Title of the Invention: Debris collecting device
Abstract Title: Debris collecting device

A debris collecting device for a rotary tool having an axially rotating tool element such as a drill, hole saw or hole cutter comprises comprises a hopper formed by a wall having an upper opening 9 allowing passage of a tool element therethrough and a lower opening (11, fig 1) through which a mounting member for the tool element may pass. The wall comprises a flexible portion 7 that permits resilient compression of the hopper in response to an applied force along its axial length. The wall can be shaped so as to define one or more debrisretaining regions within its interior with the shape also allowing the wall to be resiliently and compressively deformed in response to an applied compressive force along its length. The shape can include an annular corrugation arrangement which allows the wall to compress and can also form the debris retaining region. The wall can be substantially S-shaped with the hopper being funnel like. At least part of the hopper may be transparent.

The claims were filed later than the filing date but within the period prescribed by Rule 22(1) of the Patents Rules 2007.
Debris Collecting Device

The present invention relates to a debris collecting device for use with a rotary power tool, e.g. an electric drill, and particularly one that is suitable for use with a hole saw.

Hole saw attachments are used to bore circular holes in surfaces. They comprise a hollow metallic cylinder with a serrated upper edge and a base through which passes a drill bit which acts as a pilot when aligning the saw to the surface. The lower end of the drill bit attaches to a rotary drill in the conventional manner. Typically, the diameter of such attachments varies from between 15mm and 150mm with the depth being appropriate for the thickness of the surface to be cut. For double-skin plasterboard, for example, a depth of at least 25mm is required to penetrate the board.

An example application of hole saws is in the installation of downlighter products in plasterboard ceilings. Here, the required hole diameter is ordinarily between 60mm and 100mm.

A problem associated with using hole saws is the inevitable falling of debris such as dust, plasterboard shavings and other waste material. Given that the drill/hole saw assembly will often be used in a vertical orientation, falling debris can land in the operator’s eyes, may be inhaled and will generally cause a mess.

According to a first aspect, there is provided a debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper formed by a wall having an upper opening allowing passage of a tool element therethrough and a lower opening through which a mounting member for the tool element may pass, wherein the
wall comprises a flexible portion that permits resilient compression of the hopper in response to an applied force along its axial length.

The wall may be a funnel, i.e. frusto-conical, or cylindrical. It may be formed from a single piece of material. The flexible portion may comprise a compressible wall section between the upper and lower openings. The wall may comprise two concentric cylindrical or funnel-like sections with an inverted section in-between.

According to a further aspect, there is provided a debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper formed by a wall having an upper opening allowing passage of a tool element therethrough and a lower opening through which a tool mounting element may pass, wherein the wall is shaped so as to define one or more debris-retaining region(s) within its interior and in which said shape allows the wall to be resiliently and compressively deformed in response to an applied compressive force along its axial length.

Said device enables improved retention of debris within the hopper by virtue of one or more internal debris-retaining regions(s) which themselves allow for compression of the hopper body to enable an interior tool element, such as a hole saw, to be applied to a surface. The device can be made as a single-piece structure and reduces the chances of debris falling downwards onto a user’s face or generally outside of the device until it is required to be emptied.

The hopper wall is preferably substantially annular.
The hopper wall may include an upper portion which is substantially cylindrical or funnel-like in shape and a lower portion which projects inwardly and upwardly to define a debris-retaining region. A plurality of said upper and lower portions may be arranged in series to define concentric debris-retaining regions within the interior. The angle between the or each inwardly projecting portion and its adjacent upper portion may be, substantially, 100 degrees or less.

The transition between the upper and lower portions may be curvilinear. The sectional profile of the wall may be substantially S-shaped.

Preferably, the wall is capable of being resiliently and compressively deformed by at least 25mm along its axial length.

The hopper can comprise a single piece of material, or can be made of a plurality of pieces. The hopper can be formed from a silicon-based material. The hopper can be moulded such that its lower part is thicker than the upper part.

Preferably, at least part of the hopper is transparent to allow a user to see where the tool element, e.g. the pilot drill bit, is located in relation to a ceiling marker even though it is covered by the hopper.

The lower end of the hopper may comprise an annular mounting portion surrounding and extending downwards from the lower opening. The lower part can be made of a different material, for example nylon, to allow the drill chuck on which it rests to rotate freely with respect to the hopper.
The hopper is preferably dimensioned to enclose, in its non-compressed state, a hole saw having a depth of 25mm. The hopper may be further dimensioned to enclose a hole saw having a diameter greater than 50mm.

According to a third aspect, there is provided a debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper having an upper opening and a lower, narrower, opening through which a tool mounting spindle may pass, wherein the hopper is formed from a flexible material having at least one annular corrugation to allow resilient compression of the hopper along its lengthwise axis and in which said at least one annular corrugation provides a groove or channel for collecting debris whilst the hopper is held in a vertical orientation.

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

Figure 1 is a perspective view of a debris collecting device according to the invention;
Figure 2 is a side-sectional view of the device shown in Figure 1;
Figure 3 is a side-sectional view of the device shown in Figure 1 when connected to a rotary drill tool and enclosing a hole saw assembly;
Figure 4 is a side-sectional view of the device shown in Figure 1 when an external upwards force is applied by means of the drill tool;
Figure 5 is a plan view of the device when viewed from above;
Figure 6 is a side-sectional view of the device shown in Figure 1 which is useful for understanding the dimensions of the embodiment;
Figure 7 is a side-sectional view of a second embodiment of the invention; and
Figure 8 is a side-sectional view of a third embodiment of the invention.

Referring to Figures 1 and 2, there is shown a debris collecting device for attachment to a rotary tool, such as an electric power drill. The device comprises a collection hopper 1 formed of a single piece of silicon-based material and which is at least partially transparent, for reasons that will become clear later on. The material is resiliently flexible.

The hopper 1 comprises a number of substantially concentric funnel-like wall sections that surround a vertical or lengthwise axis X-X. These annular sections include an upper section 3, a lower section 5 and an in-between inverted section 7 which projects upwards, or at an angle of less than 90 degrees, relative to a plane transverse to axis X-X. At a lower, base, region there is a second inverted section 8 leading to a mounting base 10 that, in use, is located over a fixed part of the drill 22, for which see Figures 3 and 4. The second inverted section 8 also projects upwards.

Referring to Figure 2, it will be seen that the walls 3, 5, 7, 8 define a hollow interior. An upper, circular, rim 13 defines an upper opening 9 through which a hole saw may pass into an adjacent work surface, for example a plasterboard ceiling. At the other end, the mounting base 10 is also circular and defines a central hole 11 through which a mounting spindle for the hole saw may pass.

The interface 15 between the upper wall section 3 and the inverted section 7 defines, within the interior, an annular
channel 29 which, in use, serves to collect and retain a significant amount of falling debris from above. The angle of the channel 29 between the upper and inverted walls is approximately 110 degrees. An upwards force applied along the axis X-X will cause the inverted section 7 to flex upwards (decreasing the angle of channel 29) due to the point of weakness inherent in the interface 7 and also the interface 17 between the inverted section 7 and the lower section 5. The effect is to cause compression of the hopper 1 which allows the tool to move upwards beyond the upper rim 13 and into the work surface.

Flexing also occurs at the interface 18 between the lower hopper section 5 and the second inverted section 8, although to a lesser extent. Here, a further, channel 30 (having an angle of approximately 35 degrees) is defined which serves to collect debris not collected by channel 29.

The interface regions 15, 17 and 18 enable much of the required compression but the silicon material is itself flexible and permits additional compression.

The shape and dimensions of the base second inverted section 8 are designed to allow the hopper 1 to mount on the chuck of a drill.

Referring now to Figure 3, the hopper 1 is shown when connected to mounted on a drill 22 with a hole saw 21. The process of mounting the hopper 1 comprises the following steps. First, the hole saw 21 and spindle 24 assembly is placed within the hopper 1 with the spindle passing through the hole 11. The spindle 24 is then mounted within the chuck 23. The base of the hopper 1 rests on the chuck 23 but does not grip it allowing the chuck to rotate freely without
necessarily turning the hopper. This is enabled by the material at the base being relatively rigid, e.g. nylon, and there being a gap between the hopper base and the lower end of hole saw 21.

Referring to Figure 4, in order to use the hole saw 21, for example to cut a hole in a ceiling 27, the hopper 1 is applied to the ceiling and pressure is applied along the axis X-X by the user pushing the drill 22 upwards, as indicated by arrow 26. At least the upper section 3 is transparent to allow the user to align the pilot drill of the hole saw to a marker. The applied pressure causes the hopper 1 to compress in the axial direction due to the inverted interfaces and the inherent flexibility in the material. As the hopper 1 compresses, the serrated edge of the hole saw 21 penetrates the ceiling 27 to bore the hole. Resulting debris is collected in the annular channels 29, 30 with no or minimal debris emerging through hole 11. After boring the hole, the hopper 1 returns to its original shape and can be emptied by inverting it over a bin.

As shown in Figure 3, the hole saw 21 is fully enclosed within the un-compressed hopper 1. The dimensions of the hopper 1 are designed to cater for a wide range of hole saw sizes, for example catering for diameters up to 150 mm and depths of 50 mm. The amount of compression permitted by the shape and dimensions must be sufficient to allow the serrated upper edge of the saw 21 to penetrate work surfaces by the required amount. As indicated previously, double skin plasterboard is generally 25 mm thick and so the amount of flexion must cater for this amount plus the clearance between the serrated upper edge and the hopper’s upper rim 13.
Figure 5 is a plan view of the hopper 1 when viewed from above. Figure 6 shows preferred dimensions which are as follows: a = 150 mm; b = 5 mm; c = 65 mm; d = 50 mm; e = 108 mm; f = 23 mm; g = 13 mm; h = 5 mm, with a +/- 2 mm tolerance. 3 mm thick, 60 shore transparent silicon is the preferred material.

Figure 7 shows a second embodiment in which the hopper 1 is formed of two parts, namely an upper silicon part 33 and a lower, thicker part 35, e.g. 2 mm acrylic/plastic. The two parts are joined by bonding at a fork region.

Figure 8 shows a third embodiment in which the hopper 101 comprises two substantially concentric cylindrical walls formed by an upper portion 103 and a lower portion 103, the two being joined by an inverted wall portion 107 the interior surface of which defines an annular debris collecting region, as well as providing resilient flexibility in the axial direction. The interfaces 150 between the portions are in this case more rounded than the first and second embodiments and are found to have certain advantages in that the wall is able to roll in on itself and collapse in a smooth manner. The debris collecting region is greater in terms of volume. As the figure indicates, the sectional profile of the wall is curvilinear, particularly S-shaped.

The hopper wall can be formed of a single piece of material, as shown, or using two or more sections.

The rim 130 is a rounded 5 mm bead approximately 153 mm in diameter. The shaded portions of the wall may optionally be formed thicker than the non-shaded portions for example, with the shaded portions are formed of 2 mm 60 shore silicon with the non-shaded portions being 1 mm 60 shore silicon.
Preferably, however, the wall has substantially uniform thickness.

The lower portion of the hopper 100 comprises an outward collar 180 bonded to a separate base part 110 by overmoulding. Like the previous embodiments, base part 110 comprises an axial hole 111 through which a mounting spindle for the hole saw may pass. The base part 110 is formed of 2 mm nylon plastic with a 15 mm axial hole 111.

A with previous embodiments, the silicon material should be at least partially transparent to allow visual alignment by a user of the pilot drill bit to a marker on the surface to be worked.

The above described debris-collecting devices are capable of preventing, or at least minimising, the amount of debris falling onto the user. The device is easily produced in a single piece moulding, and is flexible by virtue of having an annular section part way down the frusto-conical wall which is corrugated or inverted to allow compression in the axial direction. A number of such concentric sections may be provided. In the case of the inverted section or sections, debris-collecting channels are defined for retaining debris.
CLAIMS

1. A debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper formed by a wall having an upper opening allowing passage of a tool element therethrough and a lower opening through which a mounting member for the tool element may pass, wherein the wall comprises a flexible portion that permits resilient compression of the hopper in response to an applied force along its axial length.

2. A device according to claim 1, wherein the wall is a funnel.

3. A device according to claim 2, wherein the wall is frusto-conical.

4. A device according to any preceding claim, wherein the wall is formed from a single piece of material.

5. A device according to any preceding claim wherein the flexible portion comprises a compressible wall section between the upper and lower openings.

6. A device according to claim 5, wherein the compressible wall comprises two concentric cylindrical or funnel-like sections with an inverted section in-between.

7. A debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper formed by a wall having an upper opening allowing passage of a tool element therethrough and a lower opening through which a tool mounting element may pass, wherein the wall is shaped so as to define one or more debris-retaining
region(s) within its interior and in which said shape allows
the wall to be resiliently and compressively deformed in
response to an applied compressive force along its axial
length.

8. A device according to claim 7, wherein the hopper wall is
annular.

9. A device according to claim 7 or claim 8, wherein the
hopper wall includes an upper portion which is substantially
cylindrical or funnel-like in shape and a lower portion which
projects inwardly and upwardly to define a debris-retaining
region.

10. A device according to claim 9, wherein a plurality of
said upper and lower portions may be arranged in series to
define concentric debris-retaining regions within the
interior.

11. A device according to claim 10, wherein the angle between
the or each inwardly projecting portion and its adjacent upper
portion may be, substantially, 100 degrees or less.

12. A device according to any one of claims 7 to 10, wherein
the transition between the upper and lower portions is
curvilinear.

13. A device according to claim 12, wherein the sectional
profile of the wall is substantially S-shaped.

14. A device according to any preceding claim, wherein the
wall is capable of being resiliently and compressively
deformed by at least 25mm along its axial length.
15. A device according to any of claims 7 to 14, wherein the hopper comprises a single piece of material.

16. A device according to any of claims 7 to 15, wherein at least part of the hopper is transparent.

17. A device according to any one of claims 7 to 16, wherein the lower end of the hopper comprises an annular mounting portion surrounding and extending downwards from the lower opening.

18. A device according to claim 17, wherein the lower part is made of a different material to allow the drill chuck on which it rests to rotate freely with respect to the hopper.

19. A debris collecting device for a rotary tool having an axially rotating tool element, wherein the device comprises a hopper having an upper opening and a lower, narrower, opening through which a tool mounting spindle may pass, wherein the hopper is formed from a flexible material having at least one annular corrugation to allow resilient compression of the hopper along its lengthwise axis and in which said at least one annular corrugation provides a groove or channel for collecting debris whilst the hopper is held in a vertical orientation.
Application No: GB0919026.5  Examiner: Mr Rhodri Evans
Claims searched: 1-19  Date of search: 15 October 2010

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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Categories:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC.X:
Worldwide search of patent documents classified in the following areas of the IPC
B08B; B23B; B23Q

The following online and other databases have been used in the preparation of this search report
WPI, EPODOC

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