



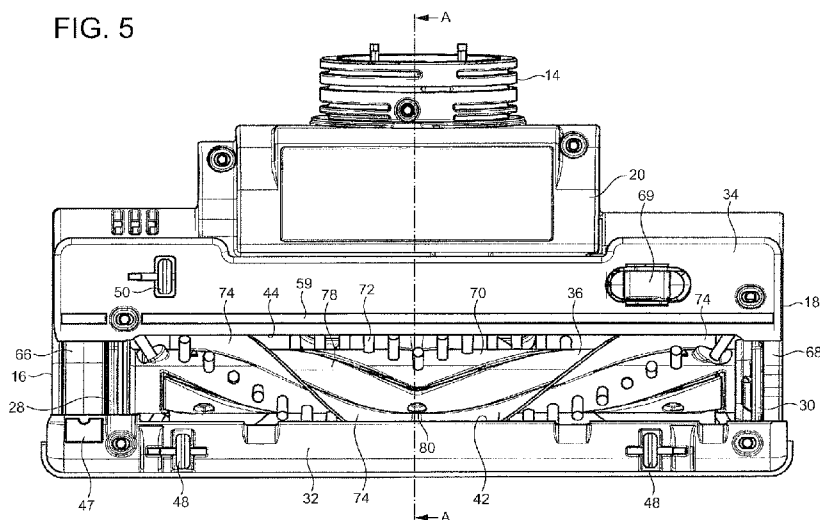
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(54) **Title:** A SURFACE TREATING APPLIANCE

FIG. 5



(57) **Abstract:** A cleaner head (10) for a surface treating appliance includes at least one floor engaging portion (20, 26, 47, 48, 50) formed from material comprising a dispersion of carbon nanotubes within a polymer matrix to disperse static electricity residing on a surface over which the cleaner head (10) is being manoeuvred.

A SURFACE TREATING APPLIANCE

FIELD OF THE INVENTION

5 The present invention relates to agitating apparatus for a surface treating appliance, and to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance. The present invention also relates to a surface treating appliance.

BACKGROUND OF THE INVENTION

10 A vacuum cleaner typically comprises a main body containing dirt and dust separating apparatus, a cleaner head connected to the main body and having a suction opening, and a motor-driven fan unit for drawing dirt-bearing air through the suction opening. The dirt-bearing air is conveyed to the separating apparatus so that dirt and dust can be
15 separated from the air before the air is expelled to the atmosphere.

The suction opening is directed downwardly to face the floor surface to be cleaned. The separating apparatus can take the form of a filter, a filter bag or, as is known, a cyclonic arrangement. The present invention is not concerned with the nature of the separating
20 apparatus and is therefore applicable to vacuum cleaners utilizing any of the above arrangements or another suitable separating apparatus.

A driven agitator, usually in the form of a brush bar, is supported in the cleaner head so as to protrude to a small extent from the suction opening. The brush bar is activated
25 mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core bearing bristles which extend radially outward from the core. The brush bar may be driven by an air turbine or by an electric motor powered by a power supply derived from the main body of the cleaner. The brush bar may be driven by the motor via a drive belt, or may be driven directly by the motor, so
30 as to rotate within the suction opening. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust, and pick up

debris. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the suction opening through the cleaner head towards the separating apparatus.

- 5 The bristles of the brush bar are usually formed from nylon. While the use of nylon bristles provides an acceptable cleaning performance on carpeted floor surfaces, we have found that the use of nylon bristles generates static electricity when the floor tool is used on some hard floor surfaces, such as laminate, wood and vinyl surfaces, which attracts fine dust and powders, such as talcum powder, on to the floor surface. This can
10 impair the cleaning performance on the cleaner head on such floor surfaces, as the sweeping action of the nylon bristles is insufficient to overcome the force attracting the fine dust to the floor surface.

- WO 2010/142968 describes a cleaner head with a brush bar having two sets of bristles.
15 The first set of bristles is relatively short and formed from nylon, whereas the second set of bristles is relatively long and formed from material having a lower surface resistivity than the first set of bristles. As a result, a hard floor surface is not charged with static electricity upon contact with the second set of bristles, which can enable fine dust to be swept from the floor surface by the second set of bristles. The second set of bristles is
20 formed from a row of carbon fibre bristles.

- Tufts of nylon bristles may be attached to a brush bar by conventional methods, such as stapling, welding, or gluing. However, to attach carbon fibre bristles to the brush bar, a strip-like, flexible carrier member is attached to the row of bristles by stitching or by
25 using an adhesive so that a row of bristles extends outwardly from a long side edge of the carrier member. The carrier member is then inserted into a helical groove formed in the brush bar so that the bristles protrude outwardly from the brush bar. A helical connector is then attached by screws to the brush bar to retain the carrier member within the brush bar.

SUMMARY OF THE INVENTION

In a first aspect, the present invention provides agitating apparatus for a surface treating appliance, comprising a plurality of bristles formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.

The present invention may allow the rows of carbon fibre bristles of the brush bar described in WO 2010/142968 to be replaced by bristles formed from composite material comprising a dispersion of carbon nanotubes within a polymer matrix. By selecting the percentage by weight of carbon nanotubes within the polymer matrix, this material can be provided with similar electrical properties to carbon fibre. This can in turn inhibit charging of a hard floor surface with static electricity upon contact with the bristles. An advantage of this composite material is that it may be extruded, spun or otherwise processed to form bristle tufts that can be secured to the agitating apparatus using a conventional technique, such as stapling, welding or gluing. This can simplify the manufacture of the agitating apparatus, reducing the time required to manufacture the apparatus and the costs associated with its manufacture. As an alternative to arranging the bristles in a plurality of bristles tufts, the bristles may be arranged in one or more rows extending along a surface of the agitating apparatus.

The percentage by weight of carbon nanotubes within the polymer matrix is preferably selected so that the material has a volume resistivity in the range from 1×10^1 to $1 \times 10^6 \Omega \cdot \text{cm}$. Values of volume resistivity discussed herein are as measured using the test method CTM E043. The percentage by weight of carbon nanotubes within the polymer matrix does not have to be particularly high to achieve the required volume resistivity. For example, the composite material may comprise up to 5% by weight of carbon nanotubes, preferably comprising between 2 and 5% by weight of carbon nanotubes.

The polymer matrix may comprise a polyamide, such as polyamide 6, polyamide 12 or polyamide 66.

The bristles may have a diameter in the range from 0.005 to 0.5 mm.

The agitating apparatus may comprise solely bristles tufts for agitating dirt and dust from a floor surface, which can make the apparatus suitable for cleaning hard floor surfaces. Alternatively, the agitating apparatus may comprise at least one additional surface agitating element, with the bristles extending outwardly from the apparatus beyond said at least one additional surface agitating element. The relatively short, at least one additional surface agitating element may be configured to agitate dirt and dust from a carpeted floor surface. The at least one additional surface agitating element may be formed from electrically insulating, plastics material, such as nylon, and so may have a lower volume resistivity than the bristles. For example, the at least one additional surface agitating element may have a volume resistivity in the range from 1×10^{12} to $1 \times 10^{16} \Omega \cdot \text{cm}$. Alternatively, the at least one additional surface agitating element may be formed from material having similar electrical properties as the bristles, and so may have a volume resistivity within the aforementioned range for the bristles in order to inhibit the build-up of static electricity on a carpeted floor surface. In this case, the at least one additional surface agitating element may also be formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.

The at least one additional surface agitating element is preferably spaced from the bristles. However, the at least one additional surface agitating element may be located within, or otherwise in contact with, the bristles. For example, the at least one additional surface agitating element may comprise a plurality of bristles which are located adjacent, or amongst, the bristles formed from composite material.

Preferably, the bristles of composite material protrude outwardly beyond said at least one additional surface agitating element by a distance in the range from 0.5 to 5 mm, more preferably by a distance in the range from 1 to 3 mm.

The at least one additional surface agitating element may be moveable relative to the bristles of composite material. For example, the bristles of composite material may be mounted on a first body, and the at least one additional surface agitating element may be mounted on a second body which is moveable relative to the first body. For example, 5 the first body may be rotatable about a first axis or translatable in a first direction, whereas the second body may be rotatable about a second axis spaced from the first axis, or translatable in a second direction different from the first direction. In a preferred embodiment, however, the bristles of composite material and the at least one additional surface agitating element are rotatable about a common axis, and are 10 preferably mounted on a common rotatable body. This body may be in the form of a disc or plate, with the bristles and the at least one additional surface agitating element being mounted on the same side of that disc or plate so that the bristles protrude outwardly from that side beyond the at least one additional surface agitating element. Preferably though, the bristles protrude radially outwardly from the body beyond the at 15 least one additional surface agitating element.

In a preferred embodiment, tufts of the bristles are arranged in at least one helical formation along the body. The at least one additional surface agitating element may also be arranged in a similar formation. For example, the at least one additional surface 20 agitating element may comprise at least one strip of material mounted on the body. Alternatively, the at least one additional surface agitating element may comprise a plurality of bristles arranged in one or more rows of bristles tufts connected to the body.

The at least one additional surface agitating element is preferably relatively stiff in 25 comparison to the bristles of composite material. For example, where the at least one additional surface agitating element comprises a plurality of bristles, these bristles may have a greater diameter than the bristles of composite material.

The agitating apparatus is preferably in the form of a rotatable brush bar.

The present invention also provides a cleaner head for a surface treating appliance, the cleaner head comprising a housing and apparatus as aforementioned. The cleaner head preferably comprises a plurality of support members, preferably in the form of rolling elements such as wheels or rollers, for supporting the cleaner head on a surface to be cleaned. Preferably, the at least one additional surface agitating element does not protrude beneath a plane extending between the lowermost extremities of the support members so that when the cleaner head is located on a hard floor surface the at least one additional surface agitating element does not come into contact with that floor surface. This can inhibit scratching or marking of the floor surface, especially when the at least one additional surface agitating element is formed from relatively stiff material. When the cleaner head is located on a carpeted surface, the support members may sink into the fibres of the carpet to bring the at least one additional surface agitating element into contact with the carpet.

The cleaner head preferably comprises a sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and through which the bristles protrude as the agitating apparatus is rotated or otherwise moved during use of the cleaner head, and the support members are preferably mounted on the sole plate.

To prevent electrostatic charge from building up on the cleaner head as it is manoeuvred over a carpeted surface, at least one floor engaging portion of the cleaner head may be formed from material comprising a dispersion of carbon nanotubes within a polymer matrix. For example, the lower surface of the sole plate, and/or the lower surfaces of the support members may be formed from such a composite material.

Therefore, in a second aspect the present invention provides a cleaner head for a surface treating appliance, wherein at least one floor engaging portion of the cleaner head is formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.

As mentioned above, the floor engaging portions of the cleaner head may comprise a lower surface of a sole plate, an outer surface of a wheel or other rotatable support member, the lower surface of a skid or other non-rotatable support member, or a lower surface of a main body of the cleaner head. In any of these alternatives, the
5 aforementioned surface may be coated with composite material comprising a dispersion of carbon nanotubes within a polymer matrix. Alternatively, a base member may be overmoulded with this composite material to form the aforementioned surface. As another alternative, the entire component may be formed from the composite material.

10 The nature of the material that forms the polymer matrix may be selected depending on a number of characteristics of the relevant portion of the cleaner head, such as the manufacturing technique used to form that portion of the cleaner head, its required strength, toughness or surface finish, and so on. For example, the floor engaging
15 surfaces of the wheels or other rolling support elements of the cleaner head may be formed from carbon nanotubes dispersed within a thermoplastic polyurethane (TPU) matrix, with this composite material being overmoulded on to a polypropylene body of the support element. Alternatively, the support members may be formed from a material comprising carbon nanotubes dispersed within a polypropylene matrix. As
20 another example, the sole plate of the cleaner head may be formed from a material comprising carbon nanotubes dispersed within a polycarbonate matrix. As a further example, the main body of the cleaner head may be formed from a material comprising carbon nanotubes dispersed within a polybutylene terephthalate (PBT) matrix.

To improve the performance of the cleaner head when it is located on a hard floor
25 surface, the cleaner head may comprise flexible surface engaging means extending downwardly from the sole plate for forming a seal with the surface on which the cleaner head is located. The surface engaging means may extend along substantially the entire length of the sole plate, preferably adjacent an edge of a suction opening formed in the sole plate. The surface engaging means may comprise a strip of flexible material, or a
30 row of bristles. The bristles may be formed from composite material comprising a dispersion of carbon nanotubes within a polymer matrix, and may be formed from a

similar material to that from which the aforementioned bristles of the agitating apparatus is formed. The diameter of these bristles is preferably such that the bristles are relatively flexible. This allows the bristles to deform readily to lie flat against the sole plate when the cleaner head is located on a carpeted floor surface so as not to
5 disturb the seal formed between the sole plate and the surface of the carpet and to present only a low resistance to motion of the cleaner head over the carpet.

The sole plate of the cleaner head may be provided with thread lifting strips, or lint pickers, to improve the removal of hair or other long fibres from a carpeted floor
10 surface. These strips may be provided on opposite sides of the sole plate. The thread lifting strips may comprise fibres formed from a material comprising carbon nanotubes dispersed within a polymer matrix. These fibres may be formed from the same or similar material as the bristles of the agitating apparatus.

15 In a third aspect the present invention provides a surface treating appliance comprising a cleaner head or agitating apparatus as aforementioned.

The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travelling over a surface to
20 clean or treat the surface in some manner. It includes, inter alia, machines which simply agitate the surface, such as carpet sweepers, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, and machines which apply material to the surface, such as polishing/waxing machines, pressure washing machines and shampooing machines.

25

One or more further floor engaging portions of the surface treating appliance may be formed from a material comprising a dispersion of carbon nanotubes within a polymer matrix. For example, the surface treating appliance may comprise a support assembly for supporting the appliance on a floor surface, and the support assembly may have a
30 floor engaging portion which is formed from this material. The support assembly may comprise a plurality of wheels or other rotatable support members, a substantially

spherical or spheroidal support member which rotates as the appliance is manoeuvred over a floor surface, or a plurality of non-rotating support members. The floor engaging surface or surface of the support assembly may be formed from carbon nanotubes dispersed within a thermoplastic polyurethane (TPU) matrix, with this composite material being overmoulded on to a polypropylene body of the support element. As another example, the appliance may comprise a body or chassis upon which the support assembly is mounted, and a floor engaging portion of the chassis may be formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.

10 In a fourth aspect, the present invention provides a surface treating appliance comprising a body having at least one floor engaging portion formed from material comprising a dispersion of carbon nanotubes within a polymer matrix..

Features described above in connection with the first aspect of the invention are equally applicable to each of the second to fourth aspects of the invention, and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred features of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

20

Figure 1 is a top view of a cleaner head;

Figure 2 is a front view of the cleaner head;

25 Figure 3 is a left side view of the cleaner head;

Figure 4 is a right side view of the cleaner head;

Figure 5 is a bottom view of the cleaner head; and

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Figure 6 is a sectional side view, taken along line A-A in Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1 to 5 are external views of an embodiment of a cleaner head 10 for a surface treating appliance. In this embodiment, the cleaner head 10 is arranged to be connectable to a wand or hose of a cylinder vacuum cleaning appliance. The cleaner head 10 comprises a main body 12 and a conduit 14 connected to the main body 12. The main body 12 comprises substantially parallel side walls 16, 18 extending forwardly from opposite ends of a rear section 20 of the main body 12, and a moveable section 22 located between the side walls 16, 18 of the main body 12. In this embodiment the moveable section 22 is rotatably connected to the main body 12 for rotation about an axis which extends generally orthogonally between the side walls 16, 18 of the main body 12.

The moveable section 22 comprises a curved upper wall 24, a lower plate, or sole plate 26, and two side walls 28, 30 which connect the sole plate 26 to the upper wall 24. The side walls 28, 30 are located between the side walls 16, 18 of the main body 12, with each side wall 28, 30 being located adjacent and substantially parallel to a respective one of the side walls 16, 18 of the main body 12. In use, the sole plate 26 faces the floor surface to be cleaned and, as described in more detail below, engages the surface of a carpeted floor surface. The sole plate 26 comprises a leading section 32 and a trailing section 34 located on opposite sides of a suction opening 36 through which a dirt-bearing air flow enters the cleaner head 10. The suction opening 36 is generally rectangular in shape, and is delimited by the side walls 28, 30, a relatively long front wall 38 and a relatively long rear wall 40 which each upstand from the bottom surface of the sole plate 26. These walls also delimit the start of a suction passage through the main body 12 of the cleaner head 10.

The sole plate 26 comprises two working edges for agitating the fibres of a carpeted floor surface as the cleaner head 10 is manoeuvred over such a surface. A front working edge 42 of the sole plate 26 is located at the intersection between the front wall and the bottom surface of the leading section 32 of the sole plate 26, and extends substantially uninterruptedly between the side walls 28, 30. A rear working edge 44 of

the sole plate 26 is located at the intersection between the rear wall 40 and the bottom surface of the trailing section 34 of the sole plate 26, and extends substantially uninterruptedly between the side walls 28, 30. The working edges 42, 44 are preferably relative sharp, preferably having a radius of curvature less than 0.5 mm.

5

A front bumper 46 is over-moulded on to the moveable section 22, and is located between the upper wall 24 and the sole plate 26. A relatively short lint picker strip 47 is attached to one side of the bottom surface of the leading section 32 of the sole plate 26. The lint picker strip 47 comprises fibres attached to a backing material, which is in turn
10 attached to the sole plate 26, for example using an adhesive.

To prevent the working edges 42, 44 from scratching or otherwise marking a hard floor surface as the cleaner head 10 is manoeuvred over such a surface, the cleaner head 10 comprises surface engaging support members which serve to space the working edges
15 42, 44 from a hard floor surface. In this embodiment, the cleaner head 10 comprises a plurality of surface engaging support members which are each in the form of a rolling element, preferably a wheel. A first pair of wheels 48 is rotatably mounted within a pair of recesses formed in the leading section 32 of the sole plate 26, and a second wheel 50 is rotatably mounted within a recess formed in the trailing section 34 of the sole plate
20 26. An additional wheel 50 may be provided on the trailing section 34 of the sole plate 26. As illustrated in Figure 6, the wheels 48, 50 protrude downwardly beyond the working edges 42, 44.

During use, a pressure difference is generated between the air passing through the
25 cleaner head 10 and the external environment. This pressure difference generates a force which acts downwardly on the cleaner head 10 towards the floor surface. When the cleaner head 10 is located on a carpeted floor surface, the wheels 48, 50 are pushed into the fibres of the carpeted floor surface under the weight of the cleaner head 10 and the force acting downwardly on the cleaner head 10. The thickness of the wheels 48, 50
30 is selected so that the wheels 48, 50 will readily sink into the carpeted floor surface to bring at least the working edges 42, 44 of the sole plate 26 into contact with the fibres of

the floor surface. The thickness of the wheels 48, 50 is preferably less than 5 mm to ensure that the wheels 48, 50 sink between the fibres of a carpeted floor surface.

As the cleaner head 10 is pulled backwards over a carpeted floor surface by a user, there is a tendency for the user to raise the rear section 20 of the main body 12 of the cleaner head 10. However, the rotatable connection of the moveable section 22 to the main body 12 allows the sole plate 26 to pivot relative to the main body 12 to maintain the working edges 42, 44 in contact with the floor surface. Clockwise rotation of the moveable member 22 relative to the main body 12 (as viewed along axis *A* in Figure 3) is restricted through the abutment of upwardly facing surfaces 52 located toward the ends of the bumper 46 of the moveable member 22 with downwardly facing surfaces 54 located towards the front of the side walls 16, 18 of the main body 12. Anticlockwise rotation of the moveable member 22 relative to the main body 12 is restricted through the abutment of the upper surface 56 of the trailing section 34 of the sole plate 26 with the bottom surfaces 58 of the side walls 16, 18 of the main body 12. Clockwise rotation of the moveable member 22 relative to the main body 12 brings the bottom surface of the trailing section 34 of the sole plate 26 into contact with the upper surface of the carpet, enabling a seal to be formed between the carpet and the sole plate 26 which extends over substantially all of the surface area of the bottom surface of the trailing section 34.

To provide a seal between the trailing section 34 of the sole plate 26 and a hard floor surface the trailing section 34 comprises a row of bristles 59 which extend downwardly from the bottom surface of the trailing section 34. The bristles are preferably relatively fine so that the bristles 59 deform readily upon contact with a hard floor surface or a carpeted floor surface, and do not impair the manoeuvring of the cleaner head 10 over the floor surface. The bristles 59 preferably extend along substantially the entire length of the trailing section 34 of the sole plate 26, as measured in a direction extending along the axis *A*, and are preferable located adjacent the rear working edge 44.

The cleaner head 10 further comprises an agitator assembly for agitating dirt and dust located on the floor surface. In this example the agitator assembly comprises a rotatable brush bar 60 which is mounted within an agitator chamber 62 of the housing 16. The agitator chamber 62 is partially defined by the curved upper wall 24 of the moveable section 22. The curved upper wall 24 is preferably formed from transparent material to allow the user to see whether the agitator chamber 62 has become blocked. The brush bar 60 is driven by a motor (not shown) located in a motor housing 64 of the main body 12. The motor is electrically connected to a terminal located in the conduit 14 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor.

The brush bar 60 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 66 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 60 is connected to the drive mechanism to enable the brush bar 60 to be driven by the motor, whereas the other end of the brush bar 60 is rotatably supported by an end cap 68 removably connected to the side wall 18 of the main body 12. A floor engaging sensor 69 is housed within a recess located in the trailing section 34 of the sole plate 26 so as to protrude downwardly beyond the bottom surface of the trailing section 34 so that the sensor 69 contacts a floor surface upon which the cleaner head 10 is located to move relative to the sole plate 26. This movement of the sensor 69 causes the motor to be activated to rotate the brush bar 60. When the cleaner head 10 is raised from the floor surface, the resulting movement of the sensor 69 causes the motor to be deactivated.

The brush bar 60 comprises an elongate body 70 bearing two different types of agitating means for agitating dirt and dust from the floor surface as the brush bar 60 is rotated by the motor. Each of the different types of agitating means protrudes from the suction opening 36 in the sole plate 26 by respective different amounts as the brush bar 60 is rotated by the motor.

A first agitating means mounted on the body 70 of the brush bar 60 comprises relatively short, preferably relatively stiff, bristles 72. In this embodiment the relatively short bristles 72 are arranged in two angularly spaced, helical rows extending along the body 70. Within each row, the relatively short bristles 72 are arranged in a series of clusters or tufts regularly spaced along the row. Each tuft preferably comprises around 100 to 150 bristles, with each tuft having a diameter in the range from 2 to 4 mm. The diameter of each bristle 72 is preferably in the range from 100 to 500 μm . The length of the relatively short bristles 72 is chosen so that, as the brush bar 60 is rotated, the tips of these bristles 72 describe a cylindrical volume which does not protrude downwardly beyond a plane passing through the lowermost extremities of the wheels 48, 50. The relatively short bristles 72 may be connected to the body 70 of the brush bar using a conventional technique, such as stapling or welding.

A second agitating means mounted on the body 70 of the brush bar 60 comprises relatively long, preferably relatively soft, bristles 74. The relatively long bristles 74 protrude radially outwardly from the body 70 beyond the relatively short bristles 72. During rotation of the body 70, the relatively long bristles 74 sweep a cylindrical volume having a diameter which is greater than the diameter of the cylindrical volume swept by the relatively short bristles 72. The difference between the diameters is preferably in the range from 1 to 10 mm, more preferably in the range from 2 to 6 mm. In contrast to the relatively short bristles 72, the length of the relatively long bristles 74 is chosen so that the relatively long bristles 74 protrude beyond the plane passing through the lowermost extremities of the wheels 48, 50.

With particular reference to Figure 6, each row of the relatively long bristles 74 is formed from a single strip of bristles. Each strip is preferably formed by attaching an elongate, generally rectangular flexible carrier member 76 to a row of bristles so that each row of bristles 74 protrudes outwardly from a respective long side edge of the carrier member 76. The carrier member may be attached to the row of bristles by stitching or by using an adhesive. Each strip 76 is then located within a respective helical groove formed in the body 70 so that the ends of the bristles protrude outwardly

from the body 70. The strips 76 are connected to the body 70 by helical connectors 78 which are mounted on the strips 76 and connected to the body 70 using screws (not shown) which are inserted into apertures 80 formed in the connectors 78. The screws may be pushed through the carrier member, or inserted through apertures formed in the carrier member.

When the cleaner head 10 is located on a carpeted floor surface the wheels 48, 50 sink between the fibres of the carpet so that the bottom surface of the trailing section 34 of the sole plate 26 engages the fibres of the carpet. As both the relatively short bristles 72 and the relatively long bristles 74 protrude from the suction opening 26 as the brush bar 60 rotates, both of the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the suction passage of the cleaner head 10, this dirt and dust becomes entrained within the air flow and is conveyed through the cleaner head 10 to the cleaning appliance.

When the cleaner head 10 is moved from the carpeted floor surface on to a hard floor surface, the sole plate 26 becomes spaced from the hard floor surface by the wheels 48, 50. As the tips of the relatively short bristles 72 do not protrude beneath the plane containing the lowermost extremities of the wheels 48, 50, these bristles do not come into contact with the hard floor surface, thereby preventing scratching or other marking of the hard floor surface by these bristles. However, as the relatively long bristles 74 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface with rotation of the brush bar 60.

As discussed above, as the cleaner head 10 is manoeuvred over a floor surface various components of the cleaner head 10 engage that floor surface. For example, when the cleaner head 10 is manoeuvred over a hard floor surface, the lowermost extremities of the wheels 48, 50 and the bristles 59 of the cleaner head 10, and the relatively long bristles 74 of the brush bar 60, engage the floor surface. When the cleaner head 10 is manoeuvred over a carpeted floor surface, the lower surfaces of the sole plate 26 and the lint picker strip 47 of the cleaner head 10, and the relatively short bristles 72 of the

brush bar 60, also engage the floor surface. The lower surface of the rear section 20 of the main body 12 may also engage the floor surface.

5 The material from which at least one of these floor engaging portions of the cleaner head 10 is formed is selected to inhibit the build-up of static electricity on a floor surface as the cleaner head 10 is manoeuvred over the floor surface. To facilitate manufacturing, this material comprises a dispersion of carbon nanotubes within a polymer matrix. This selection of material enables the relevant portion or portions of the cleaner head 10 to be manufactured using an injection moulding, extrusion, or
10 spinning technique similar to that used when that portion of the cleaner head 10 is formed using a conventional plastics material. There is also no requirement to change the method in which the cleaner head 10 is assembled.

For example, the relatively long bristles 74 may be formed from a dispersion of carbon
15 nanotubes within a polyamide matrix. This may be selected from one of polyamide 66, polyamide 12 and polyamide 6, which are each available commercially as PLATICYL™ PA 1501, PLATICYL™ PA 1502 and PLATICYL™ PA 1503 respectively. This material may be loaded with up to 15% by weight of carbon nanotubes. The percentage by weight of carbon nanotubes within the polyamide matrix
20 is preferably selected so that the material has a volume resistivity in the range from 1×10^1 to $1 \times 10^6 \Omega \cdot \text{cm}$. For example, the composite material may comprise up to 5% by weight of carbon nanotubes, preferably comprising between 2 and 5% by weight of carbon nanotubes.

25 The relatively low volume resistivity of the relatively long bristles 74 inhibits the build up of static electricity on the hard floor surface as the relatively long bristles 74 contact the floor surface, thereby enabling fine dust and powder which would otherwise be attracted to the hard floor surface to be dislodged from the floor surface by these bristles 74 and entrained within the air flow.

The selection of this material can also allow the relatively long bristles 74 to be connected to the body 70 of the brush bar 60 using a similar technique as the relatively short bristles 72, that is, in a series or row of bristle tufts connected to the body 70 by stapling or welding.

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To further prevent the build-up of static electricity on the hard floor surface, the bristles 59 of the cleaner head 10 may be formed from similar material as the relatively long bristles 74. The outer surfaces of the wheels 48, 50 of the cleaner head 10 may be formed from a material comprising carbon nanotubes dispersed within a thermoplastic polyurethane (TPU) matrix, with this composite material being overmoulded on to a polypropylene body of the wheels 48, 50. A suitable commercially available composite material is PLATICYL™ TPU 1001, which may contain up to 10% by weight of carbon nanotubes. Again, the percentage by weight of carbon nanotubes within the polymer matrix is preferably selected so that the material has a volume resistivity which is no greater than $1 \times 10^6 \Omega \cdot \text{cm}$. If so desired, the bristles 59 of the cleaner head 10 may be replaced by a strip of flexible material formed from this composite material. Alternatively, the wheels 48, 50 may be formed from a material comprising carbon nanotubes dispersed within a polypropylene (PP) matrix. A suitable commercially available composite material is PLATICYL™ PP 2001, which may contain at least 2% by weight of carbon nanotubes, preferably between 2 and 5% by weight of carbon nanotubes, to discharge static electricity residing on the floor surface.

With reference to the portions of the cleaner head 10 which come into contact with a carpeted floor surface, the fibres of the lint picker strip 47 and the relatively short bristles 72 may be formed from the same material as the relatively long bristles 74 of the brush bar 60. The sole plate 26 may be formed from a material comprising carbon nanotubes dispersed within a polycarbonate (PC) matrix. A suitable commercially available composite material is PLATICYL™ PC 1501, which may contain at least 1.5% by weight of carbon nanotubes, preferably between 1.5 and 3% by weight of carbon nanotubes, to discharge static electricity residing on the carpeted floor surface. The rear section 20 of the main body 12 may be formed from a material comprising

carbon nanotubes dispersed within a polybutylene terephthalate (PBT) matrix. A suitable commercially available composite material is PLATICYL™ PBT 1501, which may contain at least 1% by weight of carbon nanotubes, preferably between 1 and 5% by weight of carbon nanotubes so that the material has the required volume resistivity.

5

Other parts of the surface treating appliance to which the cleaner head 10 is connected may also be formed from material comprising a dispersion of carbon nanotubes within a polymer matrix. For example, at least one of the support assembly or a chassis of a main body of the surface treating appliance, which engage a floor surface over which the appliance is being manoeuvred, may be formed from such material. This material may be selected from one of the aforementioned commercially available materials depending on, for example, its required physical properties or the selected manufacturing technique.

15

CLAIMS

1. A surface treating appliance comprising a body having at least one floor
5 engaging portion formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.
2. An appliance as claimed in claim 1, wherein the material has a volume resistivity in the range from 1×10^1 to $1 \times 10^6 \Omega \cdot \text{cm}$.
- 10 3. An appliance as claimed in claim 1 or claim 2, wherein the material comprises up to 5% by weight of carbon nanotubes.
4. An appliance as claimed in any preceding claim, wherein the material comprises
15 between 1 and 5% by weight of carbon nanotubes.
5. An appliance as claimed in any preceding claim, wherein the polymer matrix comprises one of a polyamide, polypropylene, thermoplastic polyurethane, polycarbonate, and polybutylene terephthalate.
- 20 6. An appliance as claimed in any preceding claim, wherein the body comprises a support assembly for supporting the appliance on a floor surface, and wherein the support assembly comprises said at least one floor engaging portion.
- 25 7. An appliance as claimed in claim 6, wherein the support assembly comprises at least one wheel, and wherein said at least one floor engaging portion of the support assembly comprises an outer surface portion of said at least one wheel.
8. An appliance as claimed in any preceding claim, wherein the body comprises a
30 chassis, and the chassis comprises said at least one floor engaging portion.

9. An appliance as claimed in any preceding claim, wherein the body comprises a cleaner head, and wherein the cleaner head comprises said at least one floor engaging portion.

5 10. An appliance as claimed in claim 9, wherein the cleaner head comprises a plurality of support members for supporting the cleaner head on a surface to be cleaned, and wherein the support members of the cleaner head comprise said at least one floor engaging portion.

10 11. An appliance as claimed in claim 9, wherein the cleaner head comprises a floor engaging sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and wherein the sole plate comprises said at least one floor engaging portion.

15 12. A cleaner head for a surface treating appliance, the cleaner head comprising a body having at least one floor engaging portion formed from material comprising a dispersion of carbon nanotubes within a polymer matrix.

13. A cleaner head as claimed in claim 12, wherein the cleaner head comprises a
20 plurality of support members for supporting the cleaner head on a surface to be cleaned, and wherein the support members of the cleaner head comprise said at least one floor engaging portion.

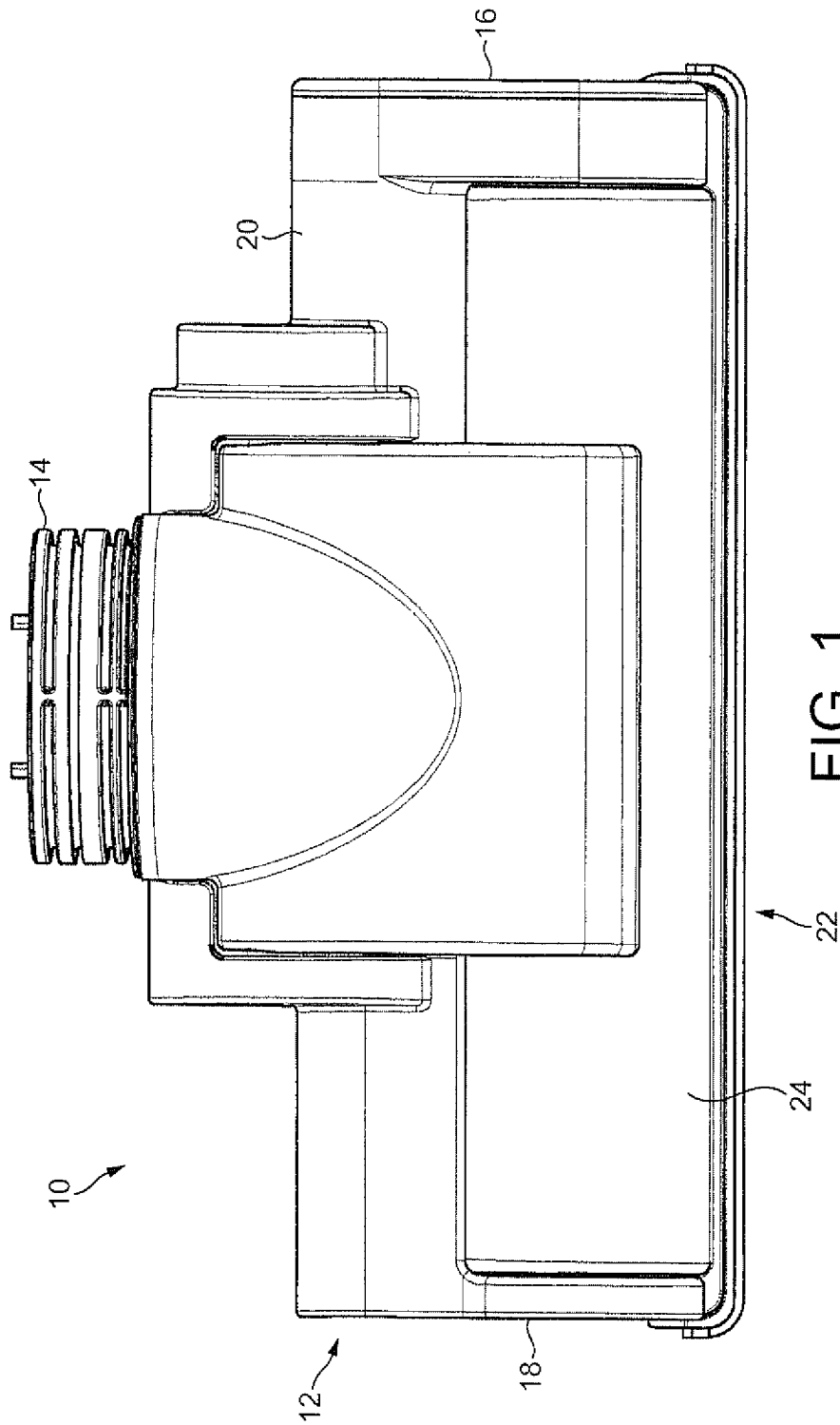
14. A cleaner head as claimed in claim 12, wherein the cleaner head comprises a
25 floor engaging sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and wherein the sole plate comprises said at least one floor engaging portion.

15. A cleaner head as claimed in any of claims 12 to 14, wherein the material has a
30 volume resistivity in the range from 1×10^1 to $1 \times 10^6 \Omega \cdot \text{cm}$.

16. A cleaner head as claimed in any of claims 12 to 15, wherein the material comprises up to 5% by weight of carbon nanotubes.

17. A cleaner head as claimed in any of claims 12 to 16, wherein the material
5 comprises between 1 and 5% by weight of carbon nanotubes.

18. A cleaner head as claimed in any of claims 12 to 17, wherein the polymer matrix comprises one of a polyamide, polypropylene, thermoplastic polyurethane, polycarbonate, and polybutylene terephthalate.



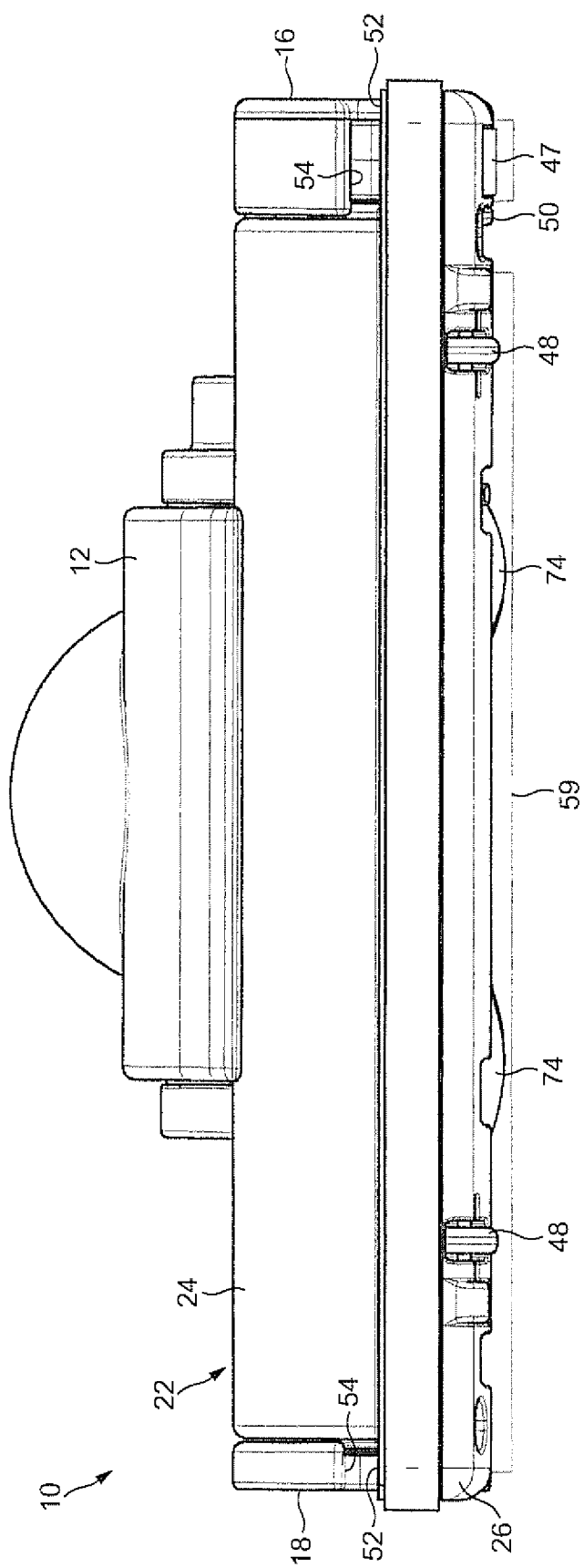


FIG. 2

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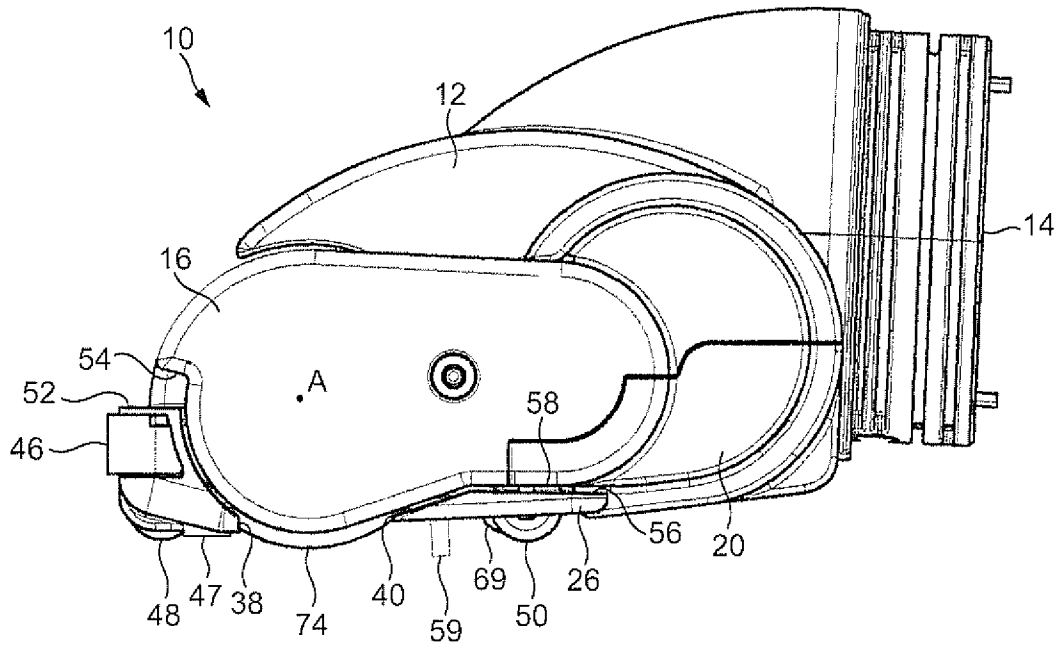


FIG. 3

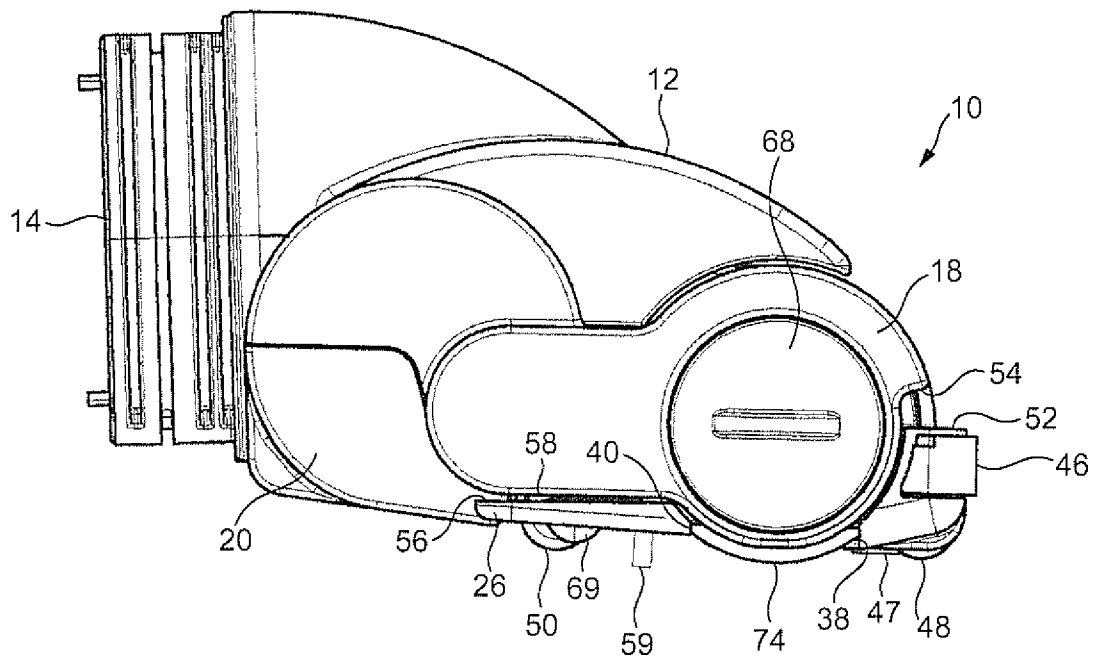


FIG. 4

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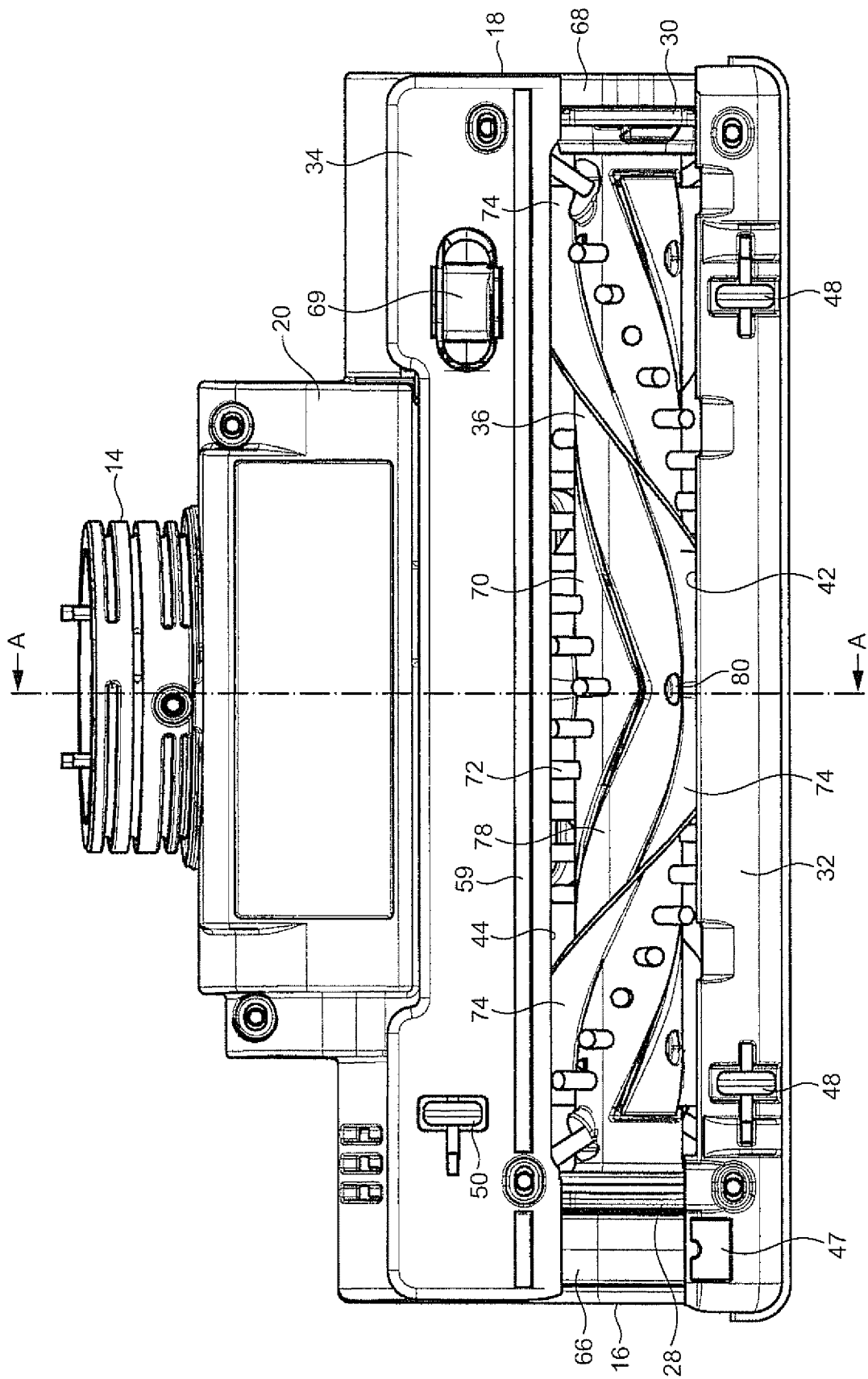


FIG. 5

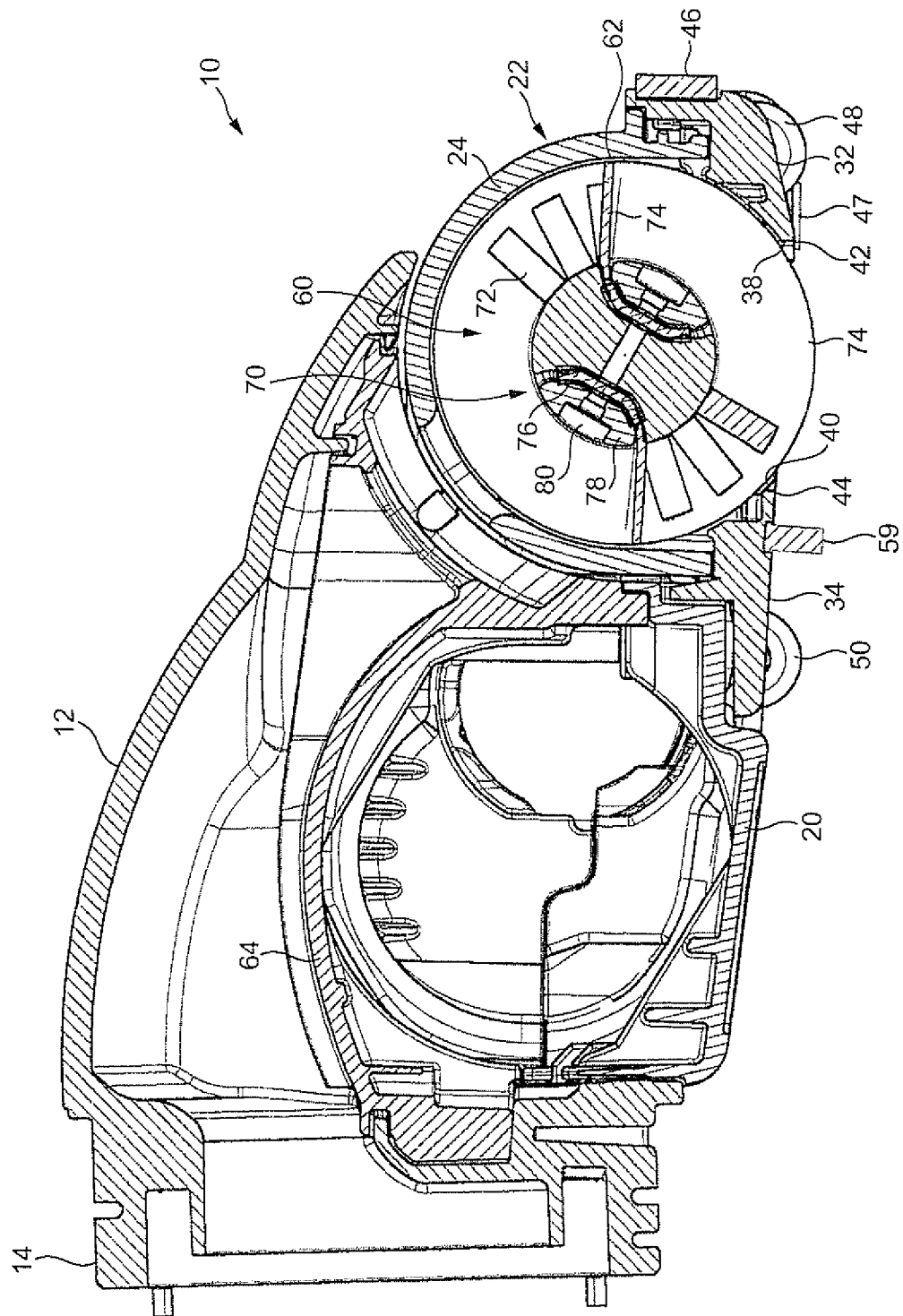


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2012/051324

A. CLASSIFICATION OF SUBJECT MATTER

INV. A47L9/04 A46B13/00

ADD.

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 A46B

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/054953 A2 (COOPER CHRISTOPHER H [US]; KELLEY WHITMORE B; BAJPAI VARDHAN; ILLESCU) 30 April 2009 (2009-04-30)	1,5,6, 12,18
A	the whole document	2-4, 7-11, 13-17
A,P	JP 2011 133692 A (CANON FINETECH INC) 7 July 2011 (2011-07-07) abstract; figure 3	1-18

☐

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

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"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

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"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

31 August 2012

Date of mailing of the international search report

12/09/2012

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Authorized officer

Blumenberg, Claus

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2012/051324

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009054953 A2	30-04-2009	JP 2011514810 A TW 200946068 A US 2009196909 A1 WO 2009054953 A2	12-05-2011 16-11-2009 06-08-2009 30-04-2009
JP 2011133692 A	07-07-2011	NONE	