the air injection openings therein. This means that the velocity of the primary air
15 flowing out through the openings in the tube may be relatively high so that an increased inflow of secondary air may be induced without increasing the risk of uncomfortable air flow or draught in the lower part of the room, where persons are sitting or moving around.

20 The maximum mutual peripheral and axial spacings of the openings in each group or pattern are dependent on the velocity of the primary air flowing out through the openings defined in the tube, and, consequently, on the pressure of the air supplied to the inner space of the tube. Generally
25 speaking, the mutual spacings of the openings should be such that the flows of primary air from all of the openings in a group or pattern of openings and the flows of secondary air induced are united so as to form a single, combined and coherent, expanding air flow close to the outer surface of
30 the air injection tube. The combined air flows from adjacent groups or patterns of openings are also eventually united to a coherent air flow, but in a greater distance from the air injection tube, said distance being dependent i.a. on the mutual longitudinal spacings of the groups or patterns of
35 openings.

The maximum peripheral spacing of adjacent rows of openings in each group or pattern depends not only on the velocity of the primary air flows, but also on the outer diameter of the injection tube. Normally, this peripheral spacing of
5 peripherally adjacent rows of openings does not exceed 120 mm, and the angular spacing of such adjacent rows of openings in each group or pattern does not exceed 35°.

If the rows of openings are too closely spaced, the inflow of secondary air may be disadvantageously reduced. Therefore,
10 the minimum peripheral spacing of the centres of a pair of openings in peripherally adjacent rows is preferably 10 mm.

Normally, it is desired to direct the primary air flows from the groups or patterns of openings in a more or less fixed direction in order to create a desired flow pattern within
15 the room in which the injection tube is arranged. Therefore, the peripheral or angular extension of each group or pattern of openings does normally not exceed 180°. Also, when such groups or patterns of openings are arranged in two or more longitudinally co-extending zones, the combined peripheral
20 extension of the groups or patterns does preferably not exceed 180°. On the other hand, the peripheral extension of each group or pattern of openings should preferably not be less than a certain minimum of 32 mm and preferably 64 mm.

Each of the said wall zones of the air injection tube, in
25 which the injection openings are defined, may extend in a spiral-like manner along the air injection tube or be defined between axially extending curves of any other shape. In the preferred embodiment, however, each of these wall zones is defined between a pair of peripherally spaced generatrices of
30 the outer tube wall surface. This means, that each of the said wall zones may be defined between a pair of angularly spaced planes extending through the longitudinal axis of the air injection tube.

The air injection openings of each group or pattern may have different mutual spacings. However, the air injection openings of each group or pattern preferably substantially uniformly mutually spaced not only axially, but also peripherally, and the mutual spacing of the injection openings is preferably also substantially the same in the various groups or patterns.

Each pattern or group may comprise any suitable number of peripherally spaced, axially extending rows of openings. However, each group or pattern should preferably comprise at least four such rows of openings.

In order to obtain primary air flows with a relatively high velocity the air injection openings should be relatively small. Each opening may, of course, have any polygonal or other suitable shape. The air injection openings are, however, preferably substantially circular with a diameter of 2-10 mm, preferably 4-5 mm.

The axial spacing of the centers of adjacent air injection openings in each pattern or group is normally 10-50 mm and preferably approximately 20 mm. The peripheral spacing of the air injection openings in a group or pattern may be dependent i.a. on the diameter of the air injection tube.

The axial extension of each group or pattern of openings may depend on the diameter and on the axial length of the air injection tube. Normally, however, such axial extension is 200-1000 mm and preferably 500-800 mm or 400-800 mm.

The mutual longitudinal spacing of adjacent groups or patterns of openings may be adapted to the architectural conditions of the room in which the air injection tube is installed. As an example, a group or pattern of air injection openings should preferably not be positioned immediately opposite to an adjacent beam column, or wall part. However,

in order to obtain substantially uniform flow conditions in the room the mutual spacing of adjacent groups or patterns of openings is preferably substantially the same along the length of the tube.

- 5 The area of each group or pattern may have any suitable outline or shape, such as circular, elliptical, or polygonal. In the preferred embodiment, however, each group or pattern of openings is defined between a pair of peripherally spaced generatrices of the tube wall and a pair of axially spaced
10 planes extending substantially at right angles to the tube axis, so that such group or pattern has a substantially rectangular shape when the tube wall is in an unfolded plane condition.

- As mentioned above, the axial spacing of adjacent groups or
15 patterns of openings is preferably substantially uniform along the length of the tube, but the axial spacing may be different due to special circumstances. Normally, the axial spacing of adjacent groups or patterns of openings is 20-150 percent of the axial extension of each group or pattern of
20 openings.

- The tube wall may be made from a stiff, self-supporting material, but is preferably made from an air-impervious, flexible material. Thus, the peripheral wall of the injection tube may be made from glass fiber or other organic or
25 inorganic fibers, which may be knitted, woven or non woven and covered by a plastic material or another material making the walls air-impervious.

- The wall thickness of the air injection tube may be 0.2-1 mm and preferably about 0.6 mm. The diameter of the tube may,
30 for example, be 200-2000 mm, and the length of the tube may correspond to the length of the room or hall in which it is installed and may, for example, be up to 100 m or even more. Air is supplied to the injection tube at such a

superatmospheric pressure that the injection tube will be maintained in a distended condition.

The injection tube may be provided with a filtering member for filtering air supplied to the air injection tube. Such a
5 filtering member may, for example, be arranged at the air inlet of the air injection tube, or a filtering medium may be positioned on the inner side of the air injection tube so as to cover the air injection openings. As an example, the filtering member may comprise an inner tube made from a
10 filtering medium and arranged within the air injection tube. Dust and microorganisms may then be filtered from the fresh air or heating air flowing into the room through the injection openings defined in the injection tube.

According to a further aspect the present invention provides
15 a method of injecting ventilating, cooling, and/or heating air into a room by means of an air injection tube according to the invention described above installed in the room, said method comprising supplying air to the inner space of the tube at a pressure so as to cause air to flow through the air
20 injecting openings defined in the wall of the tube at a velocity of 6-15 or 8-15 m/sec, preferably 10-15 m/sec. The high velocity of the flows of primary air causes a substantially increased injector effect, which in turn causes a substantially increased three-dimensional inflow of
25 secondary air. The large inflow of secondary air rapidly reduces the high velocity of the primary air flows while primary and secondary air is thoroughly intermixed. The groups or patterns of openings in the injection tube are orientated so that the injected primary air does not come
30 into the lower part of the room where animals or human beings are present, until primary and secondary air has been thoroughly mixed, and the flow velocity of the intermixed air has been reduced to an acceptable degree.

In order to obtain the above mentioned high velocity of the flows of primary air an air pressure of 60-200 Pa, preferably 80-160 Pa may be maintained in the inner space of the tube. More preferably, the pressure in the inner space of the tube
5 may be 60-120 Pa.

The flows of primary air from the injection openings are preferably directed upwardly in the room so that a thorough intermixing of primary and secondary air is obtained before the primary air enters into the lower part of the room at a
10 substantially reduced velocity. Other desired flow patterns may be obtained by directing the primary air flows obliquely downwardly into the room.

It is understood that almost any desired flow pattern may be obtained in a specific room by properly selecting parameters,
15 such as the diameter of injection openings, the tube diameter, the number of axially extending rows of openings in each group of openings, the peripheral mutual spacing of such rows of openings, the number of openings in each axial row of openings, the mutual axial spacing of the openings in such
20 rows, the mutual axial spacing of axially adjacent groups or patterns of openings, the number of peripherally spaced groups or patterns of openings, the peripheral spacing of such groups or patterns of openings, and the air pressure maintained within the inner space of the injection tube.

25 The invention will now be further described with reference to the drawings, wherein

Fig. 1 is a cross-sectional view of an air injection tube according to the invention, wherein the air flow around the tube is illustrated,
30 Fig. 2 is a perspective view of part of an embodiment of the air injection tube according to the invention,
Fig. 3 is a top plane view of part of the tube shown in Fig. 2, and

Figs. 4-6 diagrammatically illustrate three different injection patterns for primary air.

An air injection tube 10, which is made from a flexible, air-impervious material, may be mounted in a large room or hall, so that the tube extends substantially horizontally through the room. The air injection tube 10 may, for example, be suspended from a roof structure or ceiling by means of suspension members 11, and ventilating and/or heating air may be supplied to the inner space of the tube 10 through an air supply conduit 12.

A great plurality of small openings 13 are punched in the wall of the tube 10 in a longitudinally extending zone, which is limited by a pair of spaced generatrices 14 of the tube wall (Fig. 3). The tube 10 shown in the drawings comprises only one such perforated zone, which is upwardly directed. Alternatively, the tube 10 may comprise two or more peripherally spaced perforated zones, which may, for example, be directed laterally in opposite directions as illustrated in Figs. 5 and 6.

The air injection openings 13 are arranged in longitudinally spaced groups or patterns 15. Each group or pattern comprises preferably at least four peripherally spaced, axially extending rows of openings, and the axial dimension or length l of each pattern is preferably 500-800 mm. The mutual spacing or the axial distance d between adjacent groups or patterns 15 is preferably $1/5 l - 1 1/2 l$. The mutual spacing d of the adjacent groups or patterns 15 of injection openings 13 is preferably substantially the same along the length of the injection tube 10. However, as illustrated in Fig. 2, the mutual spacing d_1 may be increased at one or more locations, for example to avoid that a group of openings is positioned immediately opposite to a closely adjacent beam or wall surface, which might otherwise interfere with the desired air flow pattern.

In operation, ventilating, cooling or heating air is supplied to the closed inner space of the air injection tube 10 through the air supply conduit 12 so as to create a pressure therein above that of the ambient atmosphere. Because of the
5 overpressure within the air injection tube 10 a high velocity air flow is directed radially outwardly from each of the air injection openings 13. In Figs. 1 and 3 the high velocity flows of primary air have been indicated in solid black arrows 16. The high velocity flows of primary air create an
10 underpressure by ejector effect, whereby secondary room air is forced to flow upwardly as illustrated by non-solid, "white" arrows 17 in Fig. 1. The secondary room air is mixed with the primary air of the high velocity air flows through the openings 13, whereby the primary air flows are slowed
15 down. This allows for the velocity of the primary air flows to be as high as 15 m/sec.

In Fig. 4, the tube 10 has the groups or patterns 15 of openings 13 arranged in a single longitudinally extending, upwardly directed zone and substantially corresponds to the
20 embodiment shown in Figs. 1-3. In Fig. 5, however, the tube 10 has groups or patterns 15 of openings 13 arranged in two peripherally spaced, obliquely downwardly directed zones. In the embodiment illustrated in Fig. 6, the tube 10 comprises groups or patterns 15 of openings 13 arranged in 4
25 longitudinally extending and upwardly directed zones which are mutually peripherally spaced. A great plurality of other arrangements of the groups or patterns of openings 13 are possible, whereby the air circulation or the air flow pattern within the room in which the tube 10 is mounted may be
30 adjusted to specific needs.

As the air injection openings 13 are arranged in axially spaced groups or patterns 15 the flows 17 of secondary room air have flow components not only in planes extending at right angles to the longitudinal axis of the tube 10 as
35 illustrated in Fig. 1, but also axially directed flow

component as illustrated in Fig. 3. The secondary air flowing towards the air injection tube 10 between adjacent patterns 15 of openings 13 is diverted axially as illustrated in Fig. 3, and thus the mixing of primary and secondary air is improved, and the high-velocity primary air flows are more efficiently slowed down.

EXAMPLE

In an injection tube as shown in the drawings each group or pattern 15 of openings 13 comprises eight axial rows of openings each comprising 32-34 openings 13. The diameter of the openings 13 is 4.5 mm, and the mutual axial spacing of the openings 13 is 19.3 mm, which means that the axial length of each group or pattern 15 is approximately 785 mm. The mutual peripheral spacing of adjacent rows of openings is 15.5 mm, which means that the peripheral dimension of each group or pattern 15 is approximately 145 mm. The axial mutual spacing of adjacent groups or patterns 15 is approximately 215 mm. The outer diameter of the flexible tube 10 is 400 mm, and the wall thickness of the tube is 0.6 mm.

It should be understood that various modifications and amendments of the embodiment shown in the drawing could be made within the scope of the present invention. As an example, the outline of each group or pattern of openings could be circular, elliptical, hexagonal or could have any other shape than the rectangular outline shown in the drawings. It should also be mentioned that a conventional injection tube in which the injection openings are uniformly spaced along one or more longitudinal zones of the tube could be modified by using the teachings of the present invention. Thus, the uniformly spaced injection openings in each longitudinal zone could be divided into mutually axially spaced groups or patterns by covering injection openings along axially spaced transverse zones (designated d in Fig.

2), for example by means of adhesive tape or by any other suitable means.

CLAIMS

1. An air injection tube (10) for injecting ventilating, cooling and/or heating air into a room in which the tube (10) is installed, a plurality of small, mutually spaced air
5 injecting openings (13) being defined in the peripheral wall of the tube along at least one longitudinally extending wall zone of the tube and being arranged in at least two peripherally spaced rows of openings, characterized in that the air injection openings (13) are
10 arranged in groups or patterns (15), which are mutually spaced along the length of the zone, the longitudinal spacing (d) of adjacent groups or patterns (15) substantially exceeding the mutual longitudinal spacing of the openings (13) in each group or pattern (15) of openings, the maximum
15 angular spacing of the openings (13) in peripherally adjacent rows of each group or pattern being 45°.
2. An air injection tube according to claim 1, wherein the peripheral spacing of peripherally adjacent rows of openings (13) in each group or pattern (15) does not exceed 120 mm.
- 20 3. An air injection tube according to claim 1 or 2, wherein the angular spacing of peripherally adjacent rows of openings (13) in each group or pattern (15) does not exceed 35°.
4. An air injection tube according to any of the claims 1-3, wherein the minimum peripheral spacing of the centres of a
25 pair of openings (13) in peripherally adjacent rows is 10 mm.
5. An air injection tube according to any of the claims 1-4, wherein the peripheral or angular extension of each group or pattern (15) of openings (13) does not exceed 180°.
6. An air injection tube according to any of the claims 1-5,
30 wherein the groups or patterns (15) are arranged in at least

two longitudinally co-extending zones which are all positioned within a common longitudinally extending zone of the tube wall having a peripheral or an angular extension not exceeding 180°.

- 5 7. An air injection tube according to any of the claims 1-6, wherein the peripheral or angular extension of each group or pattern (15) of openings (13) is at least 32 mm.
8. An air injection tube according to any of the claims 1-7, wherein each of said wall zones is defined between a pair of
10 peripherally spaced generatrices (14) of the outer tube wall surface.
9. An air injection tube according to any of the claims 1-8, wherein the air injection openings (13) of each group or pattern (15) are substantially uniformly mutually spaced.
- 15 10. An air injection tube according to any of the claims 1-9, wherein each pattern or group (15) of openings (13) comprises at least four peripherally spaced, axially extending rows of openings (13).
11. An air injection tube according to any of the claims
20 1-10, wherein the air injection openings (13) have a diameter of 2-10 mm, preferably 4-5 mm.
12. An air injection tube according to any of the claims 1-11, wherein the axial spacing of the centres of adjacent air injection openings (13) in each pattern or group (15) is
25 10-50 mm, preferably approximately 20 mm.
13. An air injection tube according to any of the claims 1-12, wherein the axial extension of each group or pattern (15) is 200-1000 mm.

14. An air injection tube according claim 9, wherein the axial extension of each group or pattern (15) of openings (13) is 500-800 mm, preferably 400-800 mm.

15. An air injection tube according to any of the claims 1-14, wherein the mutual longitudinal spacing of adjacent groups or patterns (15) of openings (13) is substantially the same along the length of the tube (10).

16. An air injection tube according to any of the claims 1-15, wherein each group or pattern (15) of openings (13) is defined between a pair of peripherally spaced generatrices (14) of the tube wall and a pair of axially spaced planes extending substantially at right angles to the tube axis, so that such group or pattern (15) has a substantially rectangular shape when the tube wall is in an unfolded, plane condition.

17. An air injection tube according to any of the claims 1-16, wherein the axial spacing (d) of adjacent groups or patterns (15) of openings (13) is 20-150 percent of the axial extension (l) of each group or pattern of openings.

18. An injection tube according to claim 17, wherein the axial spacing (d) of adjacent groups or patterns (15) of openings (13) is approximately 100 percent of the axial extension (l) of each group or pattern of openings.

19. An injection tube according to any of the claims 1-18, wherein the tube wall is made from an air impervious, flexible material.

20. An injection tube according to claim 19, wherein the wall thickness of the tube is 0.2-1 mm and preferably about 0.6 mm.

21. An injection tube according to any of the claims 1-20, further comprising an inner filtering member for filtering air supplied to the air injection tube.
- 5 22. A method of injecting ventilating, cooling, and/or heating air into a room by means of an air injection tube according to any of the claims 1-21 installed in the room, said method comprising supplying air to the inner space of the tube (10) at a pressure so as to cause air to flow out
10 through the air injecting openings (13) defined in the wall of the tube at a velocity of 6-15 m/sec, preferably 10-15 m/sec.
23. A method according to claim 22, wherein an air pressure of 60-200 Pa, preferably 80-160 Pa is maintained in the inner
15 space of the tube (10).
24. A method according to claim 22 or 23, wherein the air flows from the injection openings (13) are directed upwardly in the room.

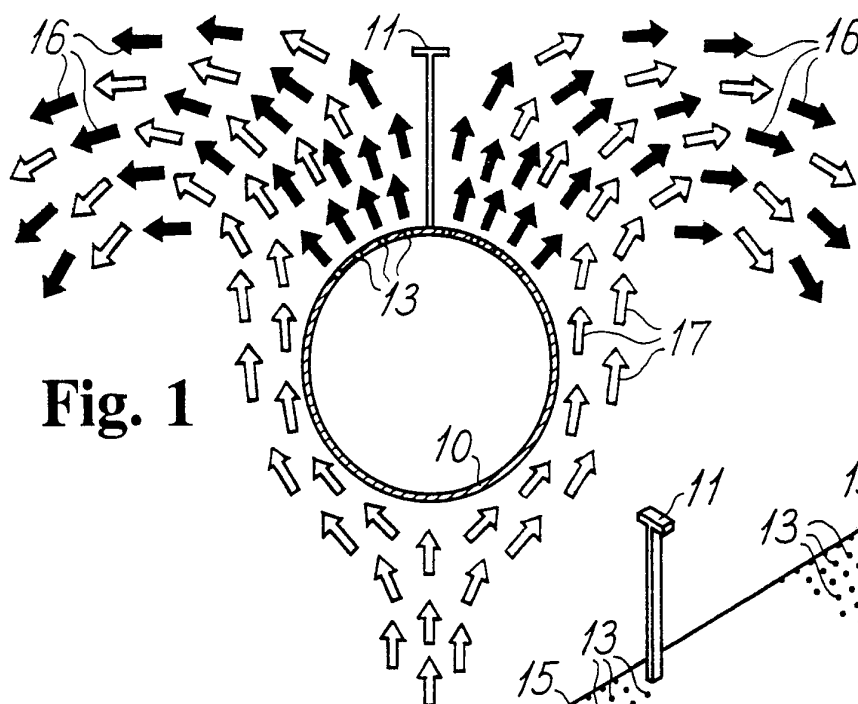


Fig. 1

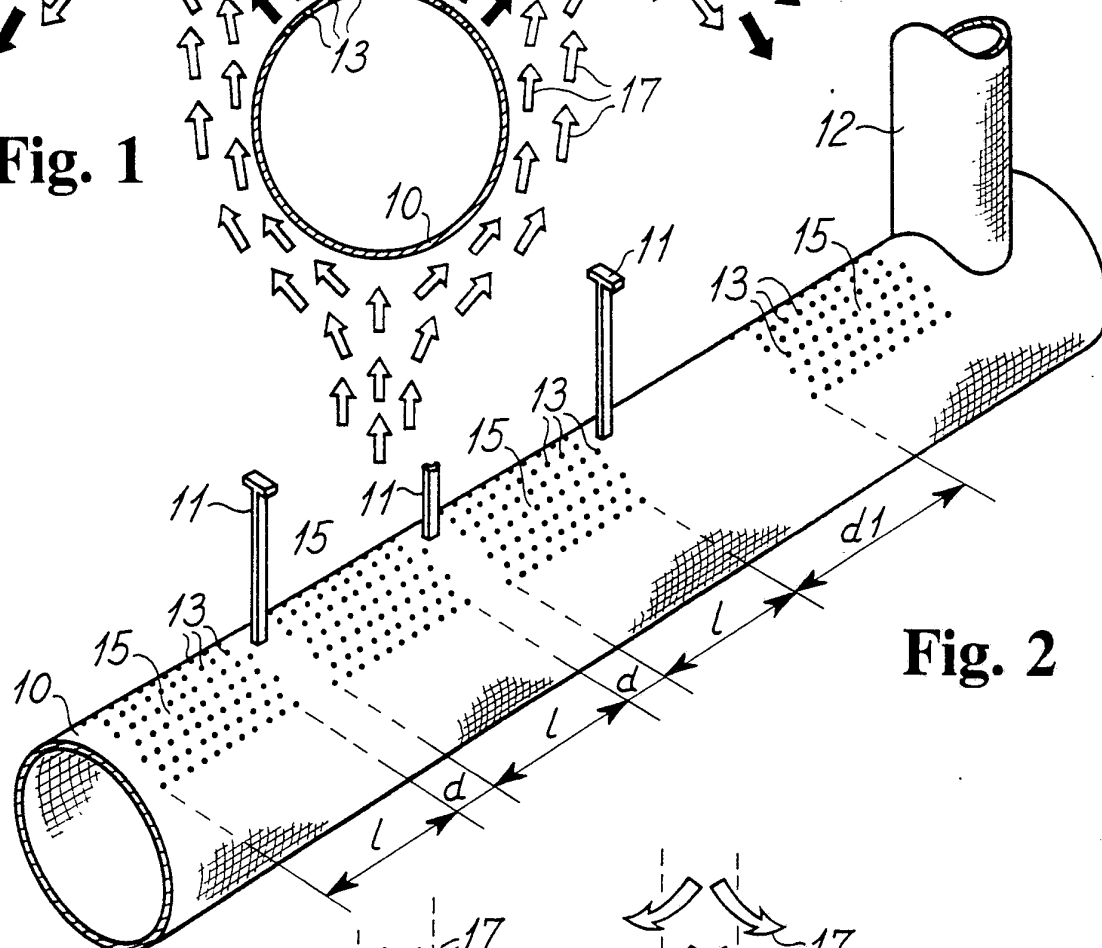


Fig. 2

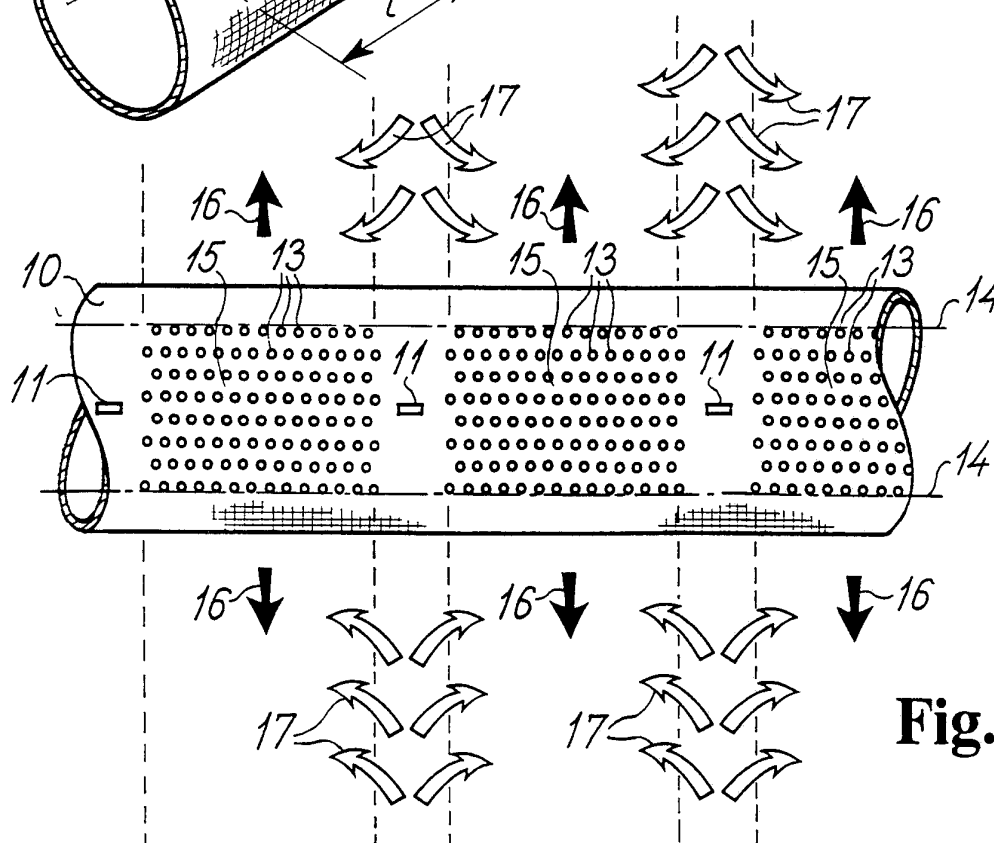


Fig. 3

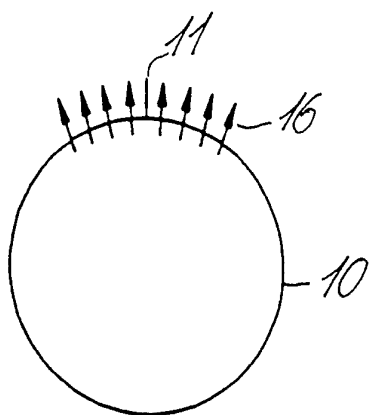


Fig. 4

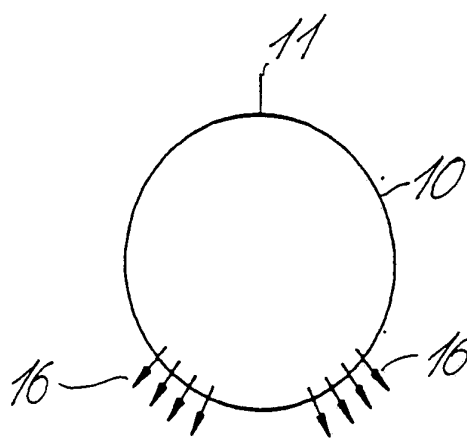


Fig. 5

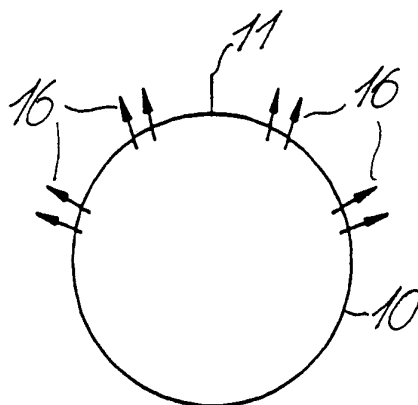


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 93/00037

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F24F 13/06, F24F 13/068

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)

IPC5: F24F

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

SE,DK,FI,NO classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SE, B, 212099 (AB BAHCO), 11 April 1967 (11.04.67) --	1-24
Y	US, A, 4616558 (BALL), 14 October 1986 (14.10.86) --	1-24
Y	GB, A, 846472 (ALAN CAMPBELL), 31 August 1960 (31.08.60) --	1-24
Y	US, A, 3824909 (HORNEFF ET AL), 23 July 1974 (23.07.74) --	1-24
Y	US, A, 5054379 (SODEC), 8 October 1991 (08.10.91) --	1-24

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

5 May 1993

Date of mailing of the international search report

14 -05- 1993

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 93/00037

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB, A, 929285 (ACTIVAIR LIMITED), 19 June 1963 (19.06.63) --	1-24
A	US, A, 3308741 (J.E. CHAMBERS), 14 March 1967 (14.03.67) --	
A	DE, B2, 2346108 (MASCHINENFABRIK GG. KIEFER GMBH), 26 February 1976 (26.02.76) --	
A	Derwent's abstract, No J1695 D/35, week 8135, ABSTRACT OF SU, B2, 785605 (PANKIN V V), 10 December 1980 (10.12.80) -- -----	

INTERNATIONAL SEARCH REPORT
Information on patent family members

31/03/93

International application No.
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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
SE-B-	212099	11/04/67	NONE		
US-A-	4616558	14/10/86	AU-B-	575448	28/07/88
			AU-A-	5019185	15/05/86
			CA-A-	1234312	22/03/88
			EP-A,B-	0200762	12/11/86
GB-A-	846472	31/08/60	NONE		
US-A-	3824909	23/07/74	NONE		
US-A-	5054379	08/10/91	DE-A-	3921813	17/01/91
			EP-A-	0406593	09/01/91
GB-A-	929285	19/06/63	NONE		
US-A-	3308741	14/03/67	NONE		
DE-B2-	2346108	26/02/76	CH-A-	575578	14/05/76