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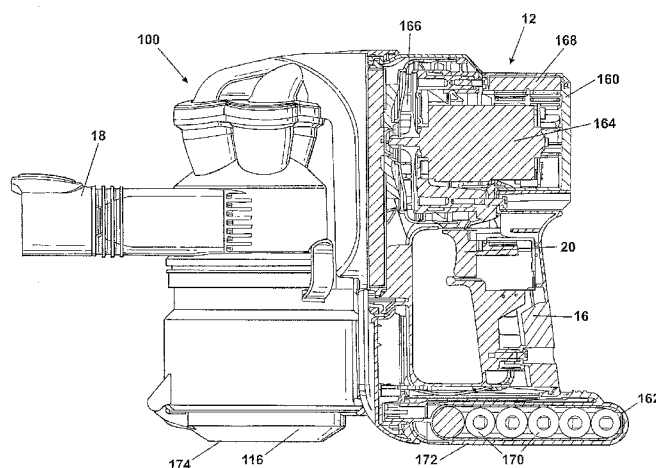
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **HANDHELD CLEANING APPLIANCE**



(57) **Abstract:** The invention provides a handheld cleaning appliance (10) comprising a main body (12), a dirty air inlet (18), a clean air outlet (24) and a cyclonic separator (100) for separating dirt and dust from an airflow located in an airflow path leading from the air inlet (18) to the air outlet (24). The cyclonic separator (100) is arranged in a generally upright orientation. A base surface (172) of the main body (12) and a base surface (174) of the cyclonic separator (100) together form a base surface of the appliance (10) for supporting the appliance (10) on a surface. By providing a base surface of the appliance (10), which is made up of the base surface (172) of the main body (12) and the base surface (174) of the cyclonic separator (100), the appliance (10) is provided with a substantial base surface on which the appliance (10) can be stably and reliably supported. This is also achieved without substantially increasing the size of the appliance (10) as a whole.

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Handheld Cleaning Appliance

The invention relates to a handheld cleaning appliance particularly, but not exclusively,
5 to a handheld vacuum cleaner. More particularly, the invention relates to a handheld
cleaning appliance having a cyclonic separator.

Handheld vacuum cleaners are well known and have been manufactured and sold by
various manufacturers for several years. Typically, a handheld vacuum cleaner
10 comprises a casing which houses a motor and fan unit for drawing air into the cleaner
via an inlet, and a separation device such as a filter or bag for separating dirt and dust
from the incoming airflow. An example of such a vacuum cleaner is shown in
GB1207278.

15 Handheld vacuum cleaners have more recently been developed to incorporate cyclonic
separation systems which are capable of removing larger items of debris from the
airflow before removing finer particles using a filter or other barrier means. An
example of such a device is sold by Black & Decker under the trade name
DUSTBUSTER®. These vacuum cleaners are generally elongate in shape with a
20 handle at or near a first end and a dirty air inlet located at the end remote from the
handle. The cyclonic separator is therefore commonly arranged generally in a
horizontal direction. This can affect the performance of the cyclonic separator or its
capacity to collect dirt and dust.

25 A further example of a handheld vacuum cleaner incorporating a cyclonic separator is
shown in GB2035787A. In this arrangement, the cyclonic separator is arranged in an
upright configuration and has a base surface on which the appliance can be supported.
However, the base surface of the cyclonic separator is relatively small in comparison to
the appliance as a whole and the appliance is therefore relatively unstable when
30 balanced on the base surface of the cyclonic separator.

It is therefore an object of the present invention to provide a handheld cleaning appliance incorporating a cyclonic separator which is oriented in a generally upright configuration for improved capacity and performance, the appliance being more convenient and stable to store on a flat surface.

5

The invention provides a handheld cleaning appliance comprising a main body, a dirty air inlet, a clean air outlet and a cyclonic separator for separating dirt and dust from an airflow located in an airflow path leading from the air inlet to the air outlet, the cyclonic separator being arranged in a generally upright orientation, wherein a base surface of the main body and a base surface of the cyclonic separator together form a base surface of the appliance for supporting the appliance on a surface.

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By providing a base surface of the appliance, which is made up of a base surface of the main body and a base surface of the cyclonic separator, the appliance is provided with a substantial base surface on which the appliance can be stably and reliably supported. This is also achieved without substantially increasing the size of the appliance as a whole.

15

Preferably, the base surface of the main body and the base surface of the cyclonic separator are each substantially planar. More preferably, the base surface of the main body lies adjacent the base surface of the cyclonic separator. Still more preferably, the base surface of the main body lies in the plane of the base surface of the cyclonic separator.

20

In a preferred embodiment, the main body includes a motor and/or battery unit arranged above the base surface of the main body. In this arrangement, the centre of gravity of the motor and/or battery unit passes through the base surface of the main body which enhances the stability of the main body when it is supported on the base surface thereof. More preferably, the motor and/or battery unit is arranged immediately above the base surface of the main body for further enhancing the stability of the main body.

25

30

It is also preferred that the width of the base surface of the main body is at least one half of the width of the cyclonic separator. This provides further increased stability of the base surface of the appliance.

- 5 An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a handheld cleaning appliance according to the invention;

- 10 Figure 2 is a side view of the appliance of Figure 1;

Figure 3 is a longitudinal cross section through the cyclonic separating apparatus forming part of the appliance of Figure 1;

- 15 Figure 4 is a side view similar to Figure 2 but with the main body shown in section; and

Figure 5 is a rear view of the appliance of Figure 1.

- 20 Figures 1 and 2 show a handheld vacuum cleaner 10. The handheld vacuum cleaner 10 has a main body 12 which houses a motor and fan unit (not shown). The main body 12 also includes a power source 14 such as a battery. A handle 16 is provided on the main body 12 for manipulating the handheld vacuum cleaner 10 in use. A cyclonic separator 100 is attached to the main body 12. A dirty air inlet 18 extends from a portion of the cyclonic separator 100 remote from the main body 12. A brush tool 22 is slidably
25 mounted on the distal end of the dirty air inlet 18. A set of exhaust vents 24 are provided on the main body 12 for exhausting air from the handheld vacuum cleaner 10.

- The cyclonic separator 100 is located between the main body 12 and the dirty air inlet 18. Consequently, the cyclonic separator 100 is located between the handle 16 and the
30 dirty air inlet 18. The cyclonic separator 100 has a longitudinal axis 26 which extends

in a generally upright direction so that the axis 26, and therefore the cyclonic separator 100, lies substantially parallel to the direction in which the handle 16 extends.

5 The orientation of the handle 16 is such that, when the user grips the handle 16, the user's hand forms a fist in a manner similar to that adopted when gripping a saw. This ensures that the user's wrist is not strained more than necessary when manipulating the handheld vacuum cleaner 10 for cleaning purposes. The cyclonic separator 100 is positioned close to the handle 16 which also reduces the moment applied to the user's wrist when the handheld vacuum cleaner 10 is in use. The handle 16 carries an on/off
10 switch 20 in the form of a trigger for turning the vacuum cleaner motor on and off.

The cyclonic separating apparatus 100 forming part of the handheld vacuum cleaner 10 is shown in more detail in Figure 3. The cyclonic separating apparatus 100 comprises a first cyclone 102 which has a longitudinal axis X-X and a collector 105 having a wall
15 104. An inlet 110 is formed in the upper portion of the wall 104. The inlet 110 is in communication with the dirty air inlet 18 and forms a communication path between the dirty air inlet 18 and the interior of the first cyclone 102. The air inlet 110 is arranged tangentially to the first cyclone 102 so that the incoming air is forced to follow a helical path around the interior of the first cyclone 102.

20 A base 116 closes the collector 105 at one end of the first cyclone 102. The base 116 is pivotably mounted on the lower end of the wall 104 by means of a hinge 118. The base 116 is retained in a closed position (as shown Figures 1, 2 and 3) by means of a catch 120 which interengages with a lip 150 located on the wall 104. When the catch 120 is
25 released, the base 116 will drop away from the wall 104.

A shroud 121 is located inwardly of the wall 104 of the first cyclone 102. The shroud 121 comprises a part-cylindrical, part-frustoconical wall 122 having a plurality of through-holes 123. The shroud 121 surrounds an outlet 124 from the first cyclone 102.
30 The outlet 124 provides a communication path between the first cyclone 102 and a second cyclone assembly 126. A lip 128 is provided at the base of the shroud 121. The

lip 128 has a plurality of through-holes 129 which are designed to allow air to pass through but to capture dirt and dust.

5 The second cyclone assembly 126 comprises a plurality of second cyclones 130 arranged in parallel with one another. In this embodiment, six second cyclones 130 are provided. The second cyclones 130 are arranged around the axis X-X of the first cyclone 102. The arrangement of the second cyclones 130 is such that the second cyclones 130 are spaced equi-angularly around the axis X-X. Each second cyclone 130 has a tangentially-arranged air inlet and an air outlet (not shown) located at a first end of
10 the respective second cyclone 130. A cone opening 136 is located at a second end of each second cyclone 130. The plane of the cone opening 136 of each second cyclone 130 is inclined with respect to a longitudinal axis (not shown) of the respective further cyclone 130. The cone opening 136 of each of the second cyclones 130 is in communication with a passageway 138 defined by a wall 140 located inwardly of the
15 shroud 121.

A collector 142 is located at the lower end of the passageway 138. The collector 142 comprises a frustoconical first portion 144 and a cylindrical second portion 146. The interior of the collector 142 is delimited by the base 116 and the sides of the first and
20 second portions 144, 146 of the collector 142.

Each of the air outlets of the second cyclones 130 is in communication with a duct 150. The duct 150 provides an airflow path from the cyclonic separating apparatus 100 into other parts of the handheld vacuum cleaner 10. Located at the downstream end of the
25 duct 150 is a pre-motor filter 152. The pre-motor filter 152 comprises a porous material such as foam and can also include a fine filter material. The pre-motor filter 152 is designed to prevent any fine dust particles from entering the motor and causing damage thereto.

30 In use, when the on/off switch 20 is depressed, the motor and fan unit draws a flow of dirt-laden air into the dirty air inlet 18 and then into the cyclonic separator 100. Dirt-

laden air enters the cyclonic separator 100 through the inlet 110. Due to the tangential arrangement of the inlet 110, the airflow is forced to follow a helical path around the interior of the wall 104. Larger dirt and dust particles are separated by cyclonic motion around the wall 104. These particles are then collected at the base 116 of the first cyclone 102.

The partially-cleaned airflow then flows back up the interior of the first cyclone 102 and exits the first cyclone 102 via the through-holes 123 in the shroud 121. Once the airflow has passed through the shroud 121, it enters the outlet 124 and from there is divided between the tangential inlets of each of the second cyclones 130. Each of the second cyclones 130 has a diameter which is smaller than that of the first cyclone 102. Therefore, the second cyclones 130 are able to separate smaller particles of dirt and dust from the partially-cleaned airflow than the first cyclone 102. Separated dirt and dust exits the second cyclones 130 via the cone openings 136. Thereafter, the separated dirt and dust passes down the passageway 138 and into the collector 142. The separated dirt and dust eventually settles at the bottom of the collector 142 on the base 116.

Cleaned air then flows back up the second cyclones 130, exits the second cyclones 130 through the air outlets and enters the duct 150. The cleaned air then passes from the duct 150 sequentially through the pre-motor filter 152, the motor and fan unit, and a post-motor filter before being exhausted from the vacuum cleaner 10 through the air vents 24.

The first cyclone 102 and the collector 142 can be emptied simultaneously by releasing the catch 120 to allow the base 116 to pivot about the hinge 118 so that the separated dirt and dust can fall away from the cyclonic separator 100. By positioning the cleaning appliance 10 above a suitable dirt receptacle such as a dustbin, the dirt and dust collected in the cyclonic separator can be efficiently and reliably emptied. The user may close the cyclonic separator 100 by moving the base 116 back into the closed position shown in Figures 1 and 2 by hand.

Figure 4 shows the vacuum cleaner 10 in side view with the main body 12 in section. The remainder of the appliance is as shown in Figure 2 except that the distal end of the dirty air inlet 18 and the brush tool 22 have been omitted. The main body 12 includes the handle 16 (which carries the on/off switch 20), an upper portion 160 and a lower portion 162. The upper portion 160 houses the motor 164 and fan 166 by means of which dirty air is drawn into the appliance when the on/off switch is depressed. A post-motor filter 168 is also provided between the air outlet of the motor and the exhaust vents 24. The lower portion 162 houses a plurality of battery cells 170 for powering the motor 164 when the on/off switch 20 is depressed. Suitable connections between the switch 20, the batteries 170 and the motor 164 are provided within the main body 12.

The lower portion 162 is shaped so as to include a base surface 172 which is planar and faces downwardly away from the handle 16 and away from the upper portion 164. The lower portion 162 is also generally rectangular in shape as can be seen from Figure 1. The base surface 172 of the lower portion 164 forms a base surface of the main body 12. The motor 164 is positioned so that it lies vertically above the base surface 172 and the battery cells 170 are positioned immediately above the base surface 172.

The cyclonic separator 100 also has a base surface 174 which is formed by the lowermost extremity of the base 116. This base surface 174 of the cyclonic separator 100 in this embodiment is shaped as an annular ring as can be seen in Figure 3. The annular ring defines the planar base surface 174. Naturally, the base 116 could have been shaped so that the area inside the annular ring forming the base surface 174 was planar but this makes no difference to the invention.

As can be seen in Figure 4, the base surface 172 of the main body 12 and the base surface 174 of the cyclonic separator 100 lie in the same plane. Together they comprise a base surface of the handheld vacuum cleaner 10. The base surface 172 of the main body 12 lies adjacent the base surface 174 of the cyclonic separator 100 as can also be seen in Figure 4.

The base surface of the handheld vacuum cleaner 10 provides the vacuum cleaner 10 with a surface on which the appliance can be placed at intervals between periods of use or for storage. Because the base surface extends beyond the area of one or the other of the base surface 172 and the base surface 174, the base surface provided for the entire machine is more stable than would otherwise be the case. This is important because the handheld cleaning appliance 10 has a height which exceeds that of many known handheld vacuum cleaners due to the upright configuration of the cyclonic separator 100.

10 The positioning of one or the other of the motor 164 and the battery cells 170 vertically above the base surface 172 of the main body 12 enhances the stability of the handheld vacuum cleaner 10 when it is placed on the base surface. This is because the centre of gravity of the motor 164 and/or the battery cells 170, which are relatively heavy components of the handheld vacuum cleaner 10, passes through the base surface 172 of the main body.

The rectangular shape of the lower portion 162 also assists in enhancing the stability of the vacuum cleaner when it is supported on the base surface formed by the base surface 172 of the main body 12 and the base surface 174 of the cyclonic separating apparatus 100. This is because an inadvertent knock to the vacuum cleaner 10 need not cause the vacuum cleaner 10 to topple over if the width of the lower portion 162 is sufficiently wide to provide stability. As can be seen in Figure 5, the width b of the lower portion 172 is approximately two thirds of the width B of the widest part of the cyclonic separator 100, which is the collector 105. The width b of the lower portion 172 can be as little one half of the width B of the cyclonic separator 100 if preferred.

The invention is not limited to the precise details of the embodiment described above. For example, the number of first and second cyclones can be varied, as can the detail of their design, such as their cone angle, axis inclination and cone opening inclination.

30 The shape of the collector and base can be altered, as can the precise location of the hinge and catch and the location of the actuator. The location of the on/off switch may

also be varied. What is important is the presence of a base surface on each of the cyclonic separator and the main body which together form a base surface for the handheld vacuum cleaner in a manner which allows the vacuum cleaner to be placed stably on a surface.

CLAIMS

1. A handheld cleaning appliance comprising a main body, a dirty air inlet, a clean air outlet and a cyclonic separator for separating dirt and dust from an airflow located in an airflow path leading from the air inlet to the air outlet, the cyclonic separator being arranged in a generally upright orientation, wherein a base surface of the main body and a base surface of the cyclonic separator together form a base surface of the appliance for supporting the appliance on a surface.
2. A handheld cleaning appliance as claimed in claim 1, wherein the base surface of the main body is substantially planar and the base surface of the cyclonic separator is also substantially planar.
3. A handheld cleaning appliance as claimed in claim 2, wherein the base surface of the main body lies in the plane of the base surface of the cyclonic separator.
4. A handheld cleaning appliance as claimed in any one of claims 1 to 3, wherein the base surface of the main body lies adjacent the base surface of the cyclonic separator.
5. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the main body includes a motor and/or a battery unit.
6. A handheld cleaning appliance as claimed in claim 5, wherein the motor and/or battery unit is arranged above the base surface of the main body.
7. A handheld cleaning appliance as claimed in claim 6, wherein the battery unit is arranged immediately above the base surface of the main body.
8. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the base surface of the main body is substantially rectangular in shape.

9. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the width of the base surface of the main body is at least one half of the width of the cyclonic separator.

5

10. A handheld cleaning appliance substantially as hereinbefore described with reference to the accompanying drawings.

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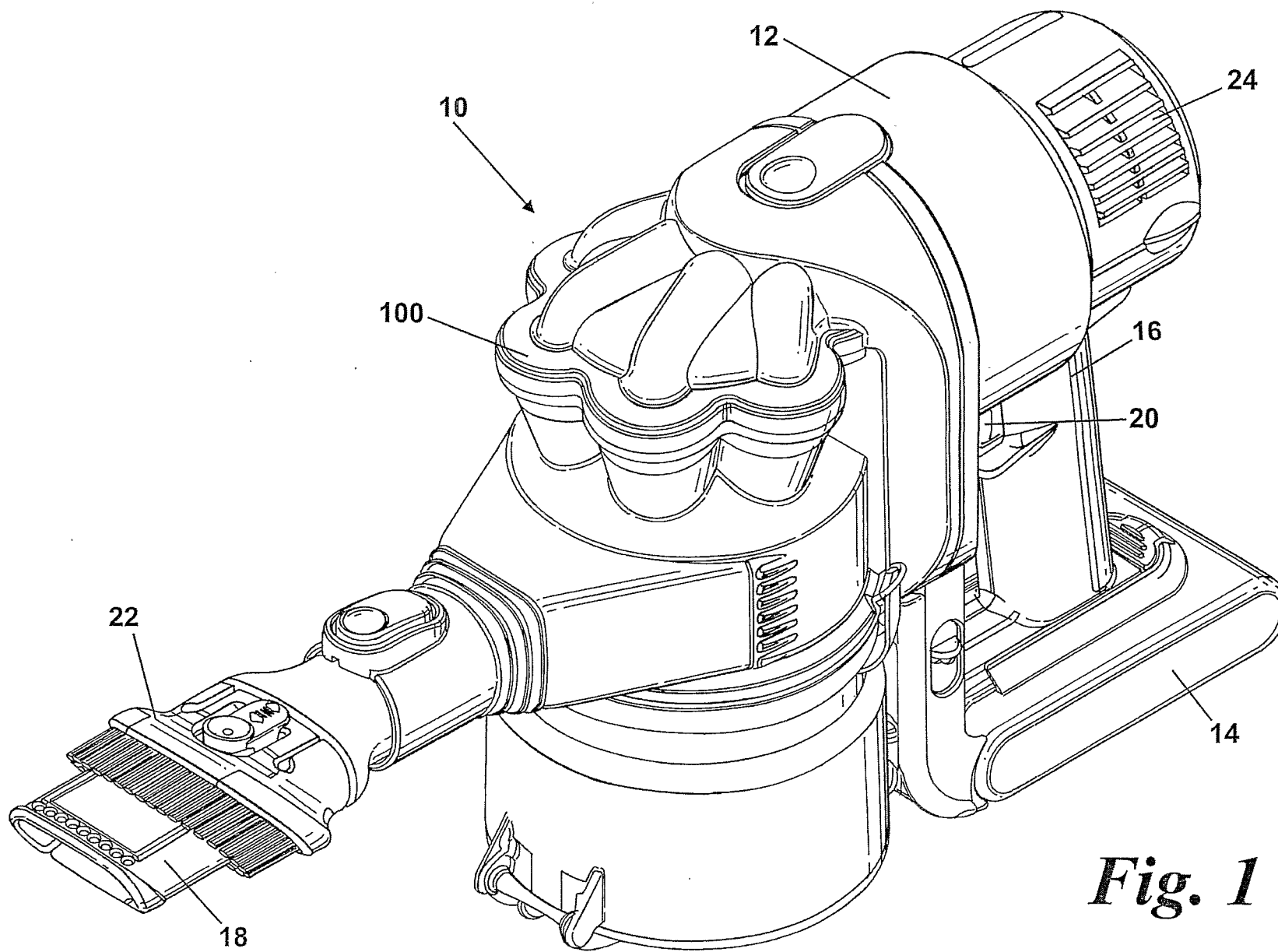


Fig. 1

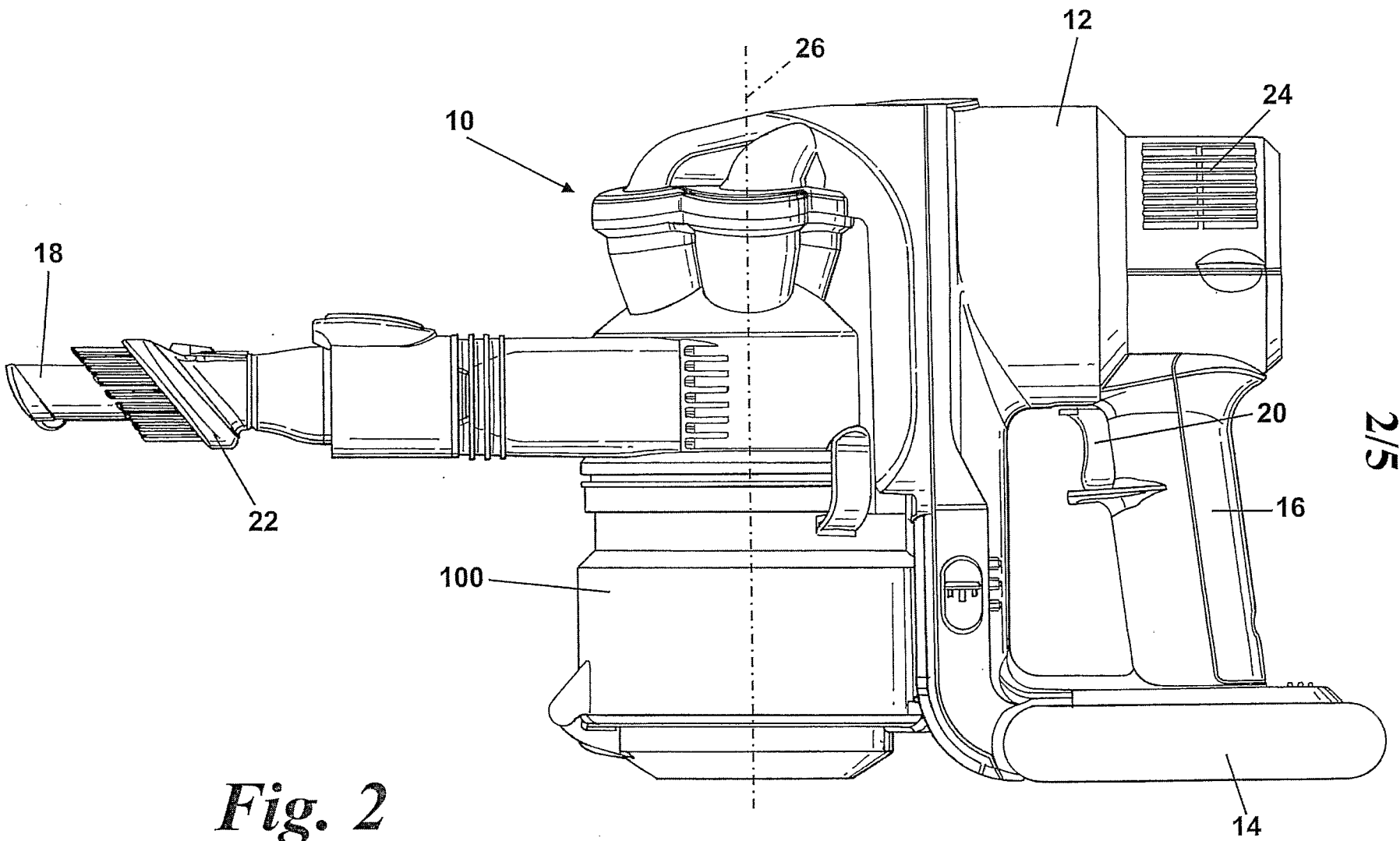


Fig. 2

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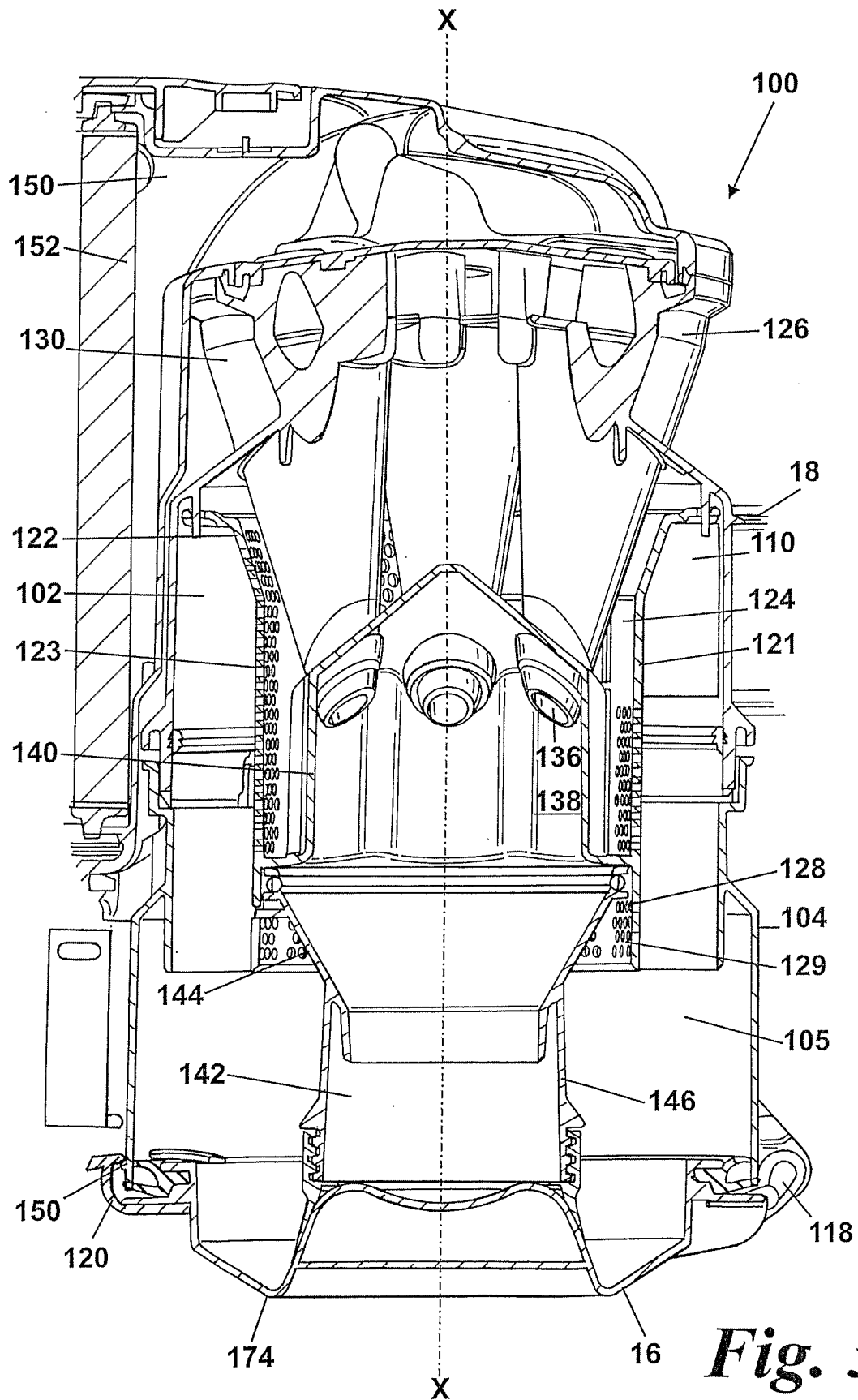
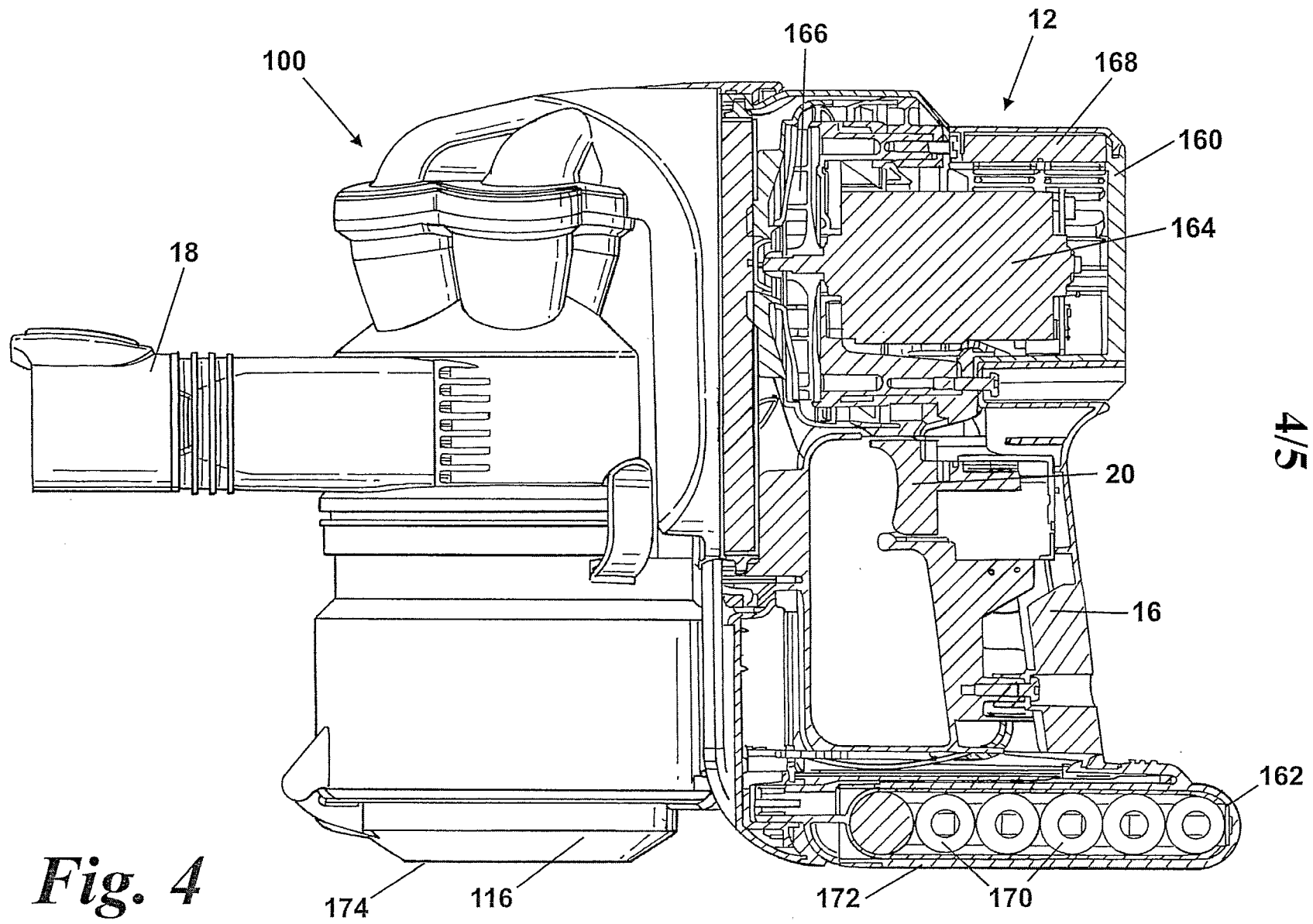


Fig. 3



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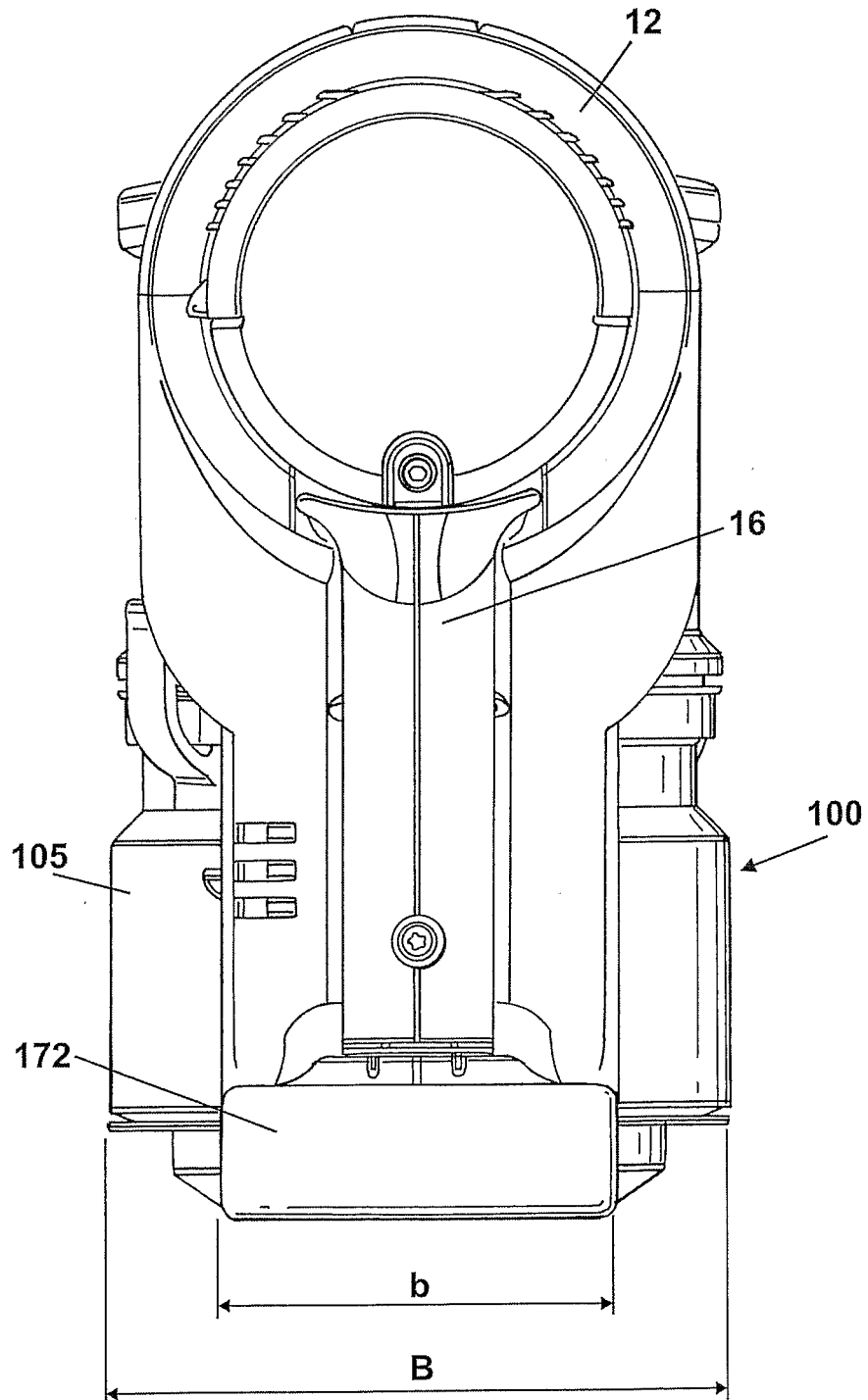


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002540

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L9/16

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)
A47L

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 035 787 A (L & H DESIGNS LTD & MERRITT H) 25 June 1980 (1980-06-25) cited in the application the whole document	1,2,4-9
A	US 2002/189048 A1 (MARUYAMA KANAME [JP] ET AL) 19 December 2002 (2002-12-19) paragraphs [0006] - [0014]	1-9
A	US 5 367 740 A (MCCRAY KIMOTHY R [US]) 29 November 1994 (1994-11-29) column 1, line 37 - column 2, line 15	1-9
A	US 2006/137132 A1 (ORUBOR LAWRENCE [CA]) 29 June 2006 (2006-06-29) paragraphs [0021] - [0047]	1-9

☐ 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 document 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

18 September 2007

Date of mailing of the international search report

26/09/2007

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2007/002540

Box 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.: 10
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:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box 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 an additional fee, this Authority did not invite payment of any additional fee.
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.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10

The general references to the description and drawings used in claim 10 are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim so unclear (Article 6 PCT) that no meaningful search can be carried out for said claim.

Furthermore, according to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2007/002540

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2035787	A	25-06-1980	NONE	
US 2002189048	A1	19-12-2002	JP 3674031 B2	20-07-2005
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			WO 2006069436 A1	06-07-2006