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(72) Inventor; and

(71) Applicant: RAWSON, Colin [AU/AU]; 71 Eskdale Road, Caulfield North, Victoria 3161 (AU).

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(74) Agent: DAVIES COLLISON CAVE PTY LTD; 1

Nicholson Street, Melbourne, Victoria 3000 (AU).

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(54) Title: AERO-ACOUSTIC MATERIALS PROCESSING PLANT WITH NOISE ATTENUATION SYSTEM

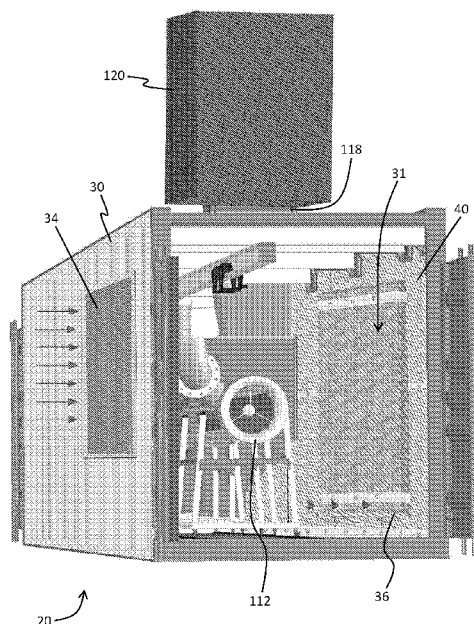


Figure 2

(57) Abstract: A housing for an aero-acoustic processing machine having rotational drive apparatus coupled to rotate an air impeller to draw air and material to be processed through an axial inlet system and expel the air and processed material through a transverse outlet. The housing includes an enclosure incorporating at least one layer of noise attenuation materials surrounding the aero-acoustic processing machine, the enclosure having a material inlet port, an air inlet port and an exhaust port for outputting processed product with air. Airflow paths that are required for operation of the aero-acoustic processing machine are provided to enable airflow into the housing whilst significantly reducing noise emission.



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**Aero-acoustic Materials Processing Plant with Noise Attenuation System**Field of the invention

5 The present invention relates to an aero-acoustic materials processing plant, and in particular to a system for noise attenuation thereof.

Background

10 A form of aero-acoustic grinding machine has been developed, referred to herein as a "vortex machine" for convenience. The vortex machine is an extreme aero-acoustic device that may be used to mill, grind, blend and dry a wide range of materials. The nature of the machine is such that it produces significant noise that can be in excess of 120dB.

15 To enable its use of such a machine in general commercial applications, the noise should be reduced to below 85dB, an accepted international standard. To achieve a noise level that meets the legal requirements of a workplace at which the vortex machine may find application, specific noise attenuation is required. For example, in Australia the national standard for exposure to noise in the occupational environment is an eight-hour equivalent continuous A-weighted sound pressure level, LAeq,8h, of 85dB(A).

20

It would therefore be desirable to provide a system for noise attenuation suitable for a vortex machine to permit operation of the machine in general occupational environments.

25 Summary of the invention

In accordance with the invention there is provided an aero-acoustic materials processing plant including an aero-acoustic processing machine having rotational drive apparatus coupled to rotate an air impeller to draw air and material to be processed through an axial inlet system and expel the air and processed material through a  
30 transverse outlet, the plant further comprising a housing enclosure surrounding the aero-acoustic processing machine, the housing enclosure constructed to include noise attenuation panels.

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In accordance with the present invention there is also provided a housing for an aero-acoustic processing machine having rotational drive apparatus coupled to rotate an air impeller to draw air and material to be processed through an axial inlet system and expel the air and processed material through a transverse outlet, the housing including an enclosure incorporating at least one layer of noise attenuation materials surrounding the  
5 aero-acoustic processing machine, the enclosure having a material inlet port, an air inlet port and an exhaust port for outputting processed product with air.

The material inlet port and exhaust port may have respective ducts for conveying  
10 raw material and processed product, respectively, into and out of the housing. Preferably the ducts are provided with at least one layer of noise attenuation material. The air inlet port may be in communication with an air inflow vent arrangement comprising one or more indirect inlet ducts that allow for air to be drawn into the enclosure via an elongate path between an outer wall of the housing and at least one of said layers of noise  
15 attenuation materials. The air inflow vent arrangement may further include a plurality of baffles arranged within the or each inlet duct for reducing sound emission from the housing through the air inlet port.

In one embodiment the housing includes a baffle wall incorporating or composed  
20 of noise attenuation materials, the baffle wall partitioning the housing interior into first and second compartments respectively containing the rotational drive apparatus and the impeller, wherein a drive shaft is arranged to extend through the baffle wall from the rotational drive apparatus to the impeller. The material inlet port, air inlet port and exhaust port are located in the second compartment. Preferably the first compartment is provided  
25 with an air-conditioning unit for forced induction of cooled air into the first compartment from outside the housing, creating a relative positive pressure as between the first and second compartments.

#### Brief description of the drawings

30 In order that the invention may be more easily understood, the following detailed description is provided including description of several embodiments, presented by way of example only, and with reference to the accompanying drawings in which:

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Figure 1 is a partial-section side view of a vortex machine in a transportable noise-attenuating enclosure, according to an embodiment of the invention;

Figure 2 is an exploded perspective view of an enclosure structure;

Figures 3A and 3B are partial-section perspective views of a vortex machine in a transportable noise-attenuating enclosure, according to an embodiment of the invention;

Figure 3C is a partial-section perspective view of an output duct noise reduction structure seen in Figure 3B;

Figures 4, 5, 6A and 6B illustrate mounting schemes for noise-attenuation panels in an enclosure according to embodiments of the invention;

Figure 7 is a diagrammatic illustration of an air inlet structure for an enclosure according to an embodiment of the invention;

Figure 8 is a partial-section end view of a vortex machine in a transportable noise-attenuating enclosure according to an embodiment of the invention, particularly illustrating an air inlet structure; and

Figure 9 is a perspective end-view of a vortex machine in an enclosure according to an embodiment of the invention.

#### Detailed description

It has been found that a cyclone created in a stream of air passing through a conduit, preferably of circular cross-section, the centripetal forces created by the motion of the air stream pull any particulate material entrained in the air stream away from the walls of the conduit and towards its central region. If a wide range of sonic frequencies are created within the conduit, a pattern of powerful vortices are created in the air stream. Without being bound by theory, it is thought that energies are released by conversion of the potential energy to kinetic energy due to the stresses created within the cyclone which causes a minute explosion. The vortices of the cyclone take the form of implosions which are capable of breaking the material up further into smaller particles.

It has also been found that the vortices created in the cyclonic air stream carry further harmonic frequencies generated by the specially designed apparatus, and this sets up a pulse from the standing wave configuration within the system, and causes pockets of air within the standing wave to achieve a velocity beyond the sonic range. This

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can be tuned for a particular type of material which enhances the ability of the vortices created to break up very hard and soft materials such as stone and to dry materials.

5 The apparatus and fan produce a harmonic/frequency which sets up pulses from the standing configuration within the system, and on occasion pockets of air through the standing wave achieve a velocity beyond the sonic range. These conditions, i.e. high local vorticity and high energy dissipation, when optimised, will produce vortices through which material may be comminuted and/or dried before reaching the impeller, by a combination of thermal shock, cavitation, and sudden extremes of pressure and frequency/harmonic  
10 interference which is sometimes beyond the sonic range.

Operation of such a vortex machine is accompanied by high noise levels, beyond recognised safe standards for workplace environments. In order for commercial application such a vortex machine should be safe to use in the many locations where the  
15 materials to be processed are found. Noise attenuation to international standards to meet local site specific requirements is therefore necessary, the principal reasons being:

1. Reducing the noise from the machine will make the machine safe to use.
2. Soundproofing will make the machine marketable to a broad range in industries  
20 applications and locations where excessive noise levels are prohibitive or prohibited.
3. The vortex machine noise is in most cases, of a low frequency making it particularly dangerous.
4. The vortex should be enclosed by walls with access via doors that can be closed.

25

Figure 1 illustrates a vortex machine 100 having a motor 102 that is coupled to rotationally drive an impeller 104 by way of drive shaft 103. An axial inlet to the impeller 104 includes a frustoconical inlet pipe 106 and first and second pipe sections 110, 108. The first pipe section 110 has an air inlet opening 112 and is coupled with a material feed  
30 tube 114. In use, air (indicated by arrow 113) is drawn in through the air inlet opening 112 and material to be processed (indicated by arrow 115) enters the machine through the feed tube 114. The material is comminuted and/or dried before reaching the impeller 104

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and thus is able to pass through the impeller and be transversely expelled through an outlet port 116 as indicated by arrow 117.

Figure 2 is a perspective exploded view illustrating the primary components forming a noise attenuating enclosure 20 that is a key element in a noise attenuation strategy for construction of an operational aero-acoustic materials processing plant. The enclosure 20 is constructed from two layers 30, 40 that form an elongate box structure for housing the vortex machine. The external layer 30 comprises a predominantly metal structure including elongate floor, wall and roof (roof not shown) and hinged access doors at the ends. Within the external layer 30 is provided an internal noise attenuation layer 40 which comprises a plurality of sound absorbing panels 42 that abut or overlap one another to cover each of the internal surfaces of the outer, structural layer 30. In order to provide support for the vortex machine apparatus, a hard floor surface 50 may be installed over the noise attenuation layer on the bottom of the enclosure.

It has been found that a vortex machine of suitable size and materials processing capacity may be constructed to be housed within an enclosure 20 including structure comprised of a 40ft standard shipping container. Specifically, a shipping container may be employed to provide the external, structural layer 30 of the enclosure. This arrangement has the added benefit of allowing the processing plant to be readily transportable using existing transport infrastructure. However, a shipping container of itself does not provide adequate noise attenuation, and thus every opportunity to increase the soundproof characteristics of the vortex housing should be pursued, considering the:

- a) Container walls;
- b) Container doors;
- c) Container floor;
- d) Air inlet vents;
- e) Material input duct;
- f) Material output and exhaust duct; and
- g) Differences between enclosure conditions that may be required as between the materials processing apparatus and the driving machinery.

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The walls of the container present the largest exposed area where noise can penetrate to the outside. In previous tests a transport container of standard construction, has been lined with dense acoustic matting and heavy metallic layer. This material used on the internal wall of the container reduced the exterior sound from the machine from 128db to 87db. Further attention to fully lining the exterior ducts, and use of air inlet baffles to increase soundproof characteristics or a combination of a range of similar materials to their best advantage may achieve the maximum possible reduction in the noise, as discussed further below.

## 10 Opportunities for noise reduction

Suitable sound absorption strategies must treat the combined phenomena of vibrations, sound transmission and sound reverberation whilst still providing for required airflow.

There are several opportunities to increase the sound absorption characteristics of the Vortex.

### 1. Target the source of the noise

- a) Feed Pipe inlet
- b) Processing pipe
- c) Fan Housing
- d) Exhaust outlet pipe

### 2. Develop an acoustic enclosure of the vortex machine as an entire unit

### 3. Develop an acoustic enclosure for a group of vortex machines

## Design Response

Based on the identified design criteria a specifically constructed vortex acoustic enclosure has been developed to achieve the noise reduction objectives specified.

The details that make it work most efficiently are;

- Materials used
- Enclosure Construction
- Air Flow

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### **Vortex Acoustic Enclosure**

Figure 3A illustrates an aero-acoustic material processing plant 10 including a vortex machine 100 housed in a noise attenuating enclosure 20. The nearside wall of the enclosure 20 is removed in this diagram for the purposes of illustration of the structure and interior arrangement. As previously described, the enclosure 20 has an exterior structure 30 fabricated from steel, which may comprise a modified shipping container, for example. The enclosure has a door 32 at each end that provide access to the interior for maintenance, but during normal operation of the materials processing plant the doors 32 would ordinarily be closed.

The vortex machine 100 is mounted within the enclosure 20 with the motor 102 toward one end and the air inlet opening 112 toward the other end. All of the interior surfaces of the structure 30 are covered with noise attenuation layer 40, comprising sound absorbing panels 42 mounted to the structure 30 in a manner described hereinbelow. A baffle wall 45 may also be included between the motor 102 and the impeller 104 to partition the materials processing apparatus from the driving machinery, as described further below.

The materials processing plant 10 has a materials input duct 115 that passes through an opening in the roof of the enclosure 20 and couples to the material feed tube 114 of the vortex machine 100. The outlet port 116 also passes through an opening in the roof of the enclosure and is coupled to an output duct 118 through which exhaust air and processed particulate material is expelled for particulate separation, for example by use of one or more cyclonic separators or the like. The input duct 115 and output duct 118 are fitted with noise reducing panels over the outside surfaces thereof. The output duct 118 may additionally or alternatively be fitted with an 'exhaust outlet silencer' 120 as seen in Figures 3B and 3C and described further hereinbelow.

There are several materials that can be used as noise reducing panels 42 in the creation of an acoustic enclosure, the most effective of which has been found to be a product known as Noiselock 2, available from IAC Acoustics. These Noiselock panels are 102mm thick, constructed from a 1.6mm plain galvanised face sheet and a 1.2mm plain



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galvanised back sheet. Infill consists of two layers of 12.5mm thick gyproc with the remaining void filled with sound absorbing material.

Characteristics of this material include:

5

- A rigid laminate noise barrier and vibration damping material
- A unique material construction which results in high sound absorption coupled with resilience and compression loading capability
- An extremely robust metal faced insulation with an indefinite life that is unaffected by oil, water, hydrolysis and vibration
- Effectively reduces sound radiation and sound transmission in the critical frequency region of rigid panels

10

The panels selected for the noise attenuation layer 40 are extremely dense and very heavy product, making it robust for many industrial applications and the most effective sound absorption product found for use in the construction of individual machine acoustic enclosures to reduce the noise across the range of frequencies encountered when the vortex is operating. Experimental tests of the configuration have shown it possible to obtain an average residual noise level outside the enclosure of 85dB(A) when measured (free field) at one metre.

20

For the specific requirements of a vortex acoustic enclosure, the construction of the enclosure may include:

- Double layer of noise attenuation panels
- Fabricated sound absorption panels attached to the inside of the enclosure as one preformed double thickness sheet
- The panels are bolted to a frame which is then bolted to the container wall in sets
- Walls, ceiling, doors, exhaust outlet to be covered with sound absorption paneling
- Outer layer of enclosure is a 40ft shipping container to enhance sound absorption.

25

30

The selected noise reducing panels 42 are quite heavy and should be fastened securely to the enclosure structure for optimum performance. Figure 4 is a perspective view of a section of the enclosure 20 illustrating one way of mounting the noise

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attenuation layer 40 to the interior wall of the structure 30 using a series of longitudinal restraints 43. There are shown lower, central and upper restraints 43 extending horizontally across the panels 42 forming the noise attenuation layer 40. The restraints 43 are secured to the structure 30 by use of a series of fasteners 44 that extend through the  
5 panels 42.

The fasteners 44 may comprise bolts, for example, affixed along the walls of the structure 30 with threaded portions projecting into the enclosure space. For ease of construction a series of bolts may be affixed to a length of flat steel that is then  
10 subsequently welded to the inner wall surface of the structure 30. Appropriately sized holes are formed in the panels 42 to allow the panels to be fitted against the surface of the structure 30, the fasteners passing through the holes with just the threaded ends exposed for securing the restraints 43 thereon, using washers and nuts, for example. Although a wall section is shown in Figure 4, a similar system may be used to affix panels  
15 42 over the ceiling, floor and doors of the enclosure of form the complete noise attenuation layer 40. Figure 5 additionally shows the incorporation of a baffle wall 45.

Figure 6A is an illustration of a wall section from the enclosure 20 (with enlarged views of several portions) showing a variation on the system for attaching the noise  
20 attenuation layer 40 to the enclosure structure 30. In this case a restraint strap 43 affixed by fasteners 44 is employed across the center of the panels 42, but channel beams 48, 49 are used to hold the panels in place at the top and bottom, respectively. The channel beams 48, 49 have a channel width to suit the thickness of the noise attenuation layer panels and may be welded, for example, to the structure 30. Also shown in this figure is  
25 the use of an adhesive tape material 47 coupling the adjoining edges of panels 42 together to reduce vibrations between the panels. Depending on the particular panel construction used in the enclosure, the restraint straps 43 and fasteners 44 may not be required. For example, panels with sufficient rigidity may be held in place just by the top and bottom channel beams 48, 49 as seen in Figure 6B.

30 It has been found that the output duct 118 through which exhaust air and processed particulate material is expelled can emit significant noise, and to combat this effect an exhaust outlet silencer 120 may be fitted as shown in Figures 3B and 3C. The

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exhaust outlet silencer 120 comprises a structure that forms part of the output duct flow path where the output duct exits the top of the enclosure as seen in Figure 3C. The exhaust outlet silencer 120 has a heavy (4mm) exterior casing 122 and interior walls lined with the same dense fibre material 124 as the panels described hereinabove. Additionally,  
5 two internal vertical baffles 126 are provided, also constructed of the same dense fibre as the panels and covered with perforated galvanized steel. The air flow from the vortex outlet passes in a linear flow through the silencer as indicated by the broken lines and arrows 130 seen in Figure 3C.

10 The vortex machine relies on airflow, and thus it is also necessary to allow for airflow into the enclosure, without permitting excessive noise to escape. To ensure the required airflow into the enclosure an air inlet vent has been designed that incorporates a noise flow confusion strategy along with a sound absorption protective layer. This is diagrammatically illustrated in Figure 7 which shows a partial section through a side wall  
15 of the enclosure 20 including an air inflow vent arrangement 31.

The enclosure 20 is designed to house the vortex machine 100 whilst it operates, reducing noise outside the enclosure to workplace acceptable levels. In order to operate the vortex machine 100 must draw in air through its air inlet opening 112. Therefore the  
20 enclosure 20 must allow for substantial airflow from the outside to the inside, which air is then expelled through the outlet port 116 and output duct 118. Moreover, the air must be admitted to the enclosure while the doors, for example, remain closed for noise attenuation. For this purpose the structure of the enclosure 20 incorporates at least one air inflow vent arrangement 31 as described hereinbelow.

25 Each air inflow vent arrangement 31 comprises one or more indirect inlet ducts 35 that allow for air to be drawn into the enclosure via an elongate path between the enclosure outer wall 30 and inner noise attenuation layer(s) 40. The inlet duct 35 as shown in Figure 7 has an external port 34 formed toward the top of the outer wall 30, and  
30 in internal port 36 formed toward the bottom of the inner noise attenuation layer 40. The air inflow vent arrangement 31 therefore includes an extended vertical path between the enclosure inner and outer layers, reducing opportunity for noise to escape the enclosure.

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Interior sound absorption panels are applied so that the duct is encased between the inner sound absorption panels, and the outer casing of the vortex machine.

Maximum noise reduction is achieved in the duct by creating;

- 5       • An indirect and confused path for noise escaping the enclosure
- Can be further enhanced by adding baffles within the duct
- The inside of the duct is covered with sound absorption panels

10       Figures 8 and 9 illustrate a variation of the air inflow vent arrangement that incorporates a series of baffles 37 designed to permit airflow while reducing noise escape. As seen in Figure 8, for example, the baffles 37 may be arranged to allow for airflow through a relatively circuitous path whilst having a structure designed to reflect or reduce the transmission of noise in the opposite direction. The external port 34 in this embodiment is enlarged and includes a vent covering grate inset to the enclosure external  
15       wall.

Referring again to Figure 2, the inclusion of baffle wall 45 in the noise attenuating enclosure 20 has multiple benefits in the operation of the materials processing plant 10. As noted, the baffle wall 45 partitions the materials processing apparatus from the  
20       driving machinery including the motor 102, and includes or is composed of noise attenuating panels 42 of the same kind used on the structure of the enclosure. Although the motor 102, depending on its type, can be quite noisy, in normal operation of the plant 10 it is the materials processing apparatus including the impeller 104 that generates the most noise. Moreover, the materials processing apparatus can also produce dust and fine  
25       particulates that escape into the enclosure interior. Thus, the baffle wall 45 may serve a dual purpose of reducing both the incursion of noise and dust to the enclosure space housing the driving machinery (e.g. motor 102). Less dust in and around the motor 102 is self-evidently beneficial and may reduce the frequency of cleaning and maintenance required, whilst lower noise levels may even permit maintenance workers to inspect the  
30       motor for short periods of time whilst it is operating.

In order to provide for airflow to and cooling of the motor 102 an air-conditioner unit 25 is installed in the wall of the enclosure 20. The air-conditioner unit 25 is arranged

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to blow cooled air into the partition space housing the motor 102, creating a relatively positive air pressure therein. The positive air pressure produces net air flow from the motor housing partition into the materials processing apparatus partition, through gaps around the panels and the drive shaft, for example, reducing the likelihood of dust incursion in the opposite direction.

Multiple vortex machines in a single enclosure

In some applications it may be desirable for multiple vortex units to be housed within a single structure, in which case the enclosure itself can be designed using noise reduction techniques as described hereinabove, including:

- a) Enclosure/building inlet ducts designed to confuse the flow of noise, in conjunction with sound attenuation panels.
- b) The exhaust duct to be covered with sound attenuation panels
- c) The overall enclosure to be covered with sound attenuation panels, preferably on the interior surfaces, potentially utilizing multiple layers of noise attenuations panels that may overlap one another.

The invention has been described by way of non-limiting example only and many modifications and variations may be made thereto without departing from the spirit and scope of the invention.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

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**THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS**

1. An aero-acoustic materials processing plant including an aero-acoustic processing machine having rotational drive apparatus coupled to rotate an air impeller to draw air and material to be processed through an axial inlet system and expel the air and processed material through a transverse outlet, the plant further comprising a housing enclosure surrounding the aero-acoustic processing machine, the housing enclosure constructed to include noise attenuation panels.
2. A housing for an aero-acoustic processing machine having rotational drive apparatus coupled to rotate an air impeller to draw air and material to be processed through an axial inlet system and expel the air and processed material through a transverse outlet, the housing including an enclosure incorporating at least one layer of noise attenuation materials surrounding the aero-acoustic processing machine, the enclosure having a material inlet port, an air inlet port and an exhaust port for outputting processed product with air.
3. A housing according to claim 2, wherein the material inlet port and exhaust port have respective ducts for conveying raw material and processed product, respectively, into and out of the housing, and wherein the ducts are provided with at least one layer of noise attenuation material.
4. A housing according to claim 2 or 3, wherein the air inlet port is in communication with an air inflow vent arrangement comprising one or more indirect inlet ducts that allow for air to be drawn into the enclosure via an elongate path between an outer wall of the housing and at least one of said layers of noise attenuation materials.
5. A housing according to claim 4, wherein the air inflow vent arrangement includes a plurality of baffles arranged within the or each inlet duct for reducing sound emission from the housing through the air inlet port.
6. A housing according to any one of claims 2 to 5, wherein the housing includes a baffle wall incorporating or composed of noise attenuation materials, the baffle wall

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partitioning the housing interior into first and second compartments respectively containing the rotational drive apparatus and the impeller, wherein a drive shaft is arranged to extend through the baffle wall from the rotational drive apparatus to the impeller.

5

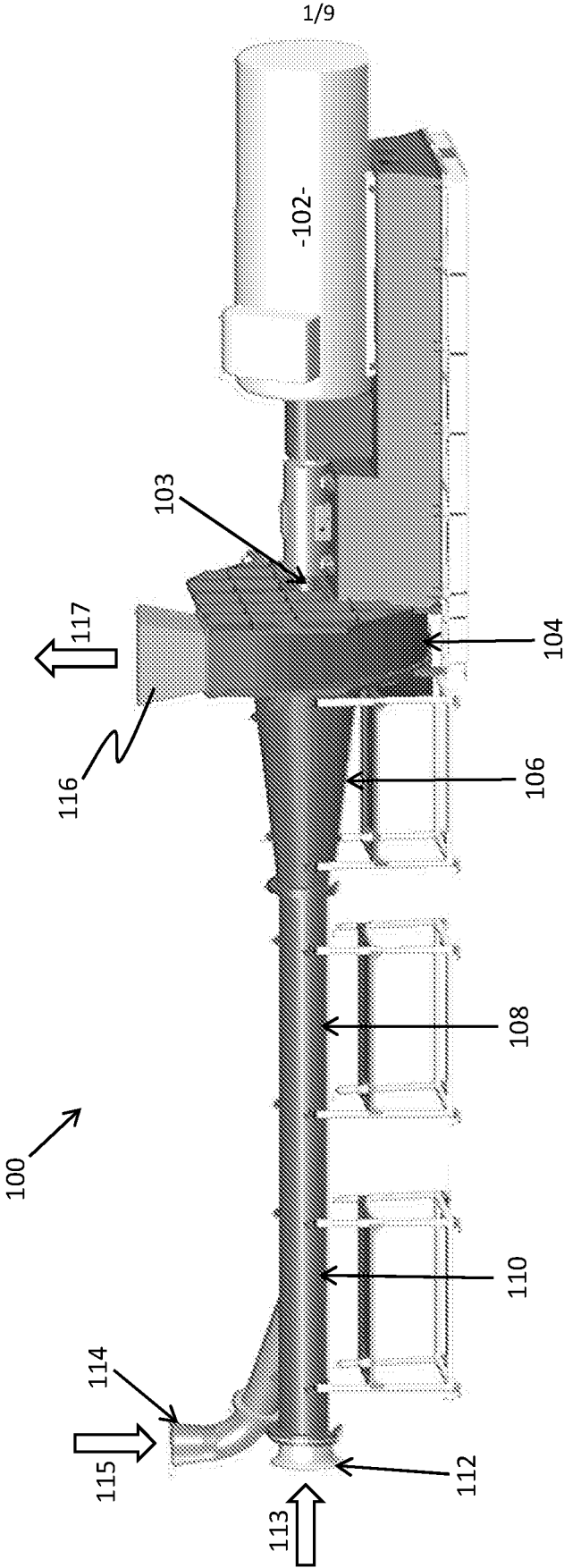
7. A housing according to claim 6, wherein the material inlet port, air inlet port and exhaust port are located in the second compartment.

8. A housing according to claim 7, wherein the first compartment is provided with an  
10 air-conditioning unit for forced induction of cooled air into the first compartment from outside the housing, creating a relative positive pressure as between the first and second compartments.

9. A housing according to claim 2 wherein the housing includes an output duct  
15 arranged to convey processed product entrained in exhaust air to a separation plant such as a cyclonic separator.

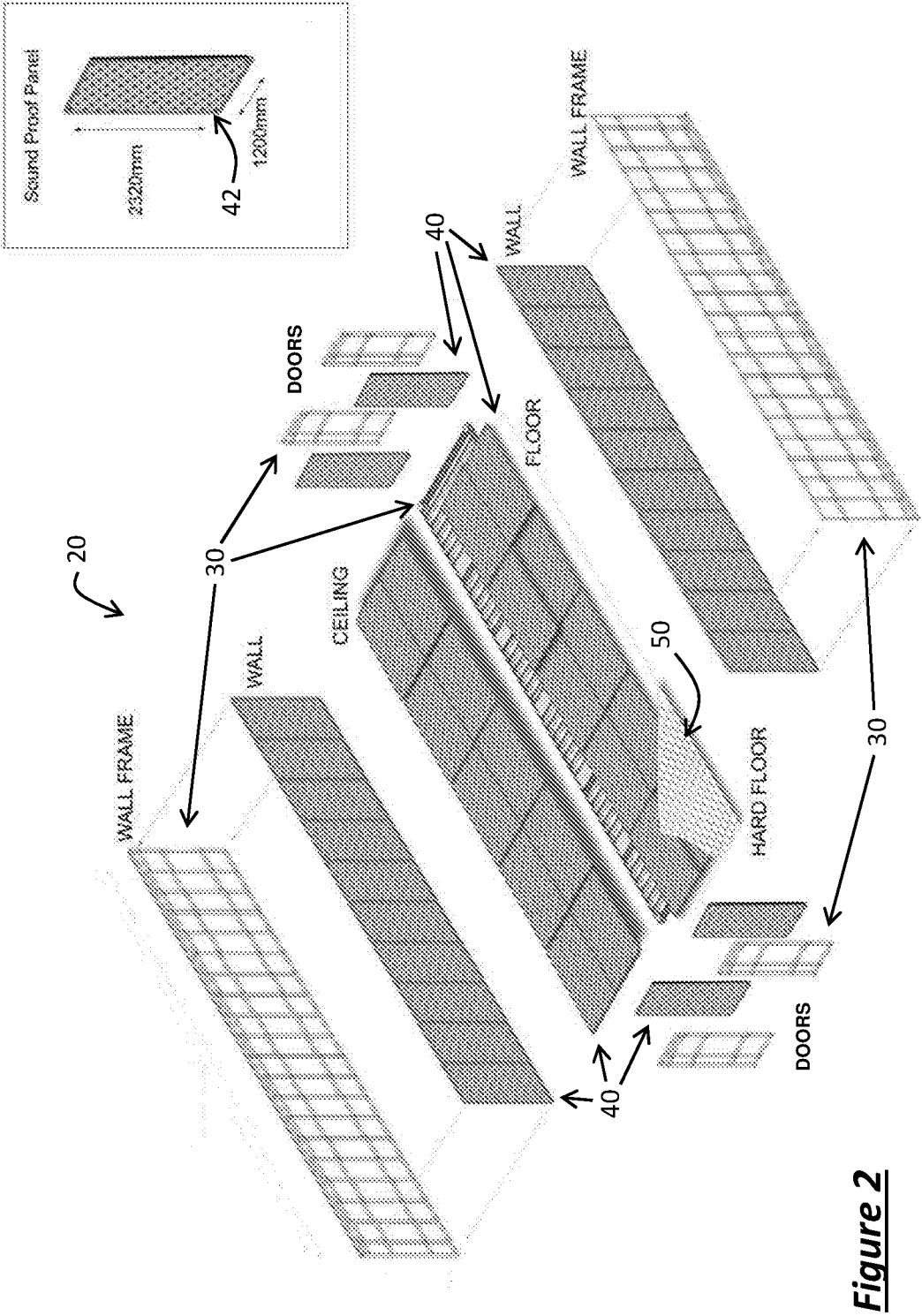
10. A housing according to claim 9 wherein the output duct includes an exhaust outlet  
20 structure having multiple flow paths between noise reduction panels.

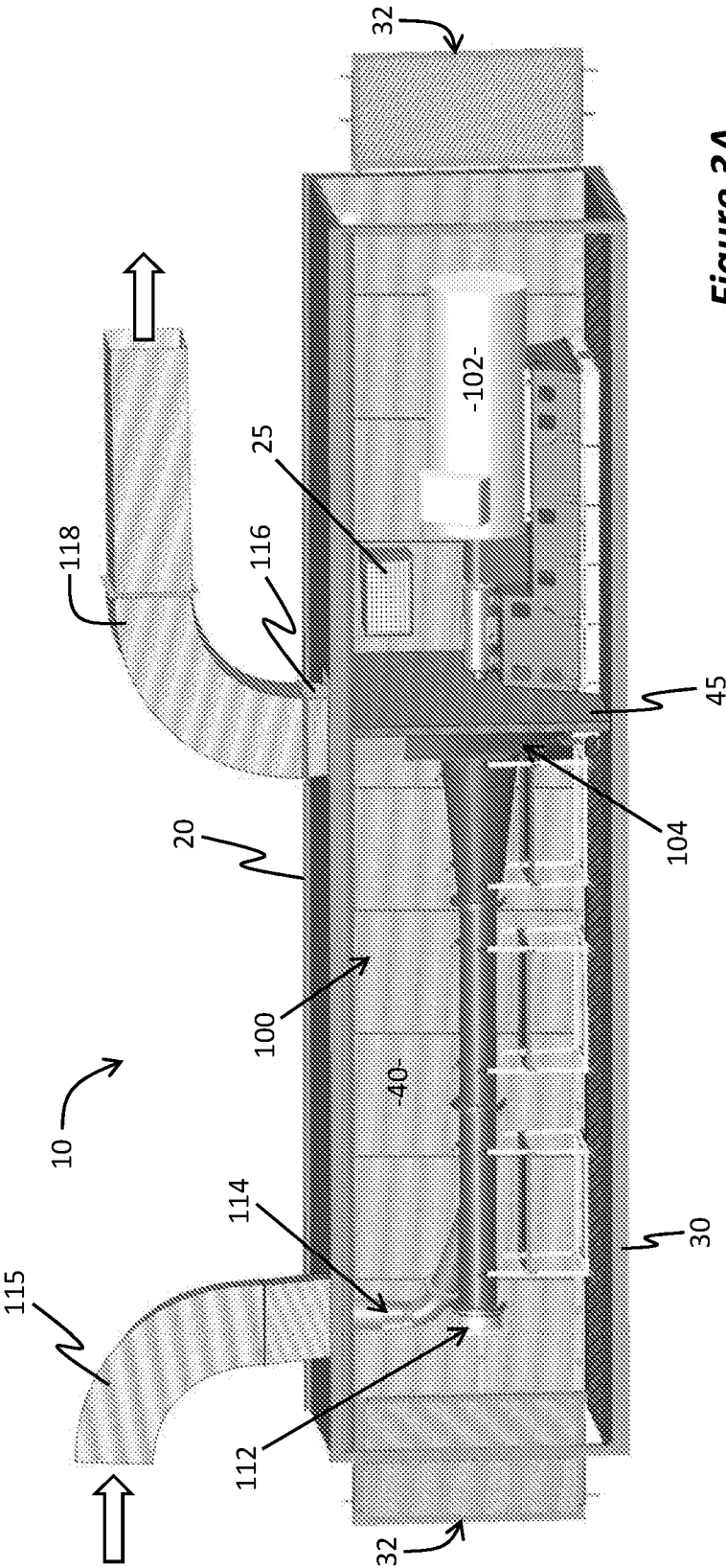
11. An aero-acoustic materials processing plant according to claim 1 including a housing as defined in any one of claims 2 to 10.



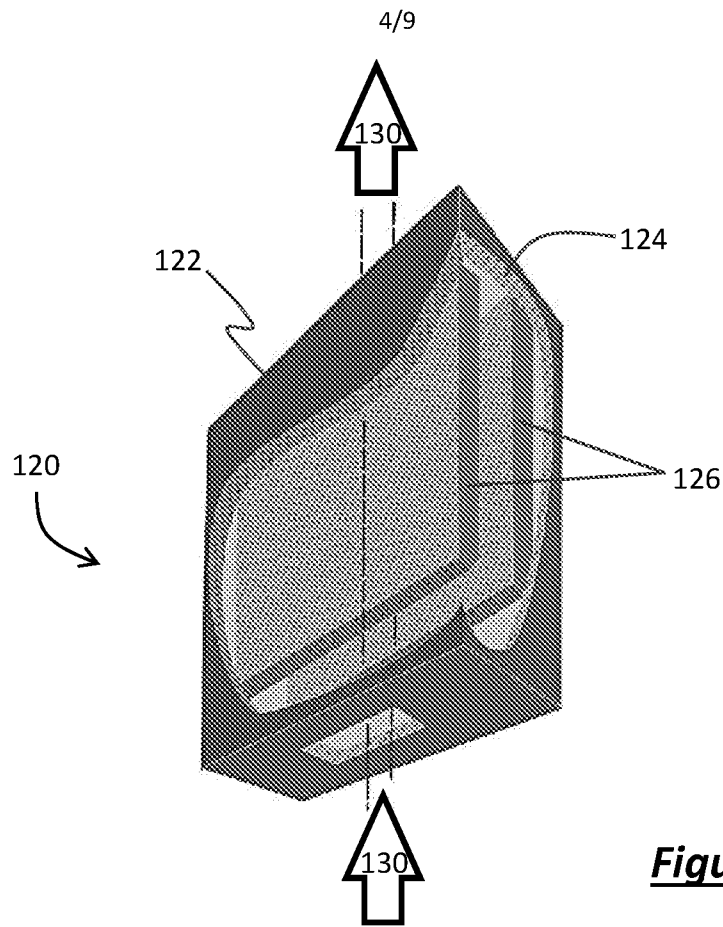
**Figure 1**



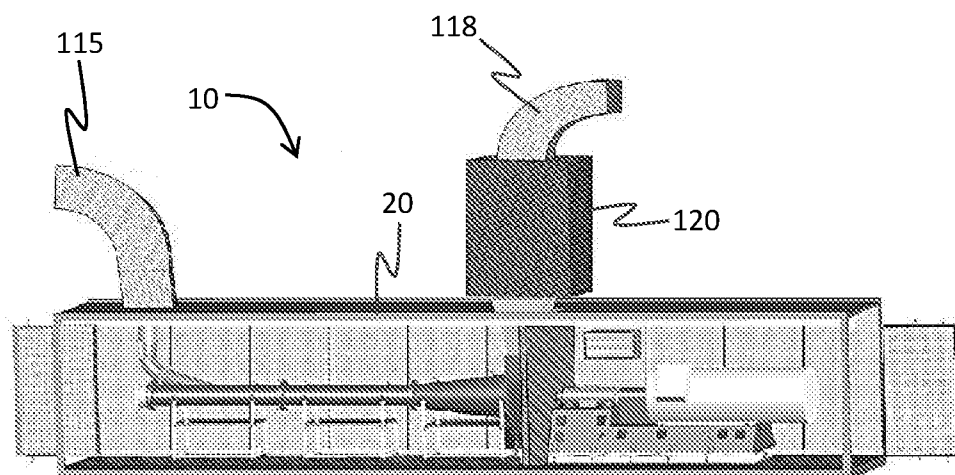




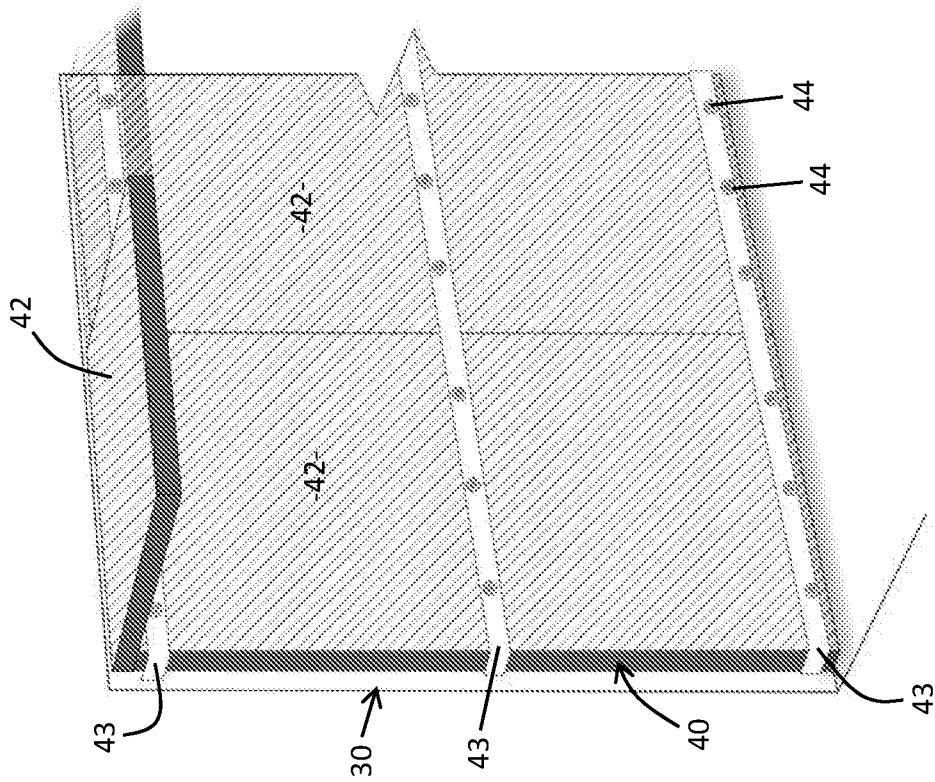
**Figure 3A**



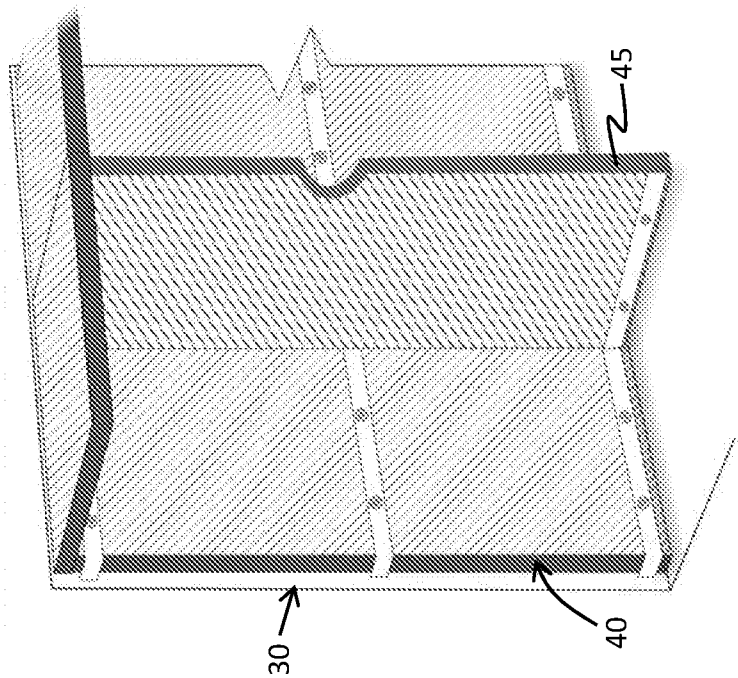
**Figure 3C**



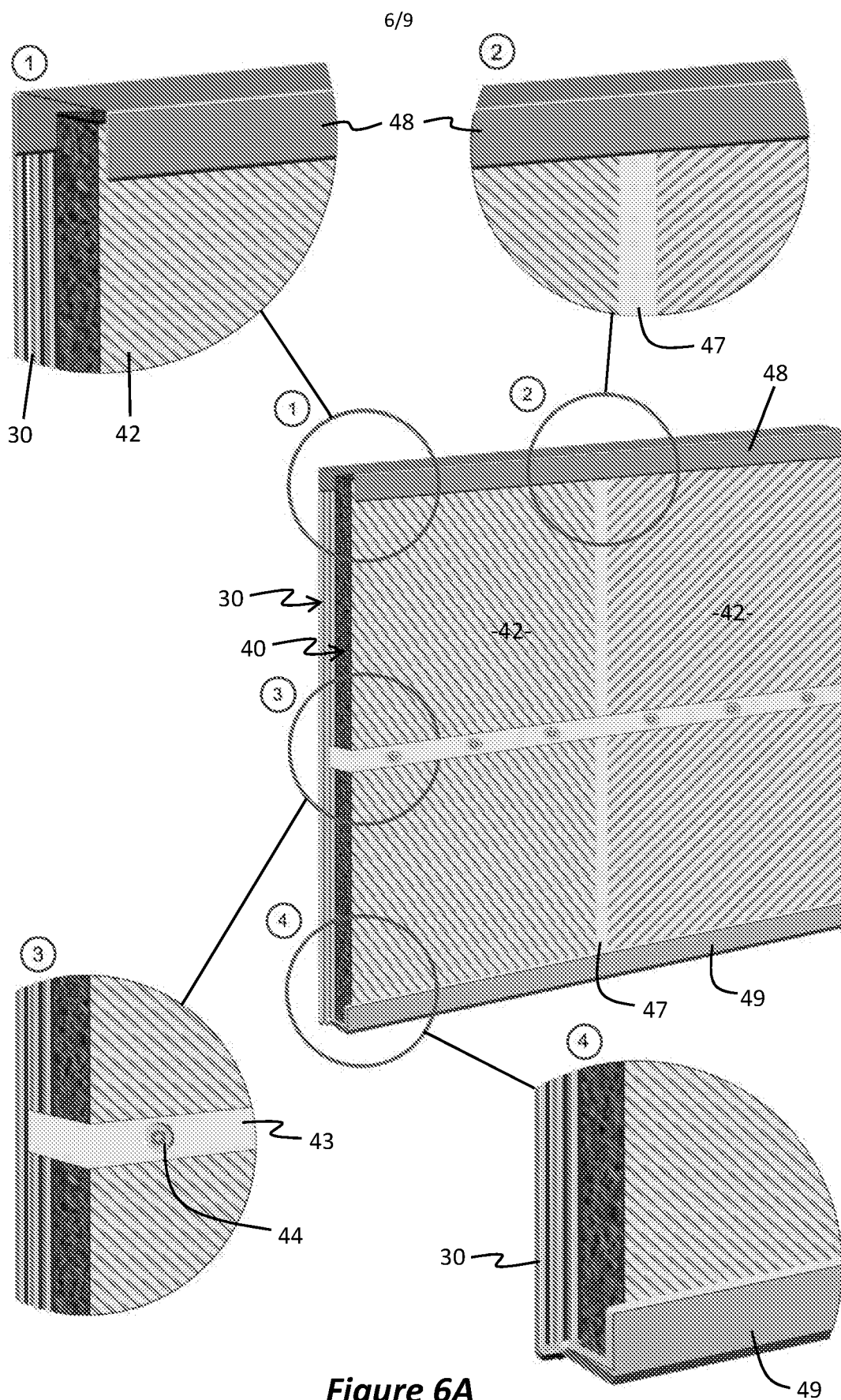
**Figure 3B**



**Figure 4**

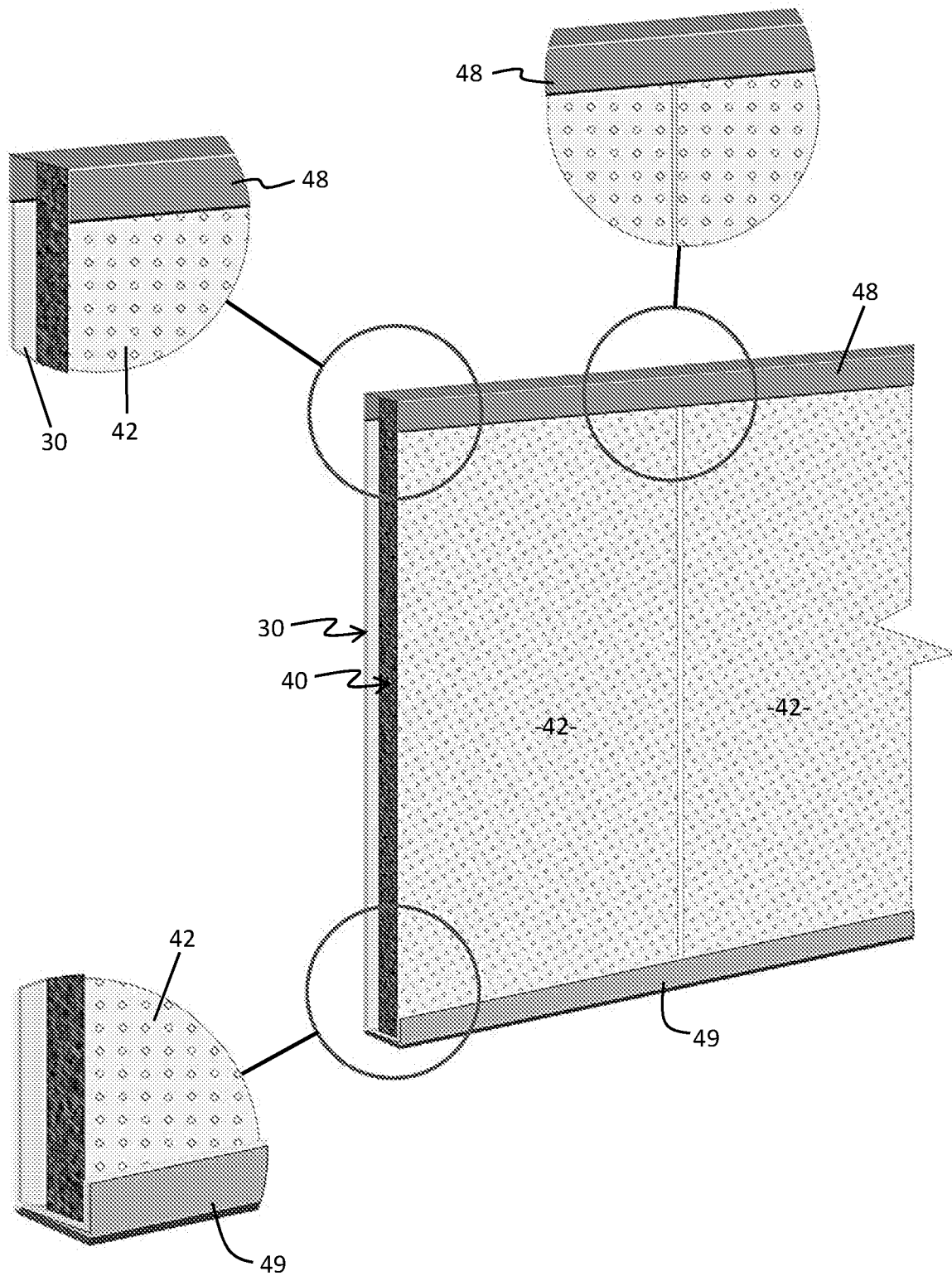


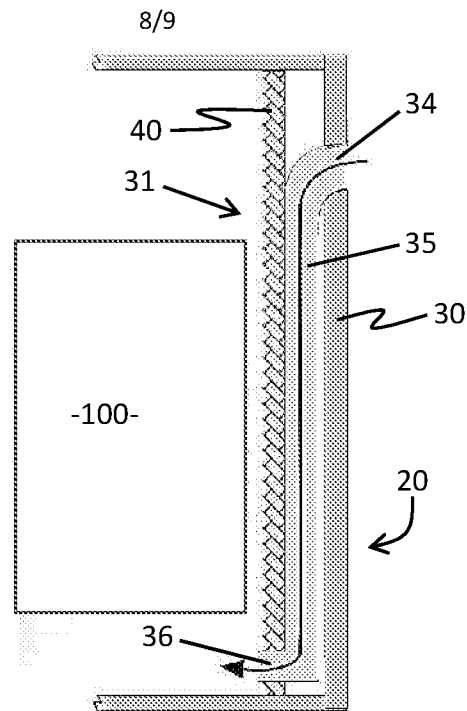
**Figure 5**



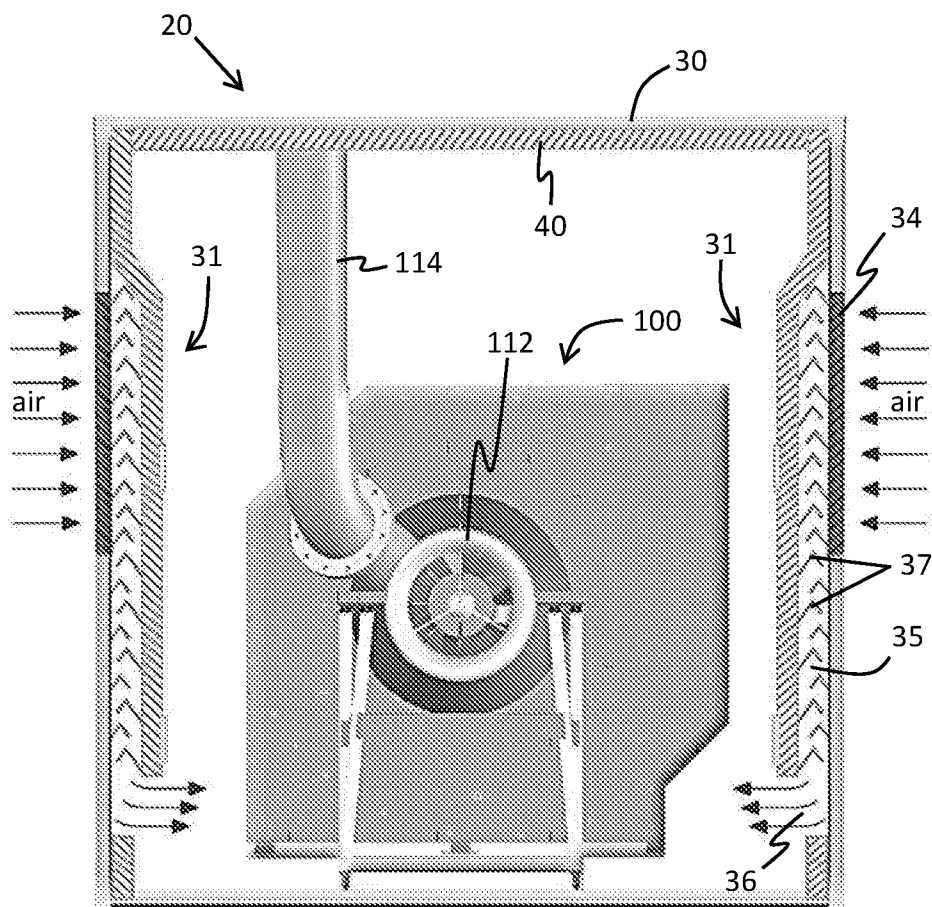
**Figure 6A**

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**Figure 6B**

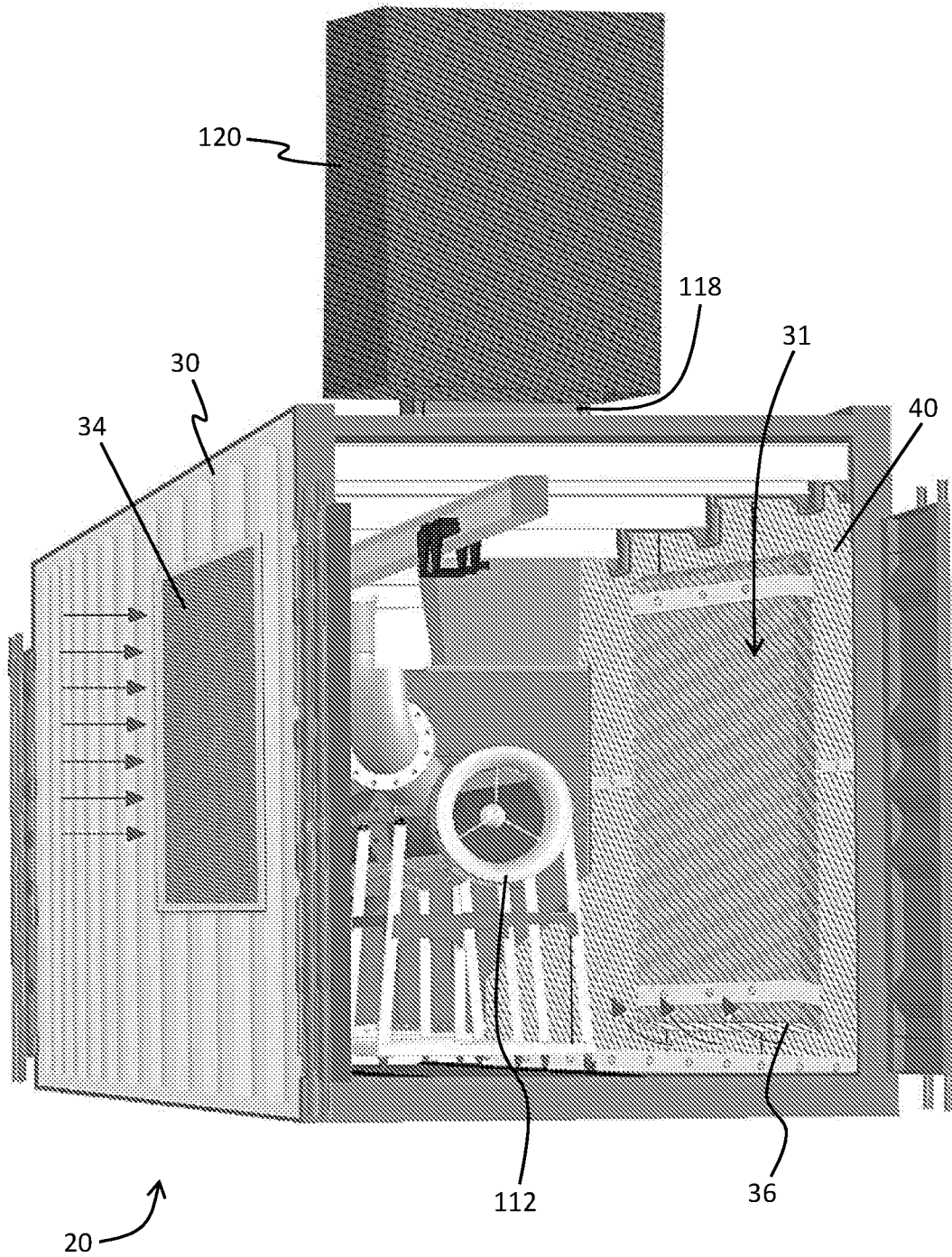


**Figure 7**



**Figure 8**

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**Figure 9**



## INTERNATIONAL SEARCH REPORT

 International application No.  
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## A. CLASSIFICATION OF SUBJECT MATTER

**E04B 1/82 (2006.01) GIOK 11/16 (2006.01) G11B 33/08 (2006.01) B02C 19/18 (2006.01) F26B 5/02 (2006.01)**  
**BOIJ 19/10 (2006.01)**

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)

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

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

PATENW:EPODOC, WPIAP, TXPEA, TXPEB, TXPEC, TXPEE, TXPEF, TXPEH, TXPEI, TXPEP, TXTPEPEA, TXPES, TXPUSEOA, TXPUSEIA, TXPUSEA, TXPUSEB, TXPWEOA, TXPEY, TXPEPEB, TXPEU: IPC/CPC marks such as E04B 1/82, E04B1/99, F05B2260/96, F04D29/664, B01F5/00, B01F1 1/02, GIOK 11/16, G11B 33/08, B02C 19/18, F26B 5/02, BOIJ 19/10, B08B3/1 2 and keywords such as noise, sound, decibel, DB, volume, loud, reduce, minimize, lower, insulate, attenuate, decrease, lessen, absorb, dampen, housing, container, enclosure, air, gas, fluid, inlet, outlet, entry, exit, expel, draw, exhaust, rotate, revolve, circulate and same keywords search through Google patent and Espacenet and Applicant and Inventor name "Rawson Colin" search through Espacenet and AusPat.

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 26 June 2018		Date of mailing of the international search report 26 June 2018	
Name and mailing address of the ISA/AU  AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au		Authorised officer  Heramb Bal AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262837966	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2018/050337
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103 127987 A (QIDONG NANYANG METALLURG MACHINERY COMPLETE EQUIPMENT CO LTD) 05 June 2013 & English translation obtained from Google patent abstract, figures 1 and 2, 0001, 0003, 0004, 0008, 0013, claims 1-4	1-1 1
X	CN 202410762 U (QIDONG NANYANG METALLURG MACHINERY COMPLETE EQUIPMENT CO LTD ) 05 September 2012 & English translation obtained from Google patent abstract, figures 1 and 2, paragraphs 0001-0003, 0005, 0008, 0013, 0014	1-1 1
<div>Form PCT/ISA/210 (fifth sheet) (January 2015)</div>		

<b>INTERNATIONAL SEARCH REPORT</b> Information on patent family members		International application No. <b>PCT/AU2018/050337</b>	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
<b>Patent Document/s Cited in Search Report</b>		<b>Patent Family Member/s</b>	
<b>Publication Number</b>	<b>Publication Date</b>	<b>Publication Number</b>	<b>Publication Date</b>
CN 103 127987 A	05 June 2013	CN 103 127987 A	05 Jun 2013
CN 202410762 U	05 September 2012		
<b>End of Annex</b>			
<div>Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.</div> <div>Form PCT/ISA/210 (Family Annex)(January 2015)</div>			