The present invention provides a hole cutter (70) for cutting a hole (H) in a surface (S). The cutter comprises a cutting head (22) having a cavity (24) formed therein and a cutting surface (36) at one end for cutting the hole. A passage (15) for a drill (12) extends from the cavity to the cutting surface. The drill is adapted for being rotatably driven for relative axial movement in the cavity between a first position in which the drill extends through the passage and a cutting end of the drill projects beyond the cutting surface, and a second position in which the drill has been at least partially retracted into the head. In use, when the drill is rotatably driven whilst in the first position it can be advanced into the surface to drill a pilot hole therein until the cutting head contacts the surface, wherein the drill can then be moved relatively axially in the head to the second position, and thereafter further rotation of the drill causes the cutting head to rotate to enable cutting of the plug hole.
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A HOLE CUTTER

FIELD OF THE INVENTION

The present invention relates to a tool for cutting holes, for example, in walls, floors and ceilings and other building applications and in surfaces such as surfcraft decks, boats etc. The invention finds particular application with the cutting of holes for electrical, plumbing, building and engineering applications, and in the cutting of plug holes for detachable surfboard fins (such as shown in Australian Patent Number 665804). The invention will be primarily described in these applications, but it should be appreciated that the invention can be used to cut holes, grooves, recesses etc in a broad variety of applications and in varying surfaces, substrates and materials.

BACKGROUND TO THE INVENTION

Hole saws are known in building and engineering applications. For example, some hole saws are adapted for fitting into a power drill to be rotated thereby and are used for cutting holes in a wide variety of surfaces and substrates. Hole saws have a tendency to become clogged, however, as debris tends to be retained within the saw interior.

So-called "speed bore" drills are also employed to form holes, being a drill bit with an enlarged cutting head at the drilling end thereof. However, the speed bore blades wear rapidly and very firm control of the power drill must be maintained if an even hole is to be formed.

Detachable fins for surfcraft have been known for some time. Detachable fins have the advantage that they can be removed for transport of the surfcraft, and when a fin is broken it can be readily replaced. The fitting of recently developed detachable fins (such as shown in Australian Patent No. 665804), and also the fitting of legrope plugs, has presented the surfcraft manufacturer with new challenges, and current techniques have to some extent slowed down the overall surfcraft manufacturing process.
It would be advantageous if a hole cutter could be provided which may assist in the easier or faster formation of holes in a variety of substrates and surfaces.

**SUMMARY OF THE INVENTION**

The present invention provides a hole cutter for cutting a hole in a surface, comprising:

- a cutting head having a cavity therein and a cutting surface at one end for cutting the hole, with a passage for a drill extending from the cavity to the cutting surface; and

- a drill adapted for being rotatably driven for relative axial movement in the cavity between a first position in which the drill extends through the passage and a cutting end of the drill projects beyond the cutting surface, and a second position in which the drill has been at least partially retracted into the head;

such that in use, when the drill is rotatably driven whilst in the first position it can be advanced into the surface to drill a pilot hole therein until the cutting head contacts the surface, wherein the drill can then be moved relatively axially in the head to the second position, and thereafter further rotation of the drill causes the cutting head to rotate to enable cutting of the plug hole.

The drill thus provides an initial ease of penetration into a surface (a drill providing a relatively high point force at the surface). It also enables the cutting head to be stably brought into engagement with the surface to be cut. Furthermore, the drill can be preferably entirely retracted into the cutting head so that thereafter the cutting head only continues with the hole cutting. This retraction can thus prevent over-penetration by the drill into the surface.

Such a tool can also readily form a hole for a plug, which when fitted in a surfcraft (eg. a surfboard) can then fasteningly receive therein a respective lug projecting from a base of a fin (such as a fin shown in Australian Patent No. 665804). The hole can also easily
receive a so-called legrope plug.

Thus, the preparation of the hole can be achieved by the one tool in a simple operation (eg. typically with the tool fitted in the end of a standard portable power drill).

Usually the cutting head is of a unitary construction, with an abrasive surface being formed or defined at a cutting end thereof. However, the cutting head can be defined by a body having a detachable cutting end thereat, such that ends of different sizes and shapes can be attached to the body for cutting different sized holes (ie with the remainder of the hole cutter being unchanged). The ends can be screw fitted to the body (in a male-female threaded coupling arrangement), or a bayonet fitting can be provided for enabling ease of attachment and detachment of different ends to the body.

Preferably said adaptation of the drill includes a drill holder into which the drill is incorporated in use, and wherein the drill holder is guided in the cavity during said axial movement. The use of a drill holder facilitates a more controlled and robust operation of the tool. Typically the flange moves freely and unencumbered in the cavity between the first and second positions in use.

Preferably a C-shaped slot is provided in a wall of the head, and a pin extends from the drill holder and into the slot to move therein and facilitate said guidance. This arrangement further enhances the controlled and robust operation of the tool.

Preferably the pin is located in a bottom end of the slot in the first position of the drill, and can be located in a top end of the slot in the second position of the drill, the pin and slot being adapted for interacting in use such that the rotation of the drill holder in both the first and second positions causes a corresponding rotation of the head. Thus, in the first position the drill can perform a pilot hole drilling function, and in the second position the drill can be essentially benign, leaving cutting to the cutting head.
Preferably the drill holder has a bore extending part way therethrough, and into which the drill is fixedly received. In this regard, the pin can extend through the drill holder to engage against the drill when in the bore to fasten the drill in the drill holder. The non-cutting end of the drill can alternatively or additionally be adhesively affixed in the bore (eg. with Loctite TM adhesive).

Preferably a spring loaded ball is positioned in a slot formed in the holder on an opposite side to the pin, in use the ball being urged by the spring against an internal wall of the head to further facilitate said guidance. Again, this makes for smoother movement of the drill holder in the cavity.

Preferably an opening is formed in an end of the head opposing said one end and extending from the cavity, with the holder including a shank which extends out from the opening for engagement by a rotating drive (eg. to be locked in the chuck of a portable power drill) that can in turn drivingly rotate the drill in use.

Preferably a ring is externally positioned around the head that can be located up and down a side wall thereof in use, the ring having a pin that extends internally therefrom and into a longitudinal slot formed at the side wall, such that the pin can be selectively fastened at various positions in the longitudinal slot, such that in use when the ring ultimately engages with the surface, the cutting head is prevented from being further advanced into the surface in use. Thus, the ring can be located to enable the cutting head to cut only to a certain depth or to prevent the head from cutting right through a surface in use.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Notwithstanding any other forms which may fall within the scope of the present invention, preferred forms of the invention will now be described, by way of example only, with reference to the accompanying drawings in which: Figures 1 and 2 show, respectively, side and underside plan
elevations of a preferred drill holder in accordance with the present invention;
Figures 3 and 4 show, respectively, side and underside plan elevations of a preferred tool body in accordance with the present invention;
Figures 5 and 6 show, respectively, side and underside plan elevations of a preferred ring for external positioning on a tool body in accordance with the present invention;
Figure 7 shows an underside plan elevation of a preferred hole cutter tool when assembled in accordance with the present invention;
Figure 8 shows a partially sectioned side elevation of the hole cutter tool when assembled, with a drill positioned in an extended first position and the ring located for a relatively shallow cutting depth;
Figure 9 shows the tool of Figure 8, but with the drill in a retracted second position and the ring located for a relatively deeper cutting depth;
Figure 10 shows a partially sectioned side elevation of an alternative tool to Figure 8 wherein a cutting end of the tool body is detached therefrom;
Figure 11 shows a side elevation of the cutting end;
Figure 12 shows an underside plan of the cutting end of Figure 11;
Figure 13 shows an assembled side elevation of the tool of Figures 10 and 11;
Figure 14 shows a partially sectioned elevation of the tool of Figure 13, illustrating schematically the attachment of a drill bit within the tool;
Figure 15 shows a side elevation of an alternative tool to Figure 13, in which a cutting end is affixed by means of a bayonet fitting, the tool in Figure 15 being in a retracted position;
Figure 16 shows a detail of the tool of Figure 15, but with the tool in an extended position;
Figure 17 shows a plan view of the tool body of Figure 15, illustrating pins used in the bayonet fitting;
Figure 18 shows an alternative cutting end to that of
Figure 11; and
Figure 19 shows an assembled partial side elevation of an alternative tool fitted with the cutting end of Figure 18.

MODES FOR CARRYING OUT THE INVENTION

Referring to Figures 1 and 2, a drill holder 10 for a drill bit 12 (Figures 8 & 9) includes a cylindrical body 14 having a bore in the form of hollow recess 15 formed therein. A non-cutting end of the drill bit 12 can be fixed or adhesively bonded (e.g., with Loctite TM adhesive) in the recess 15 to be supported in the holder.

Body 14 further includes a first bore 16 for fasteningly receiving a pin 17 therein (Figure 7). The pin 17 helps guide the movement of the holder in the tool (described below). The pin can also be used to fasten the drill bit 12 in recess 15 (Figures 13 and 14 – described below). Further, the pin inhibits the rotation of the drill holder in the tool body (described below).

A second bore 18, opposite to the first bore, is also formed in the body 14. A ball 19 that is biased by spring 20 (Figure 7) is positioned in the second bore, and also helps guide the movement of the holder in the tool (described below).

The holder 10 further includes a circular or hexagonal shank 21 projecting upwardly from body 14 and which can be fitted into the chuck of a power drill to drivingly rotate the holder in use. The shank is typically circular, triangular or hexagonal in cross-section to easily fit into and be gripped by a standard chuck.

Referring now to Figures 3 and 4, a tool body 22 includes a cylindrical cavity 24 formed therein. The upper end of cavity 24 is open for receiving the drill holder snugly thereinto (Figures 8 & 9). The lower end of the cavity is closed except at a small cylindrical hole 28, which opens onto a base 30 of the body. The cavity diameter is slightly larger than the diameter of the body 14 to facilitate a close but sliding fit therebetween (thus minimising drill vibration in use).

The drill bit 12 extends through hole 28 in use
(Figures 8 & 9), and shoulders 32, 34 delimit the downward travel of holder 10 in cavity 24 (Figure 8).

The lower end (base 30) of body 22 has an inset cutter flange 36 defined thereat. The outer surface of flange 36 is provided with an abrasive which is typically formed thereon (e.g. a hard wearing metallic or carbide grit electrically or chemically welded, deposited or adhered thereon).

One side of body 22 is provided with a C-shaped passage 38 which opens out at wall 40 and extends right through to cavity 24. The C-shaped passage has an upper lateral portion 42, a lower lateral portion 44 and an interconnecting passage 46. On the opposite side of body 22, a longitudinal groove 48 is formed in and opens out at wall 40, but groove 48 extends only part way into the wall 40 (Figure 4).

Referring to Figures 5 and 6, a ring 50 for positioning externally on body 22 is depicted. The ring includes a threaded bore 52 in and through which a threaded grub screw 54 threadingly extends to protrude into and be fastened in various positions along passage 48 in use (Figure 7). The internal diameter of the ring is slightly larger than the diameter of body 22 to facilitate a snug sliding of the ring on body 22. The ring is used to control the depth of the hole cut (described below) or can be omitted altogether.

Referring now to Figure 7, it can be seen firstly how the pin 17 protrudes into C-shaped passage 38 to guide the movement of the drill holder 10 in body 22. Secondly, it can be seen that the opposing ball 19 is urged against the wall of cavity 24 by spring 20, thereby further facilitating a smooth and balanced movement of holder 10 in cavity 24 in use. Thirdly, it can be seen how grub screw 54 protrudes into passage 48 to fixedly retain the ring externally on body 22 at a desired location.

Figures 8 and 9 show an assembled hole cutter in the form of tool 70, with the drill holder 10 carrying drill bit 12 and fitted into the tool body 22. In Figure
8, the holder 10 is shown positioned right down in the tool. In this first position, the holder lower end 71 abuts shoulders 32, 34. Further, drill bit 12 extends through passage 28 so that its cutting end 74 protrudes well beyond the body 22. Further, the pin 17 is urged into the end 72 of the lower lateral portion 44 of the C-shaped passage (Figure 8) and is maintained therein in use by the rotation of the drill holder in a power drive (not shown).

In Figure 8 the ring 50 has been fastened in a position to provide a shallow cut (i.e. to form a shallow hole - if this is required). However, the ring is often fastened further up along the wall 40 (e.g. as shown in Figure 9) or may be omitted altogether (e.g. where it is necessary to drill right through a thicker surface).

When the drill holder is rotatingly driven by the drive (e.g. a power drill), the whole assembly 70 rotates and the drill bit (end 74) can then be urged into a surface S to drill a pilot hole P (for the subsequently formed hole H). The advantage of initially using a drill in the cutting operation is that it can easily penetrate a hard surface and it at least initially also provides a locating (anchor) function for the subsequent rotational cutting made by the flange 36.

Once the drill has penetrated into the surface to the extent that the flange 36 then engages the surface at D, rotation of the tool can be stopped. The drill holder and drill can then be retracted into the tool by moving the pin 17 in the C-shaped passage, firstly into passage 46 and thence into upper lateral portion 42 (Figure 9). During this movement, the holder lower end 71 no longer abuts or faces shoulders 32, 34 and the holder is then moved freely upwards in the cavity 24.

Further rotation of the drill holder by the drive maintains the pin at end 76 of passage 42 and enables the cutting of hole H. Whilst the drill cutting end can be partially, substantially or entirely retracted into the tool in Figure 9 it can also be withdrawn to a position where it assists with the abrasive at flange 36 to cut the
hole. Also, when the end is still slightly protruding it can be relocated into the pilot hole to assist with progressive cutting of the hole. Also, as the tool is advanced into the surface to cut the hole H, the ring 50 (now at a different location) eventually engages the skin of the surface at D and thus prevents further tool advancement.

In another embodiment, the grub screw can be sized such that it enables the ring to travel up along tool body at wall 40 (i.e. with grub screw 54 travelling in groove 48). In this latter embodiment, with further tool advancement, eventually the grub screw reaches the top of groove 48 (or a stop formed or positioned therein) and thus ring travel is halted. The ring then prevents further advancement of the tool into the surface, and signals completion of the hole cutting operation.

In either case, once the ring has prevented further tool advancement, the tool can then be withdrawn from the newly formed hole, and the drill holder returned to the position of Figure 8 for cutting of further holes. The ring arrangement thus controls the depth of the hole cut (e.g. to prevent a hole being cut right through a surfcraft), thereby functioning as a depth gauge. Of course, where hole depth is not relevant the ring can be removed from the tool.

Referring now to Figures 10 to 14, where like reference numerals will be used to denote similar or like parts, an alternative tool 70' has a modified tool body 80. As can be seen, the lower open end 82 of body 80 is internally threaded at 84. A detachable cutter end 86 has external threads 88 formed therearound for threadably engaging internal threads 84. In other words, the cutter end can be screwed onto and unscrewed from body 80. The cutter end has an abrasive surface 90 formed thereon (as per the tool of Figure 8). The diameter of the abrasive end 90 can be varied to cut different sized holes. In other words, a cutter end with a different diameter cutting surface can readily replace an existing cutter end attached
to body 80. As can be seen, the cutter end is provided with a bore 92 through which the drill bit 12 extends (Figures 13 and 14).

As seen in Figure 12, a transverse passage 94 can be provided in the underside of the cutter end for releasing debris that is distributed to the underside of the cutter end by drill bit 12 during use of the device.

Referring to Figures 13 and 14, it can be seen how pin 17 can be screwed right through from the exterior of the tool to engage against and fasten drill bit 12 in drill holder 10. The pin 17 can be provided in the form of an allen screw 17 for its ready tightening and untightening. The operation of the tool 70' is in all other respects similar to the operation of the tool of Figure 8.

Referring now to Figures 15 to 17, like reference numerals will be used to denote similar or like parts to the tools of Figures 1 to 14. In this embodiment, the cutter end 86', rather than having an externally threaded section 88 has a pair of opposing L-shaped slots 100 formed therein, and into which a pair of opposing bayonet pins 102 are respectively received. In other words, attachment of cutter end 86' to tool 70'' is facilitated by pushing on and then rotating the end so that the pins are moved into and abut the end of each slot 100 (as shown in Figure 15).

An additional safe fastening of the cutter end 86' to body 80 can be facilitated by screwing an allen grub screw 104 through body 80 and into engagement with the cutter end. In all other respects, the tool 70'' of Figures 15 to 17 functions in a similar way as the tool of Figure 8.

Referring now to Figures 18 and 19, an alternative detachable cutter end 120 includes a fructoconical cutting surface 122 with an insert shank 124 extending upwardly therefrom. The drill (not shown) extends out of lower opening 126. A pair of opposing threaded holes 128 are formed in the shank and are each adapted for threadably receiving the end of a respective locking screw 130 therein.

In Figure 19, it will be seen that cutter end 120
fits snugly within modified tool body 132, with shank 124 extending up into body cavity 134. The cutter end is positioned such that holes 128 align with respective countersunk holes 136 formed in body 132. A countersunk screw 130 can then be screwed in to each aligned hole pair to releasably fasten the cutter end in place in the tool body.

Preferably a pitch is employed on the cutter end as shown, to further facilitate the drilling action of the cutting tool. Typically a 4mm pitch is employed.

It should be noted that with both the tool 70' and the tool 70'', the orientation (sense) of the threads 84, 88 and of the pin and slots 100, 102 is selected such that when the cutter head engages against the surface in a cutting operation, the threads are tightened or the pin is maintained in the end of its respective slot. In other words, the cutting action prevents the cutter end from detaching from the body 80. This feature can also be used to remove the cutter end from the body 80 (eg. where the power drive has a reversible function). In this case, the direction of tool rotation can be reversed and the tool can be urged against a surface to unscrew threads 84, 88 or to move pins 102 out of slot 100.

Typically all of the components of the tool are formed from metal (eg. steel, steel alloys, aluminium, copper etc) or other strong and hard wearing materials. Plastic may be employed in some situations for certain components (eg. body 22 or holder 10).

Typically drill holder 10 is moved manually in the tool between the positions of Figures 8 and 9. However, other mechanisms, such as an oppositely acting thread system between the holder and the body (eg. opposing the drive rotational sense), or a gear driven drill (eg. a rotating gear acting on a rack on the drill holder) can also be employed. The manual arrangement is most preferred because it is robust and simple in construction and use.

Whilst the invention has been described with reference to a number of preferred embodiments, it should
be appreciated that the invention can be embodied in many other forms.
CLAIMS

1. A hole cutter for cutting a hole in a surface, comprising:
   - a cutting head having a cavity therein and a cutting surface at one end for cutting the hole, with a passage for a drill extending from the cavity to the cutting surface; and
   - a drill adapted for being rotatably driven within and for engaging with the cutting head to rotate the same, the drill being moveable axially in the head between a first position in which the drill extends through the passage and a cutting end of the drill projects beyond the cutting surface, and a second position in which the drill has been at least partially retracted into the head;
   such that in use, when the drill is rotatably driven whilst in the first position it can be advanced into the surfcraft to drill a pilot hole therein until the cutting head contacts the surfcraft, wherein the drill can then be moved relatively axially in the head to the second position, and thereafter further rotation of the drill causes the cutting head to rotate to enable cutting of the plug hole.

2. A cutter as claimed in claim 1, wherein the cutting head is defined by a body having a detachable cutting end thereat, to enable interchange of cutting ends at the body.

3. A cutter as claimed in claim 1 or claim 2, wherein said adaptation of the drill includes a drill holder into which the drill is fixed in use, and wherein the drill holder is guided in the cavity during said axial movement.

4. A cutter as claimed in claim 3, wherein a C-shaped slot is provided in a wall of the head, and a pin extends from the drill holder and into the slot to move therein and facilitate said guidance and to translate holder rotational movement to the cutting head.

5. A cutter as claimed in claim 4, wherein the pin
can be located in a bottom end of the slot in the first position of the drill, and can be located in a top end of the slot in the second position of the drill, and wherein the pin engages end walls of the slot in the first and second positions to translate the holder rotational movement to the head.

6. A cutter as claimed in claim 4 or claim 5, wherein the drill holder includes a bore into which a non-cutting end of the drill is fixed, and the pin optionally also extends through the drill holder and into the bore to engage with the drill to fix the same in the bore in use.

7. A cutter as claimed in any one of claims 4 to 6, wherein a spring loaded ball is positioned in a slot formed in the holder on an opposite side to the pin, in use the ball being urged by the spring against an internal wall of the head to further facilitate said guidance.

8. A cutter as claimed in any one of claims 3 to 7, wherein an opening is formed in an end of the head opposing said one end and extending from the cavity, with the holder including a shank which extends out from the opening for engagement by a rotating drive that can in turn drivingly rotate the drill in use.

9. A cutter as claimed in any one of the preceding claims, wherein a ring is externally positioned around the head that can be located at various positions along a side wall thereof in use, the ring having a pin that extends internally therefrom and into a longitudinal slot formed at the side wall, such that the pin can be selectively fastened at various positions in the longitudinal slot, whereby ring engagement with the surface can prevent the cutting surface from being further advanced into the surface in use.

10. A hole cutter for cutting a hole in a surface substantially as herein described with reference to the accompanying drawings.
AMENDED CLAIMS
[received by the International Bureau on 3 November 1999 (03.11.99); original claim 1 amended; remaining claims unchanged (1 page)]

1. A hole cutter for cutting a hole in a surface, comprising:
   - a cutting head having a cavity therein and a cutting surface at one end for cutting the hole, with a passage for a drill extending from the cavity to the cutting surface; and
   - a drill adapted for being rotatably driven within and for engaging with the cutting head to rotate the same, the drill being moveable axially in the head between a first position in which the drill extends through the passage and a cutting end of the drill projects beyond the cutting surface, and a second position in which the drill has been at least partially retracted into the head;
   such that in use, when the drill is rotatably driven whilst in the first position it can be advanced into the surface to drill a pilot hole therein until the cutting head contacts the surface, wherein the drill can then be moved relatively axially in the head to the second position, and thereafter further rotation of the drill causes the cutting head to rotate to enable cutting of the hole.

2. A cutter as claimed in claim 1, wherein the cutting head is defined by a body having a detachable cutting end thereat, to enable interchange of cutting ends at the body.

3. A cutter as claimed in claim 1 or claim 2, wherein said adaptation of the drill includes a drill holder into which the drill is fixed in use, and wherein the drill holder is guided in the cavity during said axial movement.

4. A cutter as claimed in claim 3, wherein a C-shaped slot is provided in a wall of the head, and a pin extends from the drill holder and into the slot to move therein and facilitate said guidance and to translate holder rotational movement to the cutting head.

5. A cutter as claimed in claim 4, wherein the pin
INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00650

A. CLASSIFICATION OF SUBJECT MATTER

Int Cls: B23B 51/00, 51/08, B24B 19/22, B63B 35/79

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)
B23B 51/00, 51/08, B24B 19/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC As above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 5558552 A (NAMUR) 24 September 1996 Abstract</td>
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☐ Further documents are listed in the continuation of Box C

X See patent family annex

* Special categories of cited documents:
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Date of the actual completion of the international search
6 September 1999

Date of mailing of the international search report
07 SEP 1999

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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