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

(11) **EP 2 058 053 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.05.2009 Bulletin 2009/20

(21) Application number: **07828950.1**

(22) Date of filing: **01.10.2007**

(51) Int Cl.:
B05B 5/04 *(2006.01)*

(86) International application number:
PCT/JP2007/069210

(87) International publication number:
WO 2008/044527 (17.04.2008 Gazette 2008/16)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **06.10.2006 JP 2006275475**

(71) Applicant: **Ransburg Industrial Finishing K.K.**
Yokohama-shi, Kanagawa 236-0004 (JP)

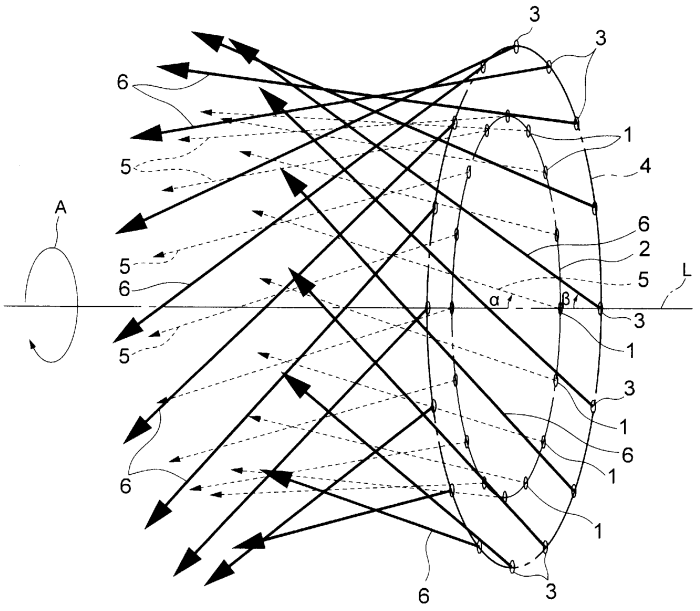
(72) Inventor: **MORI, Kenichi**
Yokohama-shi Kanagawa 2360004 (JP)

(74) Representative: **Finnie, Peter John**
Gill Jennings & Every LLP
Broadgate House
7 Eldon Street
London EC2M 7LH (GB)

(54) ROTARY ELECTROSTATIC COATING APPARATUS

(57) A rotary electrostatic atomizer is capable of changing the coating pattern width. Shaping air outlets (1) are aligned on a circle concentric with the rotation axis line (L) of a rotary head, and pattern control air outlets (3) are provided on a circle concentrically surrounding the alignment of the shaping air outlets (1). The shaping air outlets (1) and the pattern control air outlets (3) incline around the rotation axis line (L) such that shaping air (5) from the shaping air outlets (1) and pattern control air (6) from the pattern control air outlets (3) make spiral air flows twirling in the same direction. Angle (β) of inclination of the pattern control air (6) is larger in absolute value than angle (α) of inclination of the shaping air.

FIG. 1



EP 2 058 053 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a rotary electrostatic atomizer.

BACKGROUND OF THE INVENTION

[0002] Electrostatic coating is a technology for bringing atomized and electrically charged paint particles into adhesion onto a work. One of known devices for such coating is a rotary electrostatic atomizer having a rotary head (normally called a "bell cup"). This kind of electrostatic atomizer is used with a powder paint, electrically insulating liquid paint (such as oil paint) and electrically conducting paint (such as waterborne paint. Electrostatic atomizers used with an insulating paint are typically configured to electrically charge the paint with a high voltage applied to a rotary head. Most of electrostatic atomizers used with an electrically conducting paint are configured to electrically charge the paint with a high voltage applied across external electrodes provided outside the atomizer.

[0003] Rotary electrostatic atomizers use shaping air to direct the paint toward an intended work. Patent Document 1 (Japanese Patent Laid-open Publication No. H03(1991)-101858) points out the problem that the width of the coating pattern becomes narrower with an increase of the quantity of the shaping air, and proposes to improve this problem by inclining the emitting or discharging direction of the shaping air about the rotation axis line of the rotary head. By invoking this Patent Document 1 herein, detailed explanation of this proposal is omitted here. In short, such a decrease of the width or area of the coating pattern with an increase of the quantity of the shaping air is caused by a negative pressure produced in a forward region of the rotary head. That is, the negative pressure acts to pull in the shaping air inward, and this results in reducing the width (or area) of the coating pattern.

[0004] The proposal of Patent Document 1, namely, emitting the shaping air in inclined directions about the rotation axis line of the rotary head thereby makes a spiral flow of shaping air to make use of the centrifugal force of the spiral flow to alleviate or cancel the influence from the reduced or negative pressure and thereby increase the coating pattern width (or area).

[0005] This proposal of Patent Document 1 is useful for increasing the quantity of shaping air to enhance the finished quality (brightness) of coating by a rotary electrostatic atomizer when a metallic paint containing aluminum or mica particles is used.

[0006] Patent Document 2 (Japanese Patent Laid-open Publication No. H07(1995)-24367) points out that rotary electrostatic atomizers of the type disclosed in Patent Document 1 is fixed in width of the coating pattern, and therefore involves the problem of overspray when coating thin works such as vehicle pillars, and proposes a countermeasure.

[0007] More specifically, Patent Document 2 proposes to reduce the coating pattern width by emitting shaping air (first shaping air) in inclined directions about the rotation axis line of the rotary head like Patent Document 1, and emitting second shaping air outside the first shaping air, such that the both air flows get into collision.

[0008] Patent Document 3 (USP 6,991,178) is different from Patent Documents 1 and 2 in not inclining the emitting direction of shaping air about the rotation axis line of the rotary head. Patent Document 3 rather proposes to narrow the coating pattern width by emitting shaping air toward a conical outer peripheral surface of the rotary head and also emitting pattern control air radially outwardly adjacent to the shaping air to bring the both air flows into collision.

[0009]

[Patent Document] JP Laid-open Publication No. H03(1991)-101858
[Patent Document] JP Laid-open Publication No. H07(1995)-24367
[Patent Document] USP 6,991,178

OBJECTS TO BE SOLVED BY THE INVENTION

[0010] An object of the present invention is to solve the problem that the coating pattern width is fixed invariable when shaping air is emitted or discharged in directions inclined around a rotation axis line of a rotary head as disclosed in Patent Document 1.

[0011] A further object of the present invention is to provide a rotary electrostatic atomizer capable of changing the coating pattern width.

MEANS FOR SOLUTION OF THE OBJECTS

[0012] To accomplish the objects, the present invention provides a rotary electrostatic atomizer having a rotary head for centrifugally forwarding and spraying a paint expelled from a front perimeter of the rotary head toward a work with the aid of shaping air, comprising:

said shaping air being emitted in inclined directions around a rotation axis line of the rotary head;
pattern control air being emitted in an inclined direction around a rotation axis line of the rotary head radially outwardly alongside the shaping air in the same direction as that of the shaping air; and
angle (β) of the inclined direction of the pattern control air is larger in absolute value than angle (α) of the inclined direction of the shaping air.

[0013] FIG. 1 shows a general concept of the present invention. In FIG. 1, reference letter L denotes a rotation axis line of a rotary head. Shaping air outlets 1 are a plurality of holes aligned on a first circle 2 having its center on the rotation axis line L of the rotary head. Radially

outward of the first circle 2, pattern control air outlets 3 are provided. The pattern control air outlets 3 are a plurality of holes aligned on a second circle 4 concentric with and larger than the first circle 2. Arrow A in FIG. 1 indicates the rotating direction of the rotary head.

[0014] Shaping air 5 emitted in inclined directions around the rotation axis line L from the shaping air outlets 1 is shown by broken lines in FIG. 1. The shaping air 5 makes a first spiral air flow. Outside the spiral air flow of the shaping air 5, the pattern control air 6 emitted from the pattern control air outlets 3 makes a spiral air flow.

[0015] As explained in the chapter of background art with reference to Patent Document 1, the coating pattern width tends to be reduced by a negative pressure produced in a forward region of the rotary head as the quantity of the shaping air 5 increases. However, the spiral air flow of the shaping air 5 can generate a centrifugal force large enough to reduce the influence of the negative pressure or overcome the negative pressure, and can thereby increase the coating pattern width. Further, another spiral air flow of the pattern control air 6 is made radially outward of the spiral air flow of the shaping air 5 to whirl in the same direction. Setting the angle β of inclination of the pattern control air outlets 3 larger in absolute value than the angle α of inclination of the shaping air 5 makes it possible to increase the swirling rate of the pattern control air 6 and thereby enhance the centrifugal force of the shaping air 5, which further increases the coating pattern width. In addition, by changing the quantity of the pattern control air 6 relative to the quantity of the shaping air, the coating pattern width can b e controlled variously. It is also possible to change the coating pattern width by increasing or decreasing the quantity of the shaping air 5. Therefore, the present invention can control the coating pattern width variously by controlling the quantity of the shaping air 5 or quantity of the pattern control air 6, or by controlling the relative quantity of the pattern control air with respect to the quantity of the shaping air 5.

[0016] FIG. 1 shows a preferable mode in which the shaping air 5 and the pattern control air 6 as swirling in the same direction that is opposite from the rotating direction A of the rotary head, i.e. a trailing direction behind the rotating direction A of the rotary head. However, the whirling direction of the shaping air 5 and the pattern control air 6 may be the same as the rotating direction A of the rotary head.

[0017] The rotary electrostatic atomizer summarized above is typically assembled to or in a coating robot widely used for coating vehicle bodies, and used to coat works under automatic control. In this case, useless paint caused by its overspray can be reduced by changing the coating pattern width in accordance with the width of one portion to another of the work. The rotary electrostatic atomizer according to the invention is applicable to electrostatic atomizers of various types for liquid paints, powder paints, electrically insulating paints, or electrically conductive paints. Needless to say, the atomizer is also suitable for use with metallic liquid paints for which an increase of the quantity of the shaping air is especially desirable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a diagram showing a basic concept of the present invention.

FIG. 2 is a perspective view of a front end portion of an electrostatic atomizer according to a first embodiment, taken from a front diagonal direction.

FIG. 3 is side elevation of a front end portion of the electrostatic atomizer according to the first embodiment.

FIG. 4 is a sectional view of a front end portion of the electrostatic atomizer according to the first embodiment of the invention.

FIG. 5 is a sectional view corresponding to FIG. 4, for explaining a first modification.

FIG. 6 is a sectional view corresponding to FIG. 4, for explaining a second modification.

FIG. 7 is a sectional view corresponding to FIG. 4, for explaining a third modification.

FIG. 8 is a sectional view corresponding to FIG. 4, for explaining a fourth modification.

FIG. 9 is a sectional view corresponding to FIG. 4, for explaining a fifth modification.

FIG. 10 is a sectional view corresponding to FIG. 4, for explaining a second embodiment.

KEY TO REFERENCE NUMERALS AND SYMBOLS

[0019]

L	Rotation axis of the rotary head
A	Rotating direction of the rotary head
1	Shaping air outlets
2	First circle with alignment of shaping air outlets
3	Pattern control air outlets
4	Second circle with alignment of pattern control air outlets
5	Shaping air
6	Pattern control air

BEST MODES FOR CARRYING OUT THE INVENTION

[0020] Some preferred embodiments of the invention are explained below with reference to the drawings.

First Embodiment (FIGS. 2-4)

[0021] A rotary electrostatic atomizer 10 shown in FIGS. 2 to 4 include a rotary head 12, often called a bell cup 12, having a conical wall surface and rotated by an air motor housed in an atomizer main body 11 to forward and disperse a paint under a centrifugal force, similarly to existing atomizers of this type. A paint is supplied to a

central part of the bell cup 12, and after moving radially outwardly along the inner surface of the bell cup 12, the paint is expelled from the front (downstream) perimeter 12a of the bell cup 12. Reference letter L in the drawings denotes the rotation axis line of the bell cup 12, and an arrow A indicates the rotating direction of the bell cup 12.

[0022] The shaping air outlets 1 and the pattern control air outlets 3 are located behind the front perimeter 12a of the bell cup 12. In FIG. 4, reference numeral 13 denotes a ring-shaped space for the shaping air, and 14 denotes a ring-shaped space for the pattern control air. The ring-shaped space 13 for the shaping air and the ring-shaped space 14 for the pattern control air are provided at the distal end (front end, i.e. downstream end) of the atomizer main body 11. The ring-shaped space 13 for the shaping air is supplied with compressed air from a first air source 16 via a first air supply path 15. The ring-shaped space 14 for the pattern control air is supplied with compressed air from a second air source 18 through a second air supply path 17. As explained later with reference to a modification, the first air source 16 and the second air source 18 may be a single common air source 22 (see FIG. 5, for example).

[0023] A first control valve 19 and a second control valve 20 are provided respectively in the first air supply path 15 and the second air supply path 17. The first and second control valves 19, 20 are controlled by a signal from a control panel 21 to adjust the quantity of air supplied to the ring-shaped space 13 for the shaping air and the ring-shaped space 14 for the pattern control air.

[0024] The shaping air outlets 1 provided at the front end surface of the atomizer main body 11 and the pattern control air outlets 3 around the outlets 1 are configured to incline their discharge directions around the rotation axis line L of the bell cup 12, as explained before with reference to FIG. 1 (angles α and β in FIG. 1). The shaping air outlets 1 are a plurality of bores aligned on a circle (designated by reference numeral 2 in FIG. 1) having its center on the rotation axis line L of the bell cup 12. In the illustrated atomizer, these bores are in form of a number of minute pores. The pattern control air outlets 3 are a plurality of bores aligned on a circle (designated by reference numeral 4 in FIG. 1) that is concentric with and larger than the circle 2 of the shaping air outlets 1. The pattern control air outlets 3 are also illustrated in this embodiment as being a number of minute pores.

[0025] The direction of inclination of the shaping air outlets 1 and the pattern control air outlets 3 may be equal to the rotating direction A of the bell cup 12. However, it is preferable that the direction of inclination is opposite from the rotating direction A of the bell cup 12, i.e. a trailing direction behind the rotating direction A of the bell cup 12, as shown in FIG. 1. In addition, as already explained with reference to FIG. 1, the inclination angle α of the shaping air outlets 1 is smaller than the inclination angle β of the pattern control air outlets 3 in absolute value. In other words, absolute value of the inclination angle β of the pattern control air outlets 3 is larger than absolute value α of the shaping air outlets 1 ($|\beta| > |\alpha|$).

[0026] In the first embodiment, both the orientation of the shaping air outlets 1 and the orientation of the pattern control air outlets 3 are parallel to the rotating axis line L of the bell cup 12, and the shaping air outlets 1 is directed toward the front (downstream) perimeter 12a of the bell cup 12, as best shown in FIG. 4. As a result, shaping air emitted from the shaping air outlets 1 acts to spray the paint toward a work (not shown) located downstream (forward) of the bell cup 12. That is, the shaping air not only acts to direct the paint toward the work, but also functions to atomize the liquid paint expelled from the front perimeter 12a of the bell cup 12.

[0027] The rotary electrostatic atomizer 10 according to the first embodiment is optimum for use with a liquid paint, such as a metallic paint, i.e. a liquid paint containing metal powder or particulates, especially for vehicle bodies. In the course of coating a vehicle body, control of the first and second control valves 19, 20 is performed to adjust the spread width of the atomized paint and make a coating pattern width suitable for a relatively wide coating target such as a roof of a vehicle body, or a relatively narrow coating target such as pillars of a vehicle body. This is particularly effective to reduce overspray upon coating relatively narrow portions such as pillars.

First Modification (FIG. 5)

[0028] The above-explained rotary electrostatic atomizer 10 according to the first embodiment may be modified as shown in FIG. 5. More specifically, although the rotary electrostatic atomizer 10 according to the first embodiment is configured to supply compressed air to the ring-shaped space 13 for the shaping air and the ring-shaped space 14 for the pattern control air from independent first and second air sources 16, 18, the rotary electrostatic atomizer 30 shown in FIG. 5 is configured to supply compressed air to the ring-shaped space 13 for the shaping air and the ring-shaped space 14 for the pattern control air from a common air source 22.

[0029] The rotary electrostatic atomizer 30 according to the first modification is identical to the first embodiment in the feature that the angle β of inclination of the pattern control air outlets 3 is larger in absolute value than the angle α of inclination of the shaping air outlets 1 and in the feature that the orientation of the pattern control air outlets 3 is parallel to the orientation of the shaping air 1. However, the atomizer 30 according to the first modification is different from the atomizer 10 according to the first embodiment in that the shaping air outlets 1 direct toward the conical outer surface 12b of the bell cup 12 instead of its front (downstream) perimeter 12a.

Second Modification (FIG. 6)

[0030] A rotary electrostatic atomizer 40 as a second modification shown in FIG. 6 is different from the electrostatic atomizer 30 according to the first modification

(FIG. 5) in orientation of the pattern control air outlets 3. In the second modification, orientation of the pattern control air outlets 3 is determined such that the shaping air 5 emitted from the shaping air outlets 1 flows in parallel to the center line of the shaping air 5 deflected by the front (downstream) perimeter 12a of the bell cup 12.

Third Modification (FIG. 7)

[0031] A rotary electrostatic atomizer according to a third modification show in FIG. 7 is common to the first embodiment shown in FIG. 4 in that the shaping air outlets 1 are directed to the front (downstream) perimeter 12a of the bell cup 12. However, the direction of the shaping air outlets 1 pointing the front (downstream) perimeter 12a of the bell cup 12 is not parallel to the rotation axis line L. Instead, the direction of the shaping air outlets 1 is angled with an elevation angle (+θ) relative to an imaginary line L' drawn from the center of the front end of each shaping air outlet 1 in parallel to the rotation axis line L of the bell cup 12, for example, by changing the diameter of the first circle 2 of the shaping air outlets relative to the outermost diameter of the bell cup 12.

Fourth Modification (FIG. 8)

[0032] A rotary electrostatic atomizer 60 according to the fourth modification shown in FIG. 8 is contrary to the atomizer 50 according to the third modification shown in FIG. 7 in that the direction of the shaping air outlets 1 is angled by a depression angle (-θ) relative to an imaginary line L' drawn from the center of the front end of each shaping air outlet 1 in parallel to the rotation axis line L of the bell cup 12.

Fifth Modification (FIG. 9)

[0033] Although the first embodiment (FIG. 4), third modification (FIG. 7) and fourth modification (FIG. 8) propose to direct the orientation of the shaping air outlets 1 toward the front (downstream) perimeter 12a of the bell cup 12, the rotary electrostatic atomizer 70 according to the fifth modification orients the direction of the shaping air outlets 1 toward a proximity of the front (downstream) perimeter of the bell cup, that is, toward an imaginary concentric circle slightly larger than the front (downstream) perimeter 12a of the bell cup 12.

Second Embodiment (FIG. 10)

[0034] The first embodiment and its modifications have been explained with reference to FIGS. 2 through 9 as the shaping air 5 acting to spray the paint expelled from the front (downstream) perimeter 12a of the bell cup 12 toward a work and to atomize the paint just after expelled from the front perimeter 12a of the bell cup 12. In a rotary electrostatic atomizer 80 according to the second embodiment shown in FIG. 10, however, the shaping air 5 does not function to atomize the paint expelled from the front perimeter 12a of the bell cup 12. Instead, the shaping air 5 only acts to direct the paint toward the work. Also in the electrostatic atomizer 80 according to the second embodiment, the shaping air outlets 1 and the pattern control air outlets 3 may incline in the same direction as the rotating direction A of the bell cup 12. Preferably, however, these outlets 1 and 3 had better incline in the opposite direction from the rotating direction A of the bell cup 12, i.e. a trailing direction behind the rotating direction A of the bell cup 12. Here again, as already explained with reference to FIG. 1, the angle β of inclination of the pattern control air outlets is larger in absolute value than the angle α of inclination of the shaping air outlets 1 ($|\beta| > |\alpha|$).

[0035] Also in the rotary electrostatic atomizer 80 according to the second embodiment, similarly to the first embodiment, the coating pattern width can be controlled variously by supplying the pattern control air 6 to envelope the swirling shaping air 5 from outside and to swirl in the same direction, and by controlling the quantity of the pattern control air 6 relative to the shaping air 5 or controlling the quantity of the shaping air 5.

Claims

1. A rotary electrostatic atomizer having a rotary head for centrifugally forwarding and spraying a paint expelled from a front perimeter of the rotary head toward a work with the aid of shaping air, comprising:

   said shaping air being emitted in inclined directions around a rotation axis line of the rotary head;
   pattern control air being emitted in an inclined direction around a rotation axis line of the rotary head radially outwardly alongside the shaping air in the same direction as that of the shaping air; and
   angle (β) of the inclined direction of the pattern control air is larger in absolute value than angle (α) of the inclined direction of the shaping air.

2. The rotary electrostatic atomizer according to claim 1 wherein the inclined direction of the shaping air and the inclined direction of the pattern control air are trailing directions behind the rotating direction of the rotary head.

3. The rotary electrostatic atomizer according to claim 1 or 2 wherein emitting directions of the shaping air are directed to the front perimeter of the rotary head or to a proximity of the front perimeter of the rotary head.

4. A rotary electrostatic atomizer comprising:

a rotary head for centrifugally forwarding a paint;
a plurality of shaping air outlets aligned on a first circle concentric with a rotation axis line of the rotary head to emit shaping air which directs the paint emitted from an outer perimeter of the rotary head toward a work;
a plurality of pattern control air outlets aligned on a second circle concentric with and having a larger diameter than the first circle to emit pattern control air alongside the shaping air;
a shaping air adjusting means for adjusting the quantity of the shaping air emitted from the shaping air outlets;
a pattern control air adjusting means for adjusting the quantity of the pattern control air emitted from the pattern control air outlets; and
a control means for controlling the shaping air adjusting means and the pattern control air adjusting means,

wherein the shaping air outlets and the pattern control air outlets are oriented in inclined directions around the rotation axis line of the rotary head, and the inclined direction of the shaping air outlets and that of the pattern control air outlets are the same directions, and
wherein angle (β) of the inclined direction of the pattern control air outlets is larger in absolute value than angle (α) of the inclined direction of the shaping air outlets.

FIG. 1

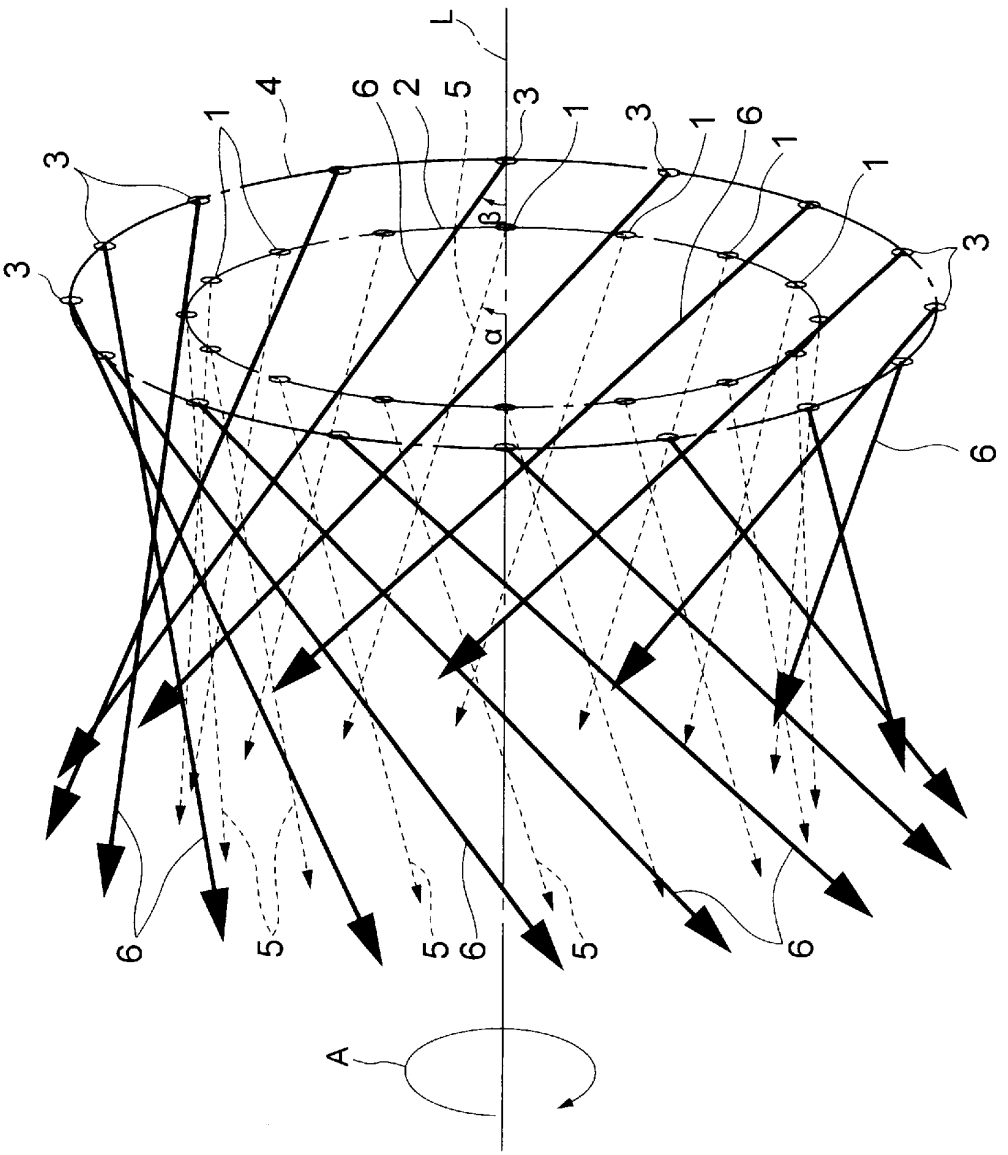


FIG. 2

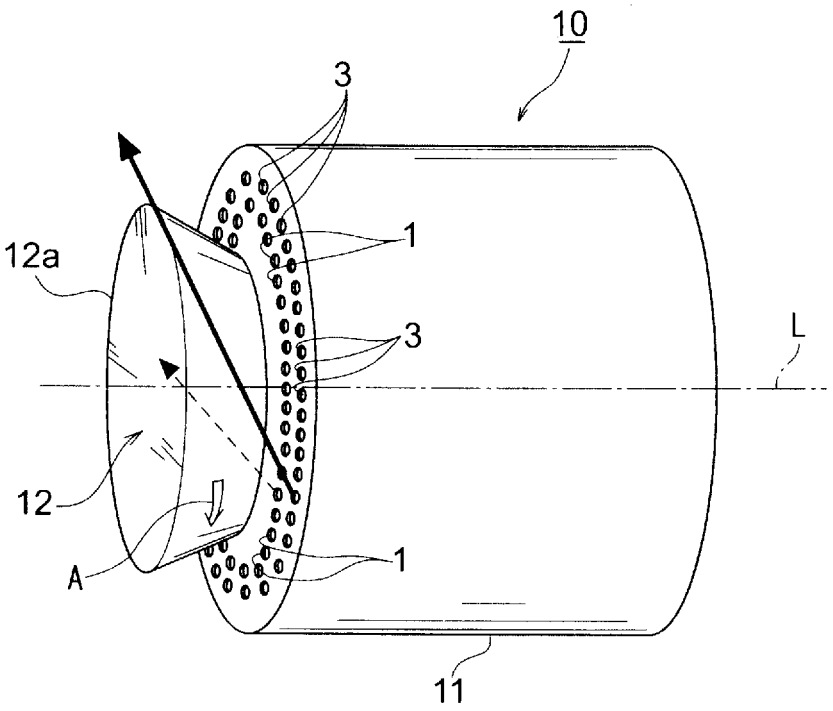


FIG. 3

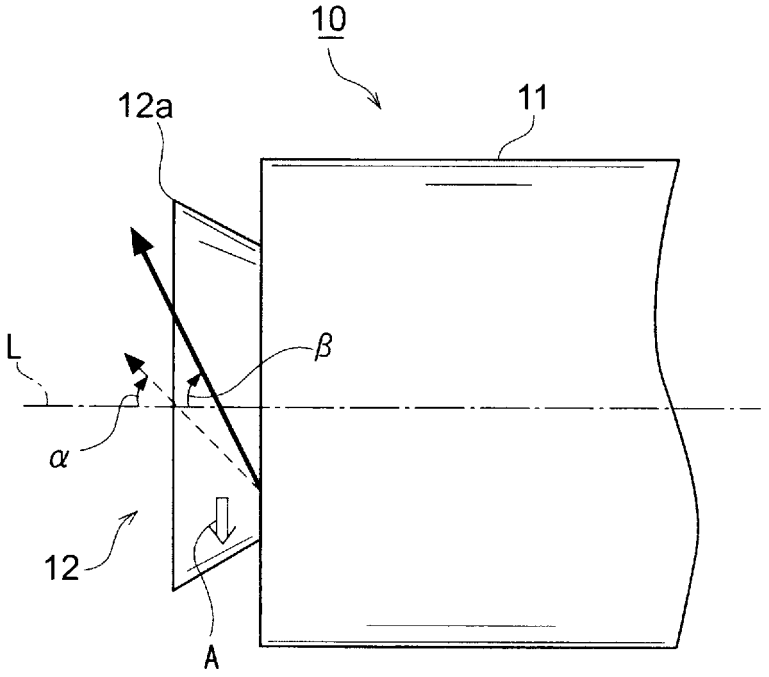


FIG. 4

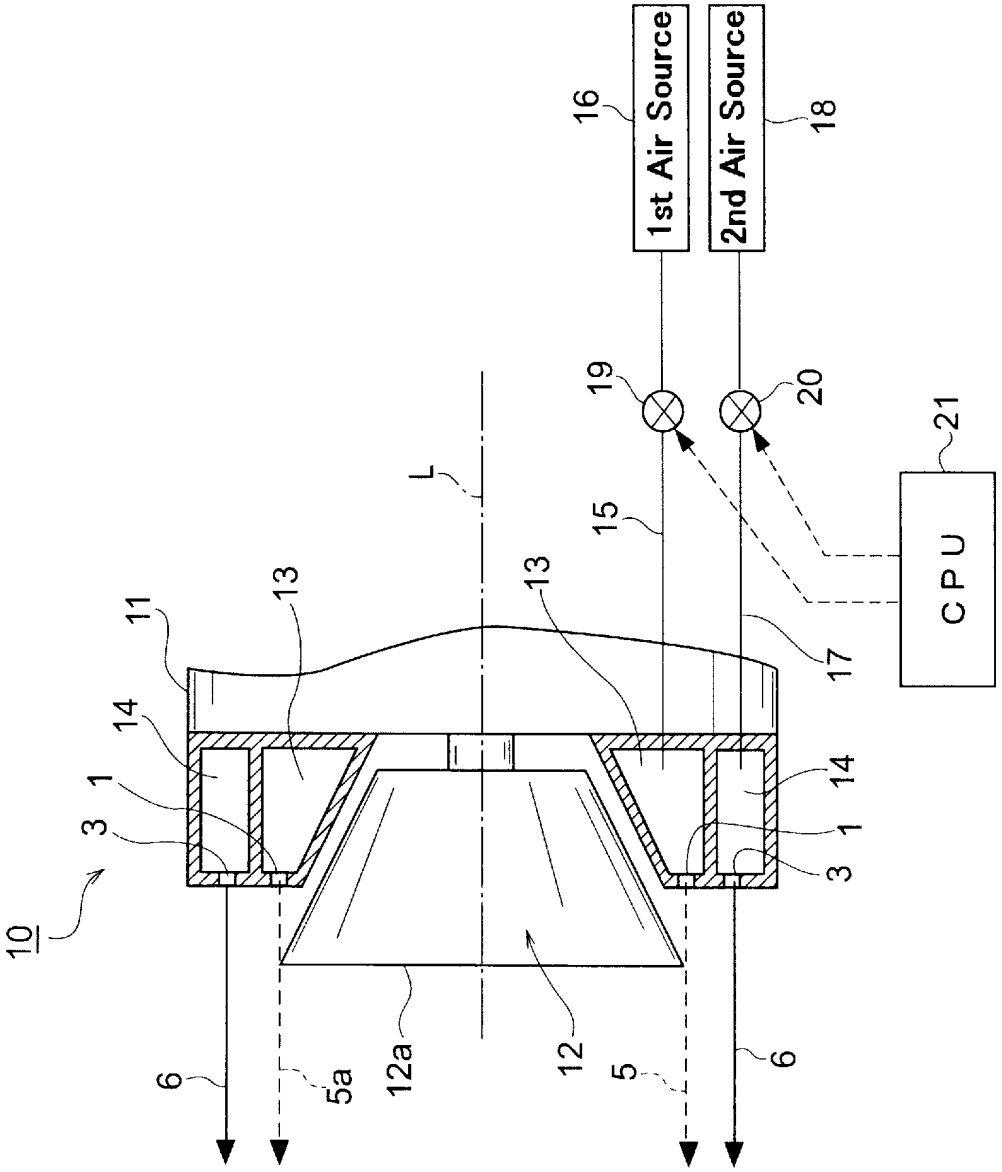

1st Air Source
2nd Air Source
CPU
16
18
19
20
21
15
17
L
10
11
13
14
1
3
6
5a
12a
12
5

FIG. 5

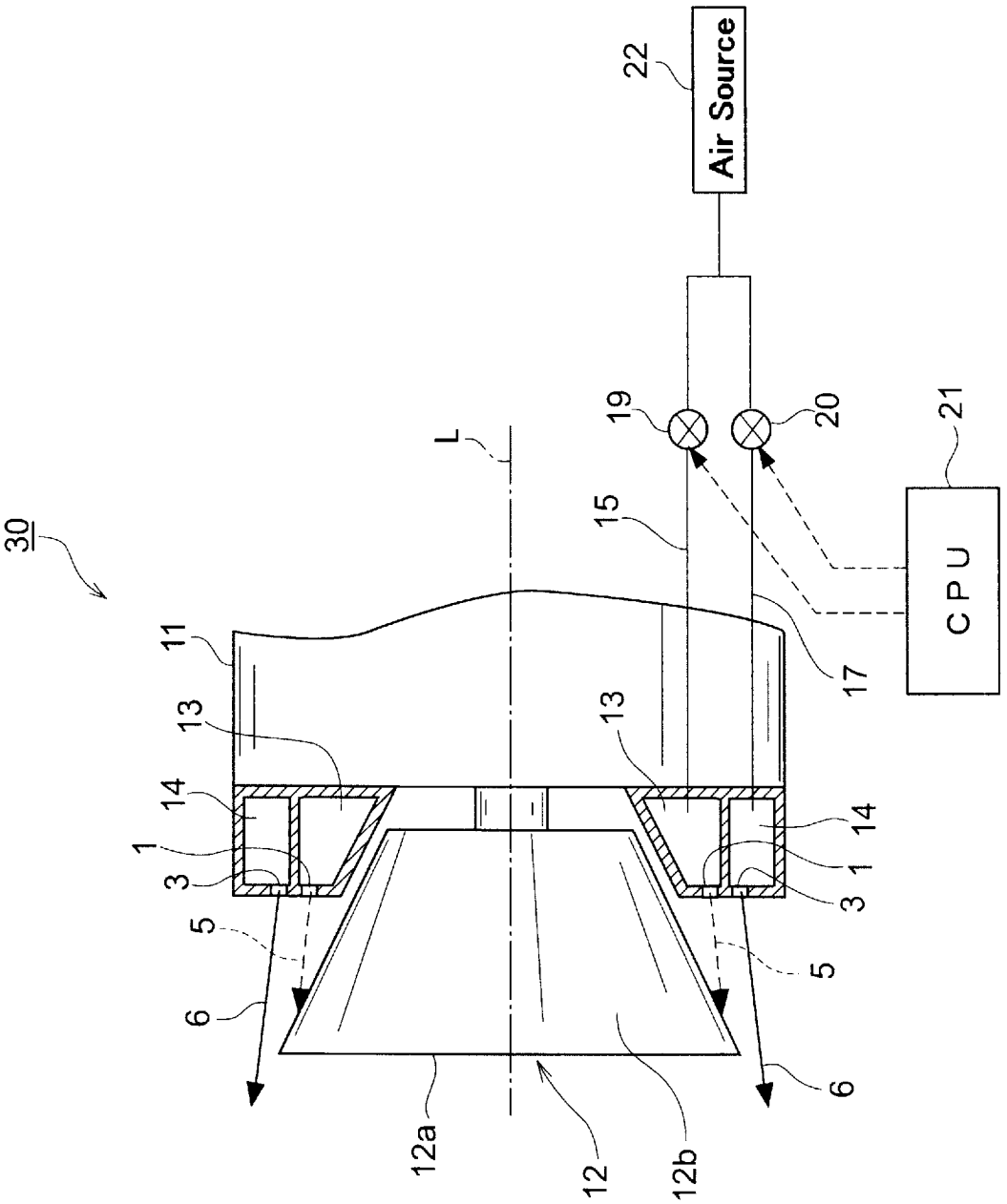

30
L
22
Air Source
19
20
21
CPU
15
17
11
13
13
14
14
1
1
3
3
5
5
6
6
12a
12
12b

FIG. 6

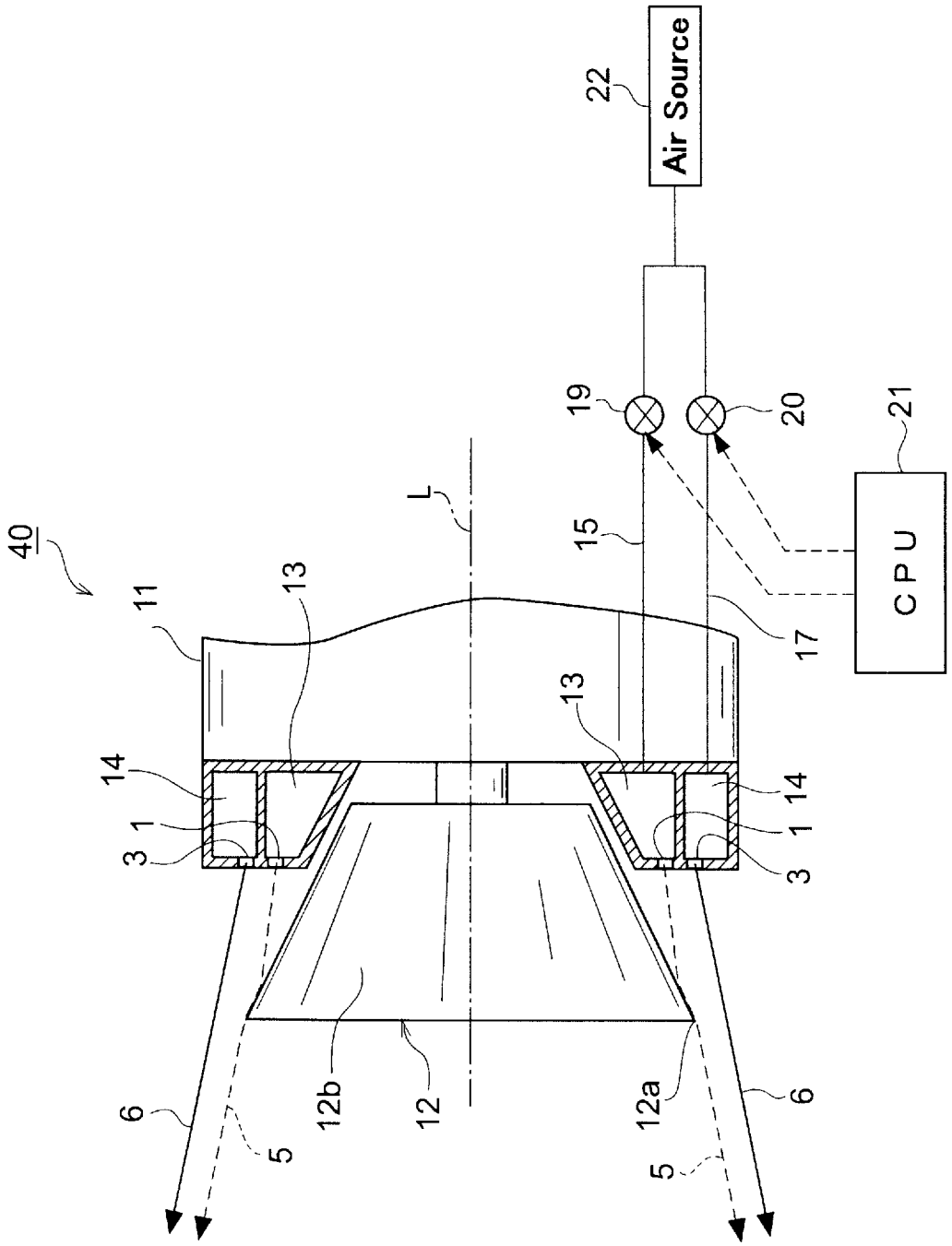

Air Source
22
19
20
21
CPU
15
17
L
40
11
13
13
14
14
3 1
3 1
6
6
5
5
12b
12
12a

FIG. 7

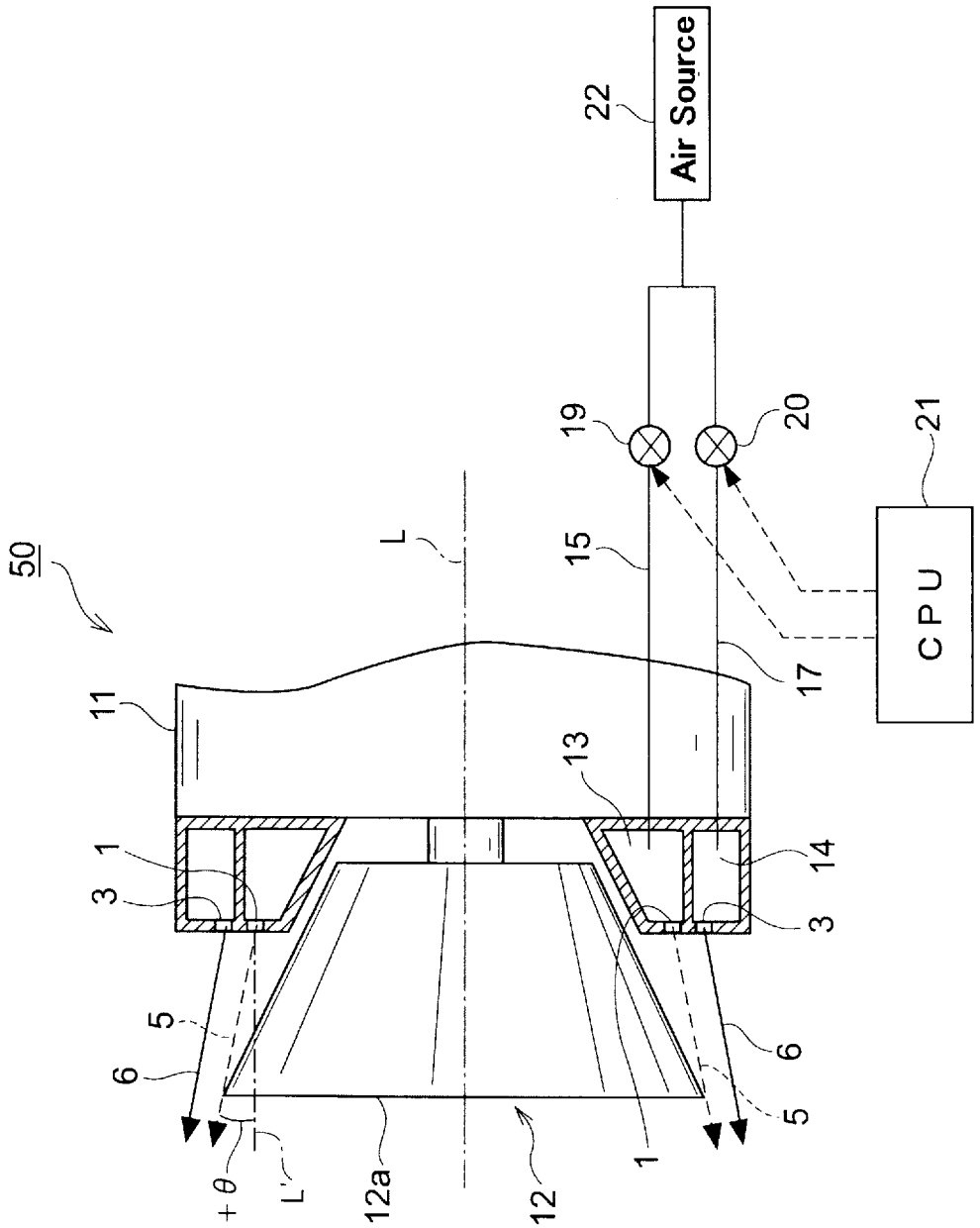


FIG. 8

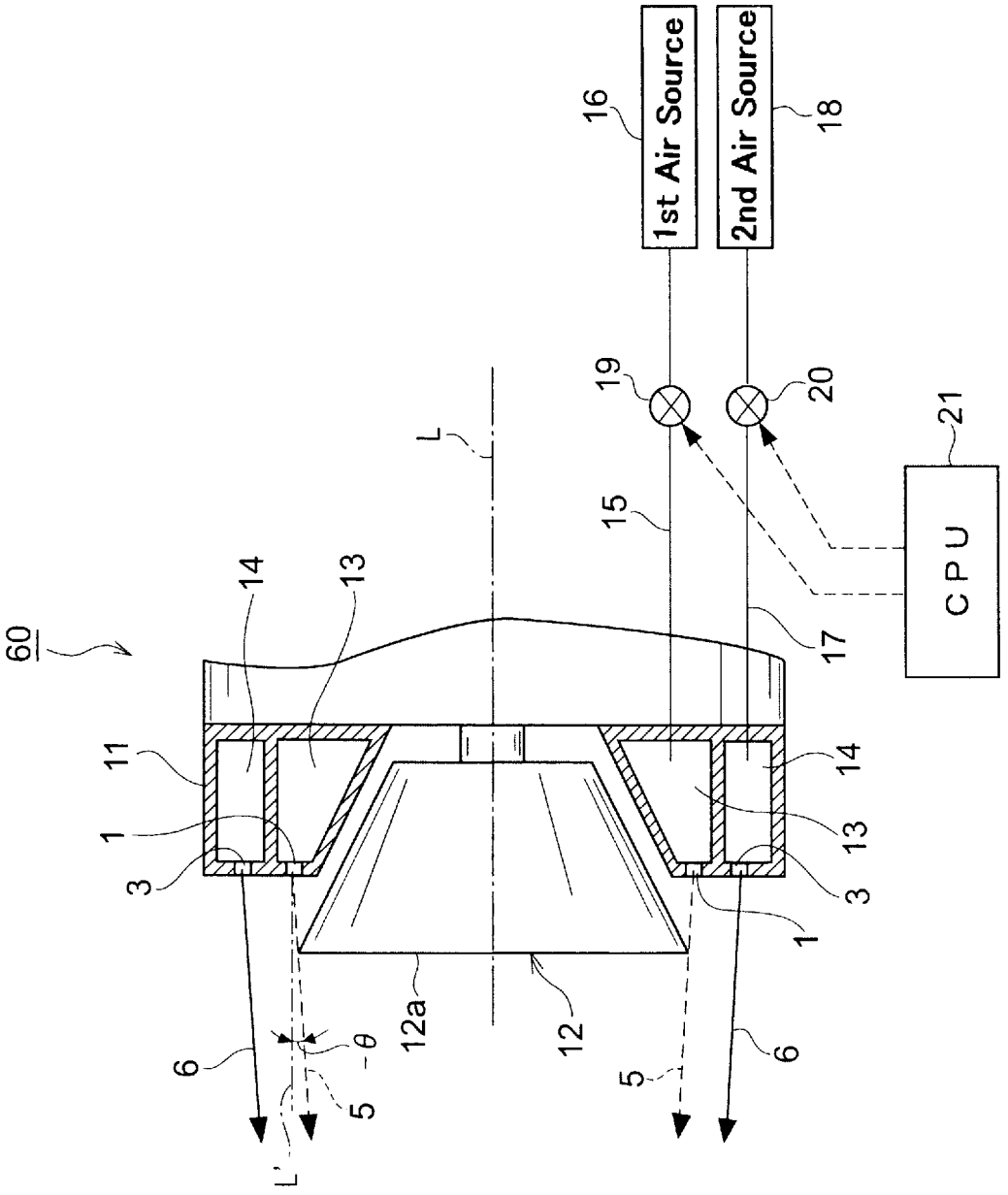

60
1st Air Source
2nd Air Source
16
18
19
20
21
CPU
15
17
L
L'
1
3
11
13
14
12
12a
5
6
θ

FIG. 9

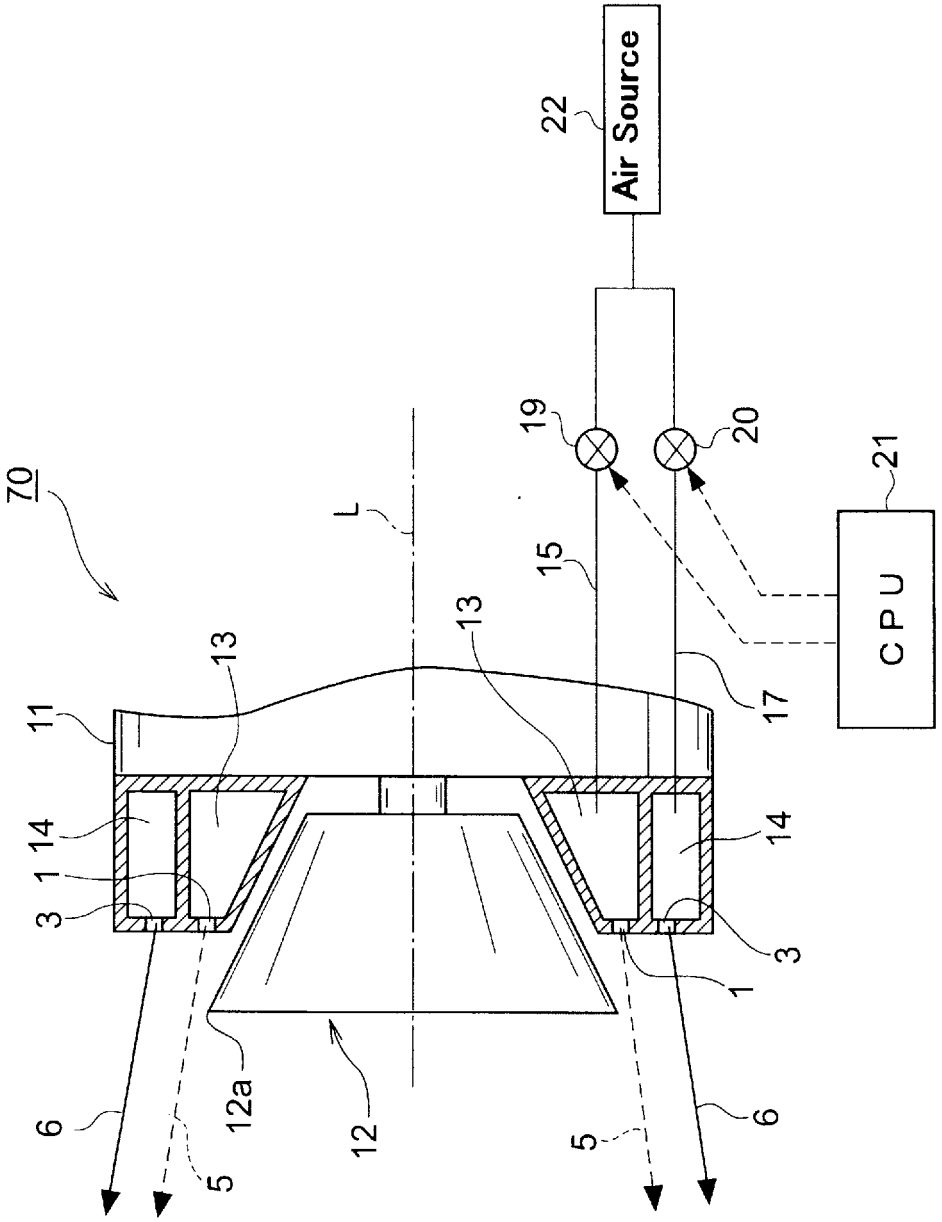
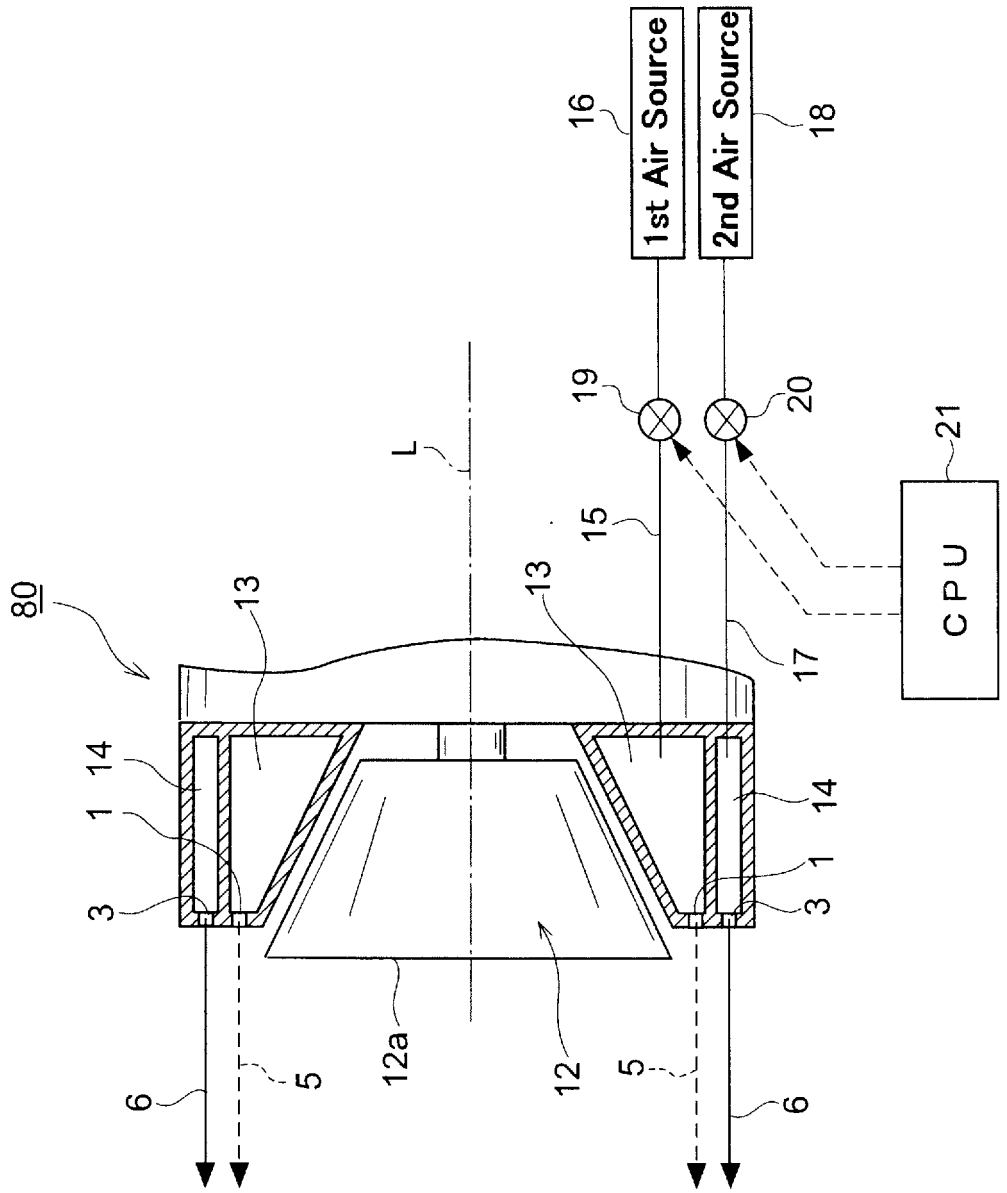


FIG. 10


1st Air Source
2nd Air Source
CPU
16
18
19
20
21
15
17
L
80
13
13
14
14
1
1
3
3
12a
12
5
5
6
6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/069210

A. CLASSIFICATION OF SUBJECT MATTER
B05B5/04(2006.01)i

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)
B05B5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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.
X Y	JP 08-84941 A (Nissan Motor Co., Ltd.), 02 April, 1996 (02.04.96), Par. Nos. [0071], [0076] to [0079]; Figs. 19, 20 (Family: none)	1-3 4
Y	JP 07-256156 A (Toyota Motor Corp.), 09 October, 1995 (09.10.95), Par. Nos. [0011] to [0013]; Figs. 3, 4 (Family: none)	4
A	JP 03-101858 A (Toyota Motor Corp.), 26 April, 1991 (26.04.91), Full text; all drawings (Family: none)	1-4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October, 2007 (24.10.07)	06 November, 2007 (06.11.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/069210

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 10-76190 A (ABB Industry Kabushiki Kaisha), 24 March, 1998 (24.03.98), Full text; all drawings (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H031991101858 B **[0003]**
- JP H07199524367 B **[0006]**
- US P6991178 B **[0008] [0009]**
- JP H031991101858 A **[0009]**
- JP H07199524367 A **[0009]**