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(54) Title: VACUUM CLEANER TOOL

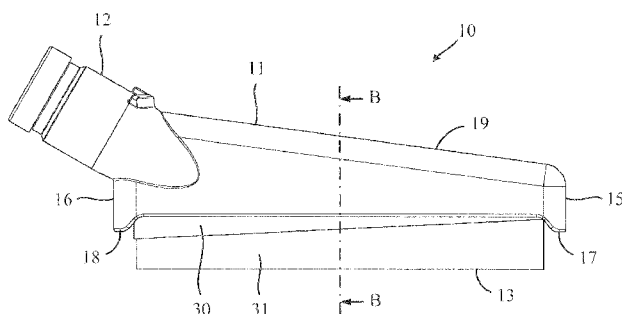


Fig. 4

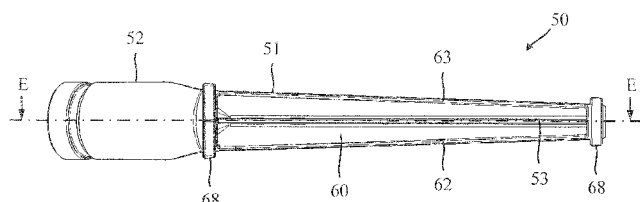


Fig. 11

(57) Abstract: A tool for a vacuum cleaner that comprises a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly. The nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle. The duct is attached to the rear of nozzle, and the bristle assembly is mounted within the nozzle and protrudes through the suction opening.



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Vacuum Cleaner Tool

The present invention relates to a tool for a vacuum cleaner.

5 Figures 1 and 2 illustrate a known type of vacuum cleaner tool 1. The tool 1 comprises a nozzle 2 having an elongate suction opening 3, and a strip of the bristles 4 that protrude through the suction opening 3. The tool 1 is intended to be swept from side-to-side in directions normal to the suction opening 3. As the tool 1 is swept forwards, the bristles 4 bend backwards and contact the trailing edge of the nozzle 2. The suction
10 opening 3 is therefore located in front of the bristles 4 irrespective of the direction of travel.

A problem with the tool 1 is that the bristles 4 must be relatively stiff in order to avoid the ends of the bristles 4 being sucked up into the nozzle 2. The disadvantage of stiff
15 bristles is that they are more likely to mark the cleaning surface.

In a first aspect, the present invention provides a tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the nozzle comprises an elongate suction
20 opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within the nozzle and protrudes through the suction opening, the bristle assembly comprises a strip of bristles, and the lengths of the bristles at the rear of the nozzle are shorter than those at the front of the nozzle.

25 Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is generally greatest at the rear. Longer bristles have the advantage that they are more flexible and thus less likely to mark the cleaning surface. Additionally, longer bristles are better able to penetrate awkward surfaces and thus improve pickup performance. However, if longer bristles are employed along the full length of the
30 bristle assembly then the bristles at the rear of the nozzle are likely to be drawn up into the nozzle. By employing shorter bristles at the rear of the nozzle, the bristles are stiffer

and thus less likely to be drawn up into the nozzle. Conversely, by employing longer bristles at the front of the nozzle, the bristles are better able to penetrate awkward surfaces and thus improve pickup.

- 5 The length of the bristles may taper from the front to the rear of the nozzle. The suction at the suction opening will typically decrease along the length of the suction opening. Accordingly, by having bristles that taper in length, the pickup performance of the tool may be improved whilst ensuring that the bristles are of a length that prevents them from being drawn up into the nozzle.

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- The bristle assembly may comprise a carrier to which a strip of bristles is attached, and the carrier may be arranged to pivot or flex relative to the nozzle. By attaching the bristles to a carrier that pivots or flexes, the bristles are required to bend through a smaller angle. The bristles are therefore subjected to smaller stresses, thus improving
15 the longevity of the bristles. Additionally, the bristles are better able to retain their shape. The carrier may also be used to provide support for the bristles. Consequently, finer bristles may be used, which might otherwise be drawn into the nozzle by the suction generated at the suction opening.

- 20 The bristle assembly may comprise a carrier to which the bristles are attached, and the carrier may protrude beyond the suction opening. The carrier has the advantage of providing support for the bristles. Consequently, finer bristles may be used that might otherwise be drawn into the nozzle by the suction generated at the suction opening. The suction decreases markedly just beyond the suction opening owing to the sudden
25 expansion in available volume. Since the carrier protrudes beyond the suction opening, the suction experienced by the bristles is much reduced and thus particularly soft and fine bristles may be used.

- The amount by which the carrier protrudes beyond the suction opening may be greater
30 at the rear of the nozzle than at the front of the nozzle. In particular, the amount by which the carrier protrudes beyond the suction opening may taper from the rear to the

front of the nozzle. Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is generally greatest at the rear. By ensuring that the carrier protrudes beyond the suction opening by a greater amount at the rear of the nozzle, the carrier provides additional support to the bristles where it is needed most.

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The carrier may be arranged to pivot or flex relative to the nozzle. By attaching the bristles to a carrier that pivots or flexes, the bristles are required to bend through a smaller angle. The bristles are therefore subjected to smaller stresses, thus improving the longevity of the bristles. Additionally, the bristles are better able to retain their shape.

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The suction opening may be delimited along its length by a leading edge and a trailing edge. Where the carrier pivots or flexes relative to the nozzle, the carrier may extend beyond the suction opening by an amount that permits the carrier to pivot or flex and contact the trailing edge. By contacting the trailing edge, the carrier provides a better seal against the trailing edge than would otherwise be possible with the bristles. Consequently, in contrast to the tool of Figures 1 and 2, the pickup performance of the tool is improved.

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The bristle assembly may be attached along a top of the nozzle. Consequently, fluff and other dirt are prevented from becoming trapped between the bristle assembly and the top of the nozzle. In contrast, with the tool of Figures 1 and 2, fluff and other dirt may become trapped between the bristles and the top of the nozzle. Additionally, the top of the nozzle is able to provide a support for the bristle assembly. As a result, the bristle assembly is prevented from bending upwards during use, e.g. due to the suction generated within the nozzle or when swept over an uneven surface.

25

The height or width of the nozzle may taper from the rear to the front of the nozzle. If the nozzle were of uniform height and width, the suction generated at the suction opening would be much greater at the rear of the suction opening than at the front of the suction opening. This would then have two potentially adverse consequences. First, the

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suction would be weaker at the front of the suction opening and thus pickup would be poorer at the front of the nozzle. Second, the suction at the rear of the suction opening may be sufficiently strong that it causes the ends of the bristles to be drawn into the nozzle. By tapering the height and/or width of the nozzle, a larger open volume is created within the nozzle at the rear, and a smaller open volume is created at the front. As a result, the suction is better balanced along the length of the suction opening, and thus longer bristles may be employed at the rear of the nozzle.

The bristles may be formed of carbon fibre. A strip of bristles has the advantage that no streaks of dirt are left behind as the tool is swept over the cleaning surface. Carbon fibre has at least two advantages. First, carbon fibre allows for relatively soft and fine bristles to be used, which help reduce marking of the cleaning surface. Second, carbon fibre has good anti-static properties, which means that the bristles can be swept over the cleaning surface without charging the surface. In contrast, nylon bristles tend to charge the cleaning surface and the resulting static then acts to attract dirt to the cleaning surface.

In a second aspect, the present invention provides a tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within the nozzle and protrudes through the suction opening, and the width of the suction opening at the rear of the nozzle is greater than that at the front of the nozzle.

Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is greatest at the rear. If the width of the suction opening were uniform, the suction at the rear of the suction opening would be significantly higher than that at the front of the suction opening. The higher level of suction could cause the bristles at the rear of the nozzle to be drawn into the nozzle. This particular problem might be solved by having shorter stiffer bristles. However, longer bristles have the advantage that they

are more flexible and thus less likely to mark the cleaning surface. Additionally, longer bristles are better able to penetrate awkward surfaces and thus improve pickup performance. By employing a suction opening that is wider at the rear and narrower at the front, the suction along the length of the suction opening is better balanced.

5 Accordingly, longer bristles may be employed at the rear of the nozzle.

The width of the suction opening may taper from the rear to the front of the nozzle. For a suction opening of uniform width, the suction will typically decrease along the length of the nozzle. By having a suction opening that tapers from the rear to the front, the
10 suction at the rear of the suction opening may be reduced so as to prevent the bristles being drawn into the nozzle, whilst nevertheless ensuring that a relatively high suction is maintained at front of the suction opening.

The amount by which the bristle assembly protrudes beyond the suction opening may be
15 greater at the rear of the nozzle than at the front of the nozzle. Moreover, the amount by which the bristle assembly protrudes beyond the suction opening may taper from the rear to the front of the nozzle. The suction opening may be regarded as delimited by a leading edge and a trailing edge. As the tool is swept forwards over the cleaning surface, the bristle assembly is swept backwards and contacts the trailing edge. In
20 contacting the trailing edge, the bristle assembly creates a seal behind the suction opening thereby improving pickup. Since the width of the suction opening is greater at the rear of the nozzle, having a bristle assembly that is likewise greater at the rear of the nozzle helps ensure that a seal is created along the full length of the bristle assembly.

25 The bristle assembly may be attached along a top of the nozzle. Consequently, fluff and other dirt are prevented from becoming trapped between the bristle assembly and the top of the nozzle. In contrast, with the tool of Figures 1 and 2, fluff and other dirt may become trapped between the bristles and the top of the nozzle. Additionally, the top of the nozzle is able to provide a support for the bristle assembly. As a result, the bristle
30 assembly is prevented from bending upwards during use, e.g. due to the suction generated within the nozzle or when swept over an uneven surface.

The height or width of the nozzle may taper from the rear to the front of the nozzle. If the nozzle were of uniform height and width, the suction generated at the suction opening would be much greater at the rear of the suction opening than at the front of the suction opening. This would then have two potentially adverse consequences. First, the suction would be weaker at the front of the suction opening and thus pickup would be poorer at the front of the nozzle. Second, the suction at the rear of the suction opening may be sufficiently strong that it causes the ends of the bristles to be drawn into the nozzle. By tapering the height and/or width of the nozzle, a larger open volume is created within the nozzle at the rear, and a smaller open volume is created at the front. As a result, the suction is better balanced along the length of the suction opening, and thus longer bristles may be employed at the rear of the nozzle. Tapering the width of the nozzle has the further advantage that a relatively low profile may be achieved for the tool, i.e. the height of the tool may be kept relatively low and the required change in the open volume may be achieved by tapering the width of the nozzle. As a result, the tool may be used to clean spaces of relatively low height.

The bristle assembly may comprise a carrier to which a strip of bristles is attached, and the height of the carrier at the rear of the nozzle may be greater than that at the front of the nozzle. Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is generally greatest at the rear. By ensuring that the carrier is taller at the rear of the nozzle, the carrier provides additional support to the bristles where it is needed most. Consequently, finer bristles may be used, which might otherwise be drawn into the nozzle by the suction generated at the suction opening.

The bristle assembly may comprise a carrier to which a strip of bristles is attached, and the carrier may be arranged to pivot or flex relative to the nozzle. By attaching the bristles to a carrier that pivots or flexes, the bristles are required to bend through a smaller angle. The bristles are therefore subjected to smaller stresses, thus improving the longevity of the bristles. Additionally, the bristles are better able to retain their shape. The carrier may also be used to provide support for the bristles. Consequently,

finer bristles may be used, which might otherwise be drawn into the nozzle by the suction generated at the suction opening.

5 The bristle assembly may comprise a carrier to which the bristles are attached, and the carrier may protrude beyond the suction opening. The carrier has the advantage of providing support for the bristles. Consequently, finer bristles may be used that might otherwise be drawn into the nozzle by the suction generated at the suction opening. The suction decreases markedly just beyond the suction opening owing to the sudden expansion in available volume. Since the carrier protrudes beyond the suction opening,
10 the suction experienced by the bristles is much reduced and thus particularly soft and fine bristles may be used.

The amount by which the carrier protrudes beyond the suction opening may be greater at the rear of the nozzle than at the front of the nozzle. In particular, the amount by
15 which the carrier protrudes beyond the suction opening may taper from the rear to the front of the suction opening. Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is greatest at the rear. By ensuring that the carrier protrudes beyond the suction opening by a greater amount at the rear of the nozzle, the carrier provides additional support to the bristles where it is needed most.

20 The suction opening may be delimited along its length by a leading edge and a trailing edge. Where the carrier pivots or flexes relative to the nozzle, the carrier may extend beyond the suction opening by an amount that permits the carrier to pivot or flex and contact the trailing edge. By contacting the trailing edge, the carrier provides a better
25 seal against the trailing edge than would otherwise be possible with the bristles. Consequently, in contrast to the tool of Figures 1 and 2, the pickup performance of the tool is improved.

30 The bristle assembly may comprise a strip of bristles formed of carbon fibre. A strip of bristles has the advantage that no streaks of dirt are left behind as the tool is swept over the cleaning surface. Carbon fibre has at least two advantages. First, carbon fibre

allows for relatively soft and fine bristles to be used, which help reduce marking of the cleaning surface. Second, carbon fibre has good anti-static properties, which means that the bristles can be swept over the cleaning surface without charging the surface. In contrast, nylon bristles tend to charge the cleaning surface and the resulting static then acts to attract dirt to the cleaning surface.

In a third aspect, the present invention provides a tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within the nozzle and protrudes through the suction opening, the bristle assembly comprises a strip of bristles attached to a carrier, and the height of the carrier at the rear of the nozzle is greater than that at the front of the nozzle.

The carrier acts to support the bristles. Consequently, finer bristles may be used that might otherwise be drawn into the nozzle. Since the duct is located at the rear of the nozzle, the suction generated at the suction opening is generally greatest at the rear. By employing a carrier that is taller at the rear of the nozzle, the carrier provides additional support to the bristles where it is needed most.

The height of the carrier may taper from the rear to the front of the nozzle. The suction at the suction opening will typically decrease along the length of the suction opening. Accordingly, by having a carrier that tapers in height, the carrier may provide a measure of support that is commensurate with the suction experienced by the bristles.

The carrier may be arranged to pivot or flex relative to the nozzle. By attaching the bristles to a carrier that pivots or flexes, the bristles are required to bend through a smaller angle. The bristles are therefore subjected to smaller stresses, thus improving the longevity of the bristles. Additionally, the bristles are better able to retain their shape.

The carrier may protrude beyond the suction opening. The suction decreases markedly just beyond the suction opening owing to the sudden expansion in available volume. Since the carrier protrudes beyond the suction opening, the suction experienced by the
5 bristles is much reduced and thus particularly soft and fine bristles may be used.

The suction opening may be delimited along its length by a leading edge and a trailing edge. Where the carrier pivots or flexes relative to the nozzle, the carrier may extend beyond the suction opening by an amount that permits the carrier to pivot or flex and
10 contact the trailing edge. By contacting the trailing edge, the carrier provides a better seal against the trailing edge than would otherwise be possible with the bristles. Consequently, in contrast to the tool of Figures 1 and 2, the pickup performance of the tool is improved.

The bristle assembly may be attached along a top of the nozzle. Consequently, fluff and other dirt are prevented from becoming trapped between the bristle assembly and the top of the nozzle. In contrast, with the tool of Figures 1 and 2, fluff and other dirt may become trapped between the bristles and the top of the nozzle. Additionally, the top of the nozzle is able to provide a support for the bristle assembly. As a result, the bristle
15 assembly is prevented from bending upwards during use, e.g. due to the suction generated within the nozzle or when swept over an uneven surface.
20

The height or width of the nozzle may taper from the rear to the front of the nozzle. If the nozzle were of uniform height and width, the suction generated at the suction
25 opening would be much greater at the rear of the suction opening than at the front of the suction opening. This would then have two potentially adverse consequences. First, the suction would be weaker at the front of the suction opening and thus pickup would be poorer at the front of the nozzle. Second, the suction at the rear of the suction opening may be sufficiently strong that it causes the ends of the bristles to be drawn into the
30 nozzle. By tapering the height and/or width of the nozzle, a larger open volume is created within the nozzle at the rear, and a smaller open volume is created at the front.

As a result, the suction is better balanced along the length of the suction opening, and thus longer bristles may be employed at the rear of the nozzle.

The bristles may be formed of carbon fibre. A strip of bristles has the advantage that no streaks of dirt are left behind as the tool is swept over the cleaning surface. Carbon fibre has at least two advantages. First, carbon fibre allows for relatively soft and fine bristles to be used, which help reduce marking of the cleaning surface. Second, carbon fibre has good anti-static properties, which means that the bristles can be swept over the cleaning surface without charging the surface. In contrast, nylon bristles tend to charge the cleaning surface and the resulting static then acts to attract dirt to the cleaning surface.

In order that the present invention may be more readily understood, embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a known type of vacuum cleaner tool;

Figure 2 is a sectional view through the tool of Figure 1, the section being taken in the plane A---A;

Figure 3 is a perspective view of a first vacuum cleaner tool in accordance with the present invention;

Figure 4 is a side view of the tool of Figure 3;

Figure 5 is an underside view of the tool of Figure 3;

Figure 6 is a sectional view through the tool of Figure 3, the section being taken in the plane C---C indicated in Figure 5;

Figure 7 is a sectional view through the tool of Figure 3, the section being taken in the plane B---B indicated in Figure 4;

5 Figure 8 is a sectional view through the tool of Figure 3 as the tool is swept across a surface, the section being taken in the plane B---B;

Figure 9 is a perspective view of a second vacuum cleaner tool in accordance with the present invention;

10 Figure 10 is a side view of the tool of Figure 9;

Figure 11 is an underside view of the tool of Figure 9;

15 Figure 12 is a sectional view through the tool of Figure 9, the section being taken in the plane E---E indicated in Figure 11;

Figure 13 is a sectional view through the tool of Figure 9, the section being taken in the plane D---D indicated in Figure 10; and

20 Figure 14 is a sectional view through the tool of Figure 9 as the tool is swept across a surface, the section being taken in the plane D---D.

The vacuum cleaner tool 10 of Figures 3 to 8 comprises a nozzle 11, a connecting duct 12, and a bristle assembly 13.

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The nozzle 11 is a relatively narrow structure, with the width of the nozzle 11 being much smaller than the length of the nozzle 11. The height of the nozzle 11 tapers (i.e. decreases gradually) from the rear 16 to the front 15 of the nozzle 11, the advantages of which are explained below. The nozzle 11 comprises a suction opening 20 that opens
30 up into an internal cavity 21 within the nozzle 11. The suction opening 20 is located in the base of the nozzle 11 and extends centrally from the front 15 to the rear 16 of the

nozzle 11. The suction opening 20 is delimited along its length by two edges 22,23 of the nozzle 11. Each edge 22,23 is raised relative to the lower ends 17,18 of the front 15 and the rear 16 of the nozzle 11. Consequently, when the base of the nozzle 11 is brought into contact with a cleaning surface 40, a gap 25 is created between each of the edges 22,23 and the cleaning surface 40. Again, the advantages of this are explained below.

The connecting duct 12 is attached to the rear 16 of the nozzle 11 and is in fluid communication with the cavity 21 and thus the suction opening 20 of the nozzle 11.

The connecting duct 12 is intended to be attached to a hose, wand or the like of a vacuum cleaner (not shown). During use, the vacuum cleaner generates suction at the connecting duct 12, causing air to be drawn in through the suction opening 20.

The bristle assembly 13 is generally planar in shape and comprises a carrier 30 to which a strip of bristles 31 and a spine 32 are attached.

The carrier 30 is formed of a flexible material such as rubber. The bottom of the carrier 30 rises relative to the top in a direction from the rear to the front of the carrier 30. As a result, the height of the carrier 30 tapers (i.e. decreases gradually) from the rear 37 to the front 36 of the carrier 30.

The bristles 31 are formed of carbon fibre and extend beyond the bottom of the carrier 30. The bristles 31 are attached to the carrier 30 by moulding the carrier 30 over the upper ends of the bristles 31. However, the bristles 31 could conceivably be attached to the carrier 30 by other means. The lengths of the bristles 31 taper (i.e. decrease gradually) from the front to the rear of the carrier 30. Consequently, the lengths of the bristles 31 at the rear of the carrier 30 are shorter than those at the front.

The spine 32 is formed of a rigid material, such as hard plastic, and is attached along the top of the carrier 30. The spine 32 provides structural support for the carrier 30, as well as providing means for attaching the bristle assembly 13 to the nozzle 11.

The bristle assembly 13 is mounted within the cavity 21 of the nozzle 11 such that the carrier 30 and the bristles 31 protrude through the suction opening 20. More specifically, the front 15 and the rear 16 of the nozzle 11 each include a recess into which the ends of the spine 32 are secured. The bristle assembly 13 is mounted within the cavity 21 such that the taller part of the carrier 30 and the shorter bristles 31 are located at the rear of the suction opening 20.

The tool 10 is intended to be swept across a cleaning surface 40 in directions normal to the suction opening 20. As the tool 10 is swept forwards, the bristle assembly 13 flexes backwards. The suction opening 20 is then located wholly in front of the bristles 31. The bristles 31 create a partial seal with the cleaning surface 40, which then improves the suction that is generated in front of the bristles 31. As the tool 10 is swept over the cleaning surface 40, the suction generated in front of the bristles 31 causes dirt to be drawn into the cavity 21 of the nozzle 11 via the suction opening 20. Thereafter, the dirt is carried to the vacuum cleaner via the connecting duct 12. The bristles 31 act to pick up much of the dirt that is not drawn into the nozzle 11. The bristles 31 then hold on to the dirt until such time as the dirt is drawn into the nozzle 11, e.g. when the tool 10 is lifted from the cleaning surface 40 or when the direction of travel of the tool 10 is reversed.

As the tool 10 is swept over the cleaning surface 40, the front 15 and the rear 16 of the nozzle 11 make contact with the cleaning surface 40. Of the two edges 22,23 that delimit the length of the suction opening 20, one defines a leading edge 22 of the nozzle 11 and the other defines a trailing edge 23. Since the two edges 22,23 are raised relative to the front 15 and rear 16 of the nozzle 11, a gap 25 is created between the leading edge 22 of the nozzle 11 and the cleaning surface 40. This gap 25 ensures that, as the tool 10 is swept over the cleaning surface 40, dirt is able to pass under the leading edge 22. As a result, the tool 10 does not push the dirt over the cleaning surface 40. During use, a user will typically tilt the tool 10 in the direction of travel such that an acute angle is formed between the nozzle 11 and the cleaning surface 40, as shown in

Figure 8. As a consequence of tilting the nozzle 11, the leading edge 22 is brought closer to the cleaning surface 40. Nevertheless, the gap 25 between the leading edge 22 and the cleaning surface 40 is maintained. As the tool 10 is tilted further forwards, the gap 25 between the leading edge 22 and the cleaning surface 40 decreases. Eventually, with sufficient tilting, the leading edge 22 may contact the cleaning surface 40. At this stage, the nozzle 11 would then start to push dirt along the cleaning surface 40. This problem may be mitigated by further raising the edges 22,23 of the nozzle 11 such that a larger nominal gap 25 is created between the leading edge 22 and the cleaning surface 40. However, a larger gap 25 has the disadvantage that more air is likely to be pulled in from the region above the cleaning surface 40 rather than at the cleaning surface 40 and thus pickup performance is adversely affected. The edges 22,23 are therefore raised by an amount which seeks to balance the need to maintain a relatively small gap 25 with the need to maintain a gap 25 over the range of angles through which the tool 10 is likely to be used.

The spine 32 provides structural support along the top 35 of the carrier 30. This then helps prevent the carrier 30 from flexing upwards during use of the tool 10, e.g. as a result of the suction generated within the nozzle 11 or when the tool 10 is swept over an uneven surface.

Employing a strip of bristles 31 has the advantage that streaks of dirt are not left behind as the tool 10 is swept over the cleaning surface 40. The choice of carbon fibre has at least two advantages. First, carbon fibre enables relatively soft and fine bristles 31 to be used, which then helps to reduce marking of the cleaning surface 40. Second, carbon fibre has good anti-static properties. Consequently, as the bristles 31 are swept over the cleaning surface 40, the bristles 31 do not charge the cleaning surface 40. In contrast, nylon bristles tend to charge the cleaning surface, and the resulting static then acts to attract dirt to the cleaning surface.

Although advantageous, employing soft, fine bristles is not without its difficulties. In particular, if such bristles were employed with the tool 1 of Figures 1 and 2, the suction

generated at the suction opening 3 would most likely to draw the bristles 4 into the nozzle 2. The tool 10 of Figures 3 to 8 has several features that help to prevent this from happening.

5 First, the lengths of the bristles 31 taper from the front to the rear of the suction opening 20. Consequently, the bristles 31 at the rear of the suction opening 20 are shorter than those at the front. Longer bristles have the advantage that they are more flexible and thus less likely to mark the cleaning surface 40. Additionally, longer
10 bristles are better able to penetrate awkward surfaces and thus improve pickup performance. It would therefore be advantageous to employ longer bristles along the full length of the suction opening 20. However, if longer bristles are employed along the full length of the suction opening 20 then the bristles 31 at the rear of the suction opening 20 may be drawn up into the nozzle 10. This is because the suction generated at the suction opening 20 is generally greatest at the rear of the suction opening 20 due
15 to the location of the connecting duct 12. By employing shorter bristles 31 at the rear of the suction opening 20, the bristles 31 are stiffer and thus less likely to be drawn up into the nozzle 11. Conversely, by employing longer bristles 31 at the front of the suction opening 20, the bristles 31 are better able to penetrate awkward surfaces and thus improve pickup. The suction at the suction opening 20 typically decreases along the
20 length of the suction opening 20. Accordingly, by having bristles 31 that taper in length along the length of the suction opening 20, relatively good pickup may be achieved whilst ensuring that the bristles 31 are of sufficient length to prevent them being drawn into the nozzle 11.

25 Second, the bristles 31 are attached to a carrier 30 which provides support for the bristles 31. Additionally, the carrier 30 protrudes beyond the suction opening 20. The suction experienced by the bristle assembly 13 decreases markedly just beyond the suction opening 20 owing to the sudden expansion in available volume. Since the carrier 30 protrudes beyond the suction opening 20, the suction experienced by the
30 bristles 31 is much reduced and thus relatively soft and fine bristles may be used. In contrast, with the tool 1 of Figures 1 and 2, the bristles 4 are unsupported and extend

through the suction opening 3 and into the cavity of the nozzle 2. As a result, the bristles 4 are subjected to higher levels of suction and thus stiffer bristles 4 must be used in order to ensure that the bristles 4 are not drawn into the nozzle 11. The carrier 30 is not of uniform height but is instead taller at the rear of the suction opening 20. As noted
5 in the preceding paragraph, the suction generated at the suction opening 20 is generally greatest at the rear of the suction opening 20. By employing a carrier 30 that is taller at the rear of the suction opening 20, the carrier 30 provides additional rigidity and support to the bristles 31 where it is needed most.

10 Third, the height of the nozzle 11 tapers from the rear 16 to the front 15 of the nozzle 11. If the nozzle 11 were of uniform height, the suction generated at the suction opening 20 would be much greater at the rear than at the front of the suction opening 20. This follows since the connecting duct 12 is located at the rear of the nozzle 11. The increased suction at the rear of the suction opening 20 might then cause
15 the bristles 31 to be drawn into the nozzle 11. Additionally, the suction and thus the pickup performance at the front of the suction opening 20 would be poorer. By tapering the height of the nozzle 11, the volume of the cavity 21 within the nozzle 11 also tapers from the rear 16 to the front 15 of the nozzle 11. A larger open volume is therefore created within the nozzle 11 at the rear of the suction opening 20, and a smaller open
20 volume is created at the front of the suction opening 20. The suction is therefore better balanced along the length of the suction opening 20. As result, softer, finer bristles may be used at the rear of the suction opening 20, and the pickup performance at the front of the suction opening 20 may be improved.

25 The carrier 30, being formed of a flexible material, flexes relative to the nozzle 11 as the tool 10 is swept over the cleaning surface 40. As a result, the bristles 31 are required to bend through a smaller angle. The bristles 31 are therefore subjected to smaller stresses, thus improving the longevity of the bristles 31. Additionally, the bristles 31 are better able to retain their shape. In contrast, the bristles 4 of the tool 1 of Figures 1 and 2 are
30 subjected to higher bending stresses. Rather than employing a flexible carrier 30, the bristle assembly 13 could conceivably comprise a carrier formed of a rigid material.

The bristle assembly 13 might then be pivotally attached to the nozzle 11 and, if required, a spring mechanism might be used to ensure that the carrier returns to a central position when the tool 10 is lifted from the cleaning surface 40.

- 5 The carrier 30 protrudes beyond the suction opening 20 by an amount that ensures that, when the bristle assembly 13 is swept backwards (e.g. during a forward sweep of the tool 10), the carrier 30 contacts the trailing edge 23. More specifically, the carrier 30 contacts the trailing edge 23 along the full length of the carrier 30. By contacting the trailing edge 23, the carrier 30 provides a better seal against the trailing edge 23 of the
10 nozzle 11 than would otherwise be possible with the bristles 31. Consequently, less air is pulled in through the trailing side of the tool 10 and thus more suction is generated in front of the bristles 31, thereby improving pickup.

- Figures 9 to 14 illustrate an alternative vacuum cleaner tool 50 that is similar in many
15 respects to that described above and illustrated in Figures 3 to 8. In particular, the tool 50 comprises a nozzle 51, a connecting duct 52, and a bristle assembly 53.

- The nozzle 51 is somewhat different in shape to that of Figures 3 to 8. The nozzle 11 of Figures 3 to 8 has a cross-sectional shape that is generally rectangular. In contrast, the
20 cross-sectional shape of the nozzle 51 of Figures 9 to 14 is generally triangular. Accordingly, the shape of the nozzle 51 may be regarded as an elongate prism. The width of the nozzle 11 of Figures 3 to 8 is constant along the length of the nozzle 11, whilst the height of the nozzle 11 tapers from the rear 16 to the front 15 of the nozzle 11. In contrast, the height of the nozzle 51 of Figures 9 to 14 is constant, and the
25 width of the nozzle 51 tapers (i.e. decreases gradually) from the rear 56 to the front 55 of the nozzle 51.

- The nozzle 51, like that of Figures 3 to 8, comprises a suction opening 60 that opens up into an internal cavity 61 within the nozzle 51. The suction opening 60 is again located
30 in the base of the nozzle 61 and extends centrally from the front 55 to the rear 56 of the nozzle 51. In contrast to the nozzle 11 of Figures 3 to 8, the suction opening 60 is not

of uniform width. Instead, the width of the suction opening 60 tapers (i.e. decreases gradually) from the rear to the front of the suction opening 60, the benefits of which are explained below. The suction opening 60 is again delimited along its length by two edges 62,63 of the nozzle 51 that are raised relative to the front 55 and the rear 56 of the nozzle 51. Consequently, when the base of the nozzle 51 is brought into contact with the cleaning surface 40, a gap 65 is created between the leading edge 62 and the cleaning surface 40. The lower ends 57,58 of the front 55 and rear 56 of the nozzle 51 are curved. Furthermore, the lower ends 57,58 are each covered with a protective pad 68 formed of a tufted fabric, the benefits of which are explained below.

The connecting duct 52 is essentially unchanged from that of Figures 3 to 8. In particular, the connecting duct 52 is attached to the rear 56 of the nozzle 51 and is intended to be attached to a hose, wand or the like of a vacuum cleaner (again, not shown).

The bristle assembly 53 is again generally planar in shape and comprises a carrier 70 to which a strip of bristles 71 is attached.

The carrier 70 is formed of a flexible material, such as rubber, and the bottom of the carrier 70 rises relative to the top in a direction from the rear to the front of the carrier 70. As a result, the height of the carrier 70 again tapers from the rear to the front of the carrier 70. In contrast to the carrier 30 of Figures 3 to 8, the carrier 70 comprises a pair of through-holes 78,79 located towards the rear of the carrier 70. The through-holes 78,79 have different sizes, with the through-hole 78 closest to the rear of the carrier 70 being larger.

The bristles 71 are again formed of carbon fibre and extend beyond the bottom of the carrier 70. However, unlike the bristles 31 of Figures 3 to 8, the lengths of the bristles 71 do not taper. Instead, the lengths of the bristles 71 are constant from the rear to the front of the carrier 70.

The bristle assembly 53 is mounted within the cavity 61 of the nozzle 51 such that the carrier 70 and the bristles 71 protrude through the suction opening 60. In contrast, to the bristle assembly 13 of Figures 3 to 8 which is attached to the front 15 and rear 16 of the nozzle 11, the bristle assembly 71 of Figures 9 to 14 is attached to the top 59 of the nozzle 51. In particular, the top of the carrier 70 is secured (e.g. by means of an adhesive) within a groove 69 formed along the top 59 of the nozzle 51. The bristle assembly 13 of Figures 3 to 8 includes a spine 32 that provides structural support along the top 35 of the carrier 30. Since the bristle assembly 53 of Figures 9 to 14 is attached along the top 59 of the nozzle 51, the spine may be omitted and the top 59 of the nozzle 51 may provide the necessary support. That being said, there may be advantages in employing a spine. For example, the bristle assembly 53 may comprise a spine that snaps into a groove in the top 59 of the nozzle 51. This then has the potential advantage of simplifying the assembly of the tool 50. In particular, the use of an adhesive to secure the bristle assembly 53 to the nozzle 51 may be avoided.

With the tool 10 of Figures 3 to 8, the bristle assembly 13 protrudes beyond the suction opening 20 by an amount that is constant along the length of the suction opening 20. In contrast, with the tool 50 of Figures 9 to 14, the amount by which the bristle assembly 53 protrudes beyond the suction opening 60 tapers (i.e. decreases gradually) from the rear to the front of the suction opening 60. Consequently, the amount by which the bristle assembly 53 protrudes beyond the suction opening 60 is greater at the rear of the suction opening 60 than at the front of the suction opening 60.

The tool 50 of Figures 9 to 14 is intended to be used in exactly the same way as that described above in connection with the tool 10 of Figures 3 to 8. In particular, the tool 50 is intended to be swept across the cleaning surface 40 in directions normal to the suction opening 60. As the tool 50 is swept forwards, the bristle assembly 53 flexes backwards such that the suction opening 60 is located wholly in front of the bristles 71. The bristle assembly 53 contacts the cleaning surface 40 and the trailing edge 63 of the nozzle 51 so as to create a seal behind the suction opening 60.

As the tool 50 is swept over the cleaning surface 40, the front 55 and the rear 56 of the nozzle 51 make contact with the cleaning surface 40. Since the leading and trailing edges 62,63 of the nozzle 51 are raised relative to the front 55 and rear 56, a gap 65 is again created between the leading edge 62 and the cleaning surface 40, thus ensuring that dirt is free to pass under the leading edge 62.

The angle formed between the tool 50 and the cleaning surface 40 typically changes as the tool 50 is swept across the cleaning surface 40. For example, the user may start with the tool 50 at an acute angle relative to the cleaning surface 40. As the tool 50 is swept across the cleaning surface 40, the tool 50 gradually straightens, perhaps finishing at an obtuse angle. The lower ends 57,58 of the nozzle 51 that contact the cleaning surface 40 are curved. This then has the advantage that, as the angle of the tool 50 changes, the lower ends 57,58 of the nozzle 51 rock over the cleaning surface 40 so as to provide a smooth transition. Moreover, the lower ends 57,58 of the nozzle 51 are each covered with a protective pad 68. This has two benefits. First, the pads 68 have a lower coefficient of friction than that of the nozzle 51 and thus the tool 60 may be swept over the cleaning surface 40 more smoothly and with less effort. Second, the pads 68 are softer than the nozzle 51 and thus the tool 60 is less likely to mark the cleaning surface 40. In the present embodiment, the pads 68 are each formed of a tufted fabric. However, the pads 68 might equally be formed of a different material that is softer and has a lower coefficient of friction than that of the nozzle 51. By way of example only, the pads 68 may be formed of a felted fabric, an elastomeric foam perhaps having a low-friction coating such as PTFE, or a strip of very short and fine bristles.

As with the tool 10 of Figures 3 to 8, the tool 50 of Figures 9 to 14 has several features that help prevent the bristles 71 from being drawn into the nozzle 51.

First, the bristles 71 are again attached to a carrier 70, which provides support for the bristles 71. As with the tool 10 of Figures 3 to 8, the connecting duct 52 is attached to the rear 56 of the nozzle 51 and thus the suction is generally greatest at the rear of the suction opening 60. The carrier 70 is again taller at the rear of the suction opening 60.

As a result, the carrier 70 provides additional rigidity and support to the bristles 71 where it is needed most. The carrier 70 also protrudes beyond the suction opening 60, and thus the suction experienced by the bristles 71 is much reduced.

- 5 Second, the width of the suction opening 60 tapers from the rear to the front of the suction opening 60. If the width of the suction opening 60 were uniform, the suction at the rear of the suction opening 60 would be significantly higher than that at the front of the suction opening 60. The higher level of suction at the rear may cause the bristles 71 to be drawn into the nozzle 51. By employing a suction opening 60 that is wider at the rear and narrower at the front, the suction along the length of the suction opening 60 is better balanced. In particular, the suction at the rear of the suction opening 60 is reduced so as to prevent the bristles 71 being drawn into the nozzle 51, whilst the suction at the front of the suction opening 60 is increased so as to improve pickup.
- 10 Third, the width of the nozzle 51 tapers from the rear 56 to the front 55 of the nozzle 51. This has the same benefit as tapering the height of the nozzle 11 of Figures 3 to 8, namely that the volume of the cavity 61 within the nozzle 51 decreases from the rear 56 to the front 55 of the nozzle 51. A larger open volume is therefore created within the nozzle 51 at the rear of the suction opening 60, and a smaller open volume is created at the front of the suction opening 60. The suction is therefore better balanced along the length of the suction opening 60. As result, softer, finer bristles 71 may be used at the rear of the suction opening 60, whilst the pickup performance at the front of the suction opening 60 may be improved. Tapering the width rather than the height of the nozzle 51 has the additional benefit that a relatively low profile may be achieved for the tool 50. In particular, the height of the tool may be kept relatively low and the required change in the volume of the cavity 61 may be achieved through changes in the width of the nozzle 51. As a result, the tool 51 may be used to clean under spaces of relatively low height.
- 15 As with the tool 10 of Figures 3 to 8, the carrier 70 protrudes beyond the suction opening 60 by an amount that ensures that, when the bristle assembly 53 is swept
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- 25
- 30

backwards (e.g. during a forward sweep of the tool 50), the carrier 70 contacts the trailing edge 63 of the nozzle 51. As noted above, this then ensures that a better seal is formed between the bristle assembly 53 and the trailing edge 63 of the nozzle 51. The width of the suction opening 60 tapers from the rear 56 to the front 55 of the nozzle 51.

5 Accordingly, in order that the carrier 70 contacts the trailing edge 63 along the full length of the carrier 70, the amount by which the carrier 70 protrudes beyond the suction opening 60 also tapers from the rear to the front. The bristles 71, however, do not taper but are instead of constant length. This then has the advantage that longer bristles may be employed at the rear of the suction opening 60. Additionally, bristles of
10 constant length ensure that, when the bristle assembly 53 is swept backwards and the carrier 70 contacts the trailing edge 63, the bristles 71 extend beyond the trailing edge 63 by an amount that is constant along the length of the trailing edge 63. This then has the benefit of providing more even pickup along the length of the nozzle 51. Since the height of the carrier 70 tapers but the lengths of the bristles 71 are constant, the
15 bristle assembly 53 protrudes beyond the suction opening 60 by an amount that tapers from the rear to the front of the suction opening 60. This is in contrast to the tool 10 of Figures 3 to 8, in which the bristle assembly 13 protrudes by the same amount along the length of the suction opening 20.

20 With the tool 10 of Figures 3 to 8, a gap is created directly above the bristle assembly 13, i.e. between the spine 32 and the top 19 of the nozzle 11. This is perhaps best seen in Figures 6 to 8. Conceivably, fluff and other dirt drawn into the nozzle 11 may become trapped within this gap. With the tool 50 of Figures 9 to 14, on the other hand, the bristle assembly 53 is attached to the top 59 of the nozzle 51. Consequently,
25 fluff and other dirt are prevented from becoming trapped between the bristle assembly 53 and the top 59 of the nozzle 51.

As the tool 51 is swept forwards over the cleaning surface 40, the bristle assembly 53 is swept backwards and contacts the trailing edge 63 of the nozzle 51. A seal is then
30 created between the bristle assembly 53 and the trailing edge 63. The suction generated within the cavity 61 creates a partial vacuum on the trailing side of the bristle

assembly 53. Since the suction opening 60 is typically open to ambient, the pressure on the leading side of the bristle assembly 53 is generally higher. Without the through-holes 78,79 in the carrier 70, the difference in pressure on the two sides of the bristle assembly 53 may be sufficiently large that the bristle assembly 53 is forced stuck against the trailing edge 63. Consequently, when the tool 50 is lifted from the cleaning surface 40 in order to reverse the direction of travel, the bristle assembly 53 fails to return to the centre of the suction opening 60. The through-holes 78,79 in the carrier 70 prevent this from happening. The through-holes 78,79 provide a passageway between the leading side and the trailing side of the bristle assembly 53. The through-holes 78,79 thus act to better equalise the pressure on the two sides of the bristle assembly 53. The through-holes do not necessarily result in perfect equalisation. However, the through-holes 78,79 ensure that the pressure difference is not excessive. Consequently, when the tool 50 is lifted from the cleaning surface 40, the resilience of the carrier 70 is sufficient to overcome the pressure difference and return the bristles assembly 53 to the centre of the suction opening 60.

Any through-holes in the carrier 70 may present a trap for fluff or other dirt. If the through-holes were too small, the through-holes may become blocked altogether. Larger through-holes will naturally reduce the likelihood of the through-holes blocking. However, as the number and sizes of the through-holes increase, the holes will have an increasing influence over the behaviour of the carrier 70. In particular, an excessive number of holes or holes that are excessively large may cause the carrier 70 to flex in an undesired manner. The location, number and sizes of the through-holes 78,79 are therefore selected such that the bristle assembly 53 is prevented from sticking against the trailing edge 63 of the nozzle 51 whilst ensuring that the behaviour of the carrier 70 is not adversely affected.

The through-holes 78,79 are formed in a region of the carrier 70 that is proximate the rear 56 of the nozzle 51. Since the connecting duct 52 is located at the rear 56 of the nozzle 51, the suction within the nozzle 51 is generally greatest at the rear 56 of the nozzle 51. Any pressure difference between the leading side and the trailing side of the

bristle assembly 53 is therefore likely to be greatest at the rear 56 of the nozzle 51. By locating the through-holes 78,79 in a region of the carrier 70 proximate the rear 56 of the nozzle 51, the number of through-holes may be kept to a minimum whilst ensuring that adequate equalisation of pressure is achieved.

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The through-holes 78,79 in the carrier 70 are of different sizes. In particular, the through-hole 78 closest to the rear 56 of the nozzle 51 is larger. Both through-holes 78,79 are of a size that is intended to make blockage of the holes 78,79 unlikely. By having through-holes 78,79 of different sizes, a larger hole 78 can be used towards the rear of the carrier 70 where the pressure difference between the leading and trailing sides of the bristle assembly 53 is likely to be greatest. Since the pressure difference further along the carrier 70 is likely to be smaller, a smaller hole 79 may be used. As a result, the effect that the through-holes 78,79 have on the behaviour of the carrier 70 can be kept to a minimum whilst ensuring that adequate equalisation of pressure is achieved.

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CLAIMS

1. A tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the
5 nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within the nozzle and protrudes through the suction opening, the bristle assembly comprises a strip of bristles, and the lengths of the bristles at the rear of the nozzle are shorter than those at the front of the nozzle.
10
2. A tool as claimed in claim 1, wherein the lengths of the bristles taper from the front to the rear of the nozzle.
3. A tool as claimed in claim 1 or 2, wherein the bristle assembly comprises a
15 carrier to which the bristles are attached, and the carrier protrudes beyond the suction opening.
4. A tool as claimed in claim 3, wherein the amount by which the carrier protrudes beyond the suction opening is greater at the rear of the nozzle than at the front of the
20 nozzle.
5. A tool as claimed in claim 3 or 4, wherein the carrier is arranged to pivot or flex relative to the nozzle.
- 25 6. A tool as claimed in claim 5, wherein the suction opening is delimited along its length by a leading edge and a trailing edge, and the carrier extends beyond the suction opening by an amount that permits the carrier to pivot or flex relative to the nozzle and contact the trailing edge.

7. A tool as claimed in claim 1 or 2, wherein the bristle assembly comprises a carrier to which the bristles are attached, and the carrier is arranged to pivot or flex relative to the nozzle.

5 8. A tool as claimed in any one of the preceding claims, wherein the bristle assembly is attached along a top of the nozzle.

9. A tool as claimed in any one of the preceding claims, wherein the height or width of the nozzle tapers from the rear to the front of the nozzle.

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10. A tool as claimed in any one of the preceding claims, wherein the bristles are formed of carbon fibre.

11. A tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment
15 to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within the nozzle and protrudes through the suction opening, and the width of the suction opening at the rear of the nozzle is greater than that at the front of the nozzle.

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12. A tool as claimed in claim 11, wherein the width of the suction opening tapers from the rear to the front of the nozzle.

13. A tool as claimed in claim 11 or 12, wherein the amount by which the bristle
25 assembly protrudes beyond the suction opening is greater at the rear of the nozzle than at the front of the nozzle.

14. A tool as claimed in any one of claims 11 to 13, wherein the bristle assembly is attached along a top of the nozzle.

30

15. A tool as claimed in any one of claims 11 to 14, wherein the height or width of the nozzle tapers from the rear to the front of the nozzle.

16. A tool as claimed in any one of claims 11 to 15, wherein the bristle assembly comprises a carrier to which a strip of bristles is attached, and the height of the carrier at the rear of the nozzle is greater than that at the front of the nozzle.

17. A tool as claimed in any one of claims 11 to 16, wherein the bristle assembly comprises a carrier to which a strip of bristles is attached, and the carrier is arranged to pivot or flex relative to the nozzle.

18. A tool as claimed in any one of claims 11 to 17, wherein the bristle assembly comprises a carrier to which a strip of bristles is attached, and the carrier protrudes beyond the suction opening.

19. A tool as claimed in claim 18, wherein the amount by which the carrier protrudes beyond the suction opening is greater at the rear of the nozzle than at the front of the nozzle.

20. A tool as claimed in claim 18 or 19, wherein the suction opening is delimited along its length by a leading edge and a trailing edge, and the carrier extends beyond the suction opening by an amount that permits the carrier to pivot or flex relative to the nozzle and contact the trailing edge.

21. A tool as claimed in any one of the preceding claims, wherein the bristle assembly comprises a strip of bristles formed of carbon fibre.

22. A tool for a vacuum cleaner, the tool comprising a nozzle, a duct for attachment to a wand, hose or the like of the vacuum cleaner, and a bristle assembly, wherein the nozzle comprises an elongate suction opening that extends from a front to a rear of the nozzle, the duct is attached to the rear of nozzle, the bristle assembly is mounted within

the nozzle and protrudes through the suction opening, the bristle assembly comprises a strip of bristles attached to a carrier, and the height of the carrier at the rear of the nozzle is greater than that at the front of the nozzle.

5 23. A tool as claimed in claim 22, wherein the height of the carrier tapers from the rear to the front of the nozzle.

24. A tool as claimed in claim 22 or 23, wherein the carrier is arranged to pivot or flex relative to the nozzle.

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25. A tool as claimed in any one of claims 22 to 24, wherein the carrier protrudes beyond the suction opening.

15 26. A tool as claimed in claim 25, wherein the suction opening is delimited along its length by a leading edge and a trailing edge, the carrier is arranged to pivot or flex relative to the nozzle, and the carrier extends beyond the suction opening by an amount that permits the carrier to pivot or flex and contact the trailing edge.

20 27. A tool as claimed in any one of claims 22 to 26, wherein the bristle assembly is attached along a top of the nozzle.

28. A tool as claimed in any one of claims 22 to 27, wherein the height or width of the nozzle tapers from the rear to the front of the nozzle.

25 29. A tool as claimed in any one of the preceding claims, wherein the bristles are formed of carbon fibre.

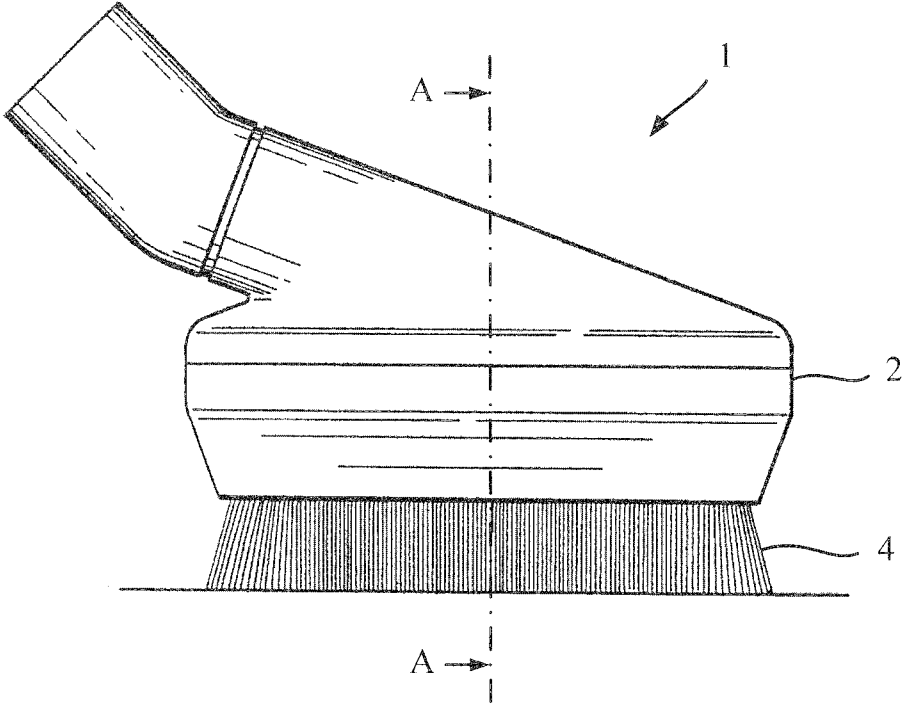


Fig. 1

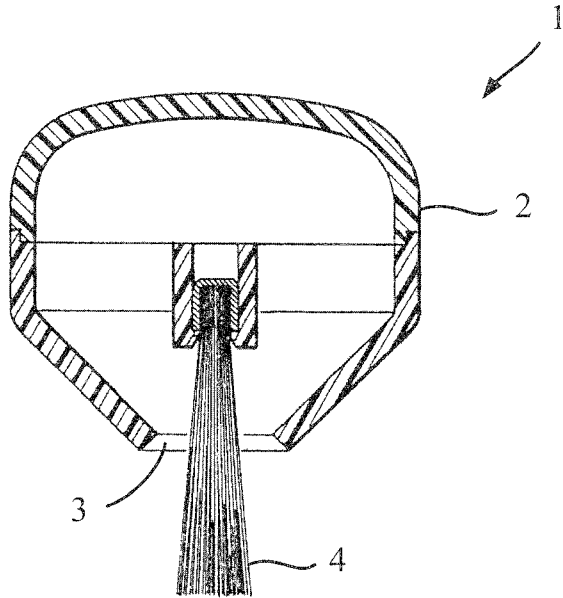


Fig. 2

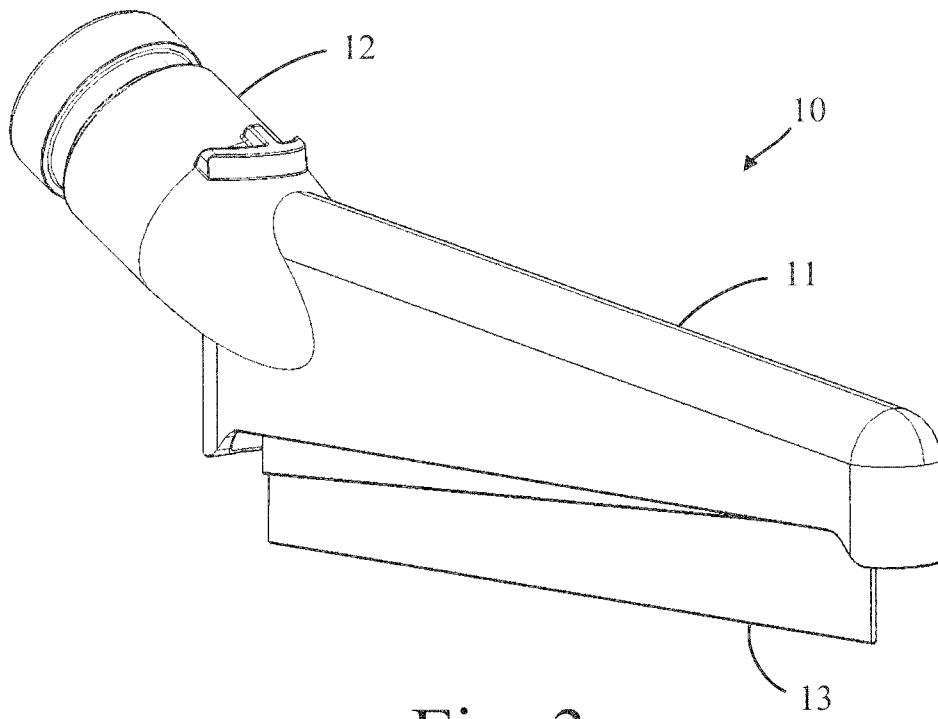


Fig. 3

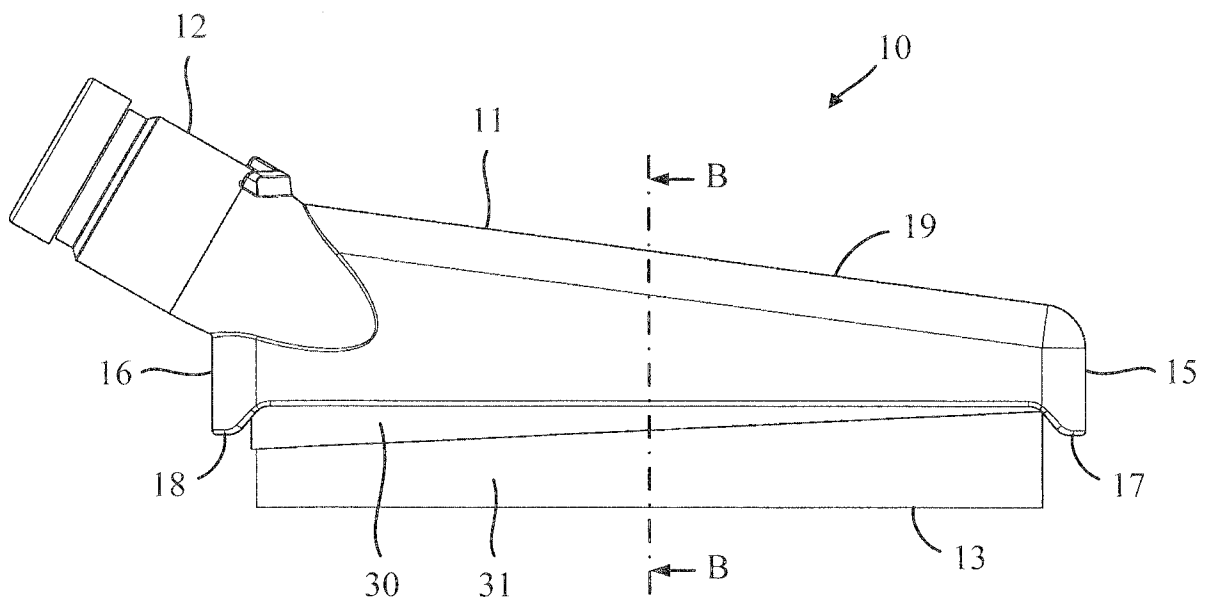


Fig. 4

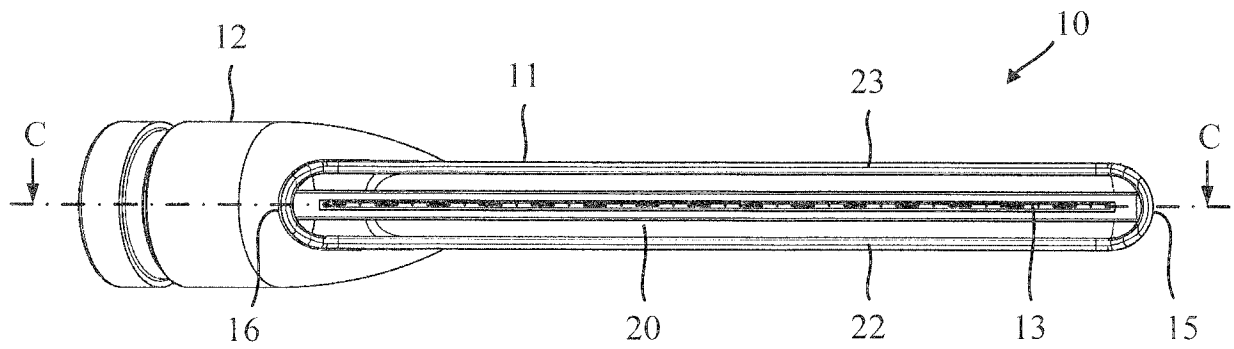


Fig. 5

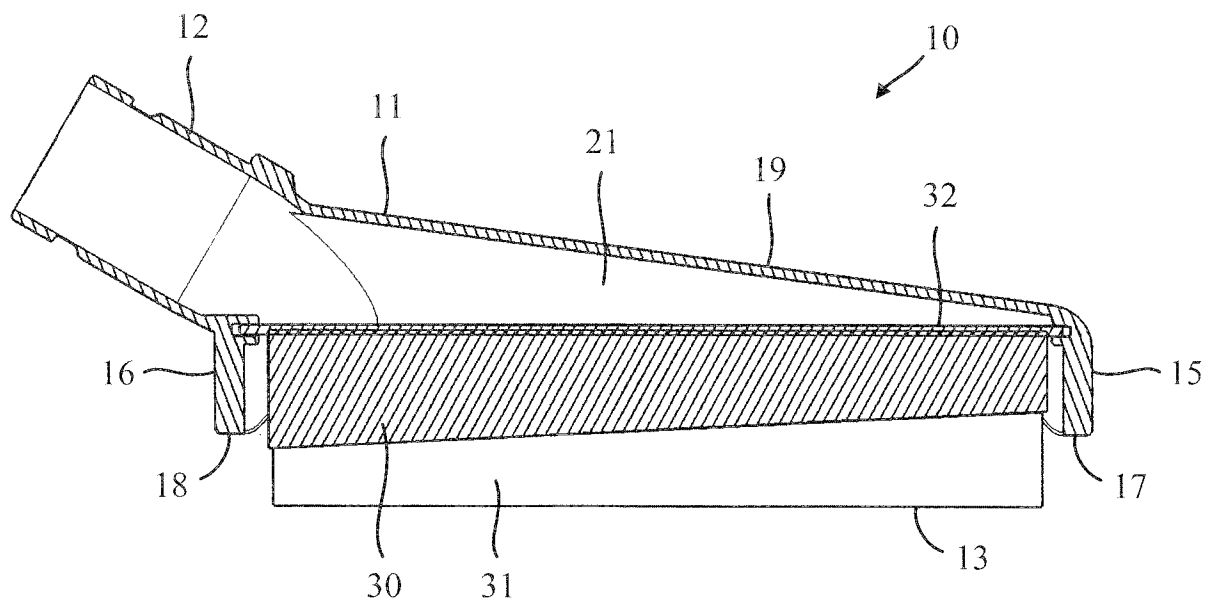


Fig. 6

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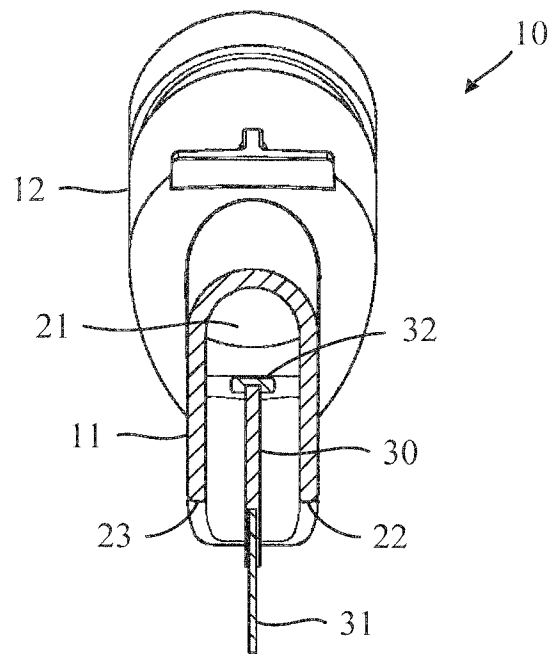


Fig. 7

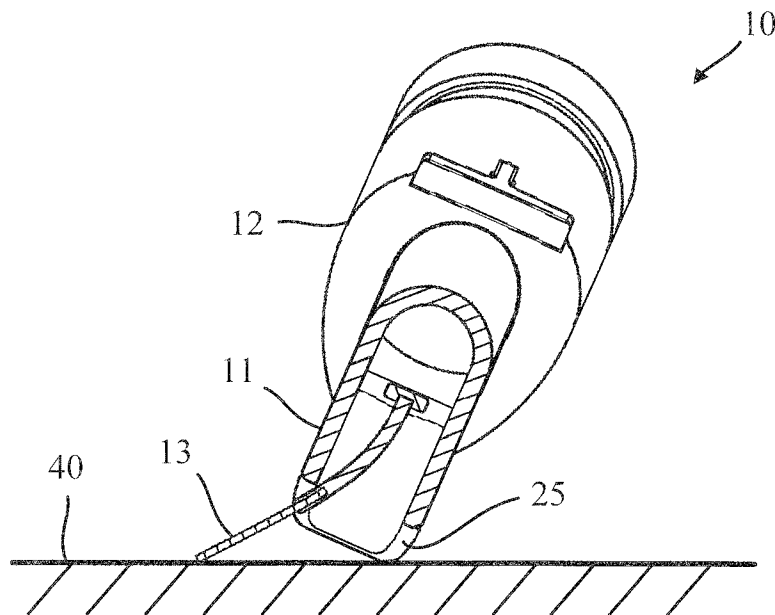


Fig. 8

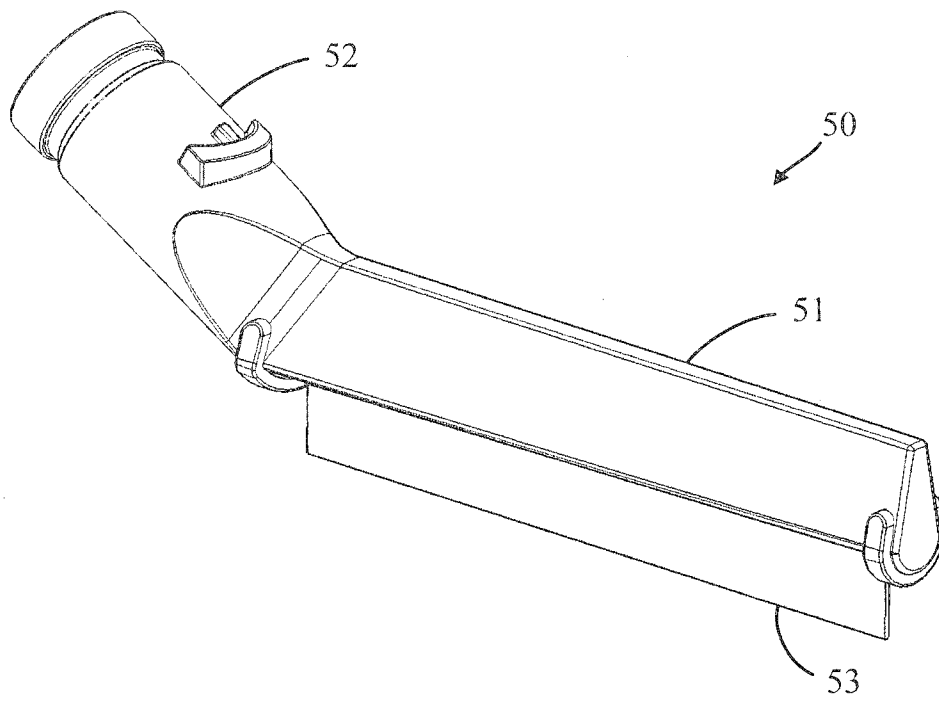


Fig. 9

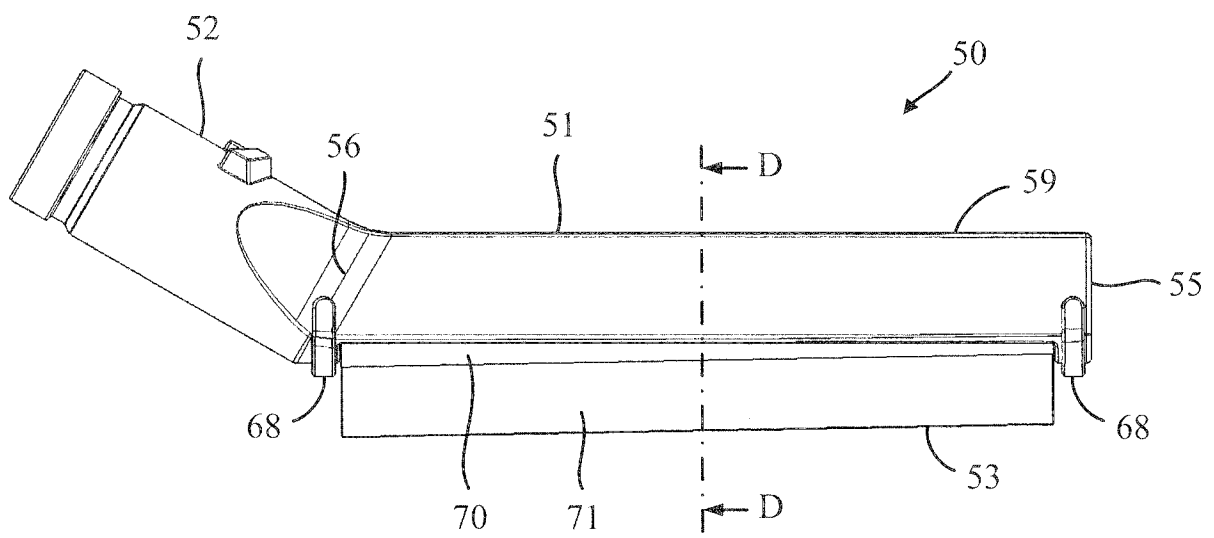


Fig. 10

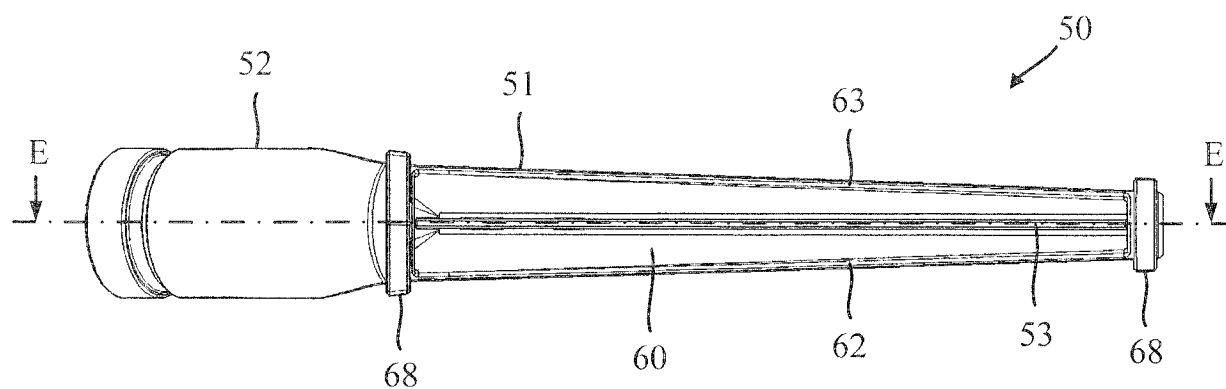


Fig. 11

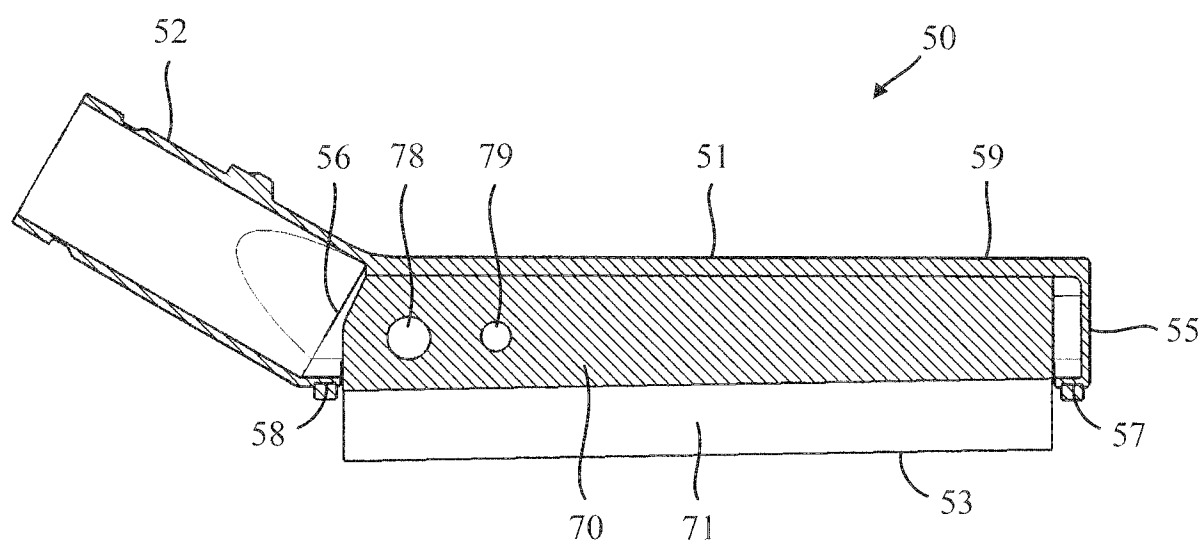


Fig. 12

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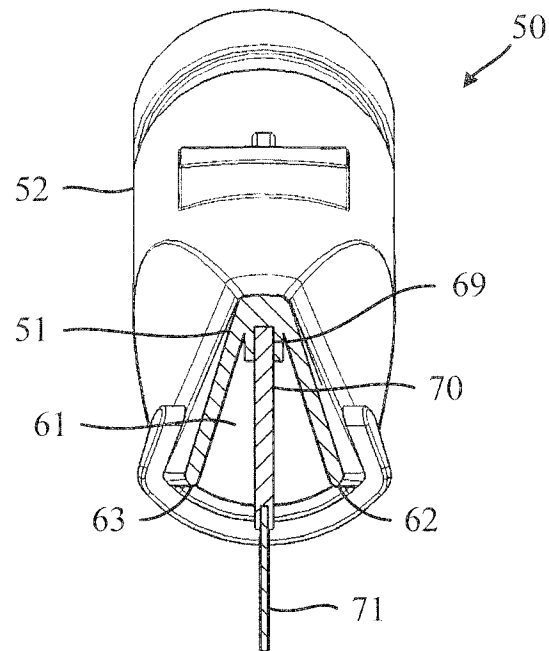


Fig. 13

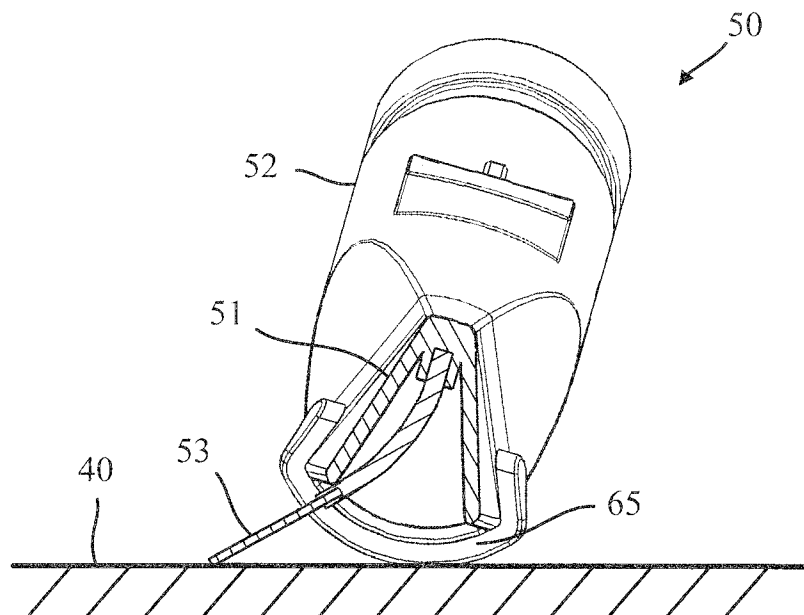


Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2014/050459

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/06
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

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 264 625 A2 (MAUZ & PFEIFFER PROGRESS [DE]) 27 April 1988 (1988-04-27)	1-3,5-10
A	abstract; figures 1-3	4,22-29
Y	DE 10 96 006 B (SIEMENS ELEKTROGERAETE GMBH) 29 December 1960 (1960-12-29)	1-3,5-10
A	abstract; figure 2	4,22-29
A	US 4 459 720 A (AHLF HEINZ-JUERGEN [DE] ET AL) 17 July 1984 (1984-07-17)	1-10, 22-29
A	FR 423 493 A (JOSEPH HEINDORF [DE]) 19 April 1911 (1911-04-19)	1-10, 22-29
	the whole document	
	-/--	

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

☒ See patent family annex.

* Special categories of cited documents :

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"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

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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

2 July 2014

Date of mailing of the international search report

16/07/2014

Name and mailing address of the ISA/

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Authorized officer

Hubrich, Klaus

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2014/050459

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/001958 A1 (RYYNAENEN ERKKI [FI]) 9 January 2003 (2003-01-09) abstract; figures 1-6 -----	1-10, 22-29
A	EP 1 421 891 A1 (CONET IND INC [KR]) 26 May 2004 (2004-05-26) abstract; figures 1/5-5/5 -----	1-29
A	EP 0 679 363 A2 (VORWERK CO INTERHOLDING [DE]) 2 November 1995 (1995-11-02) abstract; figures 1/5-5/5 -----	1-29
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A	FI 955 229 A (JAATINEN TOIVO [FI]) 2 May 1997 (1997-05-02) abstract; figure 1 -----	1-29

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2014/050459

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

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

see additional sheet

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 fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10, 22-29

Group I with:
claims 1-10 directed to a tool for a vacuum cleaner with a bristle assembly protruding through the suction opening, wherein the lengths of the bristles at the rear of the nozzle are shorter than those at the front of the nozzle, and claims 22-29 directed to a tool for a vacuum cleaner with a bristle assembly protruding through the suction opening, wherein the height of the carrier at the rear of the nozzle is greater than that at the front of the nozzle.

2. claims: 11-21

Group II with claims 11-21 directed to a tool for a vacuum cleaner with a bristle assembly protruding through the suction opening, wherein the width of the suction opening at the rear of the nozzle is greater than that at the front of the nozzle.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2014/050459

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