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Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) **Title**: ATMOSPHERIC CIRCULATION SYSTEM AND METHOD

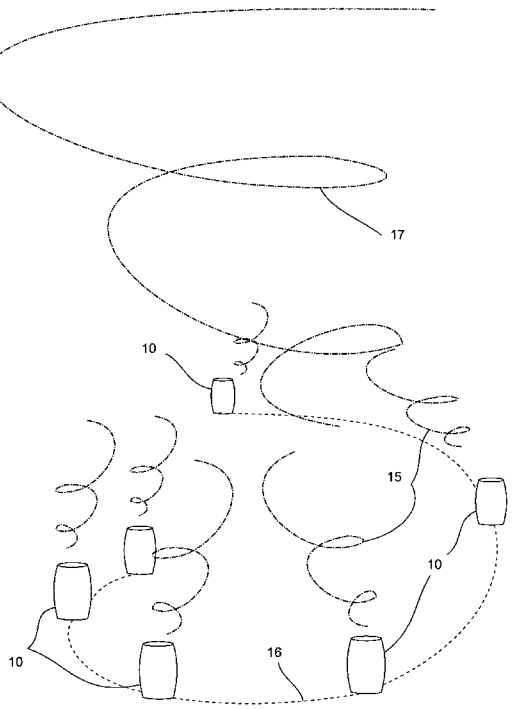

Figure 12

(57) **Abstract**: An artificially created atmospheric circulation system comprising a plurality of vortex generating units (10), wherein each vortex generating unit (10) is configured to generate an upwardly directed vortex 15 within the atmosphere and wherein the plurality of vortex generating units are configured and associated so that all of the vortices 15 produced combine to provide a single atmospheric vortex (17).

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Atmospheric Circulation System and Method

Field of the Invention

The present invention relates to the field of fluid mechanics and more particularly to the circulation of atmospheric gases. More particularly, this invention seeks to provide an artificially generated system of circulation within the atmosphere.

Background Art

There are many applications wherein it is desirable to enhance circulation within the atmosphere. Common reasons for providing circulation are for mixing, to prevent stratification and to cause rain precipitation. In addition, it has now been realised that circulation may be used to reduce atmospheric temperature in a controlled manner. Examples of these will be discussed later within this specification.

Few, industrial methods have been devised to cause the desired atmospheric circulation. In nature, however, we see many examples such as tornados, hurricanes, waterspouts, dust devils and the like. All of these cyclic motions act as atmospheric circulators.

The most significant prior art is that of Louis Marc MICHAUD. His disclosure in US 7,086,823 provides a detailed review of the prior art including certain publications made by him explaining the thermodynamics that are involved. A further disclosure by him in WO 2008/014596 describes certain improvements to his invention. These disclosures are hereby incorporated by reference.

The difficulty with Michaud's proposal is that his facility is extremely large and expensive. While the facility promises several advantages, including more efficient cooling towers, low cost operation of wind turbines, as well as possible atmospheric circulation advantages, it is not entirely clear what is the primary purpose, or

whether the system would perform any of the tasks effectively. The large area of land that would be required to put the system in to effect would make it impractical near cities where the atmospheric circulation may be of the greatest importance.

Disclosure of the Invention

According to a first aspect, the invention resides in an artificially created atmospheric circulation system comprising a plurality of vortex generating units, wherein each vortex generating unit is configured to generate an upwardly directed vortex within the atmosphere and wherein the plurality of vortex generating units are configured and associated so that all of the vortices produced combine to provide a single atmospheric vortex.

According to a preferred embodiment, each vortex generating unit comprises a jet emitting means and a nozzle, the jet emitting means being adapted to accelerate atmospheric gas into a gas jet and the nozzle being adapted to cause rotation of the gas jet relative to the axis of the nozzle.

According to a preferred feature of the invention, the jet emitting means and nozzle are supported by a support stand at a suitable distance above the surface of the ground to enable air to be drawn into the jet emitting means without significant impairment and the output of the nozzle is directed substantially vertically.

According to a preferred embodiment, the jet emitting means comprises a jet engine suitable for an aircraft.

According to a preferred embodiment, the jet emitting means is fuelled substantially by hydrogen so that the combustion products promote the formation of precipitation.

According to a preferred embodiment, each vortex generating unit comprises a fan driven by a motor, wherein the fan is configured to generate an atmospheric vortex.

According to a preferred embodiment, each vortex generating unit comprises a duct through which gas is passed and ejected at an outlet, the duct having an insert proximate the outlet, wherein the insert has one or more vanes having a spiralling-helical form of varied pitch to accelerate airflow flow through it into a vortical-like motion to thereby generate an atmospheric vortex.

According to a further aspect, the invention resides in a method of disrupting an inversion layer in the atmosphere by use of an atmospheric circulation system as previously described.

According to a further aspect, the invention resides in a method of causing the precipitation of rain by the use of an atmospheric circulation system as previously described.

According to a further aspect, the invention resides in a method of causing the abatement of tornados or storms by the use of an atmospheric circulation system as previously described.

According to a further aspect, the invention resides in a method for deflecting the course of a hurricane, cyclone, typhoon or the like by the use of an atmospheric circulation system as previously described.

According to a further aspect, the invention resides in a method of expelling heat from the lower atmosphere of the earth by use of an atmospheric circulation system as previously described.

The invention will be more fully understood in the light of the following description of several specific embodiments.

Brief Description of the Drawings

The description is made with reference to the accompanying drawings, of which:

Figure 1 is an isometric view of an elemental vortex generating unit according to a first embodiment;

Figure 2 is an isometric view of the vortex generating unit of Figure 1;

Figure 3 is a diagrammatic representation of the interaction of the flow streams from a plurality of vortex generating units of Figure 1;

Figure 4 is a plan view of the arrangement of an array of vortex generating units according to Figure 1 into a cluster along an equiangular logarithmic spiral;

Figure 5 is a diagrammatic representation of the interaction of the flow streams from a plurality of vortex generating clusters according to a second embodiment;

Figure 6 is diagrammatic indication of the flow characteristics of a cluster of vortex as shown in Figure 5 streams after they have combined;

Figure 7 is an isometric sectional view of an elemental vortex generating unit according to a fourth embodiment;

Figure 8 is a sectional view of a pulse nozzle according to a fifth embodiment;

Figure 9 is a diagrammatic representation of the vortex flow stream generated in the atmosphere in accordance with the invention that would be effective at disturbing an inversion layer;

Figure 10 is a diagrammatic representation of the vortex flow stream generated in the atmosphere in accordance with the invention that would be effective at causing precipitation;

Figure 11 is a diagrammatic representation of the vortex flow stream generated in the atmosphere in accordance with the invention that would be effective at expelling heat from the lower atmosphere; and

Figure 12 is an isometric view of the arrangement of an array of vortex generating units according to Figure 4.

Detailed Description of Specific Embodiments

The atmospheric circulation system 1 according to the invention comprises one or more elemental vortex generating units 10. An elemental vortex generating unit 10 according to a first embodiment is illustrated in Figures 1 to 4. As shown in the drawings, the vortex generating unit 10 comprises a jet generating means 11, a vortex-inducing nozzle 12 and a support stand 14. The jet generating means 11 may comprise any suitable means to create a high speed jet of gas, and, in initial testing, jet engines used for commercial passenger aircraft have been found to be the most cost-effective means during the initial development and trials, as second hand engines may be obtained relatively cheaply. Nevertheless, it is to be appreciated that other jet emitting devices can be suitable, including but not limited to rocket engines. Initial testing suggests that each of these has advantages for certain applications.

Throughout the remainder of this specification, the jet emitting device is referred to as a jet engine, but this reference is not intended to limit the jet engine to any particular form of a jet emitting means.

The vortex inducing nozzle 12 comprises a tubular body wherein the cross-sectional area decreases progressively between the inlet and the outlet. In addition, the interior of the nozzle comprises formations configured to cause the gas travelling through the nozzle from inlet to outlet to be given a rotational component of speed relative to the axis of the nozzle. As a result, the gas emitted from the nozzle is caused to rotate or spin at a significant rate relative to the longitudinal velocity. The

output of the nozzle is directed vertically upwards and as a result an upwardly directed, spinning flow stream is established.

The disclosure of Jayden David Harman, WO 2005/003616 (also published as US 20060102239 and others) discloses several embodiments of a fluid flow nozzle adapted to cause the fluid to flow through the nozzle in a vortical manner. In particular, it is noted that optimum efficiency will be achieved where the active surface of the nozzle is configured to conform to the Golden Section. It is believed that optimum efficiency for the present invention is also obtained where the nozzle 12 is designed in accordance with the principles disclosed in WO 2005/003616. Therefore, the disclosure WO 2005/003616 is hereby incorporated by reference. Nevertheless, the present invention is not restricted to use of nozzles conforming to the configurations disclosed in that reference.

The inlet of nozzle 12 is associated with the outlet of the jet engine 11. Jet engines of commercial jet aircraft include a standard nozzle and the nozzle 12 of the present invention replaces the standard nozzle. An adapter means (not shown) is provided to connect the nozzle 12 with the jet engine 11. The adapter means may be a separate component or may be integral with the inlet of the nozzle 12. It is envisaged that jet engines designed for the application may have the nozzle 12 integral with the body of the jet engine 11.

The jet engine-nozzle assembly is supported by a support stand. In its simplest form, the support stand 14 is designed to support the jet engine-nozzle assembly above the ground level in a vertical orientation with the output of the nozzle directed upwards. While it is desirable to have the engine as a far above the ground as practical, it is considered that a height of 30 metres is satisfactory and even less than this can be acceptable. For a fixed installation, the design of the support stand is a straight forward structural engineering problem which will depend upon the site selected. As an alternative, it can be possible to locate the engine much closer to

the ground if the engine inlet is provided with a suitable inlet cowling that enables air to be drawn in to the engine without excessive turbulence or hindrance.

While the erection of a fixed stand is considered a straightforward matter, the engine-nozzle assembly may also be arranged on a transportable platform such as a trailer pulled by a prime mover. While there are some technical difficulties to be overcome, it is not believed that these would be insuperable. A mobile apparatus would enable the apparatus to be operated at a variety of locations as required. This may be particularly useful for tornado abatement, as discussed below.

A single vortex generating unit 10 of the first embodiment produces an atmospheric vortex that may be likened to a whirlwind or dust devil. This is not sufficient to have any significant atmospheric effect. However, it is known that when two vortex streams which are rotating in the same direction are adjacent, they will tend to join together with very little loss of energy and form a single vortex stream of combined strength. As shown in Figure 3, the vortex streams 15 of an array of elemental vortex generating units 10 are combined to provide a single, powerful vortex stream 17 the array thereby providing a vortex generating cluster. A single jet engine for a commercial aircraft can have an output in the order of 50 megawatts. Therefore, an array of 10 units will have a combined output in the order of 500 megawatts, which Michaud suggests is the power required to form a man-made tornado of sufficient strength to influence the atmosphere. This is further illustrated in Figure 12. In a further enhancement of power, a plurality of clusters of units may be combined to create an even more powerful vortex.

While it is believed that many arrangements for the array will be functional and that the place at which the atmospheric circulation system is located will have a bearing on the layout that is selected of a particular cluster, it is believed that a layout where each vortex generating unit 10 is placed along the locus 16 of an equiangular logarithmic spiral winding in the same direction of rotation as the direction of rotation 18 of the vortex that is being produced, as is shown in Figure 4 and further

illustrated in Figure 12. This layout accords with natural fluid flow tendencies and assists the vortex streams to combine. Optimally, the units are spaced at intervals that are in accordance with the Fibonacci sequence. An example of this is shown in Figure 4 where the spacing ratios are 1:1:2:3:5:8:13.

Figures 5 and 6 illustrate a second embodiment of a group of vortex generating units. In this embodiment, swirl inducing devices are placed in the flow streams 21 exiting from the jet engines to induce rotation in the flow. The flow is the combined locally to create a single vortex 23, as is shown in Figure 6.

A third embodiment of a vortex generating unit according to the invention comprises a fan or propeller driven by an appropriate motor. While a specific engine may be designed for the application, in initial testing and development an engine for a turbo-prop aeroplane has been found to be suitable. Preferably the fan is designed to provide both axial flow and rotation of the air flow relative to axis so that in this embodiment, no nozzle is required to cause the vortex flow. The patents of Jayden David Harman, US 5,934,877 and US 7,488,151 give guidance as to the principles required to optimize the design of the rotor to produce such an air flow. The disclosure of these patents is hereby incorporated by reference. The vortex generating unit according to the second embodiment may be operated in conjunction with other units to provide clusters in the same manner as for the first embodiment to thereby provide a single, high-powered atmospheric vortex.

A vortex generating unit according to the third embodiment has potential to be more efficient than that of the first embodiment due to the operating characteristics of a fan or propeller at the speeds being contemplated. However, for a practical system, it is believed that it will be desirable to provide a unit capable of operating at power levels comparable with that of large turbofan jet engines, i.e. in the order of 50 megawatts. The unit would require development of a fan capable of handling this level, and initial design studies have shown that such a fan is quite feasible and indeed and be of quite modest size relative to the power being contemplated.

However, the practical difficulty would lie in powering such a fan. The largest turboprop engines have a power less than one tenth of this amount. It may be possible to use power sources other than a jet engine, but alternatives have their own difficulties. For instance, a 50 MW electric motor is conceivable, but powering a cluster of ten or more units is not. It is understood that high power turboprop jet engines are at least being studied and implementation of the third embodiment may need to await their development.

The first and second embodiments have been directed to a jet engine incorporating a suitable nozzle on the outlet while the third describes an engine driving a propeller. A fourth embodiment of the jet generating means according to the invention is described with reference to Figures 7 and 8. In this embodiment, the jet generating means comprises a duct 41 through which gas is passed and ejected at an outlet 42. A nozzle insert 43 is located within the duct 41 proximate the outlet 42. As shown in Figure 8, the insert 43 has one or more vanes 44 having a spiralling-helical form of varied pitch to accelerate airflow flow through it into a vortical-like motion. Examples of suitable inserts have previously been described with reference to an earlier disclosure WO 2003/056228 which is hereby incorporated by reference. As shown in Figure 7, air is provided to the insert through the duct by compressor means. The compressor means could be a single large compressor such as a jet engine, or alternatively, be supplied by a plurality of small compressors either directly through a manifold or via a large pressure vessel in which compressed gas is stored in advance. The gas may be air or another gas, or a mixture of air and another gas or gases.

It can be seen that atmospheric circulation system described creates a small man-made tornado. When produced in the way described, such a vortex can be employed with great benefit in a number of ways.

a) Destruction of Inversion layer

Inversion layers in the atmosphere can be a major cause of health problems in heavily populated cities such as Los Angeles, Beijing, Mexico City and Mumbai. In general, thermal layers occur because a warmer layer of air moves over a cooler layer. Such inversions prevent the circulation of the lower atmosphere to the upper atmosphere. In the process, pollutants are "trapped" within the lower level and can build to a level which is dangerous to health. A man-mad vortex in the atmosphere can act as a chimney funnelling the vortex flow well into the upper air layer, thereby breaking the inversion. The build up of pollutants can thereby be reduced considerably. Figure 9 indicates the creation of an artificial vortex flow which would be effective at destabilizing typical inversion layers.

b) Rain making

There are many places on the earth which have high humidity but low rainfall due to lack of suitable geographical features that might cause the moist air to rise and thereby produce rain. An artificial vortex provided in such places can cause rainfall to be initiated, as warm, moist air is caused to flow rapidly up to a high altitude, cooling it and resulting in precipitation. This particular outcome can be enhanced if the jet engine is fuelled by hydrogen. Then, depending on the purity of the hydrogen, all or substantially all of the exhaust gas of the combustion is heated water vapour which will tend to nucleate the existing atmospheric water vapour to promote precipitation when the vortex reaches a high altitude. Figure 10 illustrates the flow stream that would be typical in a rain-making use. In the event that a jet generating means according to the fourth embodiment is utilized, the other gas in a mixture may be water vapour in high concentration to cause a similar result.

c) Tornado abatement

Tornados can cause very major damage. In certain areas of USA and some other countries they are quite common at certain times of the year. Tornados rotate cyclonically in direction (counterclockwise in the northern hemisphere, clockwise in

the southern hemisphere) and it has been suggested that by generating a vortex in the opposite direction of rotation, a tornado might be stopped. It is doubtful that such an effect would be possible due to the differences in power between a real tornado and an artificial vortex. Nevertheless, it is believed that generation of the artificial vortex in advance of the storm build up may be effective at dissipating the storm before it has built to a stage where a tornado might form. By creating a vortex that is counter-rotating, it is assured that an element of control is introduced. When motivating energy for the artificial vortex is stopped, the vortex will stop

For this application, it will be appreciated that mobility of the atmospheric circulation system will be essential to allow the vortex to be produced in the optimal location, at relatively short notice.

At a broader level, by setting up the system for anti-cyclonic rotation, it is believed that the system can be used to provide control or at least ameliorate the effects of serious storms generally. By cancelling out the storm energy early, the storm can be carried away and diffused.

d) Deflecting Hurricanes

Atmospheric researchers have shown by computer modelling that the path travelled by a hurricane can be altered by a quite small atmospheric effect. It is believed that the atmospheric circulation system of the present invention can be an effective means of causing such deflection.

e) Heat expulsion

World leaders now acknowledge that Global warming is in progress, with the average temperature at the Earth's surface rising. While the process is complex, the crux of the problem is that increased levels of carbon dioxide and water vapour are trapping heat within the atmosphere. Figure11 illustrates the flow system that would be effective to transport heat to the upper atmosphere where it will more

readily dissipate into space. In order to it is believed that it would be necessary to a plurality of large clusters or clusters of clusters at selected locations around the earth. While such an undertaking would be very expensive, it is believed that the cost would be minor compared with the impact of Global Warming. At an international level, countries could be required to operate systems in proportion to the extent of greenhouse gasses they emit. This would be a much simpler and more effective obligation than contentious steps that are presently being proposed such as carbon credits / trading, etc. Operated in the vicinity of glaciers, the system may provide sufficient cooling to prevent further melting of glacier system that are threatened as part of global warming.

The above embodiments identify but a few of the potential applications to which the invention may be adapted. It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiments described above.

I claim:

1. An artificially created atmospheric circulation system comprising a plurality of vortex generating units, wherein each vortex generating unit is configured to generate an upwardly directed vortex within the atmosphere and wherein the plurality of vortex generating units are configured and associated so that all of the vortices produced combine to provide a single atmospheric vortex.

2. An atmospheric circulation system as claimed at claim 1 wherein each vortex generating unit comprises a jet emitting means and a nozzle, the jet emitting means being adapted to accelerate atmospheric gas into a gas jet and the nozzle being adapted to cause rotation of the gas jet relative to the axis of the nozzle.

3. An atmospheric circulation system as claimed at claim 2 wherein the jet emitting means and nozzle are supported by a support stand at a suitable distance above the surface of the ground to enable air to be drawn into the jet emitting means without significant impairment and the output of the nozzle is directed substantially vertically.

4. An atmospheric circulation system as claimed at claim 2 or 3 wherein the jet emitting means comprises a jet engine suitable for an aircraft.

5. An atmospheric circulation system as claimed at claim 2, 3 or 4 wherein the jet emitting means is fuelled substantially by hydrogen so that the combustion products promote the formation of precipitation.

6. An atmospheric circulation system as claimed at claim 1 wherein each vortex generating unit comprises a fan driven by a motor, wherein the fan is configured to generate an atmospheric vortex.

7. An atmospheric circulation system as claimed at claim 1 wherein each vortex generating unit comprises a duct through which gas is passed and ejected at an outlet, the duct having an insert proximate the outlet, wherein the insert has one or more vanes having a spiralling-helical form of varied pitch to accelerate airflow flow through it into a vortical-like motion to thereby generate an atmospheric vortex.

8. A method of disrupting an inversion layer in the atmosphere by use of an atmospheric circulation system as claimed in claim 1.

9. A method of causing the precipitation of rain by the use of an atmospheric circulation system as claimed in claim 1.

10. A method of causing the abatement of tornados or storms by the use of an atmospheric circulation system as claimed in claim 1.

11. A method for deflecting the course of a hurricane, cyclone, typhoon or the like by the use of an atmospheric circulation system as claimed in claim 1.

12. A method of expelling heat from the lower atmosphere of the earth by use of an atmospheric circulation system as claimed in claim 1.

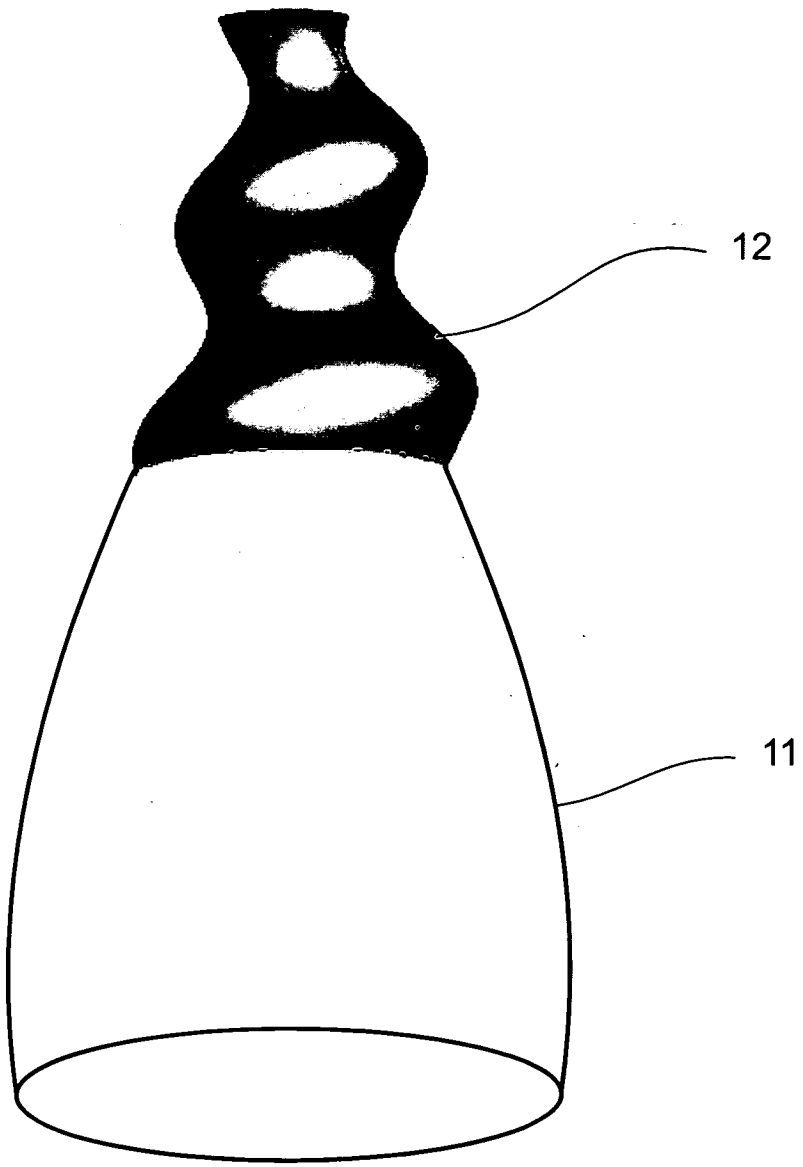

Figure 1

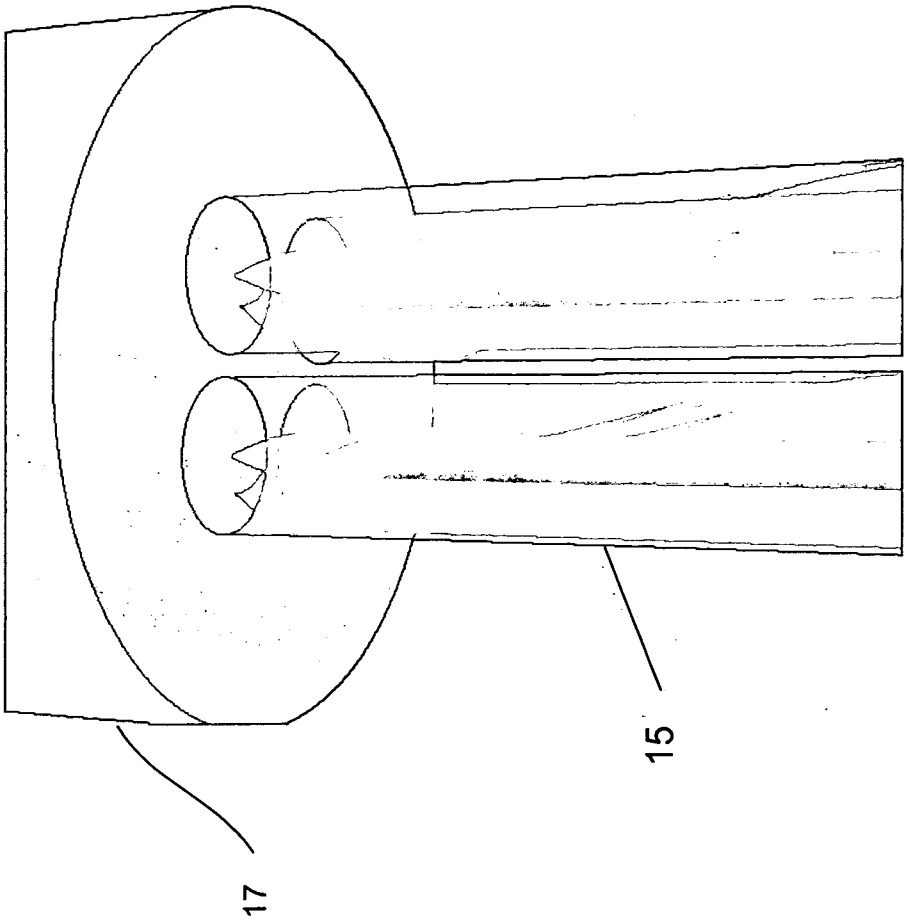

Figure 3

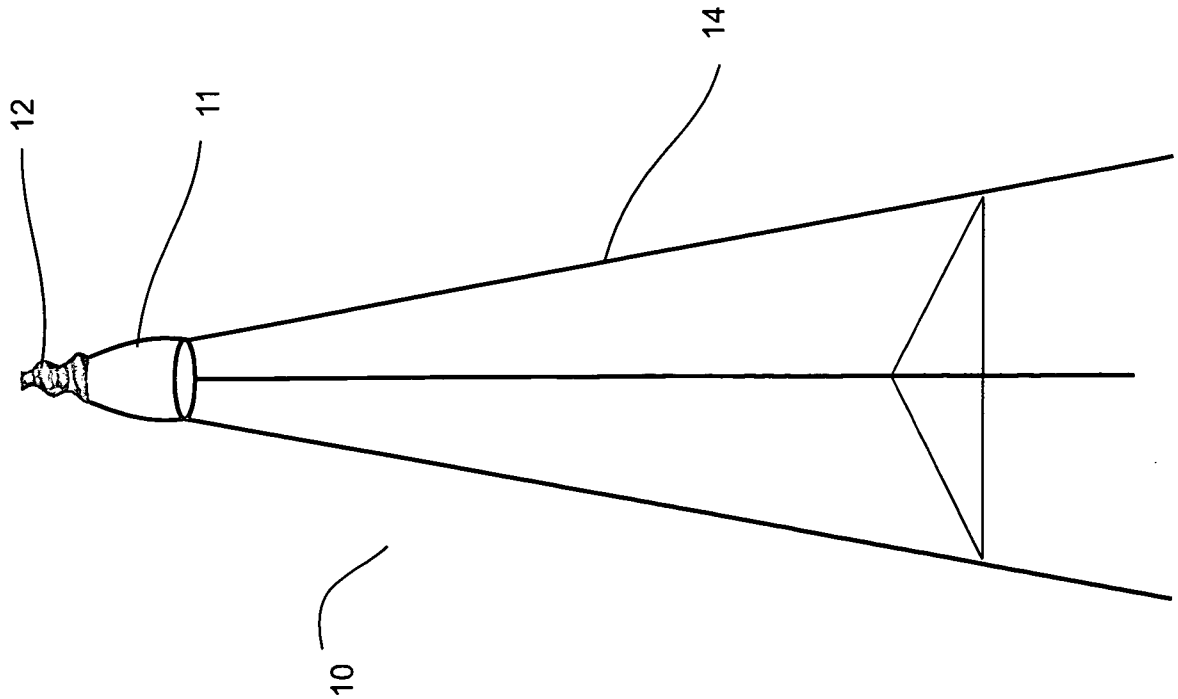

Figure 2

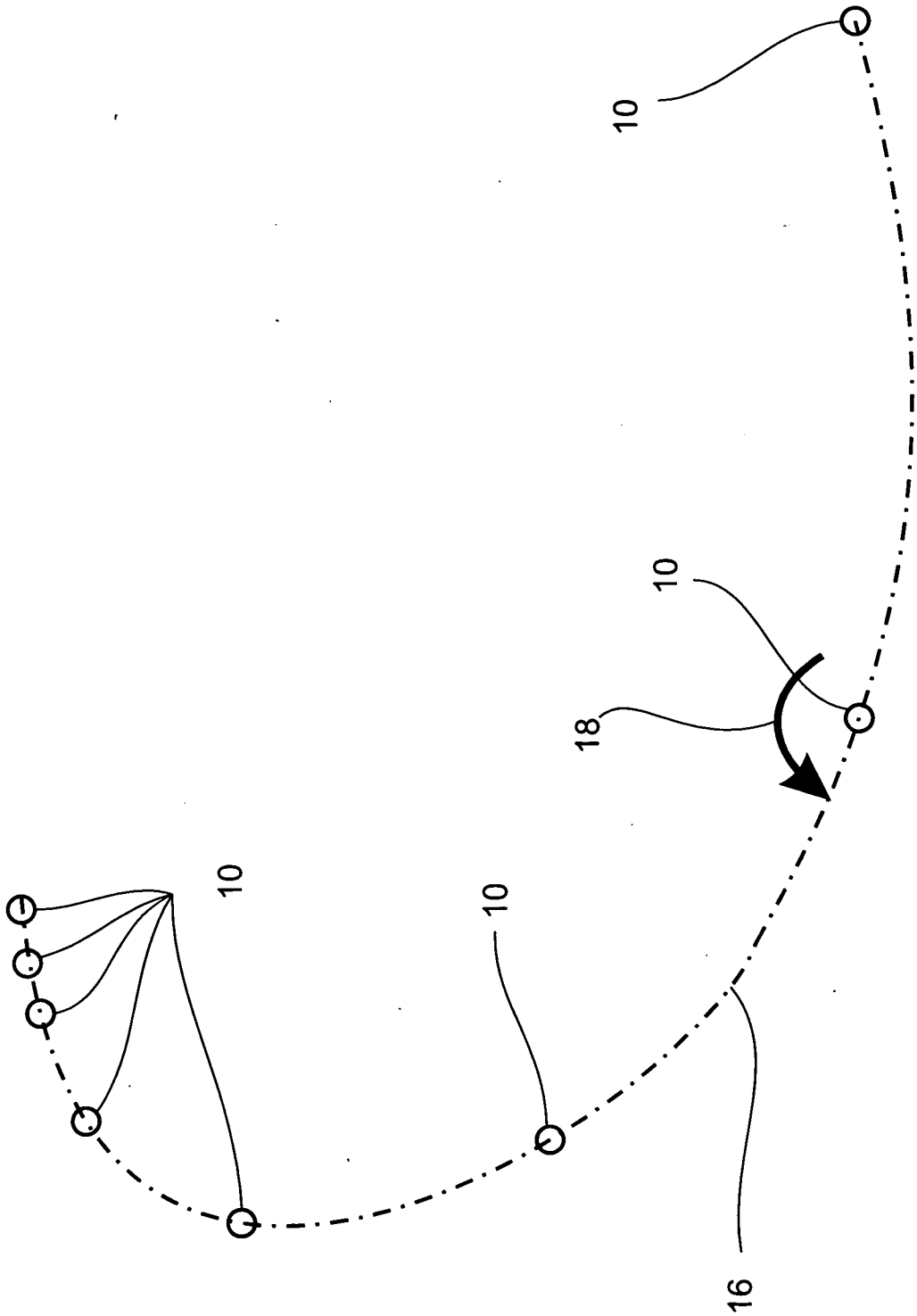

Figure 4

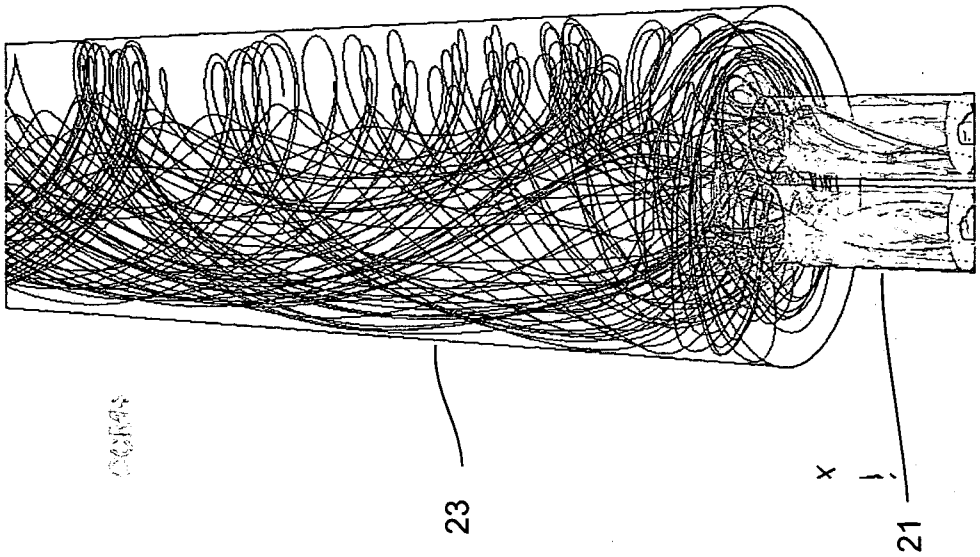

Figure 6

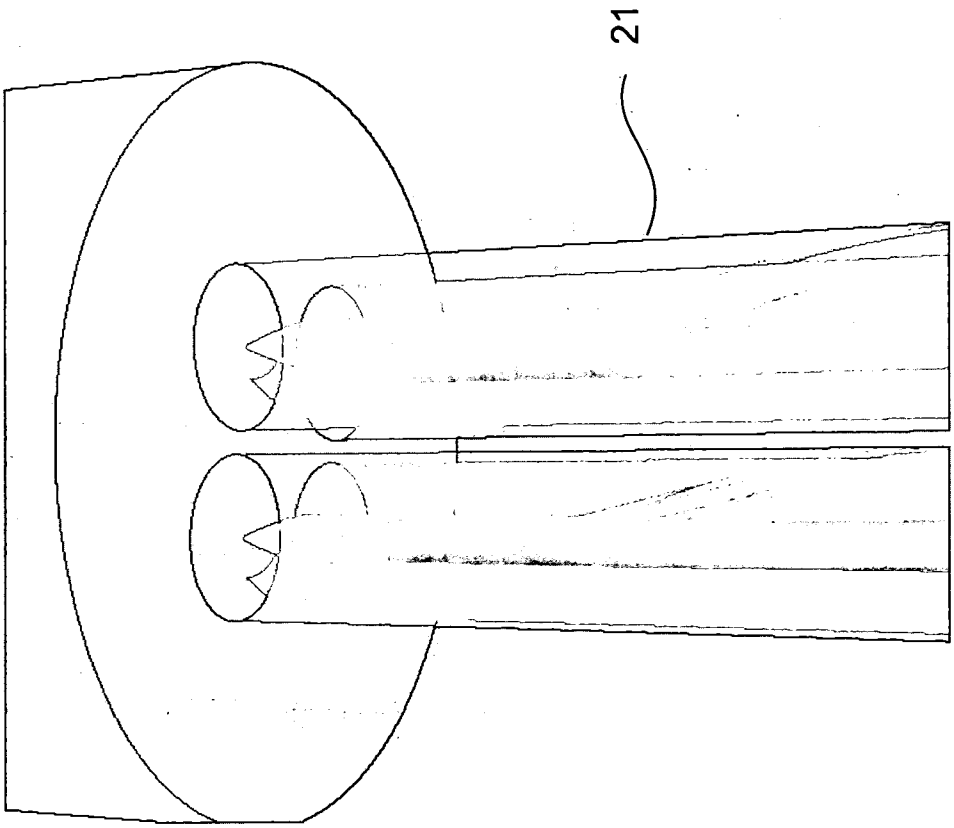

Figure 5

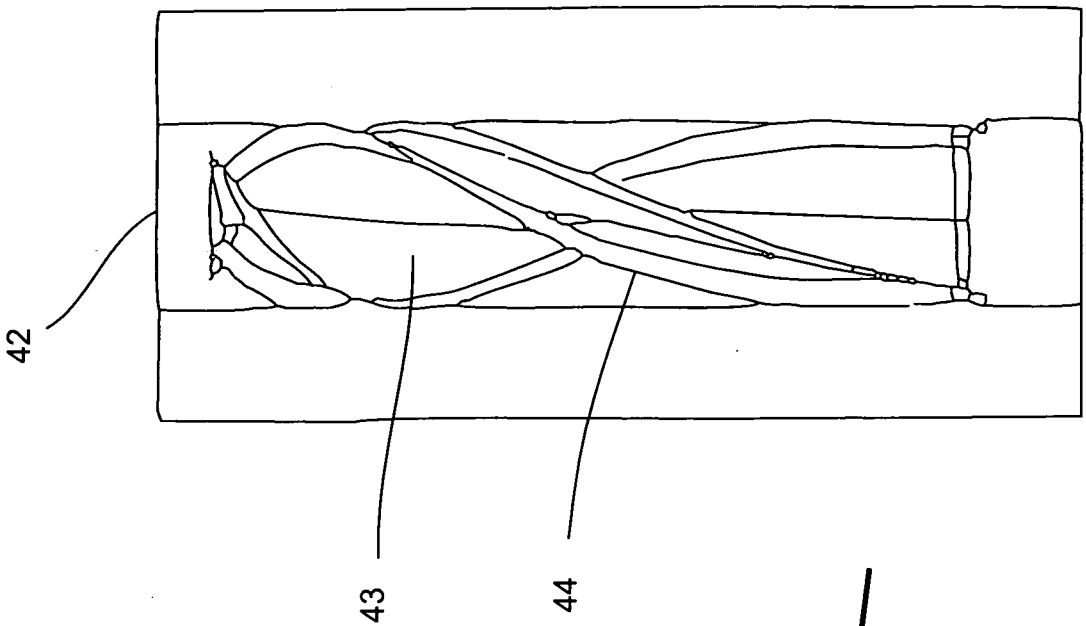

Figure 8

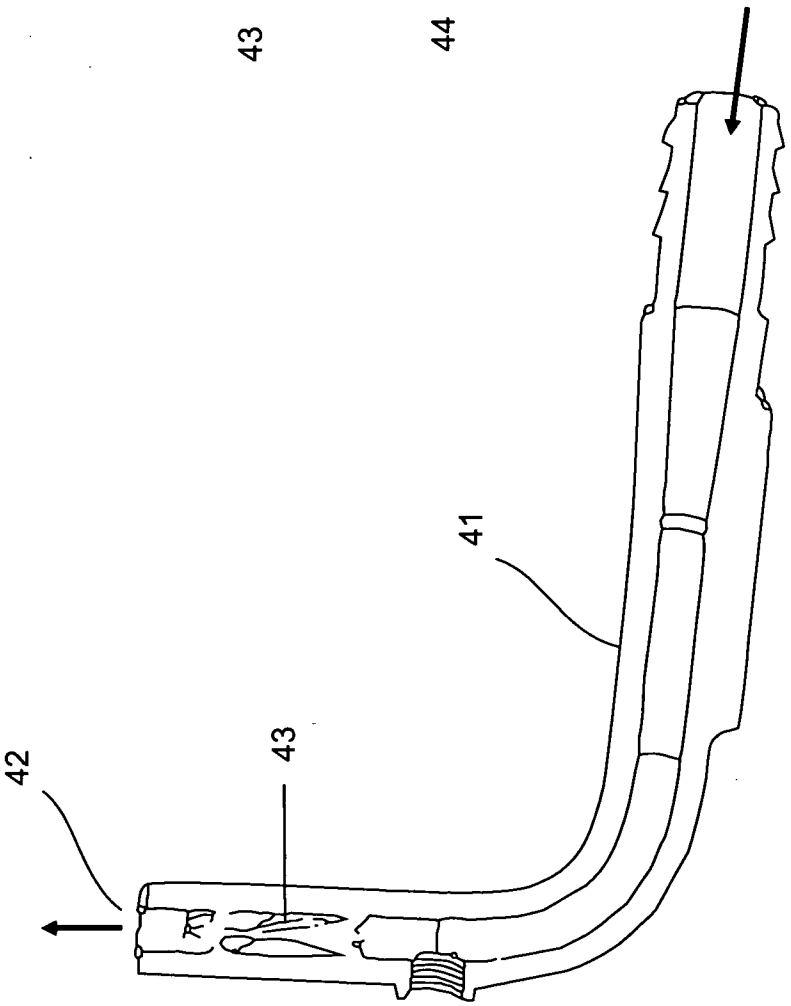

Figure 7

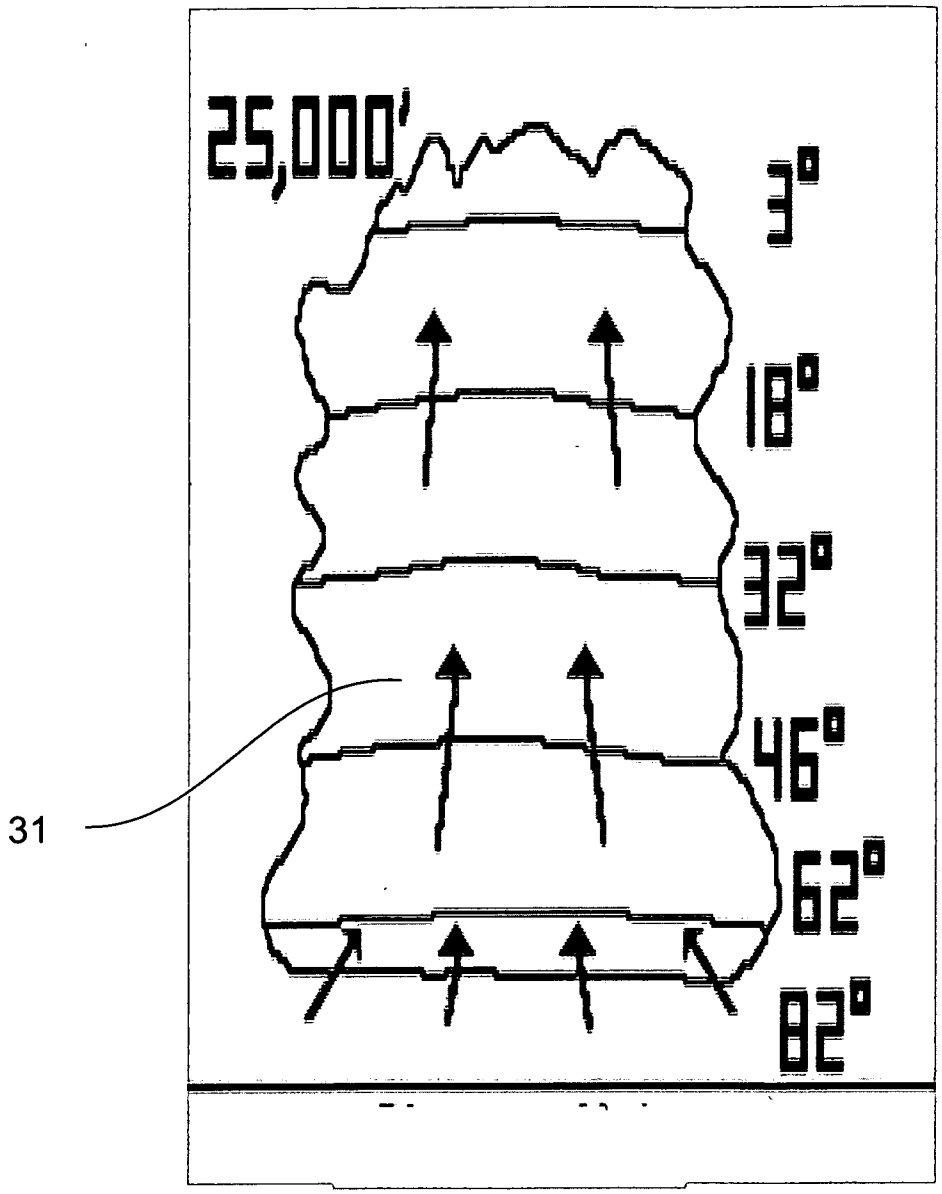

Figure 9

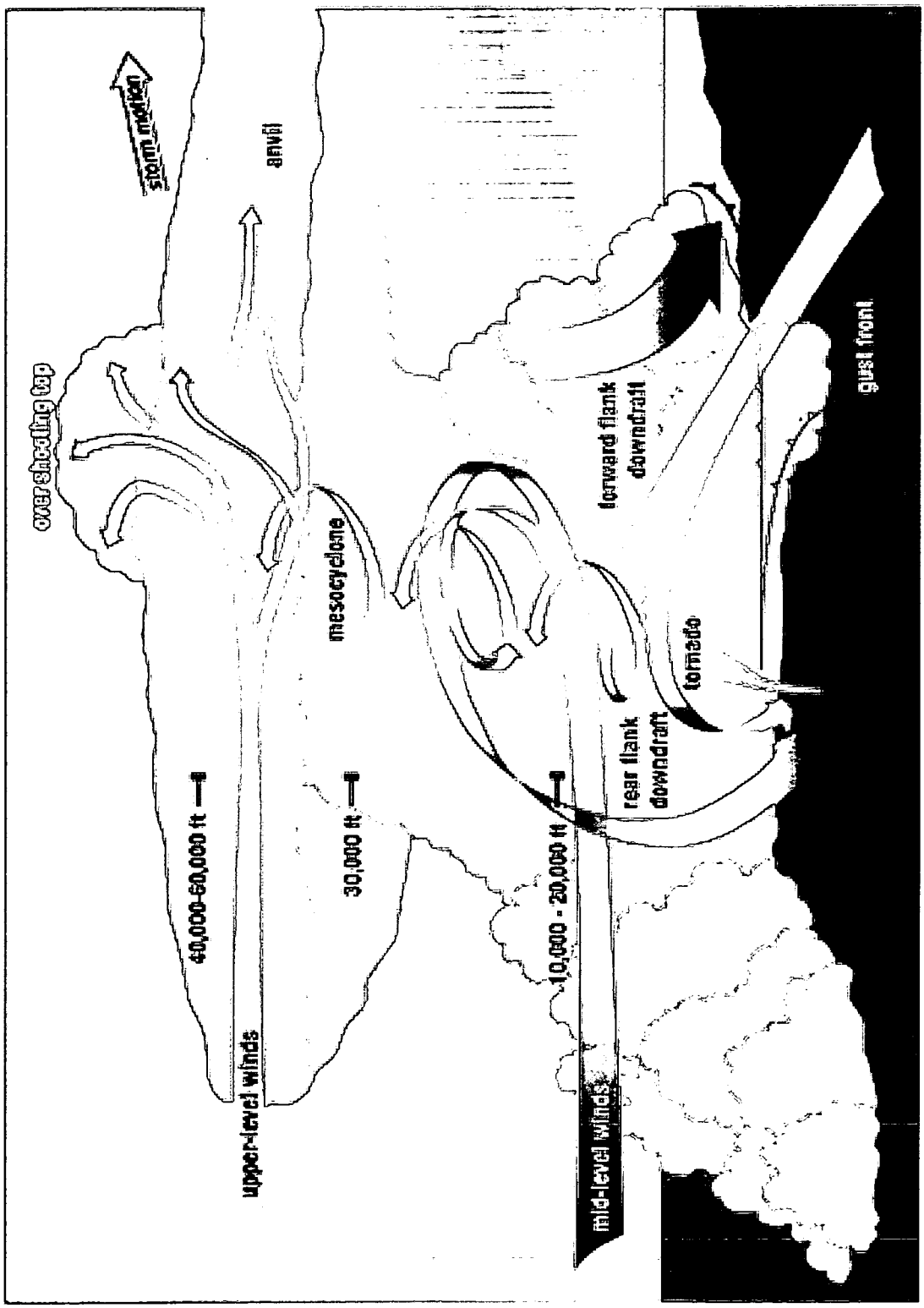
storm motion
anvil
overshooting top
mesocyclone
forward flank downdraft
gust front
tornado
rear flank downdraft
40,000-60,000 ft
30,000 ft
10,000 - 20,000 ft
upper-level winds
mid-level winds

Figure 10

Figure 11

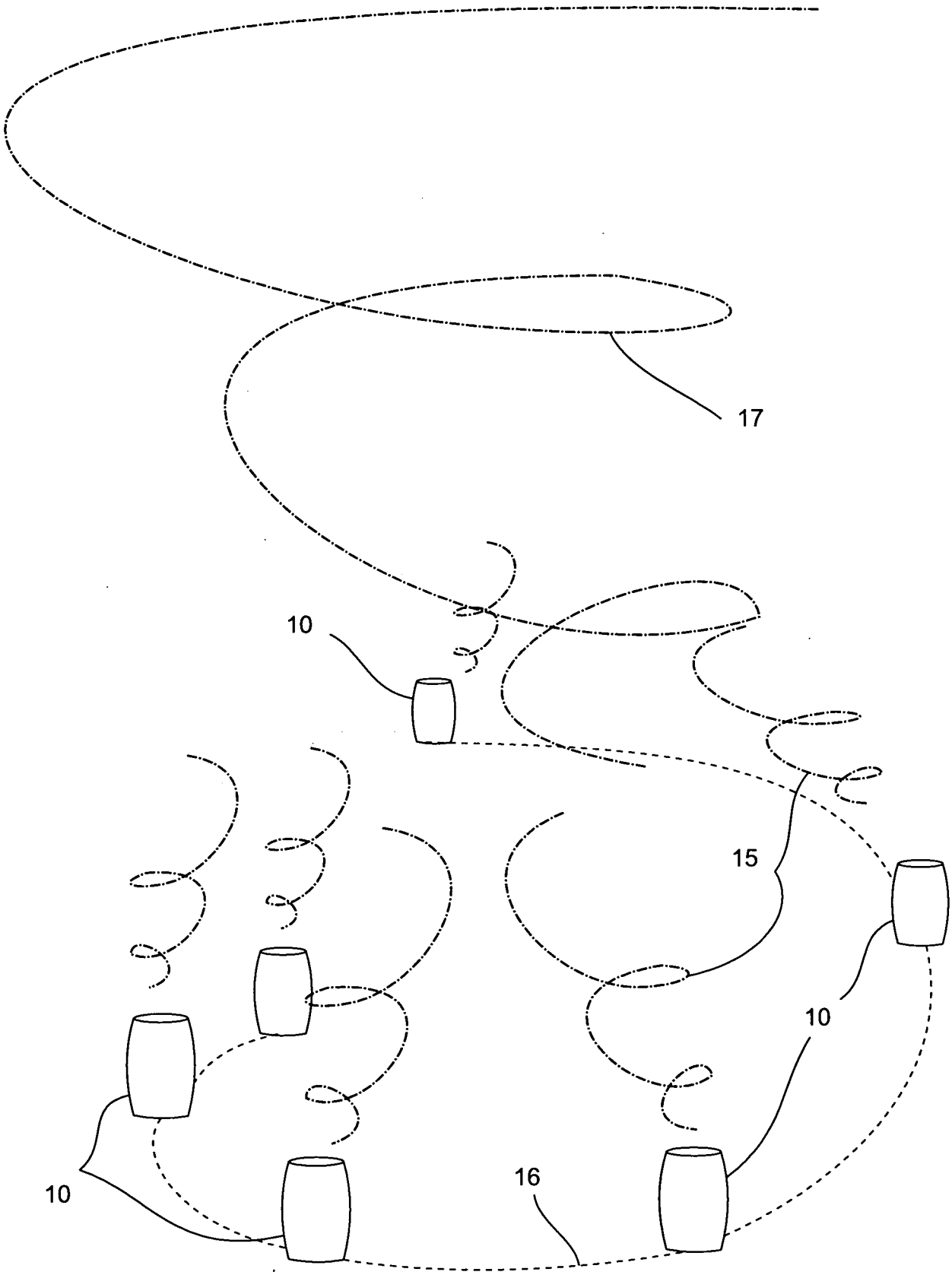

Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/00544

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F15D 1/08; B05B 1/34 (2012.01)
USPC - 137/809
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)
IPC (8) - F15D 1/08; B05B 1/34 (2012.01)
USPC - 137/809

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 137/808; 415/1, 4.2, 4.4, 212.1, 909

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase - cyclones tornadoes vortices multiple plural several many three four array conbine merge join add together generator destroy or destruction disrupt blend inversion layer vertical upward weather rain storm thunderstorm hurricane turbine jet engine
Google - weather-control (cyclone OR tornado)-generator (turbine OR jet)-engine; tornado-gene

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2005/0039626 A1 (YI, ET AL.) 24 February 2005 (24.02.2005), paras [0037]-[0039], FIG. 2-5	1-4, 8, 10-12 ---------- 6-7, 9
Y	US 2011/0052369 A1 (Michaud) 03 March 2011 (03.03.2011), para [0016] and [0049]-[0050]	6
Y	US 2007/0010339 A1 (Stone) 11 January 2007 (11.01.2007), Fig. 3-4 and para [0027]	7
Y	US 2003/0085296 A1 (WAXMANSKI) 08 May 2003 (08.05.2003), para [0032] and [0034]	9
A	US 6,241,160 B1 (REDFORD) 05 June 2001 (05.06.2001), entire document	1-4, 6-12
A	US 7,086,823 B2 (MICHAUD) 08 August 2006 (08.08.2006), entire document	1-4, 6-12
A	US 4,499,034 A (MCALLISTER, JR.) 12 February 1985 (12.02.1985), entire document	1-4, 6-12
A	US 4,070,131 A (YEN) 24 January 1978 (24.01.1978), entire document	1-4, 6-12

☐ Further documents are listed in the continuation of Box C. ☐

* 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
09 January 2013 (09.01.2013)	04 FEB 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/00544

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 5
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.