To:	MK Diamond Products, Inc. (Becker-docket@fzlz.com)
Subject:	U.S. TRADEMARK APPLICATION NO. 86813875 - M-K 1508264
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UNITED STATES PATENT AND TRADEMARK OFFICE (USPTO)
OFFICE ACTION (OFFICIAL LETTER) ABOUT APPLICANT'S TRADEMARK APPLICATION

U.S. APPLICATION
SERIAL NO. 86813875

MARK: *86813875*

CORRESPONDENT ADDRESS:
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APPLICANT: MK Diamond Products, Inc.

CORRESPONDENT'S REFERENCE/DOCKET NO:
M-K 1508264

CORRESPONDENT E-MAIL ADDRESS:
Becker-docket@fzlz.com

OFFICE ACTION

STRICT DEADLINE TO RESPOND TO THIS LETTER

TO AVOID ABANDONMENT OF APPLICANT'S TRADEMARK APPLICATION, THE USPTO MUST RECEIVE APPLICANT'S COMPLETE RESPONSE TO THIS LETTER **WITHIN 6 MONTHS** OF THE ISSUE/MAILING DATE BELOW. A RESPONSE TRANSMITTED THROUGH THE TRADEMARK ELECTRONIC APPLICATION SYSTEM (TEAS) MUST BE RECEIVED BEFORE MIDNIGHT **EASTERN TIME** OF THE LAST DAY OF THE RESPONSE PERIOD.

ISSUE/MAILING DATE: 6/14/2018

Upon further examination, the FINAL action dated 12/23/2017, is withdrawn and replaced with this NON-FINAL action below. The applicant must timely respond to the issues detailed below. The examining attorney apologizes for the lack of consistency and clear direction but assures the applicant that the Office has carefully considered the issues herein and has been diligently working to resolve this matter.

The USPTO has recognized that "consistency is highly desirable," *In re Omega SA*, 494 F.3d 1362, 83 USPQ2d 1541, 1544 (Fed. Cir. 2007). However, consistency is not a substantive rule of trademark law, and a desire for consistency with the decisions of prior examining attorneys must yield to proper determinations under the Trademark Act and rules. *See, In re Cordua Rests.*, 823 F.2d 594, 118 USPQ2d 1632, 1634 (Fed. Cir. 2016). Each mark must be evaluated on its own facts and record. *In re Nett Designs Inc.*, 236 F.3d 1339, 57 USPQ2d 1564, 1566 (Fed. Cir. 2001).

Accordingly, after much deliberation, the following new requirements and refusals are issued to which the applicant must now respond:

- Section 2(e)(5) refusal based on the functional configuration of the goods;
- Sections 1, 2, and 45 refusal based on non-distinctive product design;
- Drawing and mark description requirement; and
- Information requirement.

Section 2(e)(5) Refusal – Mark is Functional Design for Goods

Registration is refused because the applied-for mark, which consists of a three-dimensional configuration of the goods, appears to be a functional design for such goods. Trademark Act Section 2(e)(5), 15 U.S.C. §1052(e)(5); *see* TMEP §1202.02(a)-(a)(ii). A feature is functional if it is "'essential to the use or purpose of the [product]'" or "'it affects the cost or quality of the [product].'" *TrafFix Devices, Inc. v. Mktg. Displays, Inc.*, 532 U.S. 23, 33, 58 USPQ2d 1001, 1006 (2001) (quoting *Qualitex Co. v. Jacobson Prods. Co.*, 514 U.S. 159, 165, 34 USPQ2d 1161, 1163-64 (1995)); *Inwood Labs., Inc., v. Ives Labs., Inc*., 456 U.S. 844, 850 n.10, 214 USPQ 1, 4 n.10 (1982); TMEP §1202.02(a)(iii)(A).

A mark that consists of a three-dimensional configuration of a product is functional, and thus unregistrable, when the evidence shows that the

design provides identifiable utilitarian advantages to the user; *i.e.*, the product "has a particular shape because it works better in [that] shape." *Valu Eng'g, Inc. v. Rexnord Corp.* , 278 F.3d 1268, 1274, 61 USPQ2d 1422, 1425 (Fed. Cir. 2002) (internal punctuation and citation omitted); *see* TMEP §1202.02(a)(iii)(A).

The evidence need not establish that the configuration at issue is the very best design for the particular product. A configuration can be held functional when the evidence shows that it provides a specific utilitarian advantage that makes it one of a few superior designs available. *See In re Bose Corp.*, 772 F.2d 866, 227 USPQ 1 (Fed. Cir. 1985) (holding shape of a loudspeaker system enclosure functional because it conforms to the shape of the sound matrix and is thereby an efficient and superior design); *In re Dietrich*, 91 USPQ2d 1622 (TTAB 2009) (holding particular spoke arrangement of a bicycle wheel functional because it is more stable and provides better performance than wheels with other spoke arrangements featuring the same or greater number of spokes); TMEP §1202.02(a)(v), (a)(v)(C).

Determining functionality normally involves consideration of one or more of the following factors, commonly known as the " *Morton-Norwich* factors":

(1) The existence of a utility patent disclosing the utilitarian advantages of the design sought to be registered.

(2) Advertising materials of the applicant that tout the design's utilitarian advantages.

(3) The availability to competitors of alternative designs.

(4) Facts indicating that the design results in a comparatively simple or inexpensive method of manufacture.

In re Becton, Dickinson & Co., 675 F.3d 1368, 1374-75, 102 USPQ2d 1372, 1377 (Fed. Cir. 2012); *In re Morton-Norwich Prods., Inc.*, 671 F.2d 1332, 1340-41, 213 USPQ 9, 15-16 (C.C.P.A. 1982); TMEP §1202.02(a)(v). It is not required that all four factors be proven in every case, nor do all four factors have to weigh in favor of functionality to support a functionality refusal. *Poly-America, LP v. Ill. Tool Works, Inc.*, 124 USPQ2d 1508, 1514 (TTAB 2017) (citing *In re Change Wind Corp.*, 123 USPQ2d 1453, 1456 (TTAB 2017); *In re Heatcon, Inc.*, 116 USPQ2d 1366, 1370 (TTAB 2015)); TMEP §1202.02(a)(v).

Applicant's mark consists of a three-dimensional configuration of a circular saw blade wherein the particular angles and arrangement of cut-outs on the blade are claimed as features of the mark. Applicant has not claimed the overall round shape of the saw blade nor the holes at the center. Specifically, applicant's mark description indicates that the elements of the configuration that are claimed as a feature of the mark are a repeating slot design around the circumference of the blade with three holes between each slot repeating around the blade.

Functionality of Cut-Outs in Circular Saw Blades

Circular saw blades come in many configurations, and it is important to choose the correct blade for the project both from a safety standpoint and to make a precise, clean cut. The attached evidence from www.rockler.com, titled "Saw Blades 101," discusses some of the types of cut-outs that commonly appear in saw blades generally and also appear in applicant's configuration mark. This article indicates that "gullets" (the "slots" described in applicant's mark description) are cut-outs that aid in removal of debris. According to this article, smaller gullets inhibit a feed rate that is too fast, and larger gullets remove more debris more quickly. This article also discusses the angles of cut-outs in blades, which affect feed rate and affect the tendency of a blade to "climb" the material being cut.

Additional attached evidence from www.kmstools.com, titled "Diamond Blades – Blade Guide 101," discusses the different types of diamond blades, including those with segmented rims, such as the applicant's blade, and explains that these blades may be used without water due to the cut-outs (segments) on the blade edge.

> These [segments divided by gullets] allow for air flow and cooling of the blade core. The segments also allow for better exhaust of debris, allowing for a swifter cut. One of the risks to the lifetime of a diamond blade is overheating, which affects the bond and can warp the blade. Segmented blades are the best option when water is not available.

Attached evidence from www.lowes.com, titled "Circular Saw Blade Buying Guide," details that with standard circular saw blades, "Gullets between the teeth remove chips from the work pieces" and "Expansion slots cut into the rim help prevent the blade from warping as it expands and contracts during use. They reduce vibration, creating a straighter cut." This evidence also details how segmented blades "have a rim divided by gullets similar to those on a standard blade."

The attached evidence from www.carbideprocessors.com discusses the various angles of cut-outs on circular saw blades, indicating that the angle of these slots has utilitarian function and various angles work better or less well depending on the surface to be cut. After discussing the pros and cons of various angles, the article concludes that, "The gullet has to be the right size and shape to handle all the material the tooth cuts, " and, "As a saw blade heats up the outside grows more than the inside so you need expansion slots to keep the blade flat and true."

Attached evidence from www.diamond-blade.org also discusses different types of diamond circular saw blades, noting that with segmented

blades

> The spaces of air that separate the diamond segments are called gullets or slots. The slots are there to improve air flow, cutting materials dust, dissipate heat, and remove slurry from the cut, helping to maintain the saw blade's cutting performance. The size and shape of the gullets vary from blade to blade and will depend on the type of material the blade designed to cut.
>
> For example, blades for cutting asphalt tend to have wider, U-shaped slots while diamond saw blades for concrete tend to have narrower U-shaped slots or Key hole slot. The more abrasive the material, the wider the slot should be to allow for better heat dissipation. Other slots shapes include teardrop and angled. Segmented diamond saw blades with narrow slots are generally for marble and granite while keyhole shaped slot blades tend to be for general purpose.

The photographs in this evidence show that a keyhole segmented blade has v-shaped slots/gullets ending in a rounded area very similar to those shown by the applicant's drawing.

Yet another website with a "Saw Blades 101" lesson is found at www.ereplacementparts.com, attached herein. This article states that manufactures are not always specific about what a blade is designed for "requiring customers to be more familiar with all the ins and outs of standard saw blade design" to pick the best blade for a project. This article states that many "general use" or "multiple use" blades are actually best suited for particular uses based on the configuration of the blade. In order to familiarize consumers with saw blade configuration, the article discusses gullets, which "allow saw dust and chips to be ejected from the blade and cutting area" and expansion slots and holes.

> Cuts in the blade that start from the outside edge are called "expansion slots," and they usually include small holes at the end of a curved shape. These cuts give the blade a little room to expand when heating up during use, and they help dissipate some of the heat in the blade.
>
> Keeping heat down like this helps saw blades cut more efficiently and last longer. Expansion cuts also help reduce blade vibration a little.

Further attached evidence from http://circularsawblade.net indicates that expansion slots are cuts in the blade plate that disperse heat preventing blade deformation. "With many blade designs, the ends of the expansion slots are connected to holes in the center of a saw blade, positioned towards the arbor. These rounded holes are there to reduce vibration."

Further attached evidence from www.concretenetwork.com includes a buyer's guide for diamond blades used to cut concrete. Images on this website include segmented blades with circular cutouts within the blades.

The totality of this evidence shows clearly that the patterns of cut-outs in saw blades have functional utility, that consumers are aware of slight differences in the patterns of the cut-outs, which they will look for *not* to indicate the source of the goods, but to indicate the intended use and limitations of the product.

With specific reference to applicant's particular saw blade configuration, notably, in paragraph three of the declaration of Brian Delahut, provided by the applicant in its response dated September 12, 2016, Mr. Delahut indicates that the presence of the cut-outs in the applicant's blades is "virtually" non-functional, and that the "functionality of the cut-outs are all but eliminated" by the manufacturing process used by the applicant. This statement indicates that there is some functionality in the design and placement of these cut-outs. Consumers are trained to look for cut-outs to indicate function and purpose of these goods. Applicant's attempt to downplay the functionality of the saw blade configuration is an effort that is likely lost on consumers. Consumers will clearly see the functionality of the applicant's product configuration.

Patents

Considering the first *Morton-Norwich factor*, although applicant has, in response to inquiry, indicated that it holds no patents (see further inquiry, below), the absence of patent evidence is not indicative that the configuration of applicant's goods is not overall functional. A third-party utility patent is relevant evidence of functionality when the patent discloses the utilitarian advantages of the applied-for product configuration sought to be registered. *See, e.g., Kistner Concrete Prods. Inc. v. Contech Arch Techs., Inc.*, 97 USPQ2d 1912, 1921 n.7 (TTAB 2011); *In re Dietrich*, 91 USPQ2d 1622, 1627 (TTAB 2009); TMEP §1202.02(a)(v)(A). The owner of a utility patent is not relevant to determining functionality. *In re Heatcon, Inc.*, 116 USPQ2d 1366, 1371 (TTAB 2015) (citing *In re Pohl-Boskamp GmbH & Co.*, 106 USPQ2d 1042, 1046 n.22 (TTAB 2013); *In re Mars Inc.*, 105 USPQ2d 1859, 1861 (TTAB 2013); *In re Virshup*, 42 USPQ2d 1403, 1405 (TTAB 1997)).

Attached evidence from https://patents.google.com, consisting of information regarding utility patent number US8701536B2, describes the background of its invention, which is a circular sawblade wherein the essence of the invention is the shape of the gullets in the blade:

> Gullets, in the form of cutouts extending inwardly from the periphery of the blade, are often interspaced between the cutters to aid cutting, by relieving stresses in the blade and removing swarf. A variety of gullet configurations may be used. The actual gullet configuration employed for a particular blade is based on the cutting application(s) for which the blade is expected to be used.

> Saw blades having relatively narrow gullets have been found useful in sawing of construction material with portable power saws, and in other masonry cutting applications on stationary machines, where smooth cutting action is desired. It has been found that the smoothness of cutting action is enhanced when the cutters are placed relatively close to one another, such as provided by the use of relatively narrow gullets….Alternatively, saw blades having relatively wide gullets … typically have a relatively large radius at their inner ends, which have been found to provide the blade with relatively high fatigue strength. These gullets may thus be beneficial in relatively high-stress cutting environments, such as floor sawing of asphalt or concrete, in which other blade types tend to fail due to stress cracks propagating from the gullets.
>
> Keyhole-shaped gullets attempt to combine benefits of both narrow and wide gullets. These gullets enable the cutters of a blade to be positioned relatively close to one another (e.g., so as to provide a smooth cutting action) while also providing each gullet with a relatively large radius at its radially inner end (e.g., so as to help reduce crack formation).

Additional attached evidence regarding U.S. utility patent number US5896800A also details the purpose of gullets and indicates how the circumferential distance between adjacent gullets affects stability of the blade. This patent also details (in number 32 in the drawings) the "expansion slots," which are holes throughout the blade that "enable flexing of the blade, under high-heat cutting application."

Another U.S. utility patent, US5351595A, attached herein, describes the prior art by indicating that circular saw blades typically have a plurality of expansion slots "of various configurations" to prevent blade warpage from heat and to dissipate stress, and different types of blades have different shapes for the expansion slots for cutting different material. "Expansion slots are not new to the industry and are intended to relieve stress, to aid in cleaning out the kerf, to attain straighter cutting action and to achieve other beneficial results." The summary of the invention section further details the need for expansion slots:

> The expansion slots dissipate heat generated by friction between the workpiece and the cutting elements. This prevents the buildup of static stresses in both the cutting element and the body of the blade, thereby lessening the likelihood of fracture of the blade when in use, under dynamic stress. When the saw is in a bind, the expansion slots allow relative lateral movement of the cutting elements with respect to one another and permit the plural cutting elements to go back to normal after the binding action recedes.

The summary of the invention section also details that a relatively shallow gullet "improves the cutting speed and durability of the blade, and allows for sufficient heat dissipation and expansion of the blade by the utilization of a plurality of expansion slots."

Yet another attached U.S. utility patent, US4776251A, details a circular saw blade with "strain compensating, heat dissipating slots" wherein the slots "compensate for strain, dissipate heat, not become packed with sawdust during operation and not damage either the lumber being cut or the guides in which it runs." The precise shape of the cutouts in the saw blade are the essence of the invention.

In addition to the patents, two applications for utility patents are attached herein:

- US20090199693A1, titled "Circular Saw Blade With Elliptical Gullets," shows the variety of shapes that gullets can take, including angled gullets; and
- US20090199692A1, titled "Circular Saw Blade With Offset Gullets," shows additional gullet configurations.

The combination of patent evidence clearly establishes that the various cut-outs, gullets, slots, and holes in circular saw blades are utilitarian rather than merely decorative, that the precise distance between the cut-out elements has distinct functionality as does the angle, shape, and placement. Although there is no direct evidence regarding the precise formation of cut-outs disclosed in the applicant's drawing, the overall showing by the patent evidence attached herein is that these cut-outs are overall functional and utilitarian in purpose. A patent need not claim the exact configuration for which trademark protection is sought to prove functionality. *See In re Becton, Dickinson & Co.*, 675 F.3d at 1375, 102 USPQ2d at 1377 (citing *TrafFix Devices, Inc. v. Mktg. Displays, Inc.*, 532 U.S. at 32-33, 34-35, 58 USPQ2d at 1005). "[S]tatements in a patent's specification illuminating the purpose served by a design may constitute equally strong evidence of functionality." *In re Loggerhead Tools, LLC*, 119 USPQ2d 1429, 1432 (TTAB 2016) (quoting *In re Becton, Dickinson & Co.*, 675 F.3d at 1375, 102 USPQ2d at 1377).

Therefore, the patent evidence shows that consumers are not likely to look to these cut-outs or shapes as an indicator of source for the goods, but will perceive them as overall functional because they are, overall, functional.

Applicant's Advertising

Attached evidence from applicant's website shows that the saw blade configuration that is the subject of this application is a dry-cutting multipurpose diamond segmented blade, and the applicant's advertising specifically states that heat dissipation is a concern with dry-cutting blades. It is noted that the advertising contains no discussion of the shape of the cutouts – either for trademark purposes (*e.g.*, "look for" advertising) or for detailing the functionality of the configuration.

Applicant's affidavit of Vice President Brian Delahaut states that the saw-blade industry is a highly visual business wherein customers will

purchase goods based on something they can remember about the appearance of the goods (item no. 18 in the affidavit provided in the applicant's 9/12/2016 response). That the advertising does not draw attention, therefore, to the shape of the cut-outs is telling. It is noted that the goods have a distinct color combination and tiger-head logo, both being prominently displayed in applicant's advertising. The distinct color combinations and logo give consumers something visual to retain when looking for the goods other than the non-distinctive, and functional, shape of the goods.

Applicant's affidavit indicates that the applicant's manufacturing process eliminates the need for cut-outs to provide cooling during cutting. However, the applicant's website evidence clearly states that "cutting blades require sufficient airflow about the blade to prevent overheating of the steel core." Thus, the advertising evidence appears to belie applicant's statement that the configuration of the mark is non-functional, as the evidence discussed above shows that it is standard with circular saw blades for cut-outs to dissipate heat.

Finally, previously attached evidence shows competitors' advertising detailing the functionality of various cut-outs in circular saw blades. Competitors' advertising and promotional materials that extol specific utilitarian advantages of the applied-for product design are strong evidence that the matter sought to be registered is functional. TMEP §1202.02(a)(v)(B); *see, e.g.*, *In re Heatcon, Inc.*, 116 USPQ2d 1366, 1374-75 (TTAB 2015); *In re Van Valkenburgh*, 97 USPQ2d 1757, 1763 (TTAB 2011).

Availability of Alternative Designs

Previously attached evidence shows use of highly similar designs by applicant's competitors. This evidence includes:

- A page from the internet retail website HarborFreight.com, showing MOLY CARB® brand circular saw blade, which has notches with circular cut-outs at their ends;
- A page from the internet retail website Rockler.com, showing a FREUD® brand circular saw blade with circular holes cut into the blade.
- A page from the internet retail website Lowes.com, discussing circular saw blades and what it identifies as "expansion slots," which reads in part, "Expansion slots help prevent the blade from warping as it expands and contracts during use. The end result is less vibration and a straighter cut." Also on this page are images of other saw blades with similar cut-outs to applicant's and cutting surfaces that are similar to that found in applicant's proposed mark.
- Another page from the internet retail website Lowes.com, showing a KOBALT® brand circular saw blade with angled notches.
- One final page from the internet retail website Lowes.com, showing another KOBALT® brand circular saw blade with circle cut-outs around the perimeter of the blade.
- Images from the internet retail website picclick.com showing various blades with "cooling holes," gullets, slots, and holes.

The overall evidence shows that makers of saw blades have choices for placement of the cut-outs, but that the cut-outs all fit within parameters that are highly similar to applicant's. For instance, square cut-outs are not found. The evidence establishes that the options for configurations dissimilar to applicant's are limited.

Although the precise placement of the cut-outs may leave room for competitors to use alternative configurations, when functionality is found based on other considerations (as is the case here), there is "no need to consider the [third *Morton-Norwich* factor regarding] availability of alternative designs, because the feature cannot be given trade dress protection merely because there are alternative designs available." *In re Becton, Dickinson & Co.*, 675 F.3d 1368, 1376, 102 USPQ2d 1372, 1378 (Fed. Cir. 2012) (quoting *Valu Eng'g Inc. v. Rexnord Corp.* , 278 F.3d 1268, 1276, 61 USPQ2d 1422, 1427 (Fed. Cir. 2002)); TMEP §1202.02(a)(v)(C).

Cost or Ease of Manufacture

Applicant's affidavit avers that the cost of manufacture is actually increased by the configuration elements in the drawing.

> While evidence showing that a product feature results from a comparatively simple or inexpensive method of manufacture supports a finding that the design is functional, the opposite is not necessarily the case. That is, assertions by the applicant that its design is more expensive or more difficult to make, or that the design does not affect the cost, will not establish that the configuration is not functional. *In re Dietrich*, 91 USPQ2d 1622, 1637 (TTAB 2009) ("Even at a higher manufacturing cost, applicant would have a competitive advantage for what is essentially, as claimed in the patents, a superior quality wheel."); *In re N.V. Organon*, 79 USPQ2d 1639, 1646 (TTAB 2006) . Designs that work better or serve a more useful purpose may, indeed, be more expensive and difficult to produce.

TMEP §1202.02(a)(v)(D).

Conclusion

In sum, the evidence is strong that the overall configuration of a saw blade's cut-outs, including expansion slots, gullets, and various other holes, is functional. Applicant's assertion that minor detailing, such as the angle of the gullets, are not functional is both countered by the evidence that every factor of the cut-outs aids overall functionality, and is not sufficient to overcome the totality of functional elements in the configuration. A few arbitrary or otherwise nonfunctional features included within a product configuration mark do not affect a functionality determination where the evidence shows the overall design to be functional. *See Textron, Inc. v. U.S. Int'l Trade Comm'n* , 753 F.2d 1019, 1024-27, 224 USPQ 625, 628-30 (Fed. Cir. 1985); *In re Vico Prods. Mfg. Co.*, 229 USPQ 364, 368 (TTAB 1985); TMEP §1202.02(a)(v). Specifically, an applied-for mark possessed of significant functional features should not qualify for registration where insignificant elements of the design are non-functional. *In re Becton, Dickinson & Co.*, 675 F.3d at 1374, 102 USPQ2d at 1376.

The evidence provided by the trademark examining attorney has established a *prima facie* case that the applied-for mark is overall functional; therefore, the burden now shifts to applicant to provide "competent evidence" of the applied-for mark's nonfunctionality. *See In re Becton, Dickinson & Co.*, 675 F.3d 1368, 1374, 102 USPQ2d 1372, 1376 (Fed. Cir. 2012); *In re R.M. Smith, Inc.*, 734 F.2d 1482, 1484, 222 USPQ 1, 3 (Fed. Cir. 1984); TMEP §1202.02(a)(iv). The "competent evidence" standard requires proof by a preponderance of the evidence. *In re Becton, Dickinson & Co.*, 675 F.3d at 1374, 102 USPQ2d at 1377.

The examining attorney has carefully considered the arguments and evidence provided over the lengthy prosecution process of this application and has determined that the evidence against the refusal is not persuasive and does not rise to the level of a preponderance. *Id.* Accordingly, the mark is refused registration based on the functionality of the configuration of the goods.

Note that functional matter may not be registered on either the Principal or Supplemental Registers, regardless of evidence of acquired distinctiveness. Trademark Act Sections 2(e)(5) and 23(c), 15 U.S.C. §§1052(e)(5), 1091(c); *see TrafFix Devices, Inc.*, 532 U.S. at 29, 58 USPQ2d at 1006; *In re Controls Corp. of Am.*, 46 USPQ2d 1308, 1311 (TTAB 1998); TMEP §1202.02(a)(iii)(A).

Although applicant's mark has been refused registration, applicant may respond to the refusal by submitting evidence and arguments in support of registration.

Sections 1, 2, and 45 Refusal – Non-Distinctive Product Design

Distinctiveness and functionality are two separate issues in an application for a three-dimensional configuration mark consisting of a product design. *See TrafFix Devices, Inc. v. Mktg. Displays, Inc.*, 532 U.S. 23, 58 USPQ2d 1001 (2001); *In re Ennco Display Sys., Inc.*, 56 USPQ2d 1279 (TTAB 2000); TMEP §1202.02.

In addition to being refused registration as being functional, registration is refused because the applied-for mark consists of a nondistinctive product design or nondistinctive features of a product design that is not registrable on the Principal Register without sufficient proof of acquired distinctiveness. Trademark Act Sections 1, 2, and 45, 15 U.S.C. §§1051-1052, 1127; *Wal-Mart Stores, Inc. v. Samara Bros., Inc.*, 529 U.S. 205, 210, 213-14, 54 USPQ2d 1065, 1068-69 (2000); *In re Slokevage*, 441 F.3d 957, 961, 78 USPQ2d 1395, 1398 (Fed. Cir. 2006); *see* TMEP §1202.02(b)(i).

A product design can never be inherently distinctive as a matter of law; consumers are aware that such designs are intended to render the goods more useful or appealing rather than identify their source. *See Wal-Mart Stores, Inc. v. Samara Bros.*, 529 U.S. at 212-13, 54 USPQ2d at 1068-69; *In re Slokevage*, 441 F.3d at 962, 78 USPQ2d at 1399. Thus, consumer predisposition to equate a product design with its source does not exist. *Wal-Mart Stores, Inc. v. Samara Bros.*, 529 U.S. at 213, 54 USPQ2d at 1069.

Here, applicant's mark is a three-dimensional view of a saw blade. Thus, the mark consists of the design, or shape, of the goods, and as such, the mark cannot be inherently distinctive. To counter this refusal, applicant has made a claim of acquired distinctiveness based on five years' use. However, based on the nature of applicant's proposed mark, five years' use is not sufficient to show that consumers attribute the design to applicant as a trademark recognizing the product design as an indicator of the source of the goods. TMEP §1212; *see* TMEP §§1212.01, 1212.04(a), 1212.05(a).

An applicant bears the burden of proving that a mark has acquired distinctiveness under Trademark Act Section 2(f). *In re La. Fish Fry Prods., Ltd.*, 797 F.3d 1332, 1335, 116 USPQ2d 1262, 1264 (Fed. Cir. 2015) (citing *In re Steelbuilding.com*, 415 F.3d 1293, 1297, 75 USPQ2d 1420, 1422 (Fed. Cir. 2005)); TMEP §1212.01.

Where, as here, length of use is not sufficient to establish acquired distinctiveness, other actual evidence of acquired distinctiveness may be provided. TMEP §1212.01; *see Ex parte Fox River Paper Corp.*, 99 USPQ 173, 173-74 (Comm'r Pats. 1953). The amount and type of evidence necessary to prove acquired distinctiveness depends on the facts of each case and the nature of the mark sought to be registered. TMEP §1212.01; *see In re Owens-Corning Fiberglas Corp.*, 774 F.2d 1116, 1125, 227 USPQ 417, 422 (Fed. Cir. 1985).

Establishing acquired distinctiveness by actual evidence was explained by the Court of Appeals for the Federal Circuit in the *Owens-Corning*

Fiberglas case, as follows:

> An evidentiary showing of secondary meaning, adequate to show that a mark has acquired distinctiveness indicating the origin of the goods, includes evidence of the trademark owner's method of using the mark, supplemented by evidence of the effectiveness of such use to cause the purchasing public to identify the mark with the source of the product.

In re Owens-Corning Fiberglas Corp., 774 F.2d 1116, 1125, 227 USPQ 417, 422 (Fed. Cir. 1985).

To support a claim of acquired distinctiveness, an applicant may submit evidence of "advertising expenditures, sales success, length and exclusivity of use, unsolicited media coverage, and consumer studies (linking the name to a source)." *In re Change Wind Corp.*, 123 USPQ2d 1453, 1467 (TTAB 2017) (quoting *In re Steelbuilding.com*, 415 F.3d 1293, 1300, 75 USPQ2d 1420, 1424 (Fed. Cir. 2005)).

The amount and character of evidence required to establish acquired distinctiveness under Trademark Act Section 2(f) depends on the nature of the mark and the circumstances surrounding the use of the mark in each case. TMEP §1212.01; *see In re Owens-Corning Fiberglas Corp*., 774 F.2d at 1125, 227 USPQ at 422.

Here, as discussed at length above, applicant's goods comprise an overall common basic shape or design used in the industry. The attached evidence, as well as previously attached evidence, clearly shows that the overall common configuration in the industry is a round configuration containing various slots, holes, and cut-outs. Applicant's product configuration constitutes a mere refinement of commonly adopted and well known configurations. Overall, saw blades used for the purpose that applicant's blades are designed for commonly have cut-outs in the blade of various angles and dimensions. To the extent that there are differences in applicant's saw blade configuration and those of other saw blades on the market, these differences are mere minimal refinements of common designs rather than significant departures from these common designs. Even if applicant is the only current producer of saw blades with the exact angles and placement of the combination of cut-outs in the blades, this alone does not imbue the configuration with source-identifying significance. This is true even if applicant has been the only producer of saw blades with this exact permutation for a lengthy time.

Applicant has provided examples of its advertising to support its claim of acquired distinctiveness claim arguing that because its advertising shows pictures of the product, and indeed has close-up views showing the cut-outs, that the applicant has promoted the product configuration as a trademark. However, the evidence does not show applicant promoting the placement of the cut-outs on the blade *as a source identifier* (as a trademark).

Applicant's evidence does show several things: (1) that the standard of the industry is to show a picture of the blade next to wording touting the merits of the various saw blades; (2) that the standard of the industry is to include close-up shots showing the cut-outs and edges of the blade; (3) that saw blades often come in various, and varied, colors; (4) that applicant's advertisements lack the "look-for" wording that would indicate applicant expects consumers to rely on the shape of the blade and its cut-outs as a source indicator; and (5) that to the extent other providers of saw blades discuss the shape of the cut-outs in their advertising, it is to tout the functionality of these elements (for instance, in applicant's exhibit 2 of the applicant's response dated September 12, 2016, the 4x4 Explorer blade advertisement details the benefits of its "patented ellipsoidal gullets" being an "outstanding resistance to cracks for safe cut in steel and metal.")

Thus, it is not clear that the pictures of the saw blades used in advertisement serve to advertise the shape of the cut-outs in saw blades as a trademark; rather, it appears that they serve to show consumers the type of blade and its functional elements. It is not clear that the shape of the cut-outs displayed in the advertisements serve to indicate the source of the goods more than the various colors and other trademarks that appear on the goods. Rather, these advertisements indicate the opposite.

In the recent precedential decision regarding a vehicle light configuration, the TTAB emphasized that merely showing a configuration in advertisements does not establish that the advertising supports a claim of acquired distinctiveness. *Grote Industries v. Truck-Lite Co., LLC*, Opposition No. 91196923 and Cancellation No. 92053498 (March 30, 2018) ("What is needed – and what is missing from this record – is probative evidence demonstrating that the design presently serves as an indicator of source in the minds of the consuming public."). In *Truck-Lite*, the TTAB stressed that "look-for" style advertising may be crucial for determining that product configurations have acquired distinctiveness. In *Truck-Lite* the advertising did not call attention to the six-diode configuration that was at issue, and crucially, the advertising did not tell consumers to look for this pattern to identify a Truck-Lite product. Similarly, applicant's advertising does not call attention to the particular placement of the cut-outs that is claimed by the applicant as being the distinctive feature of its configuration, and crucially, applicant's advertising does not tell consumers to "look for" these patterns to recognize applicant's goods.

Applicant's declaration from Mr. Delahut also indicates that the primary way applicant sells its product is from demonstration and word of mouth. Applicant suggests that in the demonstration, the shape of the product is promoted to consumers who will retain it as a trademark indicating the source of the goods. However, it is likely that consumers' take-away from the demonstration of the product is the overall functionality of the goods.

Applicant has also provided signed statements from various distributors indicating that consumers are familiar with the shape of the goods and ask for it by the shape. However, again, it is not clear that consumers are asking for the goods based on their known functional configuration or

because of distinctiveness of the shape for its trademark function. Much of the wording in these declarations is repeated between the different statements and contradictory to the matter being asserted (*e.g.*, "Other blades on the market have a similar look…," "very few blades are recognized for their design"). These statements do not establish that the particular cut-out shapes that constitute the product configuration serve as a trademark (to recognize *source*) or are used by consumers to recognize *goods*. "To show that a mark has acquired distinctiveness, an applicant must demonstrate that the relevant public understands the primary significance of the mark as identifying the source of a product or service rather than the product or service itself." *In re Steelbuilding.com*, 415 F.3d at 1297, 75 USPQ2d at 1422.

Finally, applicant's submission that it has acquired distinctiveness in its design by use over time is not supported by the evidence, which does not clearly establish that applicant's design is significantly different enough from others to be considered a substantially exclusive use of the configuration over time. The usage by applicant cannot be substantially exclusive if the differences in the applicant's design configuration from the design configurations of others are not substantial.

Accordingly, applicant's mark is refused registration on the Principal Register as being a non-distinctive product configuration, and applicant's claim of acquired distinctiveness is not sufficient to overcome this refusal.

As an alternative to submitting evidence of acquired distinctiveness, applicant may amend the application to the Supplemental Register. Trademark Act Section 23, 15 U.S.C. §1091; *see* 37 C.F.R. §§2.47, 2.75(a); TMEP §§816, 1202.02(b)(i). Note, however, that amending to the Supplemental Register will only be acceptable if applicant can establish that the product configuration is *capable* of being a source indicator and that amending to the Supplemental Register will not overcome the refusal based on functionality, discussed above.

Although applicant's mark has been refused registration, applicant may respond to the refusal(s) by submitting evidence and arguments in support of registration.

Requirement – Drawing and Mark Description

Based on the foregoing, the drawing of applicant's applied-for product design mark is not acceptable because it depicts in solid lines nondistinctive elements that are incapable of functioning as a mark. *See* TMEP §1202.02(c)(i)(B); *cf. TrafFix Devices, Inc. v. Mktg. Displays, Inc.*, 532 U.S. 23, 32, 58 USPQ2d 1001, 1006 (2001); *In re Famous Foods, Inc.*, 217 USPQ 177, 177 (TTAB 1983). Generally, nondistinctive elements of a product design mark that are incapable of functioning as a mark are unregistrable and thus are required to be shown in broken or dotted lines on the drawing. *See* 15 U.S.C. §§1051-1052, 1127; 37 C.F.R. §2.52(b)(4); *In re Water Gremlin Co*., 635 F.2d 841, 844, 208 USPQ 89, 91 (C.C.P.A. 1980); TMEP §1202.02(c)(i)(B).

Specifically, the following non-exhaustive list includes features that are nondistinctive and incapable of functioning as a mark: (1) the overall "roundness" of the product itself; (2) the center slot(s); (3) the gullets or slots, inclusive of their angles and circular ends; and (4) the cooling holes and expansion slots. These features are nondistinctive and do not function as a mark because, as the evidence clearly shows, such elements are so common in the industry for saw blades, because these elements are the same or substantially similar to the designs of competitors' products, and because consumers are accustomed to seeing such elements on similar products from a variety of providers.

Therefore, applicant must provide (1) a new drawing of the mark showing the nondistinctive elements in broken or dotted lines, and (2) an amended mark description that references the matter in broken or dotted lines and indicates such matter is not claimed as part of the mark. *See* TMEP §1202.02(c)(i)(B), (c)(ii). Applicant must provide the amended drawing regardless of whether the remaining portions of the mark are determined to be registrable. TMEP §1202.02(c)(i)(B).

However, it is unclear that any elements of applicant's mark are distinctive and capable as functioning as a trademark to indicate the source of applicant's goods. Therefore, no suggested wording for a mark description, and no suggested amendments to the drawing, can be recommended. *See* TMEP §1202.02(c)(ii).

Requirement – Information

To permit proper examination of the application, applicant must submit additional information about applicant's goods. *See* 37 C.F.R. §2.61(b); TMEP §§814, 1402.01(e). Specifically, applicant must submit the following:

- Advertising that instructs consumers to "look for" elements that are claimed as a feature of the applicant's mark, specifically, advertising that touts the various cut-outs in the saw blades as a source indicator for applicant's goods;

- Information indicating when such advertising was used, how widely it was distributed, to whom it was distributed, and the applicant's use of this type of advertising relative to other advertising used by the applicant.

- Information showing the price point for applicant's saw blades using the configuration in the application and information about relative price points for saw blades of applicant's competitors for saw blades used for the same purposes as the saw blades comprising the configuration at issue.

- Evidence of applicant's attempts to educate consumers regarding the lack of functionality of the elements in the configuration at issue.

- Third-party reviews of the applicant's goods that refer to the product configuration.

Additionally, applicant must answer the following querries:

- What are the intended uses for the saw blades comprising the subject configuration? What "type" of saw blade is this? (*e.g.*, dry-cutting, diamond, etc.).

- What saw types are these saw blades used with?

- Is there any functionality for the cut outs in the blade, or is applicant asserting no functionality whatsoever? If there is a functional element to any of the cut outs, what is the functionality? (*e.g.*, slurry dissipation, heat dissipation, reducing wear and tear on the blade or saw, affecting the shape or angle of the cut, etc.).

- Is applicant aware of any utility patents regarding the angle and shape of the cut-outs, expansion slots, or gullets in the type of saw blade that comprises the configuration at issue? If so, provide summaries of the patents.

Factual information about the goods must clearly indicate how they operate, their salient features, and their prospective customers and channels of trade. Conclusory statements will not satisfy this requirement for information.

Failure to respond to a request for information may be grounds for refusing registration. *In re DTI P'ship LLP*, 67 USPQ2d 1699, 1701 (TTAB 2003), *see also, In re Harley*, 119 USPQ2d 1755, 1757-58 (TTAB 2016); TMEP §814. Merely stating that information is available on applicant's website is an insufficient response and will not make the relevant information of record. *See In re Planalytics, Inc.*, 70 USPQ2d 1453, 1457-58 (TTAB 2004).

Response Guidelines

For this application to proceed toward registration, applicant must explicitly address each refusal and/or requirement raised in this Office action. If the action includes a refusal, applicant may provide arguments and/or evidence as to why the refusal should be withdrawn and the mark should register. Applicant may also have other options for responding to a refusal and should consider such options carefully. To respond to requirements and certain refusal response options, applicant should set forth in writing the required changes or statements.

If applicant has questions about the application or this Office action, please contact the assigned trademark examining attorney at the telephone number or email address below.

To expedite prosecution of the application, applicant is encouraged to file its response to this Office action online via the Trademark Electronic Application System (TEAS), which is available at http://www.uspto.gov/trademarks/teas/index.jsp. If applicant has technical questions about the TEAS response to Office action form, applicant can review the electronic filing tips available online at http://www.uspto.gov/trademarks/teas/e_filing_tips.jsp and e-mail technical questions to TEAS@uspto.gov.

TEAS PLUS OR TEAS REDUCED FEE (TEAS RF) APPLICANTS – TO MAINTAIN LOWER FEE, ADDITIONAL REQUIREMENTS MUST BE MET, INCLUDING SUBMITTING DOCUMENTS ONLINE: Applicants who filed their application online using the lower-fee TEAS Plus or TEAS RF application form must (1) file certain documents online using TEAS, including responses to Office actions (see TMEP §§819.02(b), 820.02(b) for a complete list of these documents); (2) maintain a valid e-mail correspondence address; and (3) agree to receive correspondence from the USPTO by e-mail throughout the prosecution of the application. *See* 37 C.F.R. §§2.22(b), 2.23(b); TMEP §§819, 820. TEAS Plus or TEAS RF applicants who do not meet these requirements must submit an additional processing fee of $125 per class of goods and/or services. 37 C.F.R. §§2.6(a)(1)(v), 2.22(c), 2.23(c); TMEP §§819.04, 820.04. However, in certain situations, TEAS Plus or TEAS RF applicants may respond to an Office action by authorizing an examiner's amendment by telephone or e-mail without incurring this additional fee.
The USPTO proposes to change federal trademark rules to require applicants and registrants to (1) file submissions concerning applications and registrations online using the USPTO's Trademark Electronic Application System (TEAS) and (2) provide and maintain an accurate email address for receiving correspondence from the USPTO. See the Mandatory Electronic Filing Rules webpage for more information.

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All informal e-mail communications relevant to this application will be placed in the official application record.

WHO MUST SIGN THE RESPONSE: It must be personally signed by an individual applicant or someone with legal authority to bind an applicant (i.e., a corporate officer, a general partner, all joint applicants). If an applicant is represented by an attorney, the attorney must sign the response.

PERIODICALLY CHECK THE STATUS OF THE APPLICATION: To ensure that applicant does not miss crucial deadlines or official notices, check the status of the application every three to four months using the Trademark Status and Document Retrieval (TSDR) system at http://tsdr.uspto.gov/. Please keep a copy of the TSDR status screen. If the status shows no change for more than six months, contact the Trademark Assistance Center by e-mail at TrademarkAssistanceCenter@uspto.gov or call 1-800-786-9199. For more information on checking status, see http://www.uspto.gov/trademarks/process/status/.

TO UPDATE CORRESPONDENCE/E-MAIL ADDRESS: Use the TEAS form at http://www.uspto.gov/trademarks/teas/correspondence.jsp.

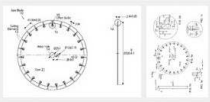
The USPTO proposes to change federal trademark rules to require applicants and registrants to (1) file submissions concerning applications and registrations online using the USPTO's Trademark Electronic Application System (TEAS) and (2) provide and maintain an accurate email address for receiving correspondence from the USPTO. See the Mandatory Electronic Filing Rules webpage for more information.

Circular saw blade with offset gullets

Abstract

A saw blade includes a circular core having a plurality of cutting elements along its periphery, and a central arbor hole. One or more offset gullets extend radially inward from the perimeter of the core. Each offset gullet includes a first opening in one side of the core and a second opening in the other side of the core. The first and second openings are adjacent but at least partially offset from one another, so that at least a portion of the offset gullet is not see-through.

Images (2)



Classifications

B23D61/021 Types of set; Variable teeth, e.g. variable in height or gullet depth: Varying pitch; Details of gullet

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Info: Patent citations (115), Non-patent citations (15), Cited by (13), Legal events, Similar documents, Priority and Related Applications

External links: USPTO, USPTO Assignment, Espacenet, Global Dossier, Discuss

Description

RELATED APPLICATIONS

This application claims the benefit under 35 USC 119(e) of U.S. Provisional Application No. 61/011,805, filed on Jan. 22, 2008, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates to saw blades, and more particularly, to circular saw blades having gullets designed to reduce fatigue and increase the life of the blade.

BACKGROUND OF THE INVENTION

Conventional circular saw blades typically include a circular steel core having a series of cutters or teeth spaced along its perimeter. Gullets, in the form of cutouts extending inwardly from the periphery of the blade, are often interspaced between the cutters to aid cutting, by relieving stresses in the blade and removing swarf. A

Claims (20)

What is claimed is:

1. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter;

a plurality of cutting elements at the outer perimeter of the core; and

one or more offset gullets configured to reduce noise and extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core;

wherein the first and second openings are adjacent and entirely offset from one another; and

the cutters to aid cutting, by relieving stresses in the blade and removing swarf. A variety of gullet configurations may be used. The actual gullet configuration employed for a particular blade is based on the cutting application(s) for which the blade is expected to be used.

Saw blades having relatively narrow gullets have been found useful in sawing of construction material with portable power saws, and in other masonry cutting applications on stationary machines, where smooth cutting action is desired. It has been found that the smoothness of cutting action is enhanced when the cutters are placed relatively close to one another, such as provided by the use of relatively narrow gullets. However, cracks tend to propagate from the tightly radiused ends of these gullets, particularly if the blade is exposed to high radial pressure. This problem is exacerbated on blades in which a fatigue barrier has been surpassed. Alternatively, saw blades having relatively wide gullets may be used. These gullets typically have a relatively large radius at their inner ends, which have been found to provide the blade with relatively high fatigue strength. These gullets may thus be beneficial in relatively high-stress cutting environments, such as floor sawing of asphalt or concrete, in which other blade types tend to fail due to stress cracks propagating from the gullets.

Keyhole-shaped gullets attempt to combine benefits of both narrow and wide gullets. These gullets enable the cutters of a blade to be positioned relatively close to one another (e.g., so as to provide a smooth cutting action) while also providing each gullet with a relatively large radius at its radially inner end (e.g., so as to help reduce crack formation). While keyhole gullets may exhibit improved characteristics over the narrow and wide gullets in some applications, they are not without drawbacks. For example, results achieved with keyhole gullets have been less than optimal in applications involving difficult to cut materials such as steel or a relatively heterogeneous mix of workpiece materials, such as steel reinforced concrete. Under these conditions, cracks have been found to propagate from the ends or sides of the gullets, which may compromise user safety and saw performance.

There is a need, therefore, for improved gullets suitable for circular saw blades.

SUMMARY OF THE INVENTION

One embodiment of the present invention provides a circular saw blade. The saw blade includes a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter. A plurality of cutting elements is at the outer perimeter of the core. In addition, there are one or more offset gullets extending radially inward from the perimeter of the core. Each offset gullet includes a first opening in the first planar side of the core and a second opening in the second planar side of the core. The first and second openings are adjacent but at least partially offset from one another, so that at least a portion of the offset gullet is not see-through (i.e., at least a portion of the first and second openings do not overlap with each other). In one such embodiment, there is no overlap between the first and second openings, such that no portion of the offset gullet is see-through. The first and second openings may be oriented, for example, in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening (such symmetry, however, is not required). In one particular example, the core is a sandwich-type core that further includes a middle layer of sound-damping material (e.g., at least one of cork, epoxy, glue, resin, copper, and soft iron) between the first and second planar sides. The first and second planar sides can be, for example, discrete pieces that are operatively coupled together (e.g., via at least one of a suitable bond material and a mechanical fastener) to form the core. The core can be made, for example, of steel and/or non-metallic material. The cutting elements may include, for instance,

wherein the first opening includes a first neck portion between two adjacent cutting elements on the first planar side of the core and the second opening includes a second neck portion between the same two adjacent cutting elements as the first neck portion on the second planar side of the core.

2. The circular saw blade of claim 1 wherein no portion of the offset gullet is see-through.

3. The circular saw blade of claim 1 wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening.

4. The circular saw blade of claim 1 wherein the first and second planar sides are discrete pieces that are operatively coupled together to form the core.

5. The circular saw blade of claim 4 wherein the first and second planar sides are operatively coupled via at least one of a bond material and a mechanical fastener.

6. The circular saw blade of claim 4 wherein the core is a sandwich-type core that further includes a middle layer of sound-damping material bonded between the first and second planar sides.

7. The circular saw blade of claim 6 wherein the sound-damping material includes at least one of cork, epoxy, glue, resin, copper, and soft iron.

8. The circular saw blade of claim 1 wherein the core is made of nonmetallic material.

9. The circular saw blade of claim 1 wherein the core is made of steel.

10. The circular saw blade of claim 1 wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives, or teeth.

11. The circular saw blade of claim 1 wherein there is at least one offset gullet between neighboring cutting elements.

12. The circular saw blade of claim 1 wherein each offset gullet includes elliptical qualities in its shape.

13. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, a middle layer of sound-damping material sandwiched between the first and second planar sides, and an outer perimeter;

a plurality of cutting elements at the outer perimeter of the core; and

one or more offset gullets configured to reduce noise and extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core;

wherein the first and second openings are adjacent and entirely offset from one another;

wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion

bonded abrasive segments, a single layer of abrasives, and/or teeth. In one particular configuration, there is at least one offset gullet between neighboring cutting elements. In another particular configuration, each offset gullet includes elliptical qualities in its shape.

The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale; emphasis has instead been placed upon illustrating the principles of the invention. Of the drawings:

FIGS. 1 *a* and **1** *b* illustrate a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention.

FIGS. 1 *c* and **1** *d* illustrate details associated with the offset gullets shown in FIG. 1 *a*, in accordance with an embodiment of the present invention.

FIG. 1 *e* illustrates details associated with the abrasive segments shown in FIG. 1 *a*, in accordance with an embodiment of the present invention.

FIGS. 2 *a*, **2** *b* and **2** *c* each illustrate a perspective view of a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An improved gullet for circular saw blades is disclosed. The gullet can be configured with essentially any suitable shapes (e.g., narrow, wide, keyhole, alphanumeric, and graphical designs), depending on the saw blade application. The gullet includes opposing openings (in each side of blade) that are offset from one another so as to not overlap or only partially overlap, and is crack-resistant and substantially reduces whistle-noise typical of conventional gullet designs.

General Overview

Conventional sandwich-type saw blades typically include two outer steel layers and a middle or 'sandwiched' layer of a different, more elastic material (e.g., cork, epoxy, glue, resin, copper, or soft iron). The aim of this sandwich-type blade is to reduce noise while in operation. As previously discussed, existing blades, including sandwich-type blades, have gullets in the form of cutouts extending inwardly from the periphery of the blade. These gullets are often interspaced between the cutters, and aid cutting and relieve stresses during cutting operation, as well as during the manufacturing process. On conventional sandwich-type blades, the gullets on both external steel cores are fully aligned. Such a design maximizes the land length and allows max airflow to pass through the gullets when the blade is in use.

In contrast, embodiments of the present invention employ offset gullets. Each offset gullet includes an opening in one side of the blade that is offset from a corresponding opening on the other side of the blade. In this way, there is no see-through gullet opening in the blade, or alternatively, there is only a partially see-through gullet opening in the blade (where a limited portion of the offset gullet openings overlap). In addition, the gullet openings can be close enough so as to

such that at least a portion of the first opening is a minor image of a portion of the second opening; and

wherein the first opening includes a first neck portion between two adjacent cutting elements on the first planar side of the core and the second opening includes a second neck portion between the same two adjacent cutting elements as the first neck portion on the second planar side of the core.

14. The circular saw blade of claim 13 wherein no portion of the offset gullet is see-through.

15. The circular saw blade of claim 13 wherein the first and second planar sides are discrete pieces that are operatively coupled together to form the core.

16. The circular saw blade of claim 13 wherein the sound-damping material includes at least one of cork, epoxy, glue, resin, copper, and soft iron.

17. The circular saw blade of claim 13 wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives; or teeth.

18. A circular saw blade, comprising:

a circular core having a first planar 'side and a second planar side, a central arbor hole, and an outer perimeter, wherein the first and second planar sides are operatively coupled via at least one of a bond material and a mechanical fastener;

a plurality of cutting elements at the outer perimeter of the core, wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives, or teeth; and

one or more offset gullets configured to reduce noise and extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core;

wherein the first and second openings are adjacent and entirely offset from one another and wherein the first opening includes a first neck portion between two adjacent cutting elements on the first planar side of the core and the second opening includes a second neck portion between the same two adjacent cutting elements as the first neck portion on the second planar side of the core.

19. The circular saw blade of claim 18 wherein no portion of the offset gullet is see-through.

20. The circular saw blade of claim 18 wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening.

allow a sufficient land length for the cutters. Thus, there is reduced airflow through the gullets while the blade is turning, or no airflow at all (depending on whether there is a partial overlap of gullet openings). This airflow on blades having fully see-through conventional gullets causes a whistle noise when cutting and even at idling speeds. The whistle is high frequency noise and unpleasant to the human ear. The offset gullet as described herein can be used to substantially reduce or otherwise totally cancel such noise. In addition, as the see-through gullet hole in the blade is eliminated or otherwise diminished, the rigidity of the blade is increased in the gullet areas. This increased rigidity in turn helps to avoid crack starts and prolongs blade life.

As previously noted, the offset gullet is not linked to any particular gullet shape. Rather, all gullet shapes and designs could be used, so long as the land's length is enough to place the cutters as desired. In addition, the offset gullet can be used with sandwich-type blades (e.g., two outer layers and a middle layer), or any other blade designs that would allow for offset gullet openings. For instance, the blade design may include two discrete outer layers coupled directly together (no middle layer), or two outer layers of a single monolithic core. The cutting elements of the saw blade may be implemented with teeth (such as for cutting wood or plastic) or abrasive segments (such as for cutting masonry or other very hard materials).

Saw Blade and Gullet Examples

FIGS. 1 *a* through **1** *d* illustrate a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention. As can be seen, the circular saw blade **10** has peripheral cutting elements **12** separated by a series of offset gullets **16**.

In the embodiment shown, blade **10** includes a core **21**, having an arbor hole **14** through which the blade **10** may be mounted and fastened to the spindle of a circular saw or other suitable machine as conventionally done (e.g., with a threaded fastener). In some embodiments, the blade **10** may further include a bushing such as described in U.S. Patent Application Publication No. 2006/0185492, and/or an assembly for accommodating multiple bore sizes such as described in U.S. Patent Application Publication No. 2006/0266176. Each of these patent applications is herein incorporated by reference in its entirety.

Saw blades configured in accordance with embodiments of the present invention can be used in any number of applications. For instance, saw blade **10** can be installed on a gasoline powered handheld saw (e.g., STIHL TS760, manufactured by Andreas Stihl AG), and used to dry cut a steel plate. Likewise, saw blade **10** can be installed onto a floor saw (e.g., Clipper CSB1 P13, manufactured by Saint-Gobain SA), and used to wet cut concrete. Likewise, saw blade **10** can be installed onto an automatic, 14 HP (10.3 kW) cut-off sawing machine (e.g., HUARD 30V53, manufactured by HUARD), and used to cut a steel or plastic tube. Numerous suitable machines and applications will be apparent in light of this disclosure.

As shown, the core **21** is substantially circular in shape. In one example embodiment, the core includes two discrete outer layers that are mechanically fastened directly to one another (e.g., via welds, rivets, and/or nut-and-bolt arrangement). Alternatively, the core **21** may be a sandwich-type core, where two discrete outer layers sandwich an inner layer of noise-damping material such as cork, glue, epoxy or other suitable damping material (e.g., resin, copper, and soft iron). Alternatively, the core **21** may be integrally formed through a suitable metrology or molding process (e.g., metal casting, injection molding, hot-pressing, cold-pressing, etc), so long as the offset gullets **16** can be provided (e.g., in situ via pressure molding, machined, or otherwise formed). The outer layers of core **21**, whether they are discrete or integral in nature, may be fabricated from substantially

any material having sufficient strength for the cutting application or applications at hand. Examples of suitable materials include steel, aluminum, titanium, bronze, their composites and alloys, and combinations thereof (e.g., ANSI 4130 steel and aluminum alloys, 2024, 6065 and 7178). Alternatively, for some applications, reinforced plastics or non-metallic composites may be used to construct the core **21**.

The core **21** may have other features, in addition to cutting elements **12** and offset gullets **16**. For example, and in one particular embodiment, the core **21** includes one or more perforations extending through the central core area, along a circumference disposed concentrically with, and between, the arbor hole **14** and the periphery of blade **10**. The perforations are arranged to form an annular window through the core **21** that corresponds to a predetermined cutting depth during rotational operation of the blade **10**. Additional details of circular saw blades having one or more cutting depth gauges are provided, for example, in U.S. Pat. No. 7,210,474, which is herein incorporated by reference in its entirety. Other functional features, such as for balancing the blade, indicating source of the blade, reducing operating noise of the blade, and indicating proper mounting of the blade, can also be employed.

As best shown in FIGS. 1 *c* and **1** *d*, each gullet **16** of this example embodiment includes two teardrop-shaped openings (shown as openings **25** and **27** in FIG. 1 *c*). In particular opening **25** is on one side of the core **21** and opening **27** is on the other side of core **21**. The two openings **25** and **27** are offset from one another and oriented about a plane **31** (imaginary, shown by dashed line in FIG. 1 *c*) that separates them in a symmetrical fashion, such that opening **25** is the mirror image of opening **27**. Each opening **25** and **27** of gullet **16** includes a neck portion **18** defined by parallel side walls extending radially inward from the periphery of the circular blade. At the radially inward end of the neck portion **18**, one of the side walls diverges (at about 45°) from the other and then forms into an arcuate base **20**. As shown, the base **20** includes elliptical qualities in its shape (at sides and/or bottom), which have been selected to further improve crack-resistance. Note, however, that the offset gullets **16** as described herein can be used with any suitable design (shape, pattern, etc) as previously explained, and the present invention is not intended to be limited to any particular design or shape or set of shapes. Further note that, in alternative embodiments, openings **25** and **27** may partially overlap. The degree of overlap between the openings **25** and **27** can vary, and in some such embodiments, ranges from 1% to 75% (e.g., where 25% or more of opening **25** does not overlap with the opening **27**). The degree of overlap between the openings **25** and **27** can be higher (e.g., approaching 99%), with such higher degrees of overlap leading to higher degrees of operational noise. As will be apparent, the discussion relevant to the openings **25** and **27** being oriented in a symmetrical fashion, such that opening **25** is a mirror image of opening **27**, can be equally applied to such partially offset gullet designs. In such cases, the mirror images will generally correspond to the non-overlapping portions of the openings **25** and **27**.

In this example embodiment, the cutting elements **12** take the form of abrasive-laden segments spaced along the periphery or the core **21**. FIG. 1 *e* shows additional dimensional details associated with these example segments. The segments may include, for example, superabrasive grains suspended in a metal bond that is brazed or otherwise secured to the periphery or the core **21**. For instance, a superabrasive tool may be manufactured by mixing superabrasive particles such as diamond and cubic boron nitride (cBN) with a suitable metal bond such as iron, copper, and tin. The mixture is then compressed in a mold to form the desired shape (e.g., segment having the desired width, length, and curvature). The 'green' form is then sintered at a suitable temperature to form a bonded segment

"green" form is then sintered at a suitable temperature to form a bonded segment with a plurality of superabrasive particles disposed therein. The segment is attached (e.g., by brazing, electroplating, or laser bonding) to the perimeter of core **21**.

Additional details of circular saw blades configured in accordance with embodiments of the present invention and having suitable abrasive segment designs for cutting elements **12** are provided, for example, in U.S. Pat. No. 5,518,443 (abrasive segments with alternating volume percentages of abrasive grain), U.S. Pat. No. 6,033,295 (portion of the abrasive segment is hardened), and U.S. Pat. No. 5,868,125 (crenelated abrasive segments), each of which is herein incorporated by reference in its entirety. In addition, the abrasive segments can be lengthened, in proportion to the blade diameter, to reduce the number of segments, improve fracture/bend resistance, and reduce manufacturing costs. In one such embodiment, the ratio of abrasive segment length to blade diameter is a minimum of 0.2. As previously mentioned, abrasive segments can be used for relatively difficult cutting operations (e.g., for cutting concrete, asphalt, stone, and other hard materials)

Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of teeth, such as typical of a wide range of circular saw blades intended for cutting relatively soft materials such as wood, plastic, and the like. As is known, the teeth may be of any size and shape. In addition, the teeth may be provided with conventional hardened tips, such as fabricated from tungsten carbide, and/or may be provided with the abrasive grain bonded thereto. In one such example embodiment, saw blade **10** is provided with a plurality of teeth having a single layer of abrasive grains chemically bonded to at least a portion of each tooth, as described in U.S. Pat. Nos. 6,817,936 and 6,935,940, each of which is herein incorporated by reference in its entirety.

Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of a single layer of abrasive grain that is brazed, electroplated, or otherwise attached to the periphery of the core **21** (as opposed to attaching bonded segments or providing teeth at the perimeter). Numerous cutting element **12** configurations and materials can be used in embodiments of the present invention, as will be apparent in light of this disclosure. The present invention is not intended to be limited to any particular cutting element configuration or scheme.

Example dimensions (in millimeters, mm) are also shown in FIGS. 1 *a* through **1** *d*. These dimensions are merely provided as one specific example embodiment that can be fabricated. However, it will be readily apparent in light of this disclosure that numerous dimensions, as well as offset gullet configurations can be used to implement a saw blade in accordance with an embodiment of the present invention. The present invention is not intended to be limited to any particular set or range of blade dimensions or configurations. Rather, embodiments of the present invention are intended to cover any saw blade that can be implemented for its intended purpose and configured with offset gullets as described herein.

FIGS. 2 *a*, **2** *b* and **2** *c* illustrate a perspective view of offset gullets configured in accordance with another embodiment of the present invention. As can be seen, the circular saw blade **10** has a core **21** with peripheral cutting elements **12** separated by a series of offset gullets **216**. The previous discussion with reference to FIGS. 1 *a* through **1** *d*, including discussion relevant to cutting elements **12** and core **21**, is equally applicable here, as is the general discussion relevant to offset gullets **16** and saw blade **10**. The main difference of the embodiment shown in FIGS. 2 *a* through **2** *c* is the design of offset gullets **216**.

In more detail, each offset gullet **216** of this example embodiment includes two musical note shaped openings (shown as openings **225** and **227**). In particular,

musical note shaped openings (shown as openings **225** and **227**). In particular, and as best shown by FIG. 2 *c*, opening **225** is on side **211** of the core **21** and opening **227** is on side **210** of core **21**. The core **21** in this example is shown as a sandwich-type core and further includes middle layer **212**, which is sandwiched between the planar sides **210** and **211**. The two openings **225** and **227** are offset from one another and oriented about a plane (imaginary) that separates them in a symmetrical fashion, such that opening **225** is the mirror image of opening **227**. Each opening **225** and **227** of gullet **216** includes a neck portion **218** defined by parallel side walls extending radially inward from the periphery of the circular blade. At the radially inward end of neck portion **218**, one of the side walls opens into a circular base **220**.

Recall that, in alternative embodiments, openings **225** and **227** may partially overlap as previously explained. In addition, other opening designs can be used to implement the offset gullets **216** (e.g., narrow openings having only a neck portion **218**, or wide openings having only a 'neck' portion that has a width of the circular base **220**, or keyhole openings as shown, or 'J' shaped openings, or question-mark or spiral shaped openings. In one example embodiment, the offset gullets **216** are implemented using openings shaped in the form of alphanumeric, graphical, and/or trademark indicia, as described in U.S. Pat. No. 6,878,051. In another example embodiment, the offset gullets **216** are implemented using arrow-shaped openings that extend radially deeper than straight keyhole openings, and interspersed with the straight keyhole openings, as shown in U.S. Design Patent Nos. 458,948, 459,375, 459,376, and 459,740. In another example embodiment, the offset gullets **216** are implemented using openings designed to reduce fatigue and cracking, as shown, for instance, in U.S. Patent Application Publication No. 2006/0236838. Each of these patents and applications is herein incorporated by reference in its entirety. In a more general sense, the selection of an opening design for offset gullets **216** for a particular saw blade can generally be based on the cutting application(s) for which that blade is expected to be used.

In addition, note that the openings **225** and **227** are shown to be oriented in a symmetrical fashion, such that opening **225** is the mirror image of opening **227**. This symmetrical, mirror image relationship is not required for all embodiments of the present invention. For instance, in alternative embodiments, opening **227** can have one design and opening **225** can have another design, such that there is little or no symmetry and no mirror image quality (e.g., where offset gullet **216** is made up of two different shaped openings proximate and offset from one another, but each on its respective side of core **21**). Likewise, openings **225** and **227** can have the same design, but be oriented in the same direction, so as to not provide the mirror image quality (e.g., where each note-shaped opening **225** and **227** faces the same direction). In general, the openings **225** and **227** making up the offset gullets **216** can have any number of shapes and configurations, as desired for a given application.

The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of this disclosure. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

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US927164A *	1908-03-16	1909-07-06	Putter Mfg Company	Grinding-wheel.
US1711102A	1927-06-22	1929-04-30	Jr Juan Sierra	Circular-saw plane
JPS51121880A	1975-04-17	1976-10-25	Masaaki Miyanaga	Core drill
US3990330A *	1973-01-17	1976-11-09	Gomex Verktyg Ab	Laminated saw blade
US4114494A	1976-02-12	1978-09-19	Budke Robert L	Noise-controlled circular saw blade
US4135421A	1977-08-19	1979-01-23	North American Products Corp.	Quiet running circular saw blade
US4222298A	1978-10-10	1980-09-16	James Vaughn F	Cutting tool or the like
US4224380A	1978-03-28	1980-09-23	General Electric Company	Temperature resistant abrasive compact and method for making same
US4232578A	1979-07-09	1980-11-11	Wallace Murray Corporation	Saw blade and method of making
US4324163A	1980-05-19	1982-04-13	Lavelle Donald R	Circular saw construction
GB2086824A	1980-10-20	1982-05-19	Canada Minister Defence	Artificial horizon device
GB2086823A	1980-08-05	1982-05-19	Secr Defence	Pressure Vessel End Wall Contour
GB2086822A	1980-11-05	1982-05-19	Englund Erik	A boat having a tiltable rudder and keel assembly
US4337750A	1980-10-08	1982-07-06	Norton Company	Abrasion resistant diamond blade
US4516560A	1982-07-29	1985-05-14	Federal-Mogul Corporation	Abrasive cutting wheel and method of cutting abradable material
JPS60109902A	1983-11-18	1985-06-15	Mitsubishi Electric Corp	Satellite tracking device
US4550708A	1983-07-06	1985-11-05	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4578984A	1984-03-05	1986-04-01	Uddeholm Strip Steel Aktiebolag	Machine for deforming the gullets of saw blades to improve resistance to fatigue stress
US4583515A	1982-07-29	1986-04-22	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4624237A *	1984-06-08	1986-11-25	Jiro Inoue	Diamond saw
US4690024A	1985-02-28	1987-09-01	Black & Decker Inc.	Saw blade and tip therefor
US4705017A	1985-08-19	1987-11-10	Federal-Mogul Corporation	Stress resistant abrasive cutting wheel
US4794835A	1985-12-20	1989-01-03	Kanefusa Hamono Kogyo Company Limited	Plate-like rotary body with vibration-suppressing characteristics and method of manufacturing same
US4854295A	1988-06-01	1989-08-08	Federal-Mogul Corporation	Wear resistant abrasive cutting wheel
US4867025A *	1978-07-28	1989-09-19	Gomex Verktyg Ab	Circular saw blade
US5082070A	1989-11-13	1992-01-21	Hilti Aktiengesellschaft	Hollow drill bit
JPH0463682A	1990-07-04	1992-02-28	N K Koki Kk	Diamond circular saw
US5127197A	1991-04-25	1992-07-07	Brukvoort Wesley J	Abrasive article and processes for producing it
US5142946A *	1991-11-18	1992-09-01	Mobile Manufacturing Company	Sharpener for circular saws
US5182976A	1983-09-09	1993-02-02	The Peerless Saw Company	Spring beamed shock absorbing circular saw blade body
US5184597A *	1990-04-27	1993-02-09	Edward Chiuminatta	Apparatus and method for cutting unhardened concrete

US5235753A	1992-03-20	1993-08-17	Black & Decker Inc.	Circular saw lower guard chip deflector
USD342270S	1992-09-29	1993-12-14	Ehwa Diamond Ind. Co., Ltd.	Core drill for perforating stone
DE9400182U1	1994-01-10	1994-03-10	Ledermann & Co	circular saw blade
US5309962A *	1993-05-13	1994-05-10	Vermont American Corporation	Multiple saw blade adjustable dado cutter assembly including a cam assembly and nestable dado blades
JPH06226638A	1993-02-02	1994-08-16	Nippon Chuzo Kk	Diamond blade
US5351595A	1991-12-20	1994-10-04	Vermont American Corporation	Thin kerf circular saw blade
US5385591A	1993-09-29	1995-01-31	Norton Company	Metal bond and metal bonded abrasive articles
US5438900A	1992-07-06	1995-08-08	Sandvik Ab	Low noise saw blade
US5471970A	1994-03-16	1995-12-05	Diamant Boart, Inc.	Method of manufacturing a segmented diamond blade
JPH0847816A	1994-08-03	1996-02-20	Hashimoto Tokushu Kogyo Kk	Circular saw
US5505750A	1994-06-22	1996-04-09	Norton Company	Infiltrant for metal bonded abrasive articles
US5518443A	1994-05-13	1996-05-21	Norton Company	Superabrasive tool
US5524518A *	1991-11-04	1996-06-11	Sandvik Ab	Saw blade
US5555788A	1995-03-29	1996-09-17	Credo Tool Company	Saw blade
US5603252A	1995-08-28	1997-02-18	Sandvik Ab	Saw blade
US5839423A *	1997-03-13	1998-11-24	Jones; Leon D.	Cutting disc
US5865571A	1997-06-17	1999-02-02	Norton Company	Non-metallic body cutting tools
US5868125A	1996-11-21	1999-02-09	Norton Company	Crenelated abrasive tool
US5884547A	1994-08-19	1999-03-23	Black & Decker Inc.	Saw blade tooth form
US5891206A	1997-05-08	1999-04-06	Norton Company	Sintered abrasive tools
US5896800A	1995-09-26	1999-04-27	Black & Decker Inc.	Circular saw blade
US6033295A	1994-12-28	2000-03-07	Norton Company	Segmented cutting tools
US6039641A	1997-04-04	2000-03-21	Sung; Chien-Min	Brazed diamond tools by infiltration
US6065370A	1995-09-26	2000-05-23	Black & Decker Inc.	Circular saw blade and method
WO2000043179A1	1999-01-25	2000-07-27	Black & Decker Inc.	Saw blade for cutting fiber cement
WO2000051789A1	1999-02-26	2000-09-08	Sankyo Diamond Industrial Co., Ltd.	Diamond saw blade
US6167792B1	1995-03-23	2001-01-02	American Saw & Mfg. Company	Tooth form for a saw blade
US6273082B1 *	1991-06-10	2001-08-14	Ultimate Abrasive Systems, L.L.C.	Abrasive cutting tool
US6283845B1 *	1998-04-21	2001-09-04	Tyrolit Schleifmittelwerke Swarovski K.G.	Grinding wheel

US6286498B1	1997-04-04	2001-09-11	Chien-Min Sung	Metal bond diamond tools that contain uniform or patterned distribution of diamond grits and method of manufacture thereof
WO2001070471A1	2000-03-21	2001-09-27	American Tool Companies, Inc.	Metal-cutting saw blade having strengthened gullet and negative tooth rake
US20020040631A1 *	1997-08-22	2002-04-11	George G. Gaydos	Saw blade for forming curved stock
USD458948S1	2001-03-19	2002-06-18	Saint-Gobain Abrasives Technology Company	Segmented saw blade
US6408838B1	1999-07-05	2002-06-25	Noritake Diamond Industries, Co., Ltd.	Rotary cutting saw with slits shaped for minimizing wear of neck portion
USD459375S1	2001-03-19	2002-06-25	Saint-Gobain Abrasives Technology Company	Segmented saw blade
USD459376S1	2001-03-19	2002-06-25	Saint-Gobain Abrasives Technology Company	Segmented saw blade
USD459740S1	2001-03-19	2002-07-02	Saint-Gobain Abrasives Technology Company	Segmented saw blade
US6427573B1	1994-08-19	2002-08-06	Black & Decker, Inc.	Saw blade tooth form and method therefor
US20020123302A1	2001-03-05	2002-09-05	S-B Power Tool Company	Cutting and grinding wheel for a rotary tool
US20020124707A1 *	2000-05-02	2002-09-12	Izard Industries Limited	Laser cut saw blades
US6458471B2	1998-09-16	2002-10-01	Baker Hughes Incorporated	Reinforced abrasive-impregnated cutting elements, drill bits including same and methods
US6460532B1 *	2000-07-05	2002-10-08	Shinhan Diamond Industrial Co. Ltd.	Diamond cutting wheel
US6482244B2	1995-06-07	2002-11-19	Ultimate Abrasive Systems, L.L.C.	Process for making an abrasive sintered product
US20030056633A1 *	2001-09-26	2003-03-27	Baron Kevin Frank	Cutting disc core with noise reduction
US20030061920A1	2000-06-27	2003-04-03	Thompson Robert Lindsay	Apparatus and method for providing an enhanced metal cutting saw blade
US6638152B1 *	1998-09-03	2003-10-28	Ehwa Diamond, Ind., Co., Ltd.	Diamond blade having segment type cutting tip for use in cutting, grinding or drilling apparatus
US20030213483A1	2002-05-14	2003-11-20	Diamant Boart, Inc.	Segmented diamond blade with undercut protection
USD485478S1	2002-08-30	2004-01-20	Tenryu Seikyo Kabushiki Kaisha	Disk cutter
US6681674B2	2001-02-23	2004-01-27	William Hakansson	Band saw blade
US6688206B1	1999-02-01	2004-02-10	Powertools International Gmbh	Saw blade with elongated air passages
US6691596B1	2000-02-29	2004-02-17	Irwin Industrial Tool Company	Circular saw blade for cutting fiber cement materials
US20040050233A1	2001-05-18	2004-03-18	Herbert Humenberger	Circular-saw blade comprising expansion slits extending radially inwards
US6729220B2	2001-11-30	2004-05-04	Black & Decker Inc.	Spring loaded diamond arbor
US20040149114A1	2003-02-05	2004-08-05	Kurt Brach	Saw blade with shaped gullets
US6817936B1	1996-03-15	2004-11-16	Saint-Gobain Abrasives Technology Company	Metal single layer abrasive cutting tool having a contoured cutting surface

US6827072B2	2002-01-25	2004-12-07	Wendt Gmbh	Dressing wheel and method of making same
US6872133B2	2003-05-30	2005-03-29	Ehwa Diamond Industrial Co., Ltd.	Wave saw blade
US6890250B1 *	1998-09-03	2005-05-10	Ehwa Diamond Ind., Co., Ltd.	Diamond blade having rim type cutting tip for use in grinding or cutting apparatus
US20050235798A1 *	2004-04-05	2005-10-27	Christoph Weber	Cutting segment tip
US20050279533A1	2004-06-22	2005-12-22	Vincent Corica	Apparatus and method for securing diamond segment to rotating tool
US20060107815A1 *	2004-11-22	2006-05-25	Tenryu Seikyo Kabushiki Kaisha	Disk cutter
US20060185492A1	2005-02-18	2006-08-24	Francois Chianese	Shoulder bushing for saw blades
US20060236838A1	2005-04-20	2006-10-26	Heyen Andre R G	Saw blade
US7127979B2 *	2000-08-03	2006-10-31	Robert Bosch Gmbh	Saw blade for hand-held tools
US20060266176A1	2005-05-25	2006-11-30	Kurt Brach	Saw blade with multiple bore sizes
US7210474B2	2005-03-23	2007-05-01	Saint-Gobain Abrasives Technology Company	Saw blade with cutting depth gauge
US20070261530A1 *	2006-05-11	2007-11-15	Indigo Innovators, Inc.	Saw blade with replaceable cutting teeth members
US20080153402A1	2006-12-20	2008-06-26	Christopher Arcona	Roadway grinding/cutting apparatus and monitoring system
US20090199692A1	2008-01-22	2009-08-13	Saint-Gobain Abrasives, Inc.	Circular Saw Blade With Offset Gullets
US20090199693A1 *	2005-04-20	2009-08-13	Saint-Gobain Abrasives, Inc.	Circular Saw Blade With Elliptical Gullets
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US20100200304A1	2009-02-12	2010-08-12	Saint-Gobain Abrasives, Inc.	Abrasive tip for abrasive tool and method for forming and replacing thereof
US20100248600A1	2009-03-31	2010-09-30	Saint-Gobain Abrasives, Inc.	Dust collection for an abrasive tool
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US7879129B2	2004-06-01	2011-02-01	Ceratizit Austria Gesellschaft Mbh	Wear part formed of a diamond-containing composite material, and production method
US20110023911A1	2009-06-24	2011-02-03	Holger Lenkeit	Material removal systems and methods utilizing foam
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US4034639A *	1976-09-16	1977-07-12	Minnesota Mining And Manufacturing Company	Sound-damped saw blade
DE3220576A1 *	1982-06-01	1983-12-01	Biedron Bsb	Diamond cutting-off disc, in particular for working natural or synthetic stone
JPH0239765Y2 *	1983-12-28	1990-10-24		
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KR100440869B1 *	2001-02-19	2004-07-19	이화다이아몬드공업 주식회사	Saw blade shank

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US8393419B1 *	2008-03-13	2013-03-12	Us Synthetic Corporation	Superabrasive elements having indicia and related apparatus and methods
US8568205B2 *	2008-08-08	2013-10-29	Saint-Gobain Abrasives, Inc.	Abrasive tools having a continuous metal phase for bonding an abrasive component to a carrier
US9097067B2 *	2009-02-12	2015-08-04	Saint-Gobain Abrasives, Inc.	Abrasive tip for abrasive tool and method for forming and replacing thereof

				thereof
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US20120042526A1 *	2010-08-18	2012-02-23	Wu-Lang Chan	Knife blade
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CN102974892A *	2011-09-02	2013-03-20	博世电动工具（中国）有限公司	Circular saw web
CN103143774B *	2011-12-06	2016-08-03	博世电动工具（中国）有限公司	Saw
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US6446621B1	2002-09-10	Saw wire
US4604933A	1986-08-12	Carbide-tipped circular saw for metal cutting at low surface speeds
US4106382A	1978-08-15	Circular saw tool
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US5738156A	1998-04-14	Removable cutting blades for a helical cutterhead
US4624237A	1986-11-25	Diamond saw
US4461268A	1984-07-24	Diamond saw
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US6074970D2	2005-04-05	Boring bit and methods for manufacturing boring bits
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US5865571A	1999-02-02	Non-metallic body cutting tools
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US6588992B2	2003-07-08	Hole saw
US5743163A	1998-04-28	Clean cutting circular saw blade
US5560348A	1996-10-01	Cutting blade with an impact load prevention layer

US4407263A	1983-10-04	Cutting blade
US5363891A	1994-11-15	Tubular saw tooth and mount assembly
US7089925B1	2006-08-15	Reciprocating wire saw for cutting hard materials
US6638152B1	2003-10-28	Diamond blade having segment type cutting tip for use in cutting, grinding or drilling apparatus
US3261384A	1966-07-19	Circular saw
US3323567A	1967-06-06	Cone hogger and trim saw unit
US4739745A	1988-04-26	Circular diamond saw blade incorporating a novel cutting segment

Priority And Related Applications

Priority Applications (2)

Application	Priority date	Filing date	Title
US1180508	2008-01-22	2008-01-22	*US Provisional Application*
US12356712	2008-01-22	2009-01-21	Circular saw blade with offset gullets

Applications Claiming Priority (1)

Application	Filing date	Title
US12356712	2009-01-21	Circular saw blade with offset gullets

Legal Events

Date	Code	Title	Description
2009-04-24	AS	Assignment	**Owner name**: SAINT-GOBAIN ABRASIVES, INC., MASSACHUSETTS **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R.G.;REEL/FRAME:022591/0449 **Effective date**: 20090408 **Owner name**: SAINT-GOBAIN ABRASIFS, FRANCE **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R.G.;REEL/FRAME:022591/0449 **Effective date**: 20090408
2017-09-25	MAFP		**Free format text**: PAYMENT OF MAINTENANCE FEE, 4TH YEAR, LARGE ENTITY (ORIGINAL EVENT CODE: M1551) **Year of fee payment**: 4

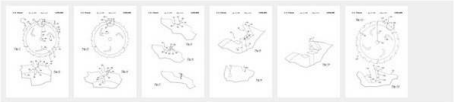
Data provided by IFI CLAIMS Patent Services

Circular saw blade

Abstract

A saw blade is stamped with a circumferential edge. At least one deep gullet and shoulder are formed in the circumferential edge. Likewise, a tooth pocket is formed in the circumferential edge. The tooth pocket is defined by a wall, generally radial to circle, on the shoulder, and a shelf substantially perpendicular to the wall. A tooth is secured, ordinarily by brazing, in the pocket such that the thickness of the tooth is substantially equal to the depth of the shelf and the face of the tooth is continuous with the gullet. The tooth may be brazed along its entire lateral edge such that resultant forces in the tooth are transmitted to the body of the blade. After the tooth is positioned into the tooth pocket, the tooth, as well as a projection of the blade shoulder, are ground off so that the tooth and shoulder are flush with one another. Thus, the tooth longitudinal edge is in complete contact with the shoulder wall maximizing its strength.

Images (6)



Classifications

B23D61/025 Details of saw blade body

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US5896800A

US Grant

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Inventor: John R. Curtsinger, Nicholas E. Achterberg

Current Assignee : Black and Decker Inc

Original Assignee: Black and Decker Inc

Priority date : 1995-09-26

Family: US (1) EP (1) CA (1)

Date	App/Pub Number	Status
1996-07-09	US08677152	Expired - Lifetime
1999-04-27	US5896800A	Grant

Info: Patent citations (82), Non-patent citations (2), Cited by (39), Legal events, Similar documents, Priority and Related Applications

External links: USPTO, USPTO Assignment, Espacenet, Global Dossier, Discuss

Description

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of U.S. application Ser. No. 08/616,387 filed Mar. 15, 1996, entitled CIRCULAR SAW BLADE AND METHOD, now U.S. Pat. No. 5,758,561 which is based upon and claims priority to U.S. Provisional patent application Ser. No. 60/004,329 filed Sep. 26, 1995, and entitled Circular Saw Blade and Method, the specification and drawings of both are herein expressly incorporated by reference.

The subject matter of the present invention is related to U.S. patent application Ser. Nos. 29/051,681 and 29/051,682 filed Mar. 15, 1996, entitled Saw Blade with Vents and Vents for Circular Saw Blades, respectively, both assigned to the assignee of the present invention and both specifications and drawings herein expressly incorporated by reference.

FIELD OF THE INVENTION

The invention relates to carbide-tipped circular saw blades, and a method for

Claims (12)

We claim:

1. A saw blade comprising:

a body having a circumferential edge;

at least one gullet formed in said circumferential edge;

at least one shoulder formed in said circumferential edge adjacent said gullet;

a tooth pocket formed in said circumferential edge, said tooth pocket defining a wall and a shelf adjacent to said wall, said shelf having a desired depth;

a tooth secured in said pocket such that said tooth having a thickness substantially equal to the depth of said shelf so that a face of the tooth is continuous with the gullet, and said shelf enables a lateral edge of the tooth to be secured with the body, said gullet includes a first side angled with

manufacturing them. The invention is particularly directed to maximizing the strength of the saw blade to enhance the blade's endurance. The result is a circular saw blade having longer usable life, in the demanding environment of the framing phase of housing construction, than the conventional carbide-tooth circular saw blade.

BACKGROUND OF THE INVENTION

Present construction techniques in the housing construction industry involve building single and multiplefamily homes with single-piece wood components like 2×4's, 2×6's and 2×10-inch fur and sheet stock, 4×8 foot in plywood and oriented-strandboard lumber. As opposed to pre-fabricated sections, all components are shipped to the homesite and assembled in a "stick-built" fashion using steel nails, screws and staples.

Crews who specialize in the specific phase of housing construction called "framing" do their work after the foundation is laid and before the house is roofed and sided. A typical 2500 square foot house can be framed in three days by a 5-person crew, working at a very fast pace. The typical activities done during the framing phase include working non-stop measuring and sawing wood, nailing wall sections, erecting the frames in place, and trimming at any time at several locations within the house. In addition to the fast work pace, the framing crews must use poor quality lumber and deal with nailing inaccuracies.

Field research reveals that about 90° of the sawing is done with a seven and one-quarter inch hand-held circular saw. The framer is not given the high-quality wood and wood materials that a cabinet or furniture maker uses, nor is he or she concerned with doing the finished trim, where the cuts must be smooth and accurate. The framer has two major user-perceived needs. One, of course, is speed; the other is how long a given saw blade will last. The latter condition occurs when the framer notices that it takes more and more effort or bias to get the saw blade through the lumber. This is the signal for the framer to replace the blade (which is now perceived as no longer being "sharp") with a new one. To date, the old blades are not resharpened, because blades sold for this type of work are usually priced so low that it is not cost-effective for the construction company to resharpen the blades, or damage to the teeth is too severe.

It has been discovered that "edge wear" is neither the only, nor the primary condition that increases the likelihood that a given blade will feel like it has lost its "sharpness". Two significant factors with equal or greater impact on blade life is "tooth loss" and "breakage". These phenomena occur when the teeth encounter foreign matter in the wood, or a particularly stressful cutting application and the cutting edge is severely broken, or the tooth is removed completely. Therefore, the unchipped edges of the carbide teeth may remain sharp (have little edge wear), but the user nevertheless perceives that the saw blade has lost its "sharpness".

Unfortunately, the framer will probably have to use low-cost framing materials, which include dirty and gummy wood, and wood with loose nails and loose staples. When a carbide tooth, which is necessarily made of material much harder and more brittle than the steel of the saw blade itself, encounters these foreign materials, it is likely to chip or be torn off. However, it has been discovered that the very changes which one would consider to reduce chipping will also cause the tip to lose edge sharpness. Accordingly, the problem that the present invention addresses is this: how to minimize the likelihood that tooth damage will cause a given blade to require an unacceptable user bias force, while nevertheless maximizing the probability that the same blade will track the edge sharpness of a conventional carbide tipped blade.

to be secured with the body, said gullet includes a first side angled with respect to the circumferential edge toward the tooth, a bottom, said bottom being on a straight tangent line to an arc which is concentric with the circumferential edge and a second side, terminating at said shelf and angled with respect to the circumferential edge away from the tooth, said first and second sides being directly continuous with said bottom and angled towards one another.

2. The saw blade according to claim 1, wherein said tooth edge and an area of the shoulder edge adjacent said tooth are flush with one another along the circumferential edge.

3. The saw blade according to claim 2, wherein a shallow arcuate recess is in said shoulder along the circumferential edge adjacent said area.

4. The saw blade according to claim 1 including a plurality of gullets, shoulders, tooth pockets, and teeth.

5. The saw blade according to claim 4, wherein between adjacent gullets, a circumferential size ratio exists between the shoulder circumferential width and gullet circumferential width of about 2:1.

6. The saw blade according to claim 1, wherein an expansion slot is connected with said gullet, said expansion slot having a neck and an ellipsoidal or oval shaped body.

7. The saw blade according to claim 1, wherein said saw blade is a wood cutting blade.

8. The saw blade according to claim 1, wherein said gullet extends below said tooth, said bottom being at a distance from the blade center of about eighty to ninety-five (80-95%) percent of the radius of the blade.

9. The saw blade according to claim 1, wherein said bottom is at a distance at about ninety (90%) percent of the radius of the blade.

10. The saw blade according to claim 1, wherein said tooth is soldered or brazed onto said blade.

11. The saw blade according to claim 1, wherein said tooth is a carbide tooth secured to said blade.

12. The saw blade according to claim 1, wherein said tooth and blade are non-unitary elements.

If a blade can exhibit a significant drop in tooth damage, it will last longer in this most demanding of home construction environments.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a circular saw blade having carbide or other relatively hard teeth (or coated with a hard surface) for use in cutting primarily construction materials which is particularly suited to the framing phase of the housing construction industry. A further object of the present invention is to provide such a saw blade which stays sharp longer in this environment, as perceived by the user. It is a particular object of the preferred embodiments of the invention to provide a circular saw blade with carbide teeth, or other hard teeth or teeth with hard coatings, whose structure minimizes the incidence of damage while at the same time maintaining an acceptable level of edge wear ("actual sharpness").

In accordance with one aspect of the invention, a saw blade comprises a body having a circumferential edge. At least one gullet and shoulder are formed or stamped into the circumferential edge. A tooth pocket is also formed or stamped into the circumferential edge between the gullet and shoulder. The tooth pocket is defined by a wall, on the shoulder, and a shelf substantially perpendicular to the wall. A tooth is secured in the tooth pocket such that a portion of the shelf extends beyond the tooth into and towards the gullet. The wall has a depth such that the tooth is fully backed by the wall and shoulder maximizing the strength of the tooth. The wall and shelf provide a maximum area to secure the tooth to the saw body. The gullet is shallow with a flat or linear base. A size ratio exists between a shoulder circumferential width and gullet circumferential width between adjacent gullets, the ratio is about 2:1.

In accordance with a second aspect of the invention, a method of manufacturing a saw blade comprises stamping a blank with an overall circular shape with a circumferential edge which includes at least one gullet, an adjacent tooth pocket and shoulder. A tooth is provided and is positioned into the tooth pocket abutting a wall of the shoulder. The tooth is secured, preferably by brazing, in the tooth pocket. The tooth, as well as the blank, are ground together to provide a sharpened tooth to form a saw blade. During stamping, a radiused projection is formed adjacent the tooth pocket on the shoulder which also forms part of the wall which the tooth abuts against and is secured because stamping operations cannot economically produce non-radiused corners. The projection is ground down during the grinding process to enable the entire back of the tooth to be in contact with the shoulder to maximize strength. Also during stamping, a shallow gullet is formed which has a relatively flat base surface. Further during stamping, an expansion slot may be formed continuous with the gullet. The expansion slot includes a neck and an elliptical or oval shaped body. Also during stamping, heat vents may be formed in the body of the blade.

In accordance with a third aspect of the invention, a saw blade comprises a body having a circumferential edge. At least one gullet and shoulder are formed or stamped into the circumferential edge. A tooth pocket is also formed or stamped into the circumferential edge between the gullet and shoulder. The tooth pocket is defined by a wall on the shoulder and a shelf substantially perpendicular to the wall. A tooth is secured in the tooth pocket such that the thickness of the tooth is substantially equal to the depth of the shelf. Thus, the face of the tooth is substantially continuous with the gullet. The wall has a depth such that the tooth is fully backed by the wall and shoulder, maximizing the strength of the tooth. The wall and shelf provide a maximum area to secure the tooth to the saw body. The gullet is deep and extends below the tooth such that the base of the gullet is on a

gullet is deep and extends below the tooth such that the base of the gullet is on a radius which is eighty to ninety-five (80-95%) percent of the radius of the circumferential edge of the saw blade. A size ratio exists between a shoulder circumferential width and gullet circumferential width between adjacent gullets, the ratio is about 2:1.

Other objects, features and advantages of the present invention will become more fully apparent from the following detailed description of the preferred embodiment and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, in which like reference characters in the same or different figures indicate like parts:

FIG. 1 is a side elevation view of a carbide-tipped circular saw blade in accordance with the present invention.

FIG. 2 is an enlarged view of a single tooth like that in FIG. 1 within circle 2.

FIG. 3 is a side elevation view of a stamping of the body of the circular saw blade in accordance with the present invention.

FIG. 4 is an enlarged elevation view of FIG. 3 within circle 4.

FIG. 5 is a view like FIG. 4.

FIG. 6 is a view like FIG. 5 after the carbide tooth has been brazed to the body.

FIG. 7 is a view like FIG. 6 after grinding of the tooth and shoulder.

FIG. 8 is an enlarged perspective view of a gullet and tooth pocket.

FIG. 9 is an elevation view of a prior art tooth.

FIG. 10 is a view like FIG. 8 with a finished tooth.

FIG. 11 is a view like FIG. 1 of another embodiment of the present invention.

FIG. 12 is an enlarged view of a portion of the blade of FIG. 11.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to FIG. 1, a finished circular saw blade is illustrated and designated with the reference numeral 10, and rotates in the direction of cut 12. The saw blade is equipped with carbide teeth 14 which are ordinarily wider than the width of the saw blade body 15. The teeth 14 are mounted at the rear surfaces of the gullet 16 on the shoulder 30 formed in the outer perimeter or circumferential edge 18 of the saw blade, the term rear meaning with respect to the direction of the cut 12. The body 15 is formed out of a thin steel plate ordinarily by stamping.

The tip of the tooth 14 is shown engaging a radius 22 passing through the center 24 of the arbor hole 26 of the saw blade 10. A thin hard coating 29 may be applied about the outer circumferential portion of the saw blade to provide increased wear characteristics and to reduce drag.

The teeth 14 may be carbide or other hard material teeth which are commercially available. The teeth preferably are manufactured from a tungsten carbide grain/cobalt sintered matrix (herein "carbide").

The teeth 14 are ordinarily alternately beveled left and right to best suit the application. The tooth 14 is at a hook angle α of about 18 degrees. Also, a

clearance angle β is present at the top or back of the tooth along the shoulder 30 at about 11 degrees.

Referring now to FIGS. 1 and 2, the peripheral or circumferential edge 18 includes at least one and ordinarily a plurality of alternating gullets 16 and shoulders 30. The gullets 16, which are the gaps between the shoulder and teeth, are ordinarily shallow and include a relatively flat or linear base 48 such that when viewed in side elevation the gullet provides a rectilinear appearance with the periphery as one of the longitudinal sides. A ratio exists between the circumferential width of the shoulder 30 to the gullet 16 of about 2:1. Thus, the circumferential distance between adjacent gullets 16 is such that the gullet makes up about one-third, and the shoulder two-thirds, of the circumferential distance between adjacent teeth.

Also, the gullet 16 may include an expansion slot 32 which extends from and is continuous with the gullet 16. The expansion slot 32 includes a short neck 34 and an ellipsoidal or oval or round shaped body 36. The expansion slots 32 enable flexing of the blade, under high-heat cutting application. Also, the shallow gullets and shorter expansion slots add to the tip or tooth stability which, in turn, enables the blade to stay on line during cutting.

The shoulders 30 on the peripheral edge 18 are substantially linear except for a shallow arcuate recess 38. The recess 38 provides clearance for a grinding wheel when the shoulder and tooth are ground to form the sharpened blade as will be discussed herein.

A tooth pocket 40 adjacent the shoulder 30 includes a wall 42 and a shelf 44 substantially perpendicular to the wall, as best seen in FIGS. 4, 5 and 8. The wall 42 is continuous along the longitudinal edge of the tooth 14. Also, the shelf 44 is continuous with the lateral edge of the tooth 14 and extends beyond the front face 46 of the tooth 14. The wall 42 and the shelf 44 provide a large contact area which maximizes the strength of the tooth in the blade. The shelf 44 is angled with respect to the base 48 of the gullet 16, is above the base 48 of the gullet, and is connected with the gullet base 48 by a step 50. Thus, with the tooth supported and secured in the blade pocket fully on two of its edges, the tooth is better secured to the blade, than in conventional blades, as well as having additional strength since the entire shoulder is behind the tooth during cutting action. Finally, the gullet is large enough to collect chips and dust during normal cutting.

Turning to FIG. 7, the force acting on the tooth and the resultant force vectors are shown. As can be seen in FIG. 7, the force at the tip of the tooth is transmitted rearwardly to the shoulder 30, as well as radially downwardly towards the shelf. By having the shelf extend beyond the front of the tooth, a reactive force is applied by the body along the lateral edge 66. Also, at the corner of the lateral edge and longitudinal edge of the tooth, the shelf provides a resistive force reducing moments which may be present in the tooth. Thus, by having the entire area brazed, the tooth is provided with maximum strength. This is compared with FIG. 9, a prior art tooth, where the shelf does not extend beyond the tooth where a reactive force is not applied at the corner of the tooth, thus enabling a moment force to be created which tends to dislodge the tooth from the braze and the body. Also, larger moment forces are capable when the tooth is not flush with the shoulder. Furthermore, in a situation where poorly supported objects are hit (such as loose nails, knots, etc.), the present invention enables more resistance to twisting forces outside the plane of the blade as seen in FIG. 10. These twisting forces are known for removing the entire tooth. However, due to the securement of the tooth in the tooth pocket, the present invention resists the twisting force and reduces the likelihood of tooth removal.

Turning to FIGS. 3 through 8, a better understanding will be provided to

Turning to FIGS. 3 through 8, a better understanding will be provided to manufacture the blade.

Manufacturing of the blade is accomplished by stamping a coil/steel raw material to form the blade plate or body 15. The stamping of the steel forms the gullets 16, shoulders 30, heat vents 28, expansion slots 32, and arbor hole 26. Also during stamping, a projection 60 is formed on the shoulders 30.

The projection 60 includes a radius 62 which has a desired size which enables the dies that stamp out the blades to eliminate sharp corners which will preserve die life.

The projection 60 includes a portion of the wall 42. Also, the projection 60 provides the wall 42 with a height which is substantially equal to or greater than the height of the tooth 14 as seen in FIG. 6. This provides a very deep pocket when the tooth 14 is first positioned in the tooth pocket 40 adjacent the wall 42 and the projection 60. By providing the projection 60 with its deep pocket, this eliminates grinding of the pocket step as is conventional in the prior art, thus reducing manufacturing tooling and production cost as well as increasing the speed of production.

After the tooth 14 is positioned into the pocket 40, abutting wall 42 and resting on shelf 44, the tooth is brazed, soldered, or otherwise attached. As seen in FIG. 8, the wall 42 and shelf 44 provide a maximum contact area to secure the tooth 14 with the blade body 15. The tooth 14, after positioned against the wall 42 and shelf 44, is brazed such that the brazing or solder flows substantially about the rearmost lateral 66 and longitudinal edge 68 of the tooth 14. This provides a substantial amount of brazing material to securely affix the tooth to the contact area of the wall 42 and shelf 44 on the blade body 15.

A prior art method of maximizing wall-contact area was to grind the pocket square eliminating the need for the radius. However, this is not cost-effective.

Once the tooth 14 is brazed with the blade body 15, the tooth 14 and shoulder 30 are ground so that the projection 60 is removed to provide the substantially flat or linear shoulder 30 as seen in FIGS. 1, 2 and 7. Also, after stamping, the plate body 15 is cleaned as is done in a conventional process. Also during the brazing, the area around the pocket may be tempered.

Turning to FIGS. 11 and 12, a saw blade 110 is illustrated. The saw blade 110 is substantially similar to that previously described, including teeth 14, shoulders 30, arbor hole 26, and heat vent 28. The blade 110 differs from the blade 10 in the gullet 116 region, as well as the connection of the tooth 14 in the tooth pocket 140.

The gullet 116 may include an expansion slot 32 which extends from and is continuous with the gullet 116. The expansion slot 32 is like that previously described. The gullets 116 are relatively deep with respect to the gullets illustrated in FIG. 1. The gullets 116 include a first annular wall 118 which is continuous with the circumference and terminates at a base 120. The base 120 is substantially parallel to the circumference of the blade. The base 120 is located at a radial distance 121 from the center of the blade at about eighty to ninety-five (80-95%) percent of the radius of the blade. Preferably, the base of the gullet is located at about ninety (90%) percent of the radius of the blade. A second side wall 122 extends angularly from the base to the tooth pocket 140.

The tooth pocket 140 includes a wall 142 and a shelf 144 substantially perpendicular to the wall. The wall is continuous along the longitudinal edge of the tooth 14. The shelf 144 is continuous with the lateral edge of the tooth 14 and has a depth substantially equal to the thickness of the tooth as illustrated in FIG. 12. Thus, the face of the tooth is substantially continuous with the second wall 122 of

Thus, the face of the tooth is substantially continuous with the second wall 122 of the gullet 116 as seen in FIG. 12. The wall 142 and shelf 144 provide a large contact area which maximizes the strength of the tooth and the blade. The shelf 144 is angled with respect to the base 120 and second side wall 122 of the gullet 116 and is connected continuously with the base via the second wall 122. Accordingly, with the tooth supported and secured in the blade pocket fully on two of its edges, the tooth is better secured to the blade than in conventional blades, as well as having additional strengths since the entire shoulder is behind the tooth during cutting action.

The top edge 15 of the tooth 14 is ground to be substantially flush or on line with the circumference of the blade. Also, the blade is manufactured in a process like that previously described.

While the above detailed description describes the preferred embodiment of the present invention, the invention is susceptible to modification, variation, and alteration without deviating from the scope and fair meaning of the subjoined claims.

Patent Citations (82)

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US88949A *		1869-04-13		Improvement in circular saws
US191198A *		1877-05-22		Improvement in circular saws
US199852A *		1878-01-29		Improvement in ci rcular saws
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US635509A *	1897-04-26	1899-10-24	George Rowe	Circular saw.
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US4026177A *	1976-07-21	1977-05-31	Lokey Tool, Inc.	Rotary insulated saw blade
DE2654625A1 *	1976-12-02	1978-06-08	Jansen Fa R	Circular saw blade for wood or metal - has radial slots arranged symmetrically at different diameters to provide elasticity
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US4106382A *	1976-05-25	1978-08-15	Ernst Salje	Circular saw tool
US4232580A *	1978-11-06	1980-11-11	Stewart John S	Circular saw blade
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US4417833A *	1979-12-04	1983-11-29	Iscar Ltd.	Rotary slot cutting tools
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Title
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Priority And Related Applications

Parent Applications (1)

Application	Priority date	Filing date	Relation	Title
US08616387	1995-09-26	1996-03-15	Continuation-In-Part	Circular saw blade and method

Priority Applications (3)

Application	Priority date	Filing date	Title
US432995	1995-09-26	1995-09-26	*US Provisional Application*
US08616387	1995-09-26	1996-03-15	Circular saw blade and method
US08677152	1995-09-26	1996-07-09	Circular saw blade

Applications Claiming Priority (3)

Application	Filing date	Title
US08677152	1996-07-09	Circular saw blade
CA 2186071	1996-09-20	Circular saw blade and method
EP19960306962	1996-09-25	Circular saw blade and method for making the same

Legal Events

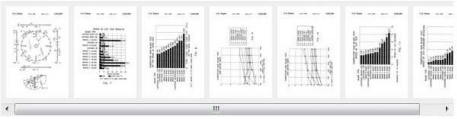
Date	Code	Title	Description
1996-09-20	AS	Assignment	**Owner name**: BLACK & DECKER INC., DELAWARE **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNORS:CURTSINGER, JOHN R.;ACHTERBERG, NICHOLAS E.;REEL/FRAME:008184/0903;SIGNING DATES FROM 19960911 TO 19960912
2002-09-27	FPAY	Fee payment	**Year of fee payment**: 4
2006-09-26	FPAY	Fee payment	**Year of fee payment**: 8
2010-10-27	FPAY	Fee payment	**Year of fee payment**: 12

Thin kerf circular saw blade

Abstract

The thin kerf circular saw blade of the present invention is a high speed saw blade having a plurality of spaced teeth around its periphery. The blade contains a plurality of radial slots extending inwardly from the periphery of the blade. A combination of features including the aggressive hook angle of the teeth, a plurality of expansion slots, a shallow gullet, reinforcing shoulder, carbide cutting elements, and a thin profile provide a saw blade for cutting a thin kerf at a high cutting speed. A slick coating including friction reducing and non-stick compounds reduce resin buildup and further improve the speed of cut of the thin kerf saw blade. The improved performance of the thin kerf saw blade in comparison with conventional carbide blades is attributable to the synergistic effect of optimizing the design parameters for each of the individual structural features and combining the features according to the present invention to obtain surprisingly good results including: an increased cutting speed, reduced tip wear, and reduced energy consumption.

Images (7)



Classifications

B23D61/026 Composite body, e.g. laminated, body of diverse material

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US5351595A
US Grant

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Inventor: Jed G. Johnston

Current Assignee : Credo Tool Co

Original Assignee: Vermont American Corp

Priority date : 1991-12-20

Family: US (1)

Date	App/Pub Number	Status
1992-09-24	US07950834	Expired - Fee Related
1994-10-04	US5351595A	Grant

Description

This is a continuation-in-part application of Ser. No. 07/810,912 filed on Dec. 20, 1991.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a high speed circular saw blade having a plurality of teeth with aggressive hook angle, a plurality of generally radial expansion slots, a shallow gullet, reinforcing extended shoulder, carbide cutting elements, and a thin profile for cutting a thin kerf. A slick coating including friction reducing and non-stick compounds reduce resin buildup and further improve the speed of cut of the thin kerf saw blade. The improved performance of the thin kerf saw blade in comparison with conventional carbide blades is attributable to the synergistic effect of optimizing the design parameters for each of the individual structural features

Claims (20)

I claim:

1. A thin kerf circular saw blade, comprising:

a generally circular main body having a pair of side faces and a plurality of teeth, each one of said teeth comprising a tooth projection having a cutting element affixed thereto, said teeth being spaced about the periphery of said main body, said cutting element having a positive hook angle of about 30 degrees to about 40 degrees relative to a radial line extending from the center of said main body to the periphery of said main body;

said saw blade having a central opening for mounting;

said main body of said saw blade having a plurality of expansion slots disposed between selected teeth and extending inwardly from the periphery of said saw blade toward said central opening;

and combining the features according to the present invention to obtain surprisingly good results including: superior cutting speed, reduced tip wear, and reduced energy consumption as compared with conventional saw blades.

2. Description of the Prior Art

There are several types and designs of saw blades for cutting different types of material. Conventional circular saw blades have a plurality of teeth spaced about the outer periphery of the blade, and a plurality of expansion slots of various configurations in the outer edges of the blade in order to dissipate stress and prevent heat warpage of the blades. Expansion slots are not new to the industry and are intended to relieve stress, to aid in cleaning out the kerf, to attain straighter cutting action and to achieve other beneficial results. An expansion slot may be formed in a radial direction being directly aligned with the center of the blade, formed in a non-radial direction spaced around the periphery of the blade, formed having a positive angle, or formed at a negative angle. A positive angle is an angle such that the bottom of the slot trails a line extending from the center of the blade to the outer edge of the slot, relative to the direction of rotation of the saw blade. The bottom of a negative angle slot leads the radial line in the direction of rotation of the saw blade. The angle of the expansion slot is sometimes referred to as the "hook" of the slot, with a radial slot having a 0 degree hook, and positive and negative angle slots having positive and negative hooks, respectively. As the saw blade rotates cutting into the wood, the sawdust enters the space between the saw teeth and the face of the saw blade. As the sawdust comes in contact with the cutting edges at the expansion slots it is propelled by centrifugal force along the face of the teeth out of the area between the saw blade and the wood cut.

There are different types of saw blades having expansion slots of various designs for cutting specific types of material. Large diameter saw blades used for cutting green wood generally have diameters of from 30 to 100 inches in diameter. Because of the large size of the blades, green wood blades are generally operated at slow rotational speeds of about 500 to 1200 revolutions per minute (r.p.m.). to achieve a desirable speed at the cutting edges yet prevent damage to the large diameter blades having high peripheral speed. Fresh cut green wood also tends to swell against the blade due to fresh moist sawdust produced by the cutting action binding in the space between the face of the blade and the wood being cut. This causes excessive friction between the blade and the wood, and contributes to heat buildup. To minimize this problem these large diameter green wood blades are provided with wide expansion slots generally from 1/4 to 1/2 inches wide and having a depth of typically 1/4 of the diameter of the blade. The expansion slots are generally formed at a negative angle often with inserts at the trailing edges of the slots.

A drawback to using inserts in the expansion slots of a saw blade is that they tend to permit the blade to flop back and forth which is undesirable for cutting dry woods requiring a true cut. Also, wide slots cannot be used safely for dry woods because the production of hard dry wood splinters and chips can become wedged into wide expansion slots within the blade and thrown outward creating potential harm to the user. The use of narrow expansion slots in dry wood blades reduces the tendency of chips and splinters becoming wedged within the expansion slots and being thrown from the blade.

Most circular saws employed for cutting dry wood or precut wood are high speed saws. Conventional saw blades having a tip angle of about 20 degrees may have a diameter of up to about 30 inches, but generally have a diameter of about 20 inches or less. The rotational speed of the saw is inversely proportional to the

each of said cutting elements being a carbide cutting element affixed to a leading edge of each one of said tooth projections, each of said carbide cutting elements tapering inwardly from top to bottom and front to back, each of said carbide cutting elements having cutting edges of greater width than said main body, each of said carbide cutting elements having an alternating top bevel so that a portion of said cutting edges alternately project laterally beyond the face of at least one side of said main body;

a shallow generally straight gullet between each tooth; and

a continuous extended shoulder extending from said gullet supporting each of said teeth.

2. The thin kerf circular saw blade of claim 1, wherein each of said cutting element is secured in a seat defined within the leading edge of each tooth projection, said seat supportingly engaging said cutting element against movement circumferentially of said body.

3. The thin kerf circular saw blade of claim 1, wherein said cutting elements are welded or brazed to said tooth projection.

4. The thin kerf circular saw blade of claim 1, wherein said carbide cutting element is a cemented carbide having a carbide phase comprised predominately of tungsten carbide, a binder phase comprised predominately of a cobalt phase, and a quarternary phase comprising tungsten, cobalt, boron and carbon.

5. The thin kerf circular saw blade of claim 1, wherein said carbide cutting element is a cemented carbide having a carbide phase comprised predominately of tungsten carbide, a binder phase comprised predominately of a nickel phase, and a quarternary phase comprising tungsten, nickel, boron and carbon.

6. The thin kerf circular saw blade of claim 1, wherein said slots extend generally radially inward toward said central opening.

7. The thin kerf circular saw blade of claim 1, said main body having at least three expansion slots.

8. The thin kerf circular saw blade of claim 1, wherein said expansion slots are equally distributed between selected teeth.

9. The thin kerf circular saw blade of claim 1, including at least one stress dispersion hole interconnecting at least one of said expansion slots.

10. The thin kerf circular saw blade of claim 1, further including a stress dispersion hole at the bottom of each expansion slot.

11. The thin kerf circular saw blade of claim 10, wherein said stress dispersion holes are generally circular in shape.

12. The thin kerf circular saw blade of claim 1, wherein said shoulder defines a back angle in the range of about 15 degrees to about 25 degrees depending upon the diameter of said blade.

13. The thin kerf circular saw blade of claim 1, including a protective coating on said main body.

diameter of the blade. For example, it is possible to run a 30 inch high speed saw blade at speeds up to about 1725 r.p.m. while a 20 inch high speed saw blade may be operated safely at 3,450 r.p.m., and a 14 inch saw blade may be operated safely at 5,000 r.p.m. Of these high speed saw blades, two types of saw blades frequently used are the "cut-off" saw blade designed for cutting across the grain of the wood, and "rip" saw blades designed for cutting lumber along the longitudinal direction or with the grain of the lumber.

As with the low speed blades, the high speed blades utilize expansion slots to prevent blade warpage due to heat buildup in the blade. Because sawdust buildup adjacent the face is not a problem with high speed blades used for cutting wood, it is not necessary to provide special designs for expansion slots for high speed blades. Typically, such slots are usually about one inch deep for a 12-30 inch blade and about 3/4 inch for a 6 to 12 inch blade. Conventional high speed blades are formed at the same positive slot hook as the teeth of the blade of between about +10 degrees to about +25 degrees; however, the expansion slots may be formed in a radial direction or at a 0 degree hook.

SUMMARY OF THE INVENTION

The thin kerf circular saw blade of the present invention is a high speed saw blade comprised of a plurality of spaced teeth around its periphery. The blade contains a plurality of radial slots extending generally radially inwardly from the periphery of the blade with stress dispersion holes formed at the end of the slots. A combination of features improve the performance of the thin kerf saw blade, including an aggressive hook angle for the teeth, a plurality of expansion slots, a shallow gullet, reinforcing extended shoulder, tungsten carbide cutting elements, and a thin body profile provide an improved saw blade for cutting a thin kerf at a high cutting speed.

The leading edge of each tooth carries a hard cutting element extending substantially full length of the tooth face and welded or brazed full length to the tooth face. Static stresses are set up during the use of the blade because the coefficient of thermal expansion of the cutting elements is different from that of the body of the saw blade, so that when a unitary or full length cutting element is welded or brazed in place, stresses are set up in the body of the blade during cooling of the blade. These remain in the blade during operation increasing the likelihood of failure of the blade and a fracture of the cutting element. Moreover, the process of securing the cutting element in place may cause sufficient buildup of heat to provide an annealing action on the body of the blade, which is undesirable and prevents the blade from retaining proper tension. Friction is also caused by the rubbing of the sides of the kerf producing heat and causing excessive stresses in the cutting element and the blade. When the saw operates under binding conditions, the unitary cutting element is relatively rigid and cannot flex.

A saw blade constructed accordingly to the present invention minimizes the heat buildup and stress related problems of prior art saw blades. There are less static stresses because the cutting elements cut a kerf wider than the main blade body into the wood. The alternating top bevel of the cutting elements reduce lateral pressure from the wood against the sides of the blade body so that the saw tends to effectively work its way through binding conditions without creating excessive heat and facilitate cooling running of the blade. The alternating top bevel of the cutting edges improves the accuracy of the cut.

The expansion slots dissipate heat generated by friction between the workpiece and the cutting elements. This prevents the buildup of static stresses in both the cutting element and the body of the blade, thereby lessening the likelihood of fracture of the blade when in use, under dynamic stress. When the saw is in a bind.

coating on said main body.

14. The thin kerf circular saw blade of claim 13, wherein said protective coating is a water based lacquer

15. The thin kerf circular saw blade of claim 13, wherein said protecting coating includes an anti-stick and friction reducing agent selected from the group comprising silicon, polytetrafluoroethylene, or wax.

16. The thin kerf circular saw blade of claim 15, wherein said friction reducing agent is a silicon based compound comprising a silicone polymer, a silicone co-polymer, or silicone oil.

17. The thin kerf circular saw blade of claim 1, including an anti-stick and friction reducing coating selected from the group comprising silicon, polytetrafluoroethylene, or wax.

18. The thin kerf saw blade of claim 1, wherein said cutting elements have an alternating top bevel so that a portion of said cutting edges alternately project laterally in opposite directions beyond the faces of said main body.

19. The thin kerf saw blade of claim 1, said cutting elements extending substantially the full length of said tooth projections intersecting at said gullet.

20. A thin kerf circular saw blade, comprising:

a generally circular main body having a pair of side faces and a plurality of teeth, each one of said teeth comprising a tooth projection having a cutting element affixed thereto, said teeth being spaced about the periphery of said main body, said cutting element having a positive hook angle of about 30 degrees to about 40 degrees relative to a radial line extending from the center of said main body to the periphery of said main body;

said saw blade having a central opening for mounting;

said main body of said saw blade having a plurality of expansion slots disposed between selected teeth and extending inwardly from the periphery of said saw blade toward said central opening

each of said cutting elements being a carbide cutting element affixed to a leading edge of each one of said tooth projections, each of said carbide cutting elements tapering inwardly from top to bottom and front to back, each of said carbide cutting elements having cutting edges of greater width than said main body each of said carbide cutting elements having an alternating top bevel so that a portion of said cutting edges alternately project laterally beyond the face of said main body;

a shallow straight gullet between each tooth; and

a continuous extended shoulder extending from said gullet supporting each of said teeth.

fracture of the blade when in use, under dynamic stress. When the saw is in a bind, the expansion slots allow relative lateral movement of the cutting elements with respect to one another and permit the plural cutting elements to go back to normal after the binding action recedes. When operating in a bind, the irregular shape of the expansion slots of the thin kerf saw blade tend to break up the collected dust in the kerf and carry it out more efficiently than conventional saw blades having straight slots. Moreover, the stresses the thin kerf saw blade experiences cutting a thin kerf are less than that of a conventional blade cutting a thicker kerf because cutting a wider kerf requires more force, more energy, and more time using a wider conventional saw blade, thus increasing the dynamic stresses on both the cutting elements and the body of the conventional saw blade.

Due to the use of an aggressive hook angle the thin kerf blade is designed utilizing a shallow gullet to provide additional support and structural strength to the tooth configuration and provide superior performance. The shallow gullet utilized with the present invention runs truer than a deep gullet used in conventional blades and reduces the flexing of the cutting elements and blade body.

The reinforcing, extended shoulder adds strength behind the teeth for clean accurate cuts. The combination of using a greater hook angle than conventional blades, a reinforcing extended shoulder, and a more shallow gullet than conventional blades provides a better flush of the saw dust than conventional blades.

The hook angle of the teeth for the thin kerf circular saw blade ranges from about 32 degrees to about 37 degrees, preferably about 35 to about 36 degrees. The use of the hard tungsten carbide cutting elements enables the cutting teeth to be designed having a greater more aggressive hook angle. The aggressive hook angle causes the teeth to sever and penetrate with less effort. The combination of the hard carbide cutting elements, aggressive tooth hook angle, shallow gullet, and reinforcing extended shoulder in a thin kerf blade improves the cutting speed and durability of the blade, and allows for sufficient heat dissipation and expansion of the blade by the utilization of a plurality of expansion slots.

The 24 tooth, 71/4 inch, thin kerf blade of the present invention is designed to saw at a sustained cutting speed of about 5500 r.p.m. and remove about 3/1000 of an inch of material per tip load resulting in an increased speed of cut of about 13 feet per minute through 3/4 inch medium density ply board at 5,500 rpm.

The fully hardened blade with the thin kerf profile builds speed, improves accuracy, resists bending, and adds stability. Shot peening the thin kerf blade tensions the blade and eliminates flutter and vibration.

The main body of the thin kerf blade is about 0.045 inches to about 0.085 inches in width as compared to conventional blades having a main body about 25 percent to about 45 percent thicker width. The thin kerf helps each tooth cut faster, smoother and more efficiently than with conventional width blades. The thin kerf design creates less drag on the saw and reduces the amount of stock that turns into sawdust. In addition, a friction reducing and non-stick coating reduces the tendency of wood resin from accumulating as a sticky residue of the blade body surface.

It is the primary object of the present invention to provide a high speed circular thin kerf saw blade employing a combination of design features including a plurality of spaced apart cutting teeth having an aggressive hook angle, a plurality of generally radial irregular shaped expansion slots uniformly distributed around the periphery of the blade, a shallow gullet between the teeth, a reinforcing extended shoulder

supporting each tooth, a carbide cutting element providing a hard cutting surface for each tooth, and a thin main body profile to provide a thin kerf saw blade capable of cutting a thin kerf at a high speed of cut.

It is another object of the present invention to coat the main body of the blade with a friction reducing and non-stick coating to reduce the tendency of wood resin and similar sticky substances from accumulating as a sticky residue on the blade body surface and to provide a slick blade surface against the wood.

It is another object of the present invention to provide a thin kerf saw blade with an aggressive hook angle which bites quickly for fast cuts with less effort.

It is another object of the present invention to provide a thin kerf saw blade having sharp carbide teeth which can be resharpened.

It is another object of the present invention to provide a thin kerf saw blade having a plurality of expansion slots and holes to reduce stress and metal fatigue and to dissipate heat to prevent warpage of the blade.

It is another object of the present invention to provide a thin kerf saw blade wherein shot peening tensions the blade and eliminates flutter and vibration.

It is yet another object of the present invention to provide a thin kerf saw blade having a reinforcing extended shoulder adding strength behind the teeth for clean accurate cuts.

A further object of the present invention is to provide a thin kerf saw blade having a fully hardened body to add stability and resist bending.

Finally, it is an object of the present invention to provide a thin kerf circular saw blade having an improved performance in comparison with conventional carbide blades, attributable to the synergistic effect of optimizing the design parameters for each of the individual design features for each structural element of the blade and combining the features according to the present invention to obtain surprisingly good results in superior cutting speed, reduced tip wear, and reduced energy consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention will be had upon reference to the following description in conjunction with the accompanying drawings in which like numerals refer to like parts throughout the several views and wherein:

FIG. 1 is a face elevational view of the saw blade of the present invention;

FIG. 2 is a left elevational view showing the saw blade of FIG. 1;

FIG. 3 is a right elevational view showing the saw blade of FIG. 1;

FIG. 4 is a top view showing the saw blade of FIG. 1;

FIG. 5 is a bottom view showing the saw blade of FIG. 1; and

FIG. 6 is a perspective fragmentary view showing the cutting elements and slot of the saw blade of FIG. 1.

FIG. 7 is a bar graph showing the speed of cut test results of the thin kerf blade of the present invention as compared to competitor's saw blades.

FIG. 8 is a bar graph showing the results of the Saw Blade Test Tip Top Wear Test at 5,000 Feet comparing the thin kerf blade of the present invention with

at 3,000 Feet comparing the thin kerf blade of the present invention with competitor's saw blades.

FIG. 9 is a line graph showing the results of the Saw Motor Amps Saw Blade Test comparing the thin kerf blade of the present invention with competitor's saw blades.

FIG. 10 is a line graph showing the results of the Saw Motor Amps Saw Blade Test comparing the thin kerf blade of the present invention with competitor's saw blades.

FIG. 11 is a bar graph showing the results of the Saw Blade Test Speed of Cut Test comparing the thin kerf blade of the present invention with competitor's saw blades.

FIG. 12 is a bar graph showing the results of the Saw Blade Speed of Cut-Standard Deviation Test comparing the thin kerf blade of the present invention with competitor's saw blades.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, the thin kerf circular saw blade 10 of the preferred embodiment has a disc shaped main body 12 having a pair of side faces 11, 13 and a central mounting opening or arbor 14. The main body 12 of the thin kerf saw blade 10 of the preferred embodiment has a width of about 0.045 inches to about 0.085 inches depending upon the diameter of the blade and is about 30 percent thinner than conventional carbide blades.

A plurality of saw teeth 16 are circumferentially spaced around the periphery of the main body 12 Each tooth comprises a cutting element 20 affixed to a tooth projection 9 having a leading edge 18 relative to the direction of rotation of the blade 10 (which is counterclockwise according to FIG. 1). More particularly, the leading edge 18 of each tooth projection 9 is faced or tipped with a suitable cutting element 20 formed of harder substance than said main body 12 which is comprised of steel, the harder substance being a cemented carbide material such as tungsten carbide, and more particularly DYANITE® tungsten carbide material, (DYANITE® is a trademark of Vermont American Corporation), as described in U.S. Pat. No. 4,916,780 and U.S. Pat. No. 5,116,416. The DYANITE® carbide cutting insert 20 is a high, tough grade of carbide capable of providing a sharper edge that remains sharp up to five times longer than conventional tungsten carbide. As set forth in U.S. Pat. No. 4,916,780, the cemented carbide element carbide cutting element is a cemented carbide having a carbide phase comprised predominately of tungsten carbide, a binder phase comprised predominately of a cobalt phase, and a quarternary phase comprising tungsten, cobalt, boron and carbon. As set forth in U.S. Pat. No. 5,116,416, the cemented carbide cutting element is a cemented carbide having a carbide phase comprised predominately of tungsten carbide, a binder phase comprised predominately of a nickel phase, and a quarternary phase comprising tungsten, nickel, boron and carbon.

Each cutting element 20 comprises a front face surface 17, a rear surface 19, a bottom surface 21, a pair of side cutting edges 22 and a top cutting edge 23 shown in FIG. 2, is affixed to the leading edge 18 of each tooth projection 9. A portion of the main body 12 defining the leading edge 18 of each tooth projection 9 defines a notched recess pocket, or seat 15 for receiving and supportingly engaging the rear surface 19 and bottom surfaces 21 of each cutting element 20. The cutting elements 20 are held within the seat 15 and fastened to the leading edges 18 of the saw teeth projection 9 by welding or brazing or the like and are ground forming a pointed tooth 16 having a top cutting edge 23 angled from about 0 degrees to 3 degrees with respect to the outer peripheral portion of the main body 12 as shown in Angle X of FIG. 1.

in Figure 1 of FIG. 1.

The peripheral portion of the main body 12 extending from the front face surface 17 of the cutting element 20 forward toward the top of the leading edge 18 of the preceding tooth 16 forms a shallow, generally straight gullet 26 which makes a smooth continuous transition blending into a generally straight extended shoulder 24 defining a back angle "A" in the range of about 15 degrees to about 25 degrees depending upon the diameter of the blade 10. Shoulder back angle, Angle A, as shown in the preferred embodiment is about 17 degrees. The extended shoulder 24 provides additional structural strength to reinforce the leading edge of the tooth 16 and cutting element 20 thereon, and to support the stress placed upon the teeth 16 by the aggressive hook of the teeth 16 and the high cutting speed of the blade. The reinforcing extended shoulder 24 also helps to guide the blade 10 and provide cleaner and more accurate cuts.

In the preferred embodiment of the present invention, the teeth 16 are spaced evenly about the outer perimeter of the blade 10 and each tooth 16 is separated by a shallow gullet 26 adjacent to the cutting edge 20 and extending to the shoulder 24 to facilitate the removal of saw dust and chips. The shallow gullet 26 runs truer than the typical deep gullet used in conventional blades, and the shallow gullet 26 reduces the flexing of the cutting elements 20 and blade body 12 which is especially important in a saw blade 10 utilizing an aggressive hook angle.

The circular saw blade 10 is provided with a plurality of generally narrow expansion slots 30 extending downward from the gullets 26 between selected teeth 16 of the main body 12. Preferably three to four expansion slots 30 extend inwardly from the outer perimeter of the saw blade 10 preceding selected teeth 16, through the main body 12 from one side face 11 to the other side face 13. The expansion slots 30 dissipate stress formed by the friction of the teeth 16 cutting into the wood, and aid in cooling the blade and the removal of sawdust. The number of expansion slots 30 is dependent upon the number of teeth 16 on the blade 10 in that the teeth 16 are arranged in consecutive multiples, for example, of three, four, or five teeth 16 between each slot 30. The expansion slots 30 are equally spaced around the blade circumference. Any number of slots 30 ("X") can be used depending upon the number of teeth 16 around the periphery of the blade 10, provided the number (X) can be divided into the number of teeth 16 ("Y") to provide an even division with no remainder. For example, the 24 tooth, 71/4 inch, thin kerf blade 10 of the preferred embodiment utilizes four expansion slots 30, whereas a blade 10 with eighteen teeth 16 would use three expansion slots 30.

The expansion slots 30 of the thin kerf circular saw blade 10 of the preferred embodiment have a varying width of from 1/16 of an inch to about 1/4 of an inch in width, and about 11/4 inches in length formed in the outer edge of the blade 10 in a generally radial direction directly aligned with the center 14 of the blade 10. The depth of the slot 30 may be designed to vary according to the depth of the material being cut so that the length of the expansion slot 30 being a depth at least as thick as the material being cut, for example from about 1 inch to about 11/2 inches in length. A generally round stress dispersion hole 32 is provided at the bottom of each slot 30 to alleviate stresses and prevent cracks in the blade 10. The diameter of the stress dispersion hole 32 is in the range of about 3/16 to about 5/16 of an inch in diameter, and more particularly the diameter of the stress dispersion hole 32 of the preferred embodiment is about 1/4 inch in diameter.

The expansion slots 30 in the preferred embodiment are formed in the general shape of a "lightning bolt" having a depth ranging from about 1 inch to about 11/2 inches, and more particularly about 11/4 inches in length, and a generally round stress dispersion hole 32 provided at the bottom of each slot 30. The "lightning

stress dispersion hole 32 provided at the bottom of each slot. The "lightning bolt" shape is a design choice rather than a functional shape. The dimensions of the lightning bolt expansion slots 30 are about the same for thin kerf saw blades 10 of various diameters.

More particularly, as shown in FIG. 6, the expansion slots 30 extend generally radially inward from the narrow gullet 26 toward the central opening 14 forming a first outer slot portion 34 increasing in width from the periphery of the main body 12 to about the center of the expansion slot 30, a wide second central slot portion 36 joining the first outer slot portion 34 extends upward into the blade body 12 at a positive angle extending past and to the side of the lower end portion of the first outer slot portion 34, and a narrowing third inner slot portion 38 joined to the second central slot portion 36 extends generally radially downward past and to the side of the first outer slot portion 34 ending in an stress dispersion hole 32 at the bottom of the expansion slot 30 having a larger diameter than the distal end of the third inner slot 38.

The expansion slots 30 extend blade life by alleviating metal stress, reducing heat buildup, and eliminating warping. The expansion slots 30 also increase the surface area of the blade resulting in better heat transfer between the metal, ambient temperature cooling air, and the sawdust particles flowing through the slots 30. The expansion slots 30 also permit expansion and contraction of the blade due to the thermal stress and metal fatigue experienced in high speed circular saw blades 10 because of the heating and cooling of the blade during use. The slots 30 also reduce saw blade vibrations allowing the user to saw in a straight path with less weaving.

The front face 17 and side cutting edges 22 of the cutting element 20 are formed at a positive hook angle "B" in a range of from about 30 degrees to a range of about 40 degrees relative to a radial line extending from the center of the blade 10 to the periphery of the blade 10, and more particularly about 36 degrees as shown in the preferred embodiment in FIG. 1. The aggressive hook angle "B" of the thin kerf blade 10 is greater than that of conventional blades which were limited to a hook angle of about 26 degrees due to lower cutting speeds of 2,000 to 2,500 r.p.m., and because of heat buildup and stress experienced by the teeth and blades. However, the use of tungsten carbide cutting elements 20, and especially a tough grade of carbide such as the DYANITE® carbide, in combination with a reinforcing extended shoulder 24 provides a means of sustaining an increased cutting speed of about 5,500 r.p.m. using an aggressive hook angle of about 36 degrees to achieve an improved cutting speed.

As shown in FIGS. 2-5, each of the cutting elements 20 are ground to have a front face surface 17 being generally rectangular in shape and having a width that symmetrically decreases about 1 degree to about 5 degrees from the top cutting edge 23 to the bottom surface 21 gradually tapering downward to the same width as the main body 12 of the blade 10 as shown by Angle "Y" of FIG. 4. Furthermore, the side cutting edges 22 gradually taper inward from the front cutting edge face surface 17 to the rear edge surface 19 to present a smooth transition with the leading edge 18 of the tooth 16 formed as part of the main body 12 as shown in FIG. 3.

The front face 17 and top cutting edge 23 of each of the cutting elements 20 are ground diagonally in the horizontal plane, alternately from left to right, from face side 11 to face side 13, and from face side 13 to face side 11 forming an alternating top bevel on the leading edge of the cutting element 20 of each tooth 16 of about 5 degrees to about 15 degrees. Moreover, the alternating top bevel of the preferred embodiment is about 10 degrees, as shown by Angle "C" in FIG. 2. The

preferred embodiment is about 15 degrees, as shown by Angle "B" in FIG. 2. The front face 17 and top cutting edge 23 of each of the cutting elements 20 are ground diagonally in the vertical plane, alternately from top to bottom, from the front face surface 17 to the top cutting edge 23, and from the top cutting edge 23 to the front face surface 17 forming an alternating top bevel back angle of about 10 degrees to about 15 degrees, more particularly about 12 degrees, shown as Angle "D" in FIG. 1.

Alternate top beveling of the cutting elements 20 provides a means for chip clearance between each tooth 16, and the lateral extension of the cutting element 20 reduces lateral pressure against the sides of the wood so that the saw blade 10 tends to effectively work its way through binding conditions without creating excessive heat and facilitate cooling running of the blade.

As shown in FIG. 2-5, each cutting edge 20 overhangs the main body 12 by about 5/1000 of an inch to about 25/1000 of an inch, and more particularly as shown in the preferred embodiment by about 12/1000 of an inch as measured from the leading edge 18 of the tooth 16 adjacent the face of the tip. Since the width of each cutting element 20 is greater than the width of the main body 12, the width of the cutting elements 20 determine the width or kerf of the cut of the saw 10 sawing through wood, plastic, or other fibrous material. The thin main body 12 allows the use of narrow cutting elements 20 resulting in a thinner kerf than conventional carbide blades with less waste and a fast cutting speed.

The thin kerf circular saw blade of the present invention is formed by a process of cutting a blank having an arbor hole therein of the desired size and having the desired number of teeth out of a roll of coiled steel. The blank is rolled flat and the desired number of slots are stamped from the blank. Carbide tips are brazed to the teeth forming the cutting edges therefor. The carbide tips brazed portions are then ground and polished to a smooth finish. The finished blade may be coated with a water based lacquer, a silicone coating, a wax coating, or a polytetrafluoroethylene coating, such as TEFLON to provide a smooth appearance and provide a friction reducing coating having a anti-sticking slick surface. The silicone coating may be silicon based compound comprising a silicon polymer, co-polymer, or oil, or a silicon compound may be added as a component of a water based lacquer. The anti-stick friction reducing coatings such as silicon reduce the tendency of substances such as wood resin from accumulating as a sticky residue on the main blade body, and provide a lubricating effect between the blade body and the material being cut to increase the overall performance of the thin kerf blade.

EXPERIMENTAL EVALUATION

The graphs shown in FIGS. 7-12, and the data provided in Tables I and II, show the results of an independent test performed comparing the "LIGHTNING™" thin kerf circular saw blade of the present invention with similar competitive circular saw blades of various manufacturer's.

FIGURE 7

The test results of FIG. 7 show all four of the LIGHTNING™ thin kerf circular saw blades (the LIGHTNING™ MICRO-20T, the LIGHTNING™ MICRO-OM1, LIGHTNING™ 18-T and the LIGHTNING™ 24-T) provide superior cutting speed as measured in feet per second as a new blade and after 5,000 feet of use cutting a 3/4 inch medium density ply board at a rate of 13 feet per minute at 5500 rpm.

FIGURE 8

The test results of FIG. 8 show three of the four LIGHTNING™ thin kerf circular saw blades (the LIGHTNING™ MICRO-20T, the LIGHTNING™ 18-T and the

saw blades (the LIGHTNING™ MICRO-20T, the LIGHTNING™ 18-T and the LIGHTNING™ 24-T) outperforming additional competitor's saw blades as measured by the wear rate of the tip wear at 5,000 feet as tested using 3/4 inch medium density ply board at a rate of 13 feet per minute at 5,500 rpm.

FIGURE 9

The test results of FIG. 9 show the LIGHTNING™ MICRO-20T, the LIGHTNING™ 18-T and the LIGHTNING™ 24-T thin kerf saw blades designed in accordance with the present invention outperform competitor's saw blades resulting in a reduction in saw motor amps after cutting for 5,000 feet as tested using 3/4 inch medium density ply board at a rate of 13 feet per minute at 5,500 rpm.

FIGURE 10

The test results of FIG. 10 show the LIGHTNING™ MICRO-20T, the LIGHTNING™ MICRO-OM1, the LIGHTNING™ 18-T and the LIGHTNING™ 24-T thin kerf saw blades designed in accordance with the present invention outperform competitor's saw blades as measured by the using less saw motor amps to saw after cutting for 5,000 feet as tested using 3/4 inch medium density ply board at a rate of 13 feet per minute at 5,500 rpm.

TABLE

I SPEED OF CUT TEST RESULTSSeconds to Cut 3/4" MDPB (4 Foot Length)

TIME SLOWS FACTOR TIMES	% NEW BLADE	TIME AFTER REDUCTION 5000 FT.	IN CUTTING SPPED
LIGHTNING-18T	2.39	2.55	6.6
1.1XLIGHTNING-24T	2.31	3.83	66.2
1.7XLIGHTNING-MICRO-20	1.89	3.39	79.5
1.8XBRAND I BLADE	5.33	10.39	98.7
2.0XBRAND C BLADE	2.47	8.84	258.4
3.6XLIGHTNING-MICRO OM1	1.89	7.34	288.2
3.9XBRAND D BLADE	2.63	10.23	289.6
3.9XBRAND E BLADE	3.23	25.40	687.1
7.9XBRAND F BLADE	3.85	32.41	741.8
8.4XBRAND B BLADE	2.35	21.45	814.1
9.1XBRAND H BLADE	5.10	48.45	850.6
9.5XBRAND G BLADE	4.50	59.60	1224.4
13.2XBRAND A BLADE	2.10	49.07	2240.5
23.4X			

TABLE I

The test results of Table I show three of the four LIGHTNING™ thin kerf circular saw blades (the LIGHTNING™ MICRO-20T, the LIGHTNING™ 18-T and the LIGHTNING™ 24-T) outperforming additional competitor's saw blades as measured by speed of cut test results in seconds to cut a four foot section of 3/4 inch medium density ply board. The LIGHTNING™ blades provide faster cutting speeds for new blades, and after 5,000 feet of use. The table set forth these results in Percent Reduction in Cutting Speed and a Slow Factor multiplier.

FIGURE 11

The test results of FIG. 11 show the LIGHTNING™ MICRO-20T, the LIGHTNING™ MICRO-OM1, the LIGHTNING™ 18-T and the LIGHTNING™ 24-T thin kerf saw blades designed in accordance with the present invention outperform competitor's saw blades, whereby an average of ten saw blades were used to determine the speed of cut in seconds through four feet lengths of 3/4 inch medium density ply board at 5,500 rpm.

density ply board at 5,500 rpm.

FIGURE 12

The test results of FIG. 12 show the standard deviation for the LIGHTNING™ MICRO-20T, the LIGHTNING™ MICRO-OM1, the LIGHTNING™ 18-T, the LIGHTNING™ 24-T thin kerf saw blades designed in accordance with the present invention and competitor's saw blades, whereby an average of ten saw blades were used to determine the speed of cut in seconds through four feet lengths of 3/4 inch medium density ply board at 5,500 rpm.

TABLE

II_____SPEED OF CUT SUMMARY

AVERAGE	STANDARDBLADE	SPEED	
DEVIATION_____LIGHTNING			
#3-20T (MICRO	2.38	0.42KERF)	LIGHTNING
#1-18T 2.40	0.30BRAND B BLADE	2.67	
0.66LIGHTNING #4-20T (MICRO-		2.68	0.86OM1R)
LIGHTNING #2-24T 2.93	0.69BRAND A BLADE	2.96	
0.65BRAND C BLADE	3.25	0.66BRAND D BLADE	3.28
0.51BRAND E BLADE	4.59	1.93BRAND F BLADE	5.69
1.59BRAND G BLADE	6.00	1.44BRAND I BLADE	7.30
1.87BRAND H BLADE	8.37		
4.39_____			

TABLE II

The test results of Table II summarize the average speed of cut and the standard deviation for the LIGHTNING™ MICRO-20T, the LIGHTNING™ MICRO-OM1, the LIGHTNING™ 18-T, the LIGHTNING™ 24-T thin kerf saw blades and competitor's saw blades clearly showing the superior performance of the thin kerf saw blades designed in accordance with the present invention.

As demonstrated by the preceding examples set forth in FIGS. 7-12 and Tables I and II, optimizing the design parameters for each structural element of the blade and combining the features according to the present invention provides surprisingly good test results to provide a thin kerf circular saw blade exhibiting superior cutting speed, reduced tip wear, and reduced energy consumption due to the synergistic effect of the design of the blade components heretobefore not demonstrated by conventional carbide blades.

The foregoing detailed description is given primarily for clearness of understanding and no unnecessary limitations are to be understood therefrom, for modification will become obvious to those skilled in the art upon reading this disclosure and may be made upon departing from the spirit of the invention and scope of the appended claims.

Patent Citations (14)

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US3176732A *	1961-09-25	1965-04-06	George A Henderson	Circular saw
US3496973A *	1967-04-12	1970-02-24	Robert L Ballard	Cutting tool edge construction
US3651841A *	1967-09-22	1972-03-28	Olof Axel Ohlsson	Saw tooth

US3981216A *	1973-06-06	1976-09-21	Lemmon & Snoap Co.	Low noise, high speed saw blade
US4034638A *	1976-07-29	1977-07-12	Mccrary Saw & Tool Company	Circular saw having reduced noise
US4123958A *	1976-04-26	1978-11-07	Pacific Saw & Knife Company	Circular saw blade
US4144777A *	1976-09-20	1979-03-20	Sandvik Aktiebolag	Circular saw blade and method for making the same
US4232578A *	1979-07-09	1980-11-11	Wallace Murray Corporation	Saw blade and method of making
US4240315A *	1978-02-16	1980-12-23	A. Ahlstrom Osakeyhtio	Circular saw blade
US4574676A *	1982-09-03	1986-03-11	Firma Rottger Jansen-Herfeld	Circular saw blade
US4587876A *	1983-01-13	1986-05-13	Herbert Erhardt	Saw blade for preparing wood and other materials
US4627322A *	1985-09-17	1986-12-09	Lebever Co.	Circular saw blade assembly
US4776251A *	1987-06-12	1988-10-11	Pacific Saw And Knife Company	Circular saw blade with circumferentally extending laser-cut slots
US4848205A *	1987-01-12	1989-07-18	Takekawa Iron Works	Circular saw blade
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US5823449A *	1997-07-21	1998-10-20	Kooima; John C.	Agricultural feed mixer blade
US5896800A *	1995-09-26	1999-04-27	Black & Decker Inc.	Circular saw blade
WO1999056155A1 *	1998-04-28	1999-11-04	Schlumberger Limited	Acoustic logging tool
US5992204A *	1995-03-15	1999-11-30	Sunds Defibrator Woodhandling Oy	Method of increasing the strength of a blade, and a blade
US6050163A *	1999-01-15	2000-04-18	Cutting Edge Designs, L.L.C.	Saw blade having liquid transport cavity for use with lubricating guide support assembly
US6065370A *	1995-09-26	2000-05-23	Black & Decker Inc.	Circular saw blade and method
US6067888A *	1997-08-01	2000-05-30	Black & Decker Inc.	Surface treatment of circular saw blades
US6092750A *	1999-05-27	2000-07-25	Kooima; John C.	Agricultural mixer auger cutting blade
US6315505B1 *	1996-02-16	2001-11-13	Bittmore	Minimum heat-generating work piece cutting tool
US20030150306A1 *	2000-05-19	2003-08-14	Adamo Sala	Apparatus for the automatically cutting of elements made of elastomeric material
US6688206B1 *	1999-02-01	2004-02-10	Powertools International Gmbh	Saw blade with elongated air passages
US20040025658A1 *	1999-12-10	2004-02-12	Fisher George F.	Polymer cutting apparatus and method
US6691596B1	2000-02-29	2004-02-17	Irwin Industrial Tool Company	Circular saw blade for cutting fiber cement materials

US6691596B1	2000-02-29	2004-02-17	Irwin Industrial Tool Company	Circular saw blade for cutting fiber cement materials
US20040050233A1 *	2001-05-18	2004-03-18	Herbert Humenberger	Circular-saw blade comprising expansion slits extending radially inwards
US20040089122A1 *	2001-03-30	2004-05-13	Satoru Nishio	Circular saw and method for fixing main spindle thereof
US6739227B2	2000-06-27	2004-05-25	Robert Lindsay Thompson	Apparatus and method for providing an enhanced metal cutting saw blade
US20040132394A1 *	2001-01-11	2004-07-08	Shiga Yamashita Co., Ltd.	Cutting-off apparatus
US20050178264A1 *	2004-02-13	2005-08-18	Setliff David D.	Reversible circular saw blade
US20060060030A1 *	2004-09-17	2006-03-23	Lowder Jeremy A	Composite circular saw blade
US20060112799A1 *	2004-11-30	2006-06-01	Hambleton Neal S	Fiber cement saw blade
US20060236838A1 *	2005-04-20	2006-10-26	Heyen Andre R G	Saw blade
US7152596B1 *	2005-09-15	2006-12-26	You Min Zhang	Circular saw blade body
US20070290545A1 *	2006-06-16	2007-12-20	Hall David R	An Attack Tool for Degrading Materials
US20080017009A1 *	2004-02-13	2008-01-24	Setliff David D	Reversible circular saw blade
US20080257127A1 *	2007-04-17	2008-10-23	The M. K. Morse Company	Saw blade
ES2306562A1 *	2003-02-05	2008-11-01	Saint-Gobain Abrasives, Inc	Saw blade grooves formed therein.
US20090199693A1 *	2005-04-20	2009-08-13	Saint-Gobain Abrasives, Inc.	Circular Saw Blade With Elliptical Gullets
US20090199692A1 *	2008-01-22	2009-08-13	Saint-Gobain Abrasives, Inc.	Circular Saw Blade With Offset Gullets
US20100139469A1 *	2007-03-14	2010-06-10	Paul Matteucci	Cutting tool
USD634343S1	2004-08-23	2011-03-15	Irwin Industrial Tool Company	Hole saw blade
US20120042526A1 *	2010-08-18	2012-02-23	Wu-Lang Chan	Knife blade
US8186611B1	2010-03-10	2012-05-29	Kooima Company	Segmented knife assembly with replaceable wear segments
USD690334S1	2010-01-13	2013-09-24	Irwin Industrial Tool Company	Hole saw
US20140283666A1 *	2011-09-02	2014-09-25	Bosch Power Toolls (China) Co., Ltd.	Circular Saw Blade
JP2014233258A *	2013-06-04	2014-12-15	株式会社ハートフル・ジャパン	Chip saw for bush cutter
US9227342B2	2012-12-31	2016-01-05	Saint-Gobain Abrasives, Inc	Abrasive article having abrasive segments with shaped gullet walls
US9586270B2	2010-01-13	2017-03-07	Irwin Industrial Tool Company	Coated hole cutter
US9724766B2	2010-01-13	2017-08-08	Irwin Industrial Tool Company	Hole cutter with multiple fulcrums
US9782839B2	2010-01-13	2017-10-10	Irwin Industrial Tool Company	Hole cutter with chip egress aperture
US9808869B2	2010-01-13	2017-11-07	Irwin Industrial Tool Company	Hole cutter with chip egress aperture
US9884374B2	2015-09-03	2018-02-06	Irwin Industrial Tool Company	Hole cutter with multiple fulcrums

Family To Family Citations

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
US3387637A	1968-06-11	Tubular saw head
US4116580A	1978-09-26	All cutting edge drill
US3299917A	1967-01-24	Circular saw
US5011342A	1991-04-30	Twist drill
US4595322A	1986-06-17	Spade drill bit
US6601495B2	2003-08-05	Structural saw blade
US6371702B1	2002-04-16	Spade blade drill and method of making
US4557172A	1985-12-10	Saw blade
US3730038A	1973-05-01	Saw blade construction
US2720229A	1955-10-11	Planer type circular saw
US5438900A	1995-08-08	Low noise saw blade
US5896800A	1999-04-27	Circular saw blade
US5316061A	1994-05-31	Shims for dado cutter set
US3971135A	1976-07-27	Dental bur
US4573831A	1986-03-04	Cutter blade
US5038653A	1991-08-13	Circular saw blade
US4641562A	1987-02-10	Cutting tool for making a smooth saw cut
US20070154272A1	2007-07-05	Rotary cutting tool
US5410935A	1995-05-02	Band saw blade
US4106382A	1978-08-15	Circular saw tool
US20040255749A1	2004-12-23	Bandsaw blade and cutter tooth arrangement therefor
US5018421A	1991-05-28	Saw blade tooth geometry
US6276248B1	2001-08-21	Band saw blade having reduced noise and uniform tooth loading characteristics
US5261306A	1993-11-16	Circular saw blade for tree cutting and bunching vehicles
US3237488A	1966-03-01	Drill

Priority And Related Applications

Parent Applications (1)

Application	Priority date	Filing date	Relation	Title
US81091291	1991-12-20	1991-12-20	Continuation-In-Part	

Priority Applications (2)

Application	Priority date	Filing date	Title
US81091291	1991-12-20	1991-12-20	*US Provisional Application*
US07950834	1991-12-20	1992-09-24	Thin kerf circular saw blade

Applications Claiming Priority (1)

Application	Filing date	Title
US07950834	1992-09-24	Thin kerf circular saw blade

Legal Events

Date	Code	Title	Description
1992-09-24	AS	Assignment	**Owner name**: VERMONT AMERICAN CORPORATION, KENTUCKY **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST.;ASSIGNOR:JONSTON, JED G.;REEL/FRAME:006380/0774 **Effective date**: 19911220
1996-02-02	AS	Assignment	**Owner name**: CREDO TOOL COMPANY, OREGON **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST,ASSIGNOR:VERMONT AMERICAN CORPORATION;REEL/FRAME:007786/0882 **Effective date**: 19950101
1997-12-22	FPAY	Fee payment	**Year of fee payment**: 4
2002-04-23	REMI	Maintenance fee reminder mailed	
2002-10-04	LAPS	Lapse for failure to pay maintenance fees	
2002-12-03	FP	Expired due to failure to pay maintenance fee	**Effective date**: 20021004

Data provided by IFI CLAIMS Patent Services

Circular saw blade with circumferentally extending laser-cut slots

Abstract

A circular saw blade is disclosed which includes a circular body having two side faces, a central bore, and a toothed peripheral edge. Disposed within the body of the saw blade is a plurality of circumferentially extending laser-cut slots. Each of the slots consists of an arc of a circle concentric with the body of the saw blade and parallel to the peripheral edge thereof. The slots extend through the body from one side face to the other, and are spaced in a manner such that each slot cools an area of the body when the saw blade is in operation.

Images (1)

Classifications

B23D61/025 Details of saw blade body

View 1 more classifications

US4776251A

US Grant

Download PDF Find Prior Art Similar

Inventor: Linwood I. Carter, Jr.

Current Assignee : Pacific Saw and Knife Co

Original Assignee: Pacific Saw and Knife Co

Priority date : 1987-06-12

Family: US (1)

Date	App/Pub Number	Status
1987-06-12	US07062231	Expired - Fee Related
1988-10-11	US4776251A	Grant

Info: Patent citations (23), Cited by (18), Legal events, Similar documents, Priority and Related Applications

External links: USPTO, USPTO Assignment, Espacenet, Global Dossier, Discuss

Description

BACKGROUND OF THE INVENTION

This invention relates to circular saw blades and more particularly, to an improved circular saw blade provided with strain compensating, heat dissipating slots in the body thereof.

Circular saw blades have been made in the past with radially extending slots projecting outwardly of the central bore of the blades to compensate for various strains occurring in the blades during operation thereof. Specifically, such blades have been formed with slots cut in the body of the blade by laser cutting machines. A circular saw blade constructed in this manner is disclosed in Jansen-Herfeld U.S. Pat. No. 4,574,676.

The Jansen-Herfeld patent discloses a blade having a plurality of radially extending slots starting immediately at the central bore. In addition, a plurality of outer radial slots extend intermediate the central bore and the peripheral edge. Both sets of slots are spaced from each other in the circumferential direction and partially

Claims (3)

I claim:

1. A circular saw blade, comprising a circular body with two side faces, the body comprising a central bore and a toothed peripheral edge and

a plurality of circumferentially extending laser-cut slots disposed within the body, each of the slots consisting of an arc of a circle concentric with the body and parallel to the peripheral edge thereof, each of the slots extending through the body from one side face to the other, the slots being spaced wherein each slot cools an area of the body when the saw blade is cutting, whereby the entire circumference of said body is substantially equally relieved of stress through said slots.

2. A circular saw blade as in claim 1 wherein the slots are between about 0.002 inch and 0.015 inch in width.

3. A circular saw blade as in claim 1 wherein a plurality of the slots

slots are spaced from each other in the circumferential direction and partially overlap each other in the radial direction. The Jansen-Herfeld saw, however, has experienced many difficulties. The radially extending slots become packed full of sawdust and also shave wood from lumber being sawn. The blades tend to rip sawguides. They are noisy, run hot, have a short life, crack easily and damage lumber and guides as aforesaid. The Jansen-Herfeld blade, however, hammers more easily than prior blades probably because of the presence of the slots.

It is thus a primary object of the present invention to provide a circular saw blade that will be easy to hammer, yet will run quieter, cooler, and longer than prior art blades, be harder to crack, resistant to sawdust packing in its slots, and not damage either lumber or guides.

It is a further object of the present invention to provide such a circular saw that will run in gap edges, whether guided or unguided, and remain strong in its mandrel or central bore area.

It is a still further object of the present invention to provide a circular saw blade of the above type with laser-cut slots disposed within the body thereof, which slots can compensate for strain, dissipate heat, not become packed with sawdust during operation and not damage either the lumber being cut or the guides in which it runs.

SUMMARY OF THE INVENTION

The aforementioned and other objects of the invention are achieved by my circular saw blade which typically comprises a circular body with two side faces, the body comprising a central bore and a toothed peripheral edge. Disposed within the body of the saw are a plurality of circumferentially extending laser-cut slots. Each of the slots consists of an arc of a circle concentric with the body of the saw and parallel to the peripheral edge thereof. The slots comprise no components in the radial direction of the saw.

Each of the slots extends through the body from one side face to the other. The slots are spaced in a manner such that each slot cools an area of the body when the saw blade is in operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a circular saw blade according to the present invention; and

FIG. 2 is a partial sectional view on line 2--2 of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the saw blade 10 of the present invention has a circular body 12 with side faces 14, 16. The body includes the usual central bore 18 and has a toothed peripheral edge 20.

A plurality of circumferentially extending laser-cut slots 22 are disposed within the body 12. Each of the slots 22 consists of an arc of a circle concentric with the body and parallel to the peripheral edge 20 thereof. Each of the slots 22 extends through the body 12 from one side 14 to the other side 16. The slots 22 are spaced such that each slot cools an area of the body 12 when the saw blade is in operation.

A twenty-four inch circular saw blade according to my invention is shown in FIG. 1. It is preferably provided with slots 22 disposed along two circles 24, 26, each of which is concentric with the body 12 and parallel to the peripheral edge 20 thereof.

3. A circular saw blade as in claim 1 wherein a plurality of the slots consist of arcs of a single circle concentric with the body and parallel to the peripheral edge thereof.

which is concentric with the body 12 and parallel to the peripheral edge 20 thereof. The slots 22a located on circle 24 are 1.270 inches in length measured along the arc thereof. The circle 24 has a diameter of 14.5728 inches. The slots 22b disposed along circle 26 are 1.863 inches long measured along the arc thereof. The circle 26 has a diameter of 21.38 inches.

Slots 22 typically are cut between about 0.002 inch and 0.015 inch in width depending on the thickness of the blade. The slots are preferably cut by an industrial laser cutting machine, such as a Spectrophysics Model 820.

The slots 22 do not have to be disposed exclusively on one or even two circles. They can be offset radially from each other. They need only be evenly spaced such that each cools an area of the blade. They must, however, each consist of an arc of a circle concentric with the body of the saw blade and parallel to the peripheral edge thereof such that none has any component in the radial direction of the blade. The slots 22 thus do not become packed full of sawdust, nor do they shave any wood from the lumber being sawn.

My saw runs cooler than saws known heretofore. The slots increase the exposed area of the saw and result in a radiator effect where the metal is cut. The saw thus runs and cuts cooler.

My saw runs more quietly than saws known heretofore. The presence of the slots results in an air gap between the metal. The resulting noncontinuous metal body portion buffers noise traveling from the rim. Also, as vibrations are produced in the mandrel, the noise thereof is dissipated, thereby reducing saw plate vibrations and resulting in less weaving. My saw blade thus runs and cuts more quietly than saw blades known heretofore.

My saw blade has better heat dissipation from the body plate than do saws of the prior art. The slots permit expansion and contraction due to heating of the blade and cooling thereof without resulting in any undue stress on the blade. The slots function much like expansion joints in concrete or like gaps that are built into steel bridges to permit the metal to expand and contract, thereby relieving the structural steel from thermal stresses.

My saw blade runs straighter than do those of the prior art. As in any rotating body, centrifugal forces in a rotating body increase generally proportionally to the distance from the center of rotation. Placing the slots in a circular pattern permits movement of the material in the body generally radially outwardly from the center. This results in a saw blade that can flatten itself better as it cuts.

My saws are also easy to hammer. When a filer strikes a saw, the metal has to go somewhere. The circular slots not only absorb the hammer blows, but they also allow the metal to expand.

Operation of my saw has demonstrated that the arcuate slots do not result in any sawdust packing as was the case with the Jansen-Herfeld blade. The result is that lumber is not damaged as it is cut.

My saw blade does not weave due to lack of tension as much as other saws do. It can thus be run in guided saws. It will work on guided edges. The circumferentially extending slots help cool the saw better due to their improved heat radiation. Also, since none of the slots extends from the central bore, the blade is provided with a solid steel area around the mandrel which is stronger than the Jansen-Herfeld blade.

blade.

My saw blade recovers from running hot better than does a solid (uncut) saw blade and better than the Jansen-Herfeld blade. My saw has a resilience which the other saws do not. My saw can take more heating than can a solid plate saw.

My saw is much more resistant to cracking than are prior art saws. This is probably due to the stress release provided by the circumferentially extending slots.

My saws are easy to hammer compared to a solid plate saw. My saws achieve reduced metal fatigue and stress due to their flexibility at the slots.

The fact that the slots 22 in my saw are circumferentially extending achieves many advantages that are not possible in saws where the slots are radially extending as, for example, in the Jansen-Herfeld blade. The area of greatest stress in a saw blade is at the peripheral edge. This is due to the friction caused by the teeth as they shear the wood and also from the centrifugal force which as aforesaid is generally proportional to the distance from the center of the mandrel. These stresses are eliminated in my saw because some of the circumferentially extending slots are located in the outer areas of the body of the blade. Compare the Jansen-Herfeld saw blade where the slots radiate from the central bore which is the area of the blade having the least stress.

The circumferentially extending slots in my blade permit a heaving action on the rim due to their circumferential nature. The Jansen-Herfeld blade with its slots extending outwardly from the central bore does not allow such heaving to occur. The Jansen-Herfeld blade with its slots radiating from the center therefore cannot buffer waves, but on the contrary allows them to continue their outward movement.

The circumferentially extending cuts in my saw blade act as a maze for noise, heat, vibrations, etc., which move from the rim or from the mandrel. Noise, heat and vibrations move in wave-like forms. The circumferentially extending slots in my blade act as buffers that trap these undesirable waves. The slots dissipate the waveform and the reduced wave is further reduced as it approaches radially successive slots. My saw blade is substantially deader than a similar solid plate saw. This can be demonstrated when both blades are hit with a hammer. The dullness of the sound emanating from my blade indicates sound absorption.

Comparing my saw blade with the Jansen-Herfeld blade:

Carter Saw Blade	Jansen-Herfeld Saw Blade
Quiet	Noisy
Runs cool	Runs hot
Runs longer	Short running life
Hard to crack	Cracks easily
No sawdust packing in slots	Sawdust packs in slots
Does not damage lumber	Does damage lumber
Does not damage guides	Does damage guides
Recovers from running hot	Does not recover easily from running hot
Runs straighter	Weaves
Will run in gap edges,	Will not run in gap edges
guided or unguided	of any form
Strong in the mandrel	Weak around the mandrel
area due to the radiating slots	area

My saws run more smoothly and more efficiently than do either Jansen-Herfeld saw blades or solid plate blades. This results in less cost for electricity, less saw

saw blades or solid plate blades. This results in less cost for electricity, less saw down time, less labor and time required in hammering, and improved safety. My saw blades have had no cracks, unusual loss of tension, unusual loss of teeth, or damage of any kind. They have performed in a superior manner to any other saw blade with which I am familiar.

While my invention has been illustrated and described as aforesaid, it is not intended to be limited to the details shown, since various modifications and changes may be made without departing in any way from the spirit of the invention.

Patent Citations (23)

Publication number	Priority date	Publication date	Assignee	Title
DE15885C *				
US1083645A *	1912-09-23	1914-01-06	Jacob Wettstein	Circular saw-blade.
US1711102A *	1927-06-22	1929-04-30	Jr Juan Sierra	Circular-saw plane
US1723843A *	1926-06-25	1929-08-06	E C Atkins & Company	Fast speed cutter
US1861218A *	1930-12-20	1932-05-31	Huther Brothers Saw Mfg Compan	Circular saw
US2013943A *	1933-03-29	1935-09-10	Henry Disston & Sons Inc	Circular saw
US2256847A *	1936-12-15	1941-09-23	Eibes Kerb Konus Gmbh	Tool
US3199171A *	1962-08-14	1965-08-10	Zero Manufacturing Co	Glass ball peening machine for treating small articles
US3205556A *	1962-09-10	1965-09-14	Eaton Mfg Co	Method for increasing endurance limit of steel articles
US3563286A *	1970-03-18	1971-02-16	Weyerhaeuser Co	Saw
US3700016A *	1971-07-26	1972-10-24	Weyerhaeuser Co	Double slotted saw
US3820419A *	1972-02-07	1974-06-28	Mc Lagan Co	Method of reducing stress concentration and cracking failures in carbide tipped saws
US3854364A *	1973-11-23	1974-12-17	Sandvik Ab	Saw blade
US3872763A *	1973-02-16	1975-03-25	Ihara High Pressure Fittings	Circular saw
US3964348A *	1975-03-04	1976-06-22	Remington Arms Company, Inc.	Method and machine for straightening and tensioning saw blades
US3981216A *	1973-06-06	1976-09-21	Lemmon & Snoap Co.	Low noise, high speed saw blade
DE2654625A1 *	1976-12-02	1978-06-08	Jansen Fa R	Circular saw blade for wood or metal - has radial slots arranged symmetrically at different diameters to provide elasticity
US4138908A *	1976-08-25	1979-02-13	Beche & Grohs Gmbh	Apparatus for the dressing (straightening) of circular-saw blanks and especially hot-sawing circular-sawblade blanks
US4240315A *	1978-02-16	1980-12-23	A. Ahlstrom Osakeyhtio	Circular saw blade

US4257201A *	1979-04-19	1981-03-24	American Hoist & Derrick Company	Self-centering telescoping beams
US4513742A *	1981-10-13	1985-04-30	Arnegger Richard E	Saw blade with aperture
US4574676A *	1982-09-03	1986-03-11	Firma Rottger Jansen-Herfeld	Circular saw blade
US4584920A *	1984-02-15	1986-04-29	Richard Jansen Gmbh	Circular saw blade
Family To Family Citations				

* Cited by examiner, † Cited by third party

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Publication number	Priority date	Publication date	Assignee	Title
WO1991020093A1 *	1990-06-15	1991-12-26	Bell Communications Research, Inc.	Ellipsometric control of material growth
US5078035A *	1989-08-21	1992-01-07	Diamond Products, Inc.	Circular saw blade
US5351595A *	1991-12-20	1994-10-04	Vermont American Corporation	Thin kerf circular saw blade
US5438900A *	1992-07-06	1995-08-08	Sandvik Ab	Low noise saw blade
EP0819491A1 *	1996-07-16	1998-01-21	Trentinutensil S.r.l.	Noiseless and stable blade disc for circular saws
US5758561A *	1995-09-26	1998-06-02	Black & Decker Inc.	Circular saw blade and method
US5896800A *	1995-09-26	1999-04-27	Black & Decker Inc.	Circular saw blade
US5960526A *	1997-05-16	1999-10-05	Natali; Gianfranco	Process for forming circuit board supports on metal sheet frames for personal computers
US6050163A *	1999-01-15	2000-04-18	Cutting Edge Designs, L.L.C.	Saw blade having liquid transport cavity for use with lubricating guide support assembly
WO2000045985A1 *	1999-02-01	2000-08-10	Powertools International Gmbh	Saw blade with elongated air passages
US6450075B1 *	1999-06-25	2002-09-17	Alex Manzo	Ventilated air cooled cutting system
US6739227B2 *	2000-06-27	2004-05-25	Robert Lindsay Thompson	Apparatus and method for providing an enhanced metal cutting saw blade
US6903304B1 *	2003-09-12	2005-06-07	Asat Ltd.	Process for dressing molded array package saw blade
US20060016315A1 *	2004-07-23	2006-01-26	Zorich Timothy A	Saw cutting blade
US20060213495A1 *	2005-03-23	2006-09-28	Gaida Olivier P	Saw blade with cutting depth gauge
EP2481509A1	2011-01-31	2012-08-01	Black & Decker Inc.	Saw Blade with Reduced Modal Frequencies in the Operating Frequency Range
US20150047482A1 *	2012-03-14	2015-02-19	Gea Food Solutions Germany Gmbh	Cutting blade having a means for producing an air flow

USD813635S1	2016-12-13	2018-03-27	Black & Decker Inc.	Circular saw blade
Family To Family Citations				

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
US3374815A	1968-03-26	Woodcutting saw blade
US5597274A	1997-01-28	Hole cutter
US5373922A	1994-12-20	Tuned mass damper for integrally bladed turbine rotor
US5624233A	1997-04-29	Gas turbine engine rotary disc
US4074737A	1978-02-21	Wood planer cutterhead design for reduced noise level
US4627322A	1986-12-09	Circular saw blade assembly
US5033938A	1991-07-23	Repaired turbine blade and method of repairing
US5062205A	1991-11-05	Method of manufacture and repair of turbine blades
US4084857A	1978-04-18	Drive key heat shield and support for wheel rim heat shield of multiple disc brake
US4848205A	1989-07-18	Circular saw blade
US5331076A	1994-07-26	Saw blade for cutting metal
US4344738A	1982-08-17	Rotor disk structure
US4784033A	1988-11-15	Triple chip ground carbide tip bandsaw blade with ductile filler
US3122030A	1964-02-25	Method of assembling a rotary saw blade with peripheral diamond teeth
US2869793A	1959-01-20	Machine for punching and cutting of wood
US4249441A	1981-02-10	Apparatus for chopping strand
US4901929A	1990-02-20	Rotary shearing wheel with individually replaceable cutting segments
US3107706A	1963-10-22	Saw blade
US4574676A	1986-03-11	Circular saw blade
US4513742A	1985-04-30	Saw blade with aperture
US4930487A	1990-06-05	Cement cutting blade
US6113347A	2000-09-05	Blade containment system
US3128755A	1964-04-14	Undercut resistant diamond abrasive saw blade
US4432264A	1984-02-21	Circular saw blade

US4432264A	1984-02-21	Circular saw blade
US3291446A	1966-12-13	Turbine wheel

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
US07062231	1987-06-12	1987-06-12	Circular saw blade with circumferentally extending laser-cut slots

Applications Claiming Priority (1)

Application	Filing date	Title
US07062231	1987-06-12	Circular saw blade with circumferentally extending laser-cut slots

Legal Events

Date	Code	Title	Description
1987-09-10	AS	Assignment	**Owner name**: PACIFIC SAW AND KNIFE COMPANY, 2700 S.E. TACOMA, S **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST.;ASSIGNOR:CARTER, LINWOOD I. JR.;REEL/FRAME:004761/0059 **Effective date**: 19870820 **Owner name**: PACIFIC SAW AND KNIFE COMPANY,OREGON **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:CARTER, LINWOOD I. JR.;REEL/FRAME:004761/0059 **Effective date**: 19870820
1992-03-31	FPAY	Fee payment	**Year of fee payment**: 4
1996-04-09	FPAY	Fee payment	**Year of fee payment**: 8
2000-05-02	REMI	Maintenance fee reminder mailed	
2000-10-08	LAPS	Lapse for failure to pay maintenance fees	
2000-12-12	FP	Expired due to failure to pay maintenance fee	**Effective date**: 20001011

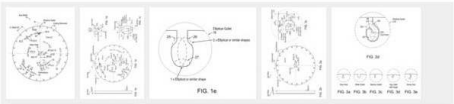
Data provided by IFI CLAIMS Patent Services

Circular Saw Blade With Elliptical Gullets

Abstract

A saw blade includes a circular core having a plurality of cutting elements along its periphery, and a central arbor hole. One or more gullets extend radially inward from the perimeter of the core. Each gullet includes a shape that includes at least one elongated curve that enlarges radii in gullet areas prone to cracking, relative to other gullet areas.

Images (5)



Classifications

B23D61/021 Types of set; Variable teeth, e.g. variable in height or gullet depth: Varying pitch; Details of gullet

View 3 more classifications

US20090199693A1

US Application

Download PDF Find Prior Art Similar

Inventor: Andre R. G. Heyen

Current Assignee : Saint-Gobain Abrasifs , Saint-Gobain Abrasives Inc

Original Assignee: Saint-Gobain Abrasifs, Saint-Gobain Abrasives Inc

Priority date : 2005-04-20

Family: US (1)

Date	App/Pub Number	Status
2009-01-21	US12356772	Abandoned
2009-08-13	US20090199693A1	Application

Description

RELATED APPLICATIONS

[0001] This application claims the benefit under 35 USC 119(e) of U.S. Provisional Application No. 61/011/806, filed on Jan. 22, 2008, and is a Continuation-in-Part of U.S. patent application Ser. No. 11/110,525, filed on Apr. 20, 2005, both of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The invention relates to saw blades, and more particularly, to circular saw blades having gullets designed to reduce fatigue and increase the life of the blade.

BACKGROUND OF THE INVENTION

[0003] Conventional circular saw blades typically include a circular steel core having a series of cutters or teeth spaced along its perimeter. Gullets, in the form of cutouts extending inwardly from the periphery of the blade, are often interspaced between the cutters to aid cutting, by relieving stresses in the blade and removing swarf. A variety of gullet configurations may be used. The actual gullet configuration employed for a particular blade is based on the cutting application(s) for which the blade is expected to be

Claims (22)

1. **1**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter;

a plurality of cutting elements at the outer perimeter of the core; and

one or more gullets extending radially inward from the perimeter of the core, each gullet having a shape that includes at least one elongated curve that enlarges radii in gullet areas prone to cracking, relative to other gullet areas.

2. **2**. The circular saw blade of claim 1 wherein the shape of the gullet includes two curved sides, each connected to a radially inward curved bottom, and the bottom is shaped like the elongated side of a first elliptical shape, and each of the two sides is shaped like the elongated side of a second elliptical shape.

based on the cutting application(s) for which the blade is expected to be used.

[0004] Saw blades having relatively narrow gullets have been found useful in sawing of construction material with portable power saws, and in other masonry cutting applications on stationary machines, where smooth cutting action is desired. It has been found that the smoothness of cutting action is enhanced when the cutters are placed relatively close to one another, such as provided by the use of relatively narrow gullets. However, cracks tend to propagate from the tightly radiused ends of these gullets, particularly if the blade is exposed to high radial pressure. This problem is exacerbated on blades in which a fatigue barrier has been surpassed. Alternatively, saw blades having relatively wide gullets may be used. These gullets typically have a relatively large radius at their inner ends, which have been found to provide the blade with relatively high fatigue strength. These gullets may thus be beneficial in relatively high-stress cutting environments, such as floor sawing of asphalt or concrete, in which other blade types tend to fail due to stress cracks propagating from the gullets.

[0005] Keyhole-shaped gullets attempt to combine benefits of both narrow and wide gullets. These gullets enable the cutters of a blade to be positioned relatively close to one another (e.g., so as to provide a smooth cutting action) while also providing each gullet with a relatively large radius at its radially inner end (e.g., so as to help reduce crack formation). While keyhole gullets may exhibit improved characteristics over the narrow and wide gullets in some applications, they are not without drawbacks. For example, results achieved with keyhole gullets have been less than optimal in applications involving difficult to cut materials such as steel or a relatively heterogeneous mix of workpiece materials, such as steel reinforced concrete. Under these conditions, cracks have been found to propagate from the ends or sides of the gullets, which may compromise user safety and saw performance.

[0006] There is a need, therefore, for improved gullets suitable for circular saw blades.

SUMMARY OF THE INVENTION

[0007] One embodiment of the present invention provides a circular saw blade. The saw blade includes a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter. A plurality of cutting elements is at the outer perimeter of the core. In addition, there are one or more gullets extending radially inward from the perimeter of the core. Each gullet includes a shape that includes at least one elongated curve that enlarges radii in gullet areas prone to cracking, relative to other gullet areas. In one such embodiment, each gullet includes three or more elliptical shapes corresponding to three different gullet areas. In one specific such configuration, the shape of the gullet includes two curved sides, each connected to a radially inward curved bottom. The bottom is shaped like the elongated side of a first elliptical shape, and each of the two sides is shaped like the elongated side of a second elliptical shape. In one such case, the gullet includes an opening that defines the two sides and the bottom. In another such case, the gullet includes a slit that defines the two sides and the bottom. In another such case, the first and the second elliptical shapes are symmetrical about their respective long and short axes. Alternatively, at least one of the first and the second elliptical shapes can be asymmetrical about at least one of its long and short axes. In another such case, the first elliptical shape has short and long axes that are both shorter than respective short and long axes of the second elliptical shape. The core may include, for example, two or more layers operatively coupled via at least one of a bond material

snape.

3. **3**. The circular saw blade of claim 2 wherein the gullet includes an opening that defines the two sides and the bottom.

4. **4**. The circular saw blade of claim 2 wherein the gullet includes a slit that defines the two sides and the bottom.

5. **5**. The circular saw blade of claim 2 wherein the first and the second elliptical shapes are symmetrical about their respective long and short axes.

6. **6**. The circular saw blade of claim 2 wherein at least one of the first and the second elliptical shapes is asymmetrical about at least one of its long and short axes.

7. **7**. The circular saw blade of claim 2 wherein the first elliptical shape has short and long axes that are both shorter than respective short and long axes of the second elliptical shape.

8. **8**. The circular saw blade of claim 1 wherein the core includes two or more layers operatively coupled via at least one of a bond material and a mechanical fastener.

9. **9**. The circular saw blade of claim 8 wherein the core is a sandwich-type core that includes a middle layer of sound-damping material bonded between the first and second planar sides.

10. **10**. The circular saw blade of claim 1 wherein the core is made of non-metallic material or steel.

11. **11**. The circular saw blade of claim 1 wherein the cutting elements include at least one of bonded abrasive segments, a single layer of abrasives, and teeth.

12. **12**. The circular saw blade of claim 1 wherein there is at least one gullet between neighboring cutting elements.

13. **13**. The circular saw blade of claim 1 wherein each gullet includes three or more elliptical shapes corresponding to three different gullet areas.

14. **14**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole;

a plurality of cutting elements at the outer perimeter of the core; and

one or more gullets extending radially inward from the perimeter of the core, each gullet having a shape that includes at least one elongated curve that enlarges radii in gullet areas prone to cracking, relative to other gullet areas, wherein the shape of each gullet includes two curved sides, each connected to a radially inward curved bottom, and the bottom is shaped like the elongated side of a first elliptical shape, and each of the two sides is shaped like the elongated side of a second elliptical shape;

wherein the first elliptical shape has short and long axes that are both shorter than respective short and long axes of the second

two or more layers specifically designed for a specific use of a core material and a mechanical fastener (as opposed to a single layer or unitary blade). In one such case, the core is a sandwich-type core that includes a middle layer of sound-damping material bonded between the first and second planar sides (e.g., cork, resin, copper, or soft iron). The core can be made, for example, of steel and/or non-metallic material, or other suitable material. The cutting elements may include, for example, bonded abrasive segments, a single layer of abrasives, or teeth, or a combination thereof. In one particular configuration, there is at least one gullet between neighboring cutting elements.

[0008] The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the accompanying drawings, reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale; emphasis has instead been placed upon illustrating the principles of the invention. Of the drawings:

[0010] FIGS. 1 *a* and **1** *b* illustrate a circular saw blade configured with elliptical gullets, in accordance with an embodiment of the present invention.

[0011] FIGS. 1 *c*, **1** *d*, and **1** *e* illustrate details associated with the elliptical gullets shown in FIG. 1 *a*, in accordance with one such embodiment.

[0012] FIGS. 2 *a* and **2** *b* illustrate a circular saw blade configured with elliptical gullets, in accordance with another embodiment of the present invention.

[0013] FIGS. 2 *c* and **2** *d* illustrate details associated with the elliptical gullets shown in FIG. 2 *a*, in accordance with one such embodiment.

[0014] FIGS. 3 *a* through **3** *e* each illustrate conventional gullets having circular shaped portions that are prone to cracking.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] An improved gullet for circular saw blades is disclosed. The gullet design employs one or more elliptical shapes to maximize the radius at one or more "weak" regions of conventional gullet designs employing circular shapes, such as each side and bottom of the circular portion at the radially innermost point of typical gullet designs. Any type of circular saw blade can employ the elliptical gullets, including blades having cutting teeth, blades having abrasive segments, and blades having a core made up of one or more layers.

General Overview

[0016] Conventional saw blades typically include a steel core (e.g., single and double layer cores, as well as sandwich-type cores that include a middle or 'sandwiched' layer of a different material such as epoxy, glue, cork, resin, copper, or soft iron). As previously discussed, such existing blades have gullets in the form of cutouts extending inwardly from the periphery of the blade. These gullets are often interspaced between the cutters, to aid cutting and relieve stresses during cutting operation, as well as during the manufacturing process. On conventional blades, the gullets typically include circular shapes in areas that are prone to cracking.

[0017] In contrast, embodiments of the present invention employ gullets having elliptical qualities. In particular, each elliptical gullet includes at least one elliptical shape having its long axis along weak areas associated with circular gullets. These weak areas include, for example, the sides and bottom of the radially inward circular portion of keyhole gullets having a neck portion that opens into a circle portion (such as shown in FIGS. 3 *a*, 3 *d*, and 3 *e*). Note that the neck portion may be on an angle (as best illustrated in FIG. 3 *d*) or have an arrow-shape (as best illustrated in FIG. 3

both shorter than respective short and long axes of the second elliptical shape.

15. **15**. The circular saw blade of claim 14 wherein the gullet includes an opening that defines the two sides and the bottom, or a slit that defines the two sides and the bottom.

16. **16**. The circular saw blade of claim 14 wherein the first and the second elliptical shapes are symmetrical about their respective long and short axes.

17. **17**. The circular saw blade of claim 14 wherein at least one of the first and the second elliptical shapes is asymmetrical about at least one of its long and short axes.

18. **18**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole;

a plurality of cutting elements at the outer perimeter of the core; and

one or more gullets extending radially inward from the perimeter of the core, each gullet having a shape that includes three or more elliptical shapes corresponding to three different gullet areas, thereby enlarging radii of those gullet areas, relative to other gullet areas.

19. **19**. The circular saw blade of claim 18 wherein the shape of the gullet includes two curved sides, each connected to a radially inward curved bottom, and the bottom is shaped like the elongated side of a first elliptical shape, and each of the two sides is shaped like the elongated side of a second elliptical shape.

20. **20**. The circular saw blade of claim 19 wherein the gullet includes an opening that defines the two sides and the bottom, or a slit that defines the two sides and the bottom.

21. **21**. The circular saw blade of claim 18 wherein the elliptical shapes are symmetrical about their respective long and short axes.

22. **22**. The circular saw blade of claim 18 wherein at least one of the elliptical shapes is asymmetrical about at least one of its long and short axes.

illustrated in FIG. 3 *d*) or have an arrow-shape (as best illustrated in FIG. 3 *e*). Other example weak gullet areas include the radially most inward semi-circle portion of narrow and wide gullets (such as shown in FIGS. 3 *b* and 3 *c*). Maximizing the radius at one or more of these weak locations renders the gullet more resistant to fatigue and cracking. The short axes of the elliptical shapes are provided along gullet areas where cracks are less likely to start spontaneously.

[0018] As will be apparent in light of this disclosure, the elliptical gullets are not required to embody a precise or 'true' ellipse, having perfect symmetry about its long and short axes. Rather, the elliptical gullets described herein are designed so as to enlarge the radii in the known weak gullet areas (e.g., traditionally the bottom and two sides as previously discussed), relative to the non-weak gullet areas. Thus, the term "elliptical" as used herein to describe a gullet's shape is intended to cover all shape variations that meet this goal, including those shapes having precise elliptical qualities as well as those shapes having an elongated curvature that effectively enlarges the radii in one or more known weak gullet areas (despite any lack of true/precise elliptical qualities of that elongated curvature).

[0019] In addition, the cutout design of the elliptical gullet may vary as well, so long as a long axis of the gullet design is maintained at the known weak areas. For instance, one embodiment provides a generally open-style drop gullet that has a cutout including a pair of first elliptical shapes, each having its long axis in the radial direction of the blade so as to elongate the gullet sides, and/or a second elliptical shape having its long axis in the axial direction of the blade so as to elongate the gullet bottom (as will be discussed with reference to FIGS. 1 *a-e*). An alternative embodiment provides a generally slit-style gullet having a slit that essentially traces the outline of the open-style drop gullet previously described (as will be discussed with reference to FIGS. 2 *a-d*). As is known, the term "axial" generally refers to a direction that is substantially parallel to the saw blade's center of rotation. The term "radial" generally refers to a direction transverse to the axial direction.

[0020] As previously noted, the elliptical gullet is not limited to any particular type of saw blade. Rather, the elliptical gullets may be implemented with blades having teeth (such as for cutting wood or plastic) or abrasive segments (such as for cutting masonry or other very hard materials). Likewise, the elliptical gullets may be implemented with blades having single layer cores, double layer cores, and sandwich-type cores (e.g., for reducing noise in various cutting applications).

Saw Blade and Gullet Examples

[0021] FIGS. 1 *a* through **1** *e* illustrate a circular saw blade configured with elliptical gullets, in accordance with an embodiment of the present invention. As can be seen, the circular saw blade **10** has peripheral cutting elements **12** separated by a series of elliptical gullets **16**.

[0022] In the embodiment shown, and as best illustrated in FIG. 1 *a*, blade **10** includes a core **21**, having an arbor hole **14** through which the blade **10** may be mounted and fastened to the spindle of a circular saw or other suitable machine as conventionally done (e.g., with a threaded fastener). In some embodiments, the blade **10** may further include a bushing such as described in U.S. Patent Application Publication No. 2006/0185492, and/or an assembly for accommodating multiple bore sizes such as described in U.S. Patent Application Publication No. 2006/0266176. Each of these patent applications is herein incorporated by reference in its entirety.

[0023] Saw blades configured in accordance with embodiments of the present invention can be used in any number of applications. For instance, saw

invention can be used in any number of applications. For instance, saw blade **10** can be installed on a gasoline powered handheld saw (e.g., STIHL TS760, manufactured by Andreas Stihl AG), and used to dry cut a steel plate. Likewise, saw blade **10** can be installed onto a floor saw (e.g., Clipper CSB1 P13, manufactured by Saint-Gobain SA), and used to wet cut concrete. Likewise, saw blade **10** can be installed onto an automatic, 14 HP (10.3 kW) cut-off sawing machine (e.g., HUARD 30V53, manufactured by HUARD), and used to cut a steel or plastic tube. Numerous suitable machines and applications will be apparent in light of this disclosure.

[0024] As shown, the core **21** is substantially circular in shape. In one example embodiment, the core includes two discrete outer layers that are mechanically fastened directly to one another (e.g., via welds, rivets, and/or nut-and-bolt arrangement). Alternatively, the core **21** may be a sandwich-type core, where two discrete outer layers sandwich an inner layer of noise-damping material such as cork, glue, epoxy or other suitable damping material (e.g., resin, copper, or soft iron). Alternatively, the core **21** may be integrally formed through a suitable metrology or molding process (e.g., metal casting, injection molding, hot-pressing, cold-pressing, etc), so long as the elliptical gullets **16** can be provided (e.g., in situ via pressure molding, machined, or otherwise formed). The outer layers of core **21**, whether they are discrete or integral in nature, may be fabricated from substantially any material having sufficient strength for the cutting application or applications at hand. Examples of suitable core materials include steel, aluminum, titanium, bronze, their composites and alloys, and combinations thereof (e.g., ANSI 4130 steel and aluminum alloys, 2024, 6065 and 7178). Alternatively, for some applications, reinforced plastics or non-metallic composites may be used to construct the core **21**.

[0025] The core **21** may have other features, in addition to cutting elements **12** and elliptical gullets **16**. For example, and as best illustrated in FIG. 1 *a*, the core **21** includes one or more perforations **33** extending through the central core, along a circumference disposed concentrically with, and between, the arbor hole **14** and the periphery of blade **10**. The perforations are arranged to form annular windows through the core **21** that corresponds to a predetermined cutting depth during rotational operation of the blade **10**. In example embodiment, the radially innermost set of perforations **33** form a first annular window corresponding to a first cutting depth, and the radially outermost set of perforations **33** form a second annular window corresponding to a second cutting depth. Additional details of circular saw blades having one or more cutting depth gauges are provided, for example, in U.S. Pat. No. 7,210,474, which is herein incorporated by reference in its entirety. Other functional features, such as for balancing the blade, indicating source of the blade, reducing operating noise of the blade, and indicating proper mounting of the blade, can also be employed.

[0026] As best shown in FIGS. 1 *c*, **1** *d*, and **1** *e*, each gullet **16** of this example embodiment includes a neck portion **18** defined by parallel side walls extending radially inward from the periphery of the saw blade **10**. At the radially inward end of the neck portion **18**, the side walls diverge (at about 45°, as best shown in FIG. 1 *d*) from each other to form an arcuate base **20**. As shown, the bottom of base **20** is shaped like the elongated side of elliptical shape **27**. Likewise, the left side of base **20** is shaped like the elongated side of elliptical shape **25**, and the right side of base **20** is shaped like the elongated side of elliptical shape **26**. As will be appreciated in light of this disclosure, elongating the radii of the gullet at these particular locations (bottom and sides of gullet) improves crack-

resistance of blade **10**. Example dimensions are shown for each of the elliptical shapes embodied (shown in dashed lines) in the design of gullet **16**, including the radius for both long and short axes of each. Note, however, and as previously explained, that the gullets **16** can also be configured with elongated shapes that do not possess perfect elliptical shapes. For instance, the shapes may have more than one radius length with respect to the long axes (and/or short axes) such as a pear-shape or wave-shape, or any concave elongated shape. In short, the elliptical gullets **16** can have any design that effectively enlarges the radii in the known weak gullet areas, relative to radii in the non-weak gullet areas.

[0027] In some embodiments, the cutting elements **12** may take the form of abrasive-laden segments spaced along the periphery or the core **21**. The segments may include, for example, superabrasive grains suspended in a metal bond that is brazed or otherwise secured to the periphery or the core **21**. For instance, a superabrasive tool may be manufactured by mixing superabrasive particles such as diamond and cubic boron nitride (cBN) with a suitable metal bond such as iron, copper, and tin. The mixture is then compressed in a mold to form the desired shape (e.g., segment having the desired width, length, and curvature). The 'green' form is then sintered at a suitable temperature to form a bonded segment with a plurality of superabrasive particles disposed therein. The segment is attached (e.g., by brazing, arc welding, or laser bonding) to the perimeter of core **21**.

[0028] Additional details of circular saw blades configured in accordance with embodiments of the present invention and having suitable abrasive segment designs for cutting elements **12** are provided, for example, in U.S. Pat. No. 5,518,443 (abrasive segments with alternating volume percentages of abrasive grain), U.S. Pat. No. 6,033,295 (portion of the abrasive segment is hardened), and U.S. Pat. No. 5,868,125 (crenelated abrasive segments), each of which is herein incorporated by reference in its entirety. In addition, the abrasive segments can be lengthened, in proportion to the blade diameter, to reduce the number of segments, improve fracture/bend resistance, and reduce manufacturing costs. In one such embodiment, the ratio of abrasive segment length to blade diameter is a minimum of 0.2. As previously mentioned, abrasive segments can be used for relatively difficult cutting operations (e.g., for cutting concrete, asphalt, stone, and other hard materials).

[0029] Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of teeth, such as typical of a wide range of circular saw blades intended for cutting relatively soft materials such as wood, plastic, and the like. As is known, the teeth may be of any size and shape. In addition, the teeth may be provided with conventional hardened tips, such as fabricated from tungsten carbide, and/or may be provided with the abrasive grain bonded thereto. In one such example embodiment, saw blade **10** is provided with a plurality of teeth having a single layer of abrasive grains chemically bonded to at least a portion of each tooth, as described in U.S. Pat. Nos. 6,017,936 and 6,935,940, each of which is herein incorporated by reference in its entirety.

[0030] Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of a single layer of abrasive grain that is brazed, electroplated, or otherwise attached to the periphery of the core **21** (as opposed to attaching bonded segments or providing teeth at the perimeter). Numerous cutting element **12** configurations and materials can be used in embodiments of the present invention, as will be apparent in light of this disclosure. The present invention is not intended to be limited to any particular cutting element configuration or scheme.

[0031] Example dimensions (in millimeters, mm) are also shown in FIGS. 1 *a*

[0031] Example dimensions (in millimeters, mm) are also shown in FIGS. 1 *a* through **1** *e*. These dimensions are merely provided as one specific example embodiment that can be fabricated. However, it will be readily apparent in light of this disclosure that numerous dimensions, as well as elliptical gullet configurations can be used to implement a saw blade in accordance with an embodiment of the present invention. The present invention is not intended to be limited to any particular set or range of blade dimensions or configurations. Rather, embodiments of the present invention are intended to cover any saw blade that can be implemented for its intended purpose and configured with elliptical gullets as described herein.

[0032] FIGS. 2 *a* through **2** *e* illustrate a circular saw blade configured with elliptical gullets, in accordance with another embodiment of the present invention. As can be seen, the circular saw blade **10** has a core **21** with peripheral cutting elements **12** separated by a series of elliptical gullets **216**. The previous discussion with reference to FIGS. 1 *a* through **1** *e*, including discussion relevant to cutting elements **12** and core **21**, is equally applicable here, as is the general discussion relevant to elliptical gullets **16** (including example dimensions) and saw blade **10**. The main difference of the embodiment shown in FIGS. 2 *a* through **2** *d* is the design of elliptical gullets **216**. Other differences, such as the lack of a cutting depth gauge formed of perforations **33** and dimensional qualities, will be apparent.

[0033] As best shown in FIGS. 2 *c* and **2** *d*, each gullet **216** of this example embodiment includes a slit **218** that extends radially inward from the periphery of the saw blade **10**, and essentially beginning at the center of what would be the neck portion **18** of the gullet **16** design. The slit **218** diverges to the right (at about 45°, as best shown in FIG. 2 *c*) and essentially traces the outline of what would be the arcuate base **20** of the gullet **16** design. At the end of the trace, slit **218** turns inward and terminates at a circular endpoint **220**. The width (kerf) of the slit can be, for example, in the range of 50 microns to 5 millimeters (the embodiment shown is about 1 millimeter). As shown, the bottom of the trace formed by slit **218** is shaped like the elongated side of elliptical shape **227**. Likewise, the left side of the trace formed by slit **218** is shaped like the elongated side of elliptical shape **225**, and the right side of the trace formed by slit **218** is shaped like the elongated side of elliptical shape **226**. Just as with gullet **16**, this gullet **216** employs elongated radii at known weak locations (bottom and sides of gullet) to improve crack-resistance of blade **10**. Example dimensions are shown for each of the elliptical shapes embodied (shown in dashed lines) in the design of gullet **216**, including the radius for both long and short axes of each. Note, however, and as previously explained, that the gullets **216** can also be configured with elongated shapes that do not possess perfect elliptical shapes. For instance, the shapes may have more than one radius length with respect to the long axes (and/or short axes) such as a pear-shape or wave-shape, or any concave elongated shape. In short, the elliptical gullets **216** can have any design that effectively enlarges the radii in the known weak gullet areas, relative to radii in the non-weak gullet areas.

[0034] The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of this disclosure. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

Patent Citations (77)

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US1711102A *	1927-06-22	1929-04-30	Jr Juan Sierra	Circular-saw plane
US3362446A *	1965-10-18	1968-01-09	Potomak Andrew	Circular saws
US3990338A *	1973-01-17	1976-11-09	Gomex Verktyg Ab	Laminated saw blade
US4034639A *	1976-09-16	1977-07-12	Minnesota Mining And Manufacturing Company	Sound-damped saw blade
US4114494A *	1976-02-12	1978-09-19	Budke Robert L	Noise-controlled circular saw blade
US4135421A *	1977-08-19	1979-01-23	North American Products Corp.	Quiet running circular saw blade
US4222298A *	1978-10-10	1980-09-16	James Vaughn F	Cutting tool or the like
US4232578A *	1979-07-09	1980-11-11	Wallace Murray Corporation	Saw blade and method of making
US4324163A *	1980-05-19	1982-04-13	Lavelle Donald R	Circular saw construction
US4337750A *	1980-10-08	1982-07-06	Norton Company	Abrasion resistant diamond blade
US4516560A *	1982-07-29	1985-05-14	Federal-Mogul Corporation	Abrasive cutting wheel and method of cutting abradable material
US4550708A *	1983-07-06	1985-11-05	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4578984A *	1984-03-05	1986-04-01	Uddeholm Strip Steel Aktiebolag	Machine for deforming the gullets of saw blades to improve resistance to fatigue stress
US4583515A *	1982-07-29	1986-04-22	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4624237A *	1984-06-08	1986-11-25	Jiro Inoue	Diamond saw
US4690024A *	1985-02-28	1987-09-01	Black & Decker Inc.	Saw blade and tip therefor
US4705017A *	1985-08-19	1987-11-10	Federal-Mogul Corporation	Stress resistant abrasive cutting wheel
US4794835A *	1985-12-20	1989-01-03	Kanefusa Hamono Kogyo Company Limited	Plate-like rotary body with vibration-suppressing characteristics and method of manufacturing same
US4854295A *	1988-06-01	1989-08-08	Federal-Mogul Corporation	Wear resistant abrasive cutting wheel
US4867025A *	1978-07-28	1989-09-19	Gomex Verktyg Ab	Circular saw blade
US5142946A *	1991-11-18	1992-09-01	Mobile Manufacturing Company	Sharpener for circular saws
US5182976A *	1983-09-09	1993-02-02	The Peerless Saw Company	Spring beamed shock absorbing circular saw blade body
US5184597A *	1990-04-27	1993-02-09	Edward Chiuminatta	Apparatus and method for cutting unhardened concrete
US5235753A *	1992-03-20	1993-08-17	Black & Decker Inc.	Circular saw lower guard chip deflector
US5309962A *	1993-05-13	1994-05-10	Vermont American Corporation	Multiple saw blade adjustable dado cutter assembly including a cam assembly and nestable dado blades
US5351595A *	1991-12-20	1994-10-04	Vermont American Corporation	Thin kerf circular saw blade
US5438900A *	1992-07-06	1995-08-08	Sandvik Ab	Low noise saw blade

US5471970A *	1994-03-16	1995-12-05	Diamant Boart, Inc.	Method of manufacturing a segmented diamond blade
US5518443A *	1994-05-13	1996-05-21	Norton Company	Superabrasive tool
US5524518A *	1991-11-04	1996-06-11	Sandvik Ab	Saw blade
US5555788A *	1995-03-29	1996-09-17	Credo Tool Company	Saw blade
US5603252A *	1995-08-28	1997-02-18	Sandvik Ab	Saw blade
USD387261S *	1996-08-12	1997-12-09	Tenryu Seikyo Kabushiki Kaisha	Disk cutter
US5839423A *	1997-03-13	1998-11-24	Jones; Leon D.	Cutting disc
US5868125A *	1996-11-21	1999-02-09	Norton Company	Crenelated abrasive tool
US5884547A *	1994-08-19	1999-03-23	Black & Decker Inc.	Saw blade tooth form
US5891206A *	1997-05-08	1999-04-06	Norton Company	Sintered abrasive tools
US5896800A *	1995-09-26	1999-04-27	Black & Decker Inc.	Circular saw blade
US6033295A *	1994-12-28	2000-03-07	Norton Company	Segmented cutting tools
US6065370A *	1995-09-26	2000-05-23	Black & Decker Inc.	Circular saw blade and method
US6167792B1 *	1995-03-23	2001-01-02	American Saw & Mfg. Company	Tooth form for a saw blade
US6273082B1 *	1991-06-10	2001-08-14	Ultimate Abrasive Systems, L.L.C.	Abrasive cutting tool
US6283845B1 *	1998-04-21	2001-09-04	Tyrolit Schleifmittelwerke Swarovski K.G.	Grinding wheel
US20020040631A1 *	1997-08-22	2002-04-11	George G. Gaydos	Saw blade for forming curved stock
USD458948S1 *	2001-03-19	2002-06-18	Saint-Gobain Abrasives Technology Company	Segmented saw blade
USD459376S1 *	2001-03-19	2002-06-25	Saint-Gobain Abrasives Technology Company	Segmented saw blade
US6408838B1 *	1999-07-05	2002-06-25	Noritake Diamond Industries, Co., Ltd.	Rotary cutting saw with slits shaped for minimizing wear of neck portion
USD459375S1 *	2001-03-19	2002-06-25	Saint-Gobain Abrasives Technology Company	Segmented saw blade
USD459740S1 *	2001-03-19	2002-07-02	Saint-Gobain Abrasives Technology Company	Segmented saw blade
US6427573B1 *	1994-08-19	2002-08-06	Black & Decker, Inc.	Saw blade tooth form and method therefor
US20020112589A1 *	2001-02-19	2002-08-22	Lee Chang Hyun	Saw blade shank
US20020123302A1 *	2001-03-05	2002-09-05	S-B Power Tool Company	Cutting and grinding wheel for a rotary tool
US20020124707A1 *	2000-05-02	2002-09-12	Izard Industries Limited	Laser cut saw blades
US6460532B1 *	2000-07-05	2002-10-08	Shinhan Diamond Industrial Co. Ltd.	Diamond cutting wheel
US20030056633A1 *	2001-09-26	2003-03-27	Baron Kevin Frank	Cutting disc core with noise reduction
US20030061920A1 *	2000-06-27	2003-04-03	Thompson Robert Lindsay	Apparatus and method for providing an enhanced metal cutting saw

US20030061920A1	2000-06-27	2003-04-03	Thompson Robert Lindsay	Apparatus and method for providing an enhanced metal cutting saw blade
US6638152B1 *	1998-09-03	2003-10-28	Ehwa Diamond, Ind., Co., Ltd.	Diamond blade having segment type cutting tip for use in cutting, grinding or drilling apparatus
US20030213483A1 *	2002-05-14	2003-11-20	Diamant Boart, Inc.	Segmented diamond blade with undercut protection
USD485478S1 *	2002-08-30	2004-01-20	Tenryu Seikyo Kabushiki Kaisha	Disk cutter
US6681674B2 *	2001-02-23	2004-01-27	William Hakansson	Band saw blade
US6688206B1 *	1999-02-01	2004-02-10	Powertools International Gmbh	Saw blade with elongated air passages
US6691596B1 *	2000-02-29	2004-02-17	Irwin Industrial Tool Company	Circular saw blade for cutting fiber cement materials
US20040050233A1 *	2001-05-18	2004-03-18	Herbert Humenberger	Circular-saw blade comprising expansion slits extending radially inwards
US6729220B2 *	2001-11-30	2004-05-04	Black & Decker Inc.	Spring loaded diamond arbor
US20040149114A1 *	2003-02-05	2004-08-05	Kurt Brach	Saw blade with shaped gullets
US6817936B1 *	1996-03-15	2004-11-16	Saint-Gobain Abrasives Technology Company	Metal single layer abrasive cutting tool having a contoured cutting surface
US20050235798A1 *	2004-04-05	2005-10-27	Christoph Weber	Cutting segment tip
US20060107815A1 *	2004-11-22	2006-05-25	Tenryu Seikyo Kabushiki Kaisha	Disk cutter
US20060185492A1 *	2005-02-18	2006-08-24	Francois Chianese	Shoulder bushing for saw blades
US7117863B1 *	1999-01-25	2006-10-10	Black & Decker Inc.	Saw blade for cutting fiber cement
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US7127979B2 *	2000-08-03	2006-10-31	Robert Bosch Gmbh	Saw blade for hand-held tools
US20060266176A1 *	2005-05-25	2006-11-30	Kurt Brach	Saw blade with multiple bore sizes
US7210474B2 *	2005-03-23	2007-05-01	Saint-Gobain Abrasives Technology Company	Saw blade with cutting depth gauge
US20070261530A1 *	2006-05-11	2007-11-15	Indigo Innovators, Inc.	Saw blade with replaceable cutting teeth members
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Family To Family Citations				

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Publication number	Priority date	Publication date	Assignee	Title
US20090199692A1 *	2008-01-22	2009-08-13	Saint-Gobain Abrasives, Inc.	Circular Saw Blade With Offset Gullets
US20100035530A1 *	2000-00-00	2010-02-11	Saint-Gobain Abrasives, Inc.	Abrasive tools having a continuous metal phase for bonding an abrasive component to a carrier
US20100200304A1 *	2009-02-12	2010-08-12	Saint-Gobain Abrasives, Inc.	Abrasive tip for abrasive tool and method for forming and replacing thereof
US20100248600A1 *	2009-03-31	2010-09-30	Saint-Gobain Abrasives, Inc.	Dust collection for an abrasive tool

US20110023911A1 *	2009-06-24	2011-02-03	Holger Lenkeit	Material removal systems and methods utilizing foam
US20110165826A1 *	2009-12-31	2011-07-07	Saint-Gobain Abrasives, Inc.	Abrasive article incorporating an infiltrated abrasive segment
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US8591295B2	2010-07-12	2013-11-26	Saint-Gobain Abrasives, Inc.	Abrasive article for shaping of industrial materials
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US9463518B2	2011-01-31	2016-10-11	Black & Decker Inc.	Saw blade with reduced modal frequencies in the operating frequency range
WO2017079146A1 *	2015-11-02	2017-05-11	Milwaukee Electric Tool Corporation	Saw blade
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US5518443A	1996-05-21	Superabrasive tool
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US3261384A	1966-07-19	Circular saw
US5865571A	1999-02-02	Non-metallic body cutting tools
US5813308A	1998-09-29	Saw tooth attack face and edge structure
US5647263A	1997-07-15	Saw tooth attack face and edge structure
US7210474B2	2007-05-01	Saw blade with cutting depth gauge
US6878051B2	2005-04-12	Saw blade with shaped gullets
US4739745A	1988-04-26	Circular diamond saw blade incorporating a novel cutting segment
US6769423B1	2004-08-03	Sandwich tuck pointing blade

US6945850B2	2005-09-20	Saw blade with abrasive surface
US3436871A	1969-04-08	Abrasive cutting tools
US6408838B1	2002-06-25	Rotary cutting saw with slits shaped for minimizing wear of neck portion
USD459376S1	2002-06-25	Segmented saw blade
US20060185492A1	2006-08-24	Shoulder bushing for saw blades
US6691596B1	2004-02-17	Circular saw blade for cutting fiber cement materials
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US4114494A	1978-09-19	Noise-controlled circular saw blade
USD459375S1	2002-06-25	Segmented saw blade

Priority And Related Applications

Priority Applications (3)

Application	Priority date	Filing date	Title
US11110525	2005-04-20	2005-04-20	Saw blade gullet configuration
US1180608	2008-01-22	2008-01-22	*US Provisional Application*
US12356772	2005-04-20	2009-01-21	Circular Saw Blade With Elliptical Gullets

Applications Claiming Priority (1)

Application	Filing date	Title
US12356772	2009-01-21	Circular Saw Blade With Elliptical Gullets

Legal Events

Date	Code	Title	Description
2009-04-24	AS	Assignment	**Owner name**: SAINT-GOBAIN ABRASIFS, FRANCE **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R. G.;REEL/FRAME:022591/0467 **Effective date**: 20090408 **Owner name**: SAINT-GOBAIN ABRASIVES, INC., MASSACHUSETTS **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R. G.;REEL/FRAME:022591/0467 **Effective date**: 20090408

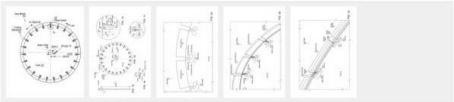
Data provided by IFI CLAIMS Patent Services

Circular Saw Blade With Offset Gullets

Abstract

A saw blade includes a circular core having a plurality of cutting elements along its periphery, and a central arbor hole. One or more offset gullets extend radially inward from the perimeter of the core. Each offset gullet includes a first opening in one side of the core and a second opening in the other side of the core. The first and second openings are adjacent but at least partially offset from one another, so that at least a portion of the offset gullet is not see-through.

Images (5)



Classifications

B23D61/021 Types of set; Variable teeth, e.g. variable in height or gullet depth: Varying pitch; Details of gullet

View 4 more classifications

US20090199692A1

US Application

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Current Assignee : Saint-Gobain Abrasifs , Saint-Gobain Abrasives Inc

Original Assignee: Saint-Gobain Abrasifs, Saint-Gobain Abrasives Inc

Priority date : 2008-01-22

Family: US (1) EP (1) JP (1) CN (1) WO (1)

Date	App/Pub Number	Status
2009-01-21	US12356712	Active
2009-08-13	US20090199692A1	Application
2014-04-22	US8701536B2	Grant

Info: Patent citations (115), Cited by (13), Legal events, Similar documents, Priority and Related Applications

External links: USPTO, USPTO Assignment, Espacenet, Global Dossier, Discuss

Description

RELATED APPLICATIONS

[0001] This application claims the benefit under 35 USC 119(e) of U.S. Provisional Application No. 61/011,805, filed on Jan. 22, 2008, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates to saw blades, and more particularly, to circular saw blades having gullets designed to reduce fatigue and increase the life of the blade.

BACKGROUND OF THE INVENTION

[0003] Conventional circular saw blades typically include a circular steel core having a series of cutters or teeth spaced along its perimeter. Gullets, in the form of cutouts extending inwardly from the periphery of the blade, are often interspaced between the cutters to aid cutting, by relieving stresses in the blade and removing swarf. A variety of gullet configurations may be

Claims (20)

1. **1**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter;

a plurality of cutting elements at the outer perimeter of the core; and

one or more offset gullets extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core, wherein the first and second openings are adjacent but at least partially offset from one another so that at least a portion of the offset gullet is not see-through.

in the blade and remaining small. A variety of gullet configurations may be used. The actual gullet configuration employed for a particular blade is based on the cutting application(s) for which the blade is expected to be used.

[0004] Saw blades having relatively narrow gullets have been found useful in sawing of construction material with portable power saws, and in other masonry cutting applications on stationary machines, where smooth cutting action is desired. It has been found that the smoothness of cutting action is enhanced when the cutters are placed relatively close to one another, such as provided by the use of relatively narrow gullets. However, cracks tend to propagate from the tightly radiused ends of these gullets, particularly if the blade is exposed to high radial pressure. This problem is exacerbated on blades in which a fatigue barrier has been surpassed. Alternatively, saw blades having relatively wide gullets may be used. These gullets typically have a relatively large radius at their inner ends, which have been found to provide the blade with relatively high fatigue strength. These gullets may thus be beneficial in relatively high-stress cutting environments, such as floor sawing of asphalt or concrete, in which other blade types tend to fail due to stress cracks propagating from the gullets.

[0005] Keyhole-shaped gullets attempt to combine benefits of both narrow and wide gullets. These gullets enable the cutters of a blade to be positioned relatively close to one another (e.g., so as to provide a smooth cutting action) while also providing each gullet with a relatively large radius at its radially inner end (e.g., so as to help reduce crack formation). While keyhole gullets may exhibit improved characteristics over the narrow and wide gullets in some applications, they are not without drawbacks. For example, results achieved with keyhole gullets have been less than optimal in applications involving difficult to cut materials such as steel or a relatively heterogeneous mix of workpiece materials, such as steel reinforced concrete. Under these conditions, cracks have been found to propagate from the ends or sides of the gullets, which may compromise user safety and saw performance.

[0006] There is a need, therefore, for improved gullets suitable for circular saw blades.

SUMMARY OF THE INVENTION

[0007] One embodiment of the present invention provides a circular saw blade. The saw blade includes a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter. A plurality of cutting elements is at the outer perimeter of the core. In addition, there are one or more offset gullets extending radially inward from the perimeter of the core. Each offset gullet includes a first opening in the first planar side of the core and a second opening in the second planar side of the core. The first and second openings are adjacent but at least partially offset from one another, so that at least a portion of the offset gullet is not see-through (i.e., at least a portion of the first and second openings do not overlap with each other). In one such embodiment, there is no overlap between the first and second openings, such that no portion of the offset gullet is see-through. The first and second openings may be oriented, for example, in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening (such symmetry, however, is not required). In one particular example, the core is a sandwich-type core that further includes a middle layer of sound-damping material (e.g., at least one of cork, epoxy, glue, resin, copper, and soft iron) between the first and second planar sides. The first and second planar sides can be, for example, discrete pieces that are

2. **2**. The circular saw blade of claim 1 wherein there is no overlap between the first and second openings, such that no portion of the offset gullet is see-through.

3. **3**. The circular saw blade of claim 1 wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening.

4. **4**. The circular saw blade of claim 1 wherein the first and second planar sides are discrete pieces that are operatively coupled together to form the core.

5. **5**. The circular saw blade of claim 4 wherein the first and second planar sides are operatively coupled via at least one of a bond material and a mechanical fastener.

6. **6**. The circular saw blade of claim 4 wherein the core is a sandwich-type core that further includes a middle layer of sound-damping material bonded between the first and second planar sides.

7. **7**. The circular saw blade of claim 6 wherein the sound-damping material includes at least one of cork, epoxy, glue, resin, copper, and soft iron.

8. **8**. The circular saw blade of claim 1 wherein the core is made of non-metallic material.

9. **9**. The circular saw blade of claim 1 wherein the core is made of steel.

10. **10**. The circular saw blade of claim 1 wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives, or teeth.

11. **11**. The circular saw blade of claim 1 wherein there is at least one offset gullet between neighboring cutting elements.

12. **12**. The circular saw blade of claim 1 wherein each offset gullet includes elliptical qualities in its shape.

13. **13**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, a middle layer of sound-damping material sandwiched between the first and second planar sides, and an outer perimeter;

a plurality of cutting elements at the outer perimeter of the core; and

one or more offset gullets extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core, wherein the first and second openings are adjacent but at least partially offset from one another so that at least a portion of the offset gullet is not see-through;

second planar sides can be, for example, discrete pieces that are operatively coupled together (e.g., via at least one of a suitable bond material and a mechanical fastener) to form the core. The core can be made, for example, of steel and/or non-metallic material. The cutting elements may include, for instance, bonded abrasive segments, a single layer of abrasives, and/or teeth. In one particular configuration, there is at least one offset gullet between neighboring cutting elements. In another particular configuration, each offset gullet includes elliptical qualities in its shape.

[0008] The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the accompanying drawings, reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale; emphasis has instead been placed upon illustrating the principles of the invention. Of the drawings:

[0010] FIGS. 1 *a* and **1** *b* illustrate a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention.

[0011] FIGS. 1 *c* and **1** *d* illustrate details associated with the offset gullets shown in FIG. 1 *a*, in accordance with an embodiment of the present invention.

[0012] FIG. 1 *e* illustrates details associated with the abrasive segments shown in FIG. 1 *a*, in accordance with an embodiment of the present invention.

[0013] FIGS. 2 *a*, **2** *b* and **2** *c* each illustrate a perspective view of a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] An improved gullet for circular saw blades is disclosed. The gullet can be configured with essentially any suitable shapes (e.g., narrow, wide, keyhole, alphanumeric, and graphical designs), depending on the saw blade application. The gullet includes opposing openings (in each side of blade) that are offset from one another so as to not overlap or only partially overlap, and is crack-resistant and substantially reduces whistle-noise typical of conventional gullet designs.

General Overview

[0015] Conventional sandwich type saw blades typically include two outer steel layers and a middle or 'sandwiched' layer of a different, more elastic material (e.g., cork, epoxy, glue, resin, copper, or soft iron). The aim of this sandwich-type blade is to reduce noise while in operation. As previously discussed, existing blades, including sandwich-type blades, have gullets in the form of cutouts extending inwardly from the periphery of the blade. These gullets are often interspaced between the cutters, and aid cutting and relieve stresses during cutting operation, as well as during the manufacturing process. On conventional sandwich-type blades, the gullets on both external steel cores are fully aligned. Such a design maximizes the land length and allows max airflow to pass through the gullets when the blade is in use.

[0016] In contrast, embodiments of the present invention employ offset gullets. Each offset gullet includes an opening in one side of the blade that is offset from a corresponding opening on the other side of the blade. In this way, there is no see-through gullet opening in the blade, or alternatively, there is only a partially see-through gullet opening in the blade (where a

wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening.

14. **14**. The circular saw blade of claim 13 wherein there is no overlap between the first and second openings, such that no portion of the offset gullet is see-through.

15. **15**. The circular saw blade of claim 13 wherein the first and second planar sides are discrete pieces that are operatively coupled together to form the core.

16. **16**. The circular saw blade of claim 13 wherein the sound-damping material includes at least one of cork, epoxy, glue, resin, copper, and soft iron.

17. **17**. The circular saw blade of claim 13 wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives, or teeth.

18. **18**. A circular saw blade, comprising:

a circular core having a first planar side and a second planar side, a central arbor hole, and an outer perimeter, wherein the first and second planar sides are operatively coupled via at least one of a bond material and a mechanical fastener;

a plurality of cutting elements at the outer perimeter of the core, wherein the cutting elements include one of bonded abrasive segments, a single layer of abrasives, or teeth; and

one or more offset gullets extending radially inward from the perimeter of the core, each offset gullet including a first opening in the first planar side of the core and a second opening in the second planar side of the core, wherein the first and second openings are adjacent but at least partially offset from one another so that at least a portion of the offset gullet is not see-through.

19. **19**. The circular saw blade of claim 18 wherein there is no overlap between the first and second openings, such that no portion of the offset gullet is see-through.

20. **20**. The circular saw blade of claim 18 wherein the first and second openings are oriented in a symmetrical fashion, such that at least a portion of the first opening is a mirror image of a portion of the second opening.

there is only a partially see-through gullet opening in the blade (where a limited portion of the offset gullet openings overlap). In addition, the gullet openings can be close enough so as to allow a sufficient land length for the cutters. Thus, there is reduced airflow through the gullets while the blade is turning, or no airflow at all (depending on whether there is a partial overlap of gullet openings). This airflow on blades having fully see-through conventional gullets causes a whistle noise when cutting and even at idling speeds. The whistle is high frequency noise and unpleasant to the human ear. The offset gullet as described herein can be used to substantially reduce or otherwise totally cancel such noise. In addition, as the see-through gullet hole in the blade is eliminated or otherwise diminished, the rigidity of the blade is increased in the gullet areas. This increased rigidity in turn helps to avoid crack starts and prolongs blade life.

[0017] As previously noted, the offset gullet is not linked to any particular gullet shape. Rather, all gullet shapes and designs could be used, so long as the land's length is enough to place the cutters as desired. In addition, the offset gullet can be used with sandwich-type blades (e.g., two outer layers and a middle layer), or any other blade designs that would allow for offset gullet openings. For instance, the blade design may include two discrete outer layers coupled directly together (no middle layer), or two outer layers of a single monolithic core. The cutting elements of the saw blade may be implemented with teeth (such as for cutting wood or plastic) or abrasive segments (such as for cutting masonry or other very hard materials).

Saw Blade and Gullet Examples

[0018] FIGS. 1 *a* through **1** *d* illustrate a circular saw blade configured with offset gullets, in accordance with an embodiment of the present invention. As can be seen, the circular saw blade **10** has peripheral cutting elements **12** separated by a series of offset gullets **16**.

[0019] In the embodiment shown, blade **10** includes a core **21**, having an arbor hole **14** through which the blade **10** may be mounted and fastened to the spindle of a circular saw or other suitable machine as conventionally done (e.g., with a threaded fastener). In some embodiments, the blade **10** may further include a bushing such as described in U.S. Patent Application Publication No. 2006/0185492, and/or an assembly for accommodating multiple bore sizes such as described in U.S. Patent Application Publication No. 2006/0266176. Each of these patent applications is herein incorporated by reference in its entirety.

[0020] Saw blades configured in accordance with embodiments of the present invention can be used in any number of applications. For instance, saw blade **10** can be installed on a gasoline powered handheld saw (e.g., STIHL TS760, manufactured by Andreas Stihl AG), and used to dry cut a steel plate. Likewise, saw blade **10** can be installed onto a floor saw (e.g., Clipper CSB1 P13, manufactured by Saint-Gobain SA), and used to wet cut concrete. Likewise, saw blade **10** can be installed onto an automatic, 14 HP (10.3 kW) cut-off sawing machine (e.g., HUARD 30V53, manufactured by HUARD), and used to cut a steel or plastic tube. Numerous suitable machines and applications will be apparent in light of this disclosure.

[0021] As shown, the core **21** is substantially circular in shape. In one example embodiment, the core includes two discrete outer layers that are mechanically fastened directly to one another (e.g., via welds, rivets, and/or nut-and-bolt arrangement). Alternatively, the core **21** may be a sandwich-type core, where two discrete outer layers sandwich an inner layer of noise-damping material such as cork, glue, epoxy or other suitable damping material (e.g., resin, copper, and soft iron). Alternatively, the core

damping material (e.g., resin, copper, and soft iron). Alternatively, the core **21** may be integrally formed through a suitable metrology or molding process (e.g., metal casting, injection molding, hot-pressing, cold-pressing, etc), so long as the offset gullets **16** can be provided (e.g., in situ via pressure molding, machined, or otherwise formed). The outer layers of core **21**, whether they are discrete or integral in nature, may be fabricated from substantially any material having sufficient strength for the cutting application or applications at hand. Examples of suitable materials include steel, aluminum, titanium, bronze, their composites and alloys, and combinations thereof (e.g., ANSI 4130 steel and aluminum alloys, 2024, 6065 and 7178). Alternatively, for some applications, reinforced plastics or non-metallic composites may be used to construct the core **21**.

[0022] The core **21** may have other features, in addition to cutting elements **12** and offset gullets **16**. For example, and in one particular embodiment, the core **21** includes one or more perforations extending through the central core area, along a circumference disposed concentrically with, and between, the arbor hole **14** and the periphery of blade **10**. The perforations are arranged to form an annular window through the core **21** that corresponds to a predetermined cutting depth during rotational operation of the blade **10**. Additional details of circular saw blades having one or more cutting depth gauges are provided, for example, in U.S. Pat. No. 7,210,474, which is herein incorporated by reference in its entirety. Other functional features, such as for balancing the blade, indicating source of the blade, reducing operating noise of the blade, and indicating proper mounting of the blade, can also be employed.

[0023] As best shown in FIGS. 1 *c* and **1** *d*, each gullet **16** of this example embodiment includes two teardrop-shaped openings (shown as openings **25** and **27** in FIG. 1 *c*). In particular opening **25** is on one side of the core **21** and opening **27** is on the other side of core **21**. The two openings **25** and **27** are offset from one another and oriented about a plane **31** (imaginary, shown by dashed line in FIG. 1 *c*) that separates them in a symmetrical fashion, such that opening **25** is the mirror image of opening **27**. Each opening **25** and **27** of gullet **16** includes a neck portion **18** defined by parallel side walls extending radially inward from the periphery of the circular blade. At the radially inward end of the neck portion **18**, one of the side walls diverges (at about 45°) from the other and then forms into an arcuate base **20**. As shown, the base **20** includes elliptical qualities in its shape (at sides and/or bottom), which have been selected to further improve crack-resistance. Note, however, that the offset gullets **16** as described herein can be used with any suitable design (shape, pattern, etc) as previously explained, and the present invention is not intended to be limited to any particular design or shape or set of shapes. Further note that, in alternative embodiments, openings **25** and **27** may partially overlap. The degree of overlap between the openings **25** and **27** can vary, and in some such embodiments, ranges from 1% to 75% (e.g., where 25% or more of opening **25** does not overlap with the opening **27**). The degree of overlap between the openings **25** and **27** can be higher (e.g., approaching 99%), with such higher degrees of overlap leading to higher degrees of operational noise. As will be apparent, the discussion relevant to the openings **25** and **27** being oriented in a symmetrical fashion, such that opening **25** is a mirror image of opening **27**, can be equally applied to such partially offset gullet designs. In such cases, the mirror images will generally correspond to the non-overlapping portions of the openings **25** and **27**.

[0024] In this example embodiment, the cutting elements **12** take the form of

[0024] In this example embodiment, the cutting elements **12** take the form of abrasive-laden segments spaced along the periphery or the core **21**. FIG. 1 *e* shows additional dimensional details associated with these example segments. The segments may include, for example, superabrasive grains suspended in a metal bond that is brazed or otherwise secured to the periphery or the core **21**. For instance, a superabrasive tool may be manufactured by mixing superabrasive particles such as diamond and cubic boron nitride (cBN) with a suitable metal bond such as iron, copper, and tin. The mixture is then compressed in a mold to form the desired shape (e.g., segment having the desired width, length, and curvature). The 'green' form is then sintered at a suitable temperature to form a bonded segment with a plurality of superabrasive particles disposed therein. The segment is attached (e.g., by brazing, electroplating, or laser bonding) to the perimeter of core **21**.

[0025] Additional details of circular saw blades configured in accordance with embodiments of the present invention and having suitable abrasive segment designs for cutting elements **12** are provided, for example, in U.S. Pat. No. 5,518,443 (abrasive segments with alternating volume percentages of abrasive grain), U.S. Pat. No. 6,033,295 (portion of the abrasive segment is hardened), and U.S. Pat. No. 5,868,125 (crenelated abrasive segments), each of which is herein incorporated by reference in its entirety. In addition, the abrasive segments can be lengthened, in proportion to the blade diameter, to reduce the number of segments, improve fracture/bend resistance, and reduce manufacturing costs. In one such embodiment, the ratio of abrasive segment length to blade diameter is a minimum of 0.2. As previously mentioned, abrasive segments can be used for relatively difficult cutting operations (e.g., for cutting concrete, asphalt, stone, and other hard materials).

[0026] Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of teeth, such as typical of a wide range of circular saw blades intended for cutting relatively soft materials such as wood, plastic, and the like. As is known, the teeth may be of any size and shape. In addition, the teeth may be provided with conventional hardened tips, such as fabricated from tungsten carbide, and/or may be provided with the abrasive grain bonded thereto. In one such example embodiment, saw blade **10** is provided with a plurality of teeth having a single layer of abrasive grains chemically bonded to at least a portion of each tooth, as described in U.S. Pat. Nos. 6,817,936 and 6,935,940, each of which is herein incorporated by reference in its entirety.

[0027] Alternatively, saw blade **10** may be provided with cutting elements **12** in the form of a single layer of abrasive grain that is brazed, electroplated, or otherwise attached to the periphery of the core **21** (as opposed to attaching bonded segments or providing teeth at the perimeter). Numerous cutting element **12** configurations and materials can be used in embodiments of the present invention, as will be apparent in light of this disclosure. The present invention is not intended to be limited to any particular cutting element configuration or scheme.

[0028] Example dimensions (in millimeters, mm) are also shown in FIGS. 1 *a* through **1** *d*. These dimensions are merely provided as one specific example embodiment that can be fabricated. However, it will be readily apparent in light of this disclosure that numerous dimensions, as well as offset gullet configurations can be used to implement a saw blade in accordance with an embodiment of the present invention. The present invention is not intended to be limited to any particular set or range of blade dimensions or configurations. Rather, embodiments of the present invention are intended to cover any saw blade that can be implemented

invention are intended to cover any saw blade that can be implemented for its intended purpose and configured with offset gullets as described herein.

[0029] FIGS. 2 *a*, **2** *b* and **2** *c* illustrate a perspective view of offset gullets configured in accordance with another embodiment of the present invention. As can be seen, the circular saw blade **10** has a core **21** with peripheral cutting elements **12** separated by a series of offset gullets **216**. The previous discussion with reference to FIGS. 1 *a* through **1** *d*, including discussion relevant to cutting elements **12** and core **21**, is equally applicable here, as is the general discussion relevant to offset gullets **16** and saw blade **10**. The main difference of the embodiment shown in FIGS. 2 *a* through **2** *c* is the design of offset gullets **216**.

[0030] In more detail, each offset gullet **216** of this example embodiment includes two musical note shaped openings (shown as openings **225** and **227**). In particular, and as best shown by FIG. 2 *c*, opening **225** is on side **211** of the core **21** and opening **227** is on side **210** of core **21**. The core **21** in this example is shown as a sandwich-type core and further includes middle layer **212**, which is sandwiched between the planar sides **210** and **211**. The two openings **225** and **227** are offset from one another and oriented about a plane (imaginary) that separates them in a symmetrical fashion, such that opening **225** is the mirror image of opening **227**. Each opening **225** and **227** of gullet **216** includes a neck portion **218** defined by parallel side walls extending radially inward from the periphery of the circular blade. At the radially inward end of neck portion **218**, one of the side walls opens into a circular base **220**.

[0031] Recall that, in alternative embodiments, openings **225** and **227** may partially overlap as previously explained. In addition, other opening designs can be used to implement the offset gullets **216** (e.g., narrow openings having only a neck portion **218**, or wide openings having only a 'neck' portion that has a width of the circular base **220**, or keyhole openings as shown, or 'J' shaped openings, or question-mark or spiral shaped openings. In one example embodiment, the offset gullets **216** are implemented using openings shaped in the form of alphanumeric, graphical, and/or trademark indicia, as described in U.S. Pat. No. 6,878,051. In another example embodiment, the offset gullets **216** are implemented using arrow-shaped openings that extend radially deeper than straight keyhole openings, and interspersed with the straight keyhole openings, as shown in U.S. Design Patent Nos. 458,948, 459,375, 459,376, and 459,740. In another example embodiment, the offset gullets **216** are implemented using openings designed to reduce fatigue and cracking, as shown, for instance, in U.S. Patent Application Publication No. 2006/0236838. Each of these patents and applications is herein incorporated by reference in its entirety. In a more general sense, the selection of an opening design for offset gullets **216** for a particular saw blade can generally be based on the cutting application(s) for which that blade is expected to be used.

[0032] In addition, note that the openings **225** and **227** are shown to be oriented in a symmetrical fashion, such that opening **225** is the mirror image of opening **227**. This symmetrical, mirror image relationship is not required for all embodiments of the present invention. For instance, in alternative embodiments, opening **227** can have one design and opening **225** can have another design, such that there is little or no symmetry and no mirror image quality (e.g., where offset gullet **216** is made up of two different shaped openings proximate and offset from one another, but each on its respective side of core **21**). Likewise, openings **225** and **227** can have the

respective side of core **211**. Likewise, openings **225** and **227** can have the same design, but be oriented in the same direction, so as to not provide the mirror image quality (e.g., where each note-shaped opening **225** and **227** faces the same direction). In general, the openings **225** and **227** making up the offset gullets **216** can have any number of shapes and configurations, as desired for a given application.

[0033] The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of this disclosure. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

Patent Citations (115)

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US1711102A *	1927-06-22	1929-04-30	Jr Juan Sierra	Circular-saw plane
US3990338A *	1973-01-17	1976-11-09	Gomex Verktyg Ab	Laminated saw blade
US4114494A *	1976-02-12	1978-09-19	Budke Robert L	Noise-controlled circular saw blade
US4135421A *	1977-08-19	1979-01-23	North American Products Corp.	Quiet running circular saw blade
US4222298A *	1978-10-10	1980-09-16	James Vaughn F	Cutting tool or the like
US4224380A *	1978-03-28	1980-09-23	General Electric Company	Temperature resistant abrasive compact and method for making same
US4232578A *	1979-07-09	1980-11-11	Wallace Murray Corporation	Saw blade and method of making
US4324163A *	1980-05-19	1982-04-13	Lavelle Donald R	Circular saw construction
US4337750A *	1980-10-08	1982-07-06	Norton Company	Abrasion resistant diamond blade
US4516560A *	1982-07-29	1985-05-14	Federal-Mogul Corporation	Abrasive cutting wheel and method of cutting abradable material
US4550708A *	1983-07-06	1985-11-05	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4578984A *	1984-03-05	1986-04-01	Uddeholm Strip Steel Aktiebolag	Machine for deforming the gullets of saw blades to improve resistance to fatigue stress
US4583515A *	1982-07-29	1986-04-22	Federal-Mogul Corporation	Abrasive cutting wheel for cutting rock-like material
US4624237A *	1984-06-08	1986-11-25	Jiro Inoue	Diamond saw
US4690024A *	1985-02-28	1987-09-01	Black & Decker Inc.	Saw blade and tip therefor
US4705017A *	1985-08-19	1987-11-10	Federal-Mogul Corporation	Stress resistant abrasive cutting wheel
US4794835A *	1985-12-20	1989-01-03	Kanefusa Hamono Kogyo Company Limited	Plate-like rotary body with vibration-suppressing characteristics and method of manufacturing same
US4854295A *	1988-06-01	1989-08-08	Federal-Mogul Corporation	Wear resistant abrasive cutting wheel

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US5082070A *	1989-11-13	1992-01-21	Hilti Aktiengesellschaft	Hollow drill bit
US5127197A *	1991-04-25	1992-07-07	Brukvoort Wesley J	Abrasive article and processes for producing it
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US5184597A *	1990-04-27	1993-02-09	Edward Chiuminatta	Apparatus and method for cutting unhardened concrete
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US5471970A *	1994-03-16	1995-12-05	Diamant Boart, Inc.	Method of manufacturing a segmented diamond blade
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US6408838B1 *	1999-07-05	2002-06-25	Noritake Diamond Industries, Co., Ltd.	Rotary cutting saw with slits shaped for minimizing wear of neck portion
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JP5453315B2	2008-01-22	2014-03-26	サンーゴバン アブレイシブズ，インコーポレイティド	Circular saw blades with offset gullets

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US6638152B1	2003-10-28	Diamond blade having segment type cutting tip for use in cutting, grinding or drilling apparatus
US7089925B1	2006-08-15	Reciprocating wire saw for cutting hard materials

US7089925B1	2006-08-15	Reciprocating wire saw for cutting hard materials
US3261384A	1966-07-19	Circular saw
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US4739745A	1988-04-26	Circular diamond saw blade incorporating a novel cutting segment
US6408838B1	2002-06-25	Rotary cutting saw with slits shaped for minimizing wear of neck portion
US6691596B1	2004-02-17	Circular saw blade for cutting fiber cement materials
US5647263A	1997-07-15	Saw tooth attack face and edge structure

Priority And Related Applications

Priority Applications (2)

Application	Priority date	Filing date	Title
US1180508	2008-01-22	2008-01-22	*US Provisional Application*
US12356712	2008-01-22	2009-01-21	Circular saw blade with offset gullets

Applications Claiming Priority (1)

Application	Filing date	Title
US12356712	2009-01-21	Circular saw blade with offset gullets

Legal Events

Date	Code	Title	Description
2009-04-24	AS	Assignment	**Owner name**: SAINT-GOBAIN ABRASIVES, INC., MASSACHUSETTS **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R.G.;REEL/FRAME:022591/0449 **Effective date**: 20090408 **Owner name**: SAINT-GOBAIN ABRASIFS, FRANCE **Free format text**: ASSIGNMENT OF ASSIGNORS INTEREST;ASSIGNOR:HEYEN, ANDRE R.G.;REEL/FRAME:022591/0449 **Effective date**: 20090408
2017-09-25	MAFP		**Free format text**: PAYMENT OF MAINTENANCE FEE, 4TH YEAR, LARGE ENTITY (ORIGINAL EVENT CODE: M1551) **Year of fee payment**: 4

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4-1/2"	(114mm)	.080"	7/8"-5/8"	162785
7"	(178mm)	.090"	DM-7/8"-5/8"	162786
8"	(203mm)	.090"	DM-7/8"-5/8"	165890
9"	(229mm)	.095"	DM-7/8"-5/8"	165109
12"	(305mm)	.125"	7/8"	163930Y
12"	(305mm)	.125"	1"	163930
14"	(356mm)	.125"	20mm	163931Z
14"	(356mm)	.125"	1"	163931
16"	(406mm)	.125"	1"	167423
			Segment Height	*7mm*

Tiger Tooth Video

As a part of the System Assessment and Validation for Emergency Responders (SAVER) Program, Texas A&M Engineering, including Texas Engineering Extension Service (TEEX) and Texas Transportation Institute (TTI), conducted a comparative assessment of multipurpose cutoff saw blades. The MK Diamond Tiger Tooth blade rated highest of all blades tested. The findings are presented in the Multipurpose Cutoff Saw Blades Assessment Overview, which is can be accessed at this link.

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Understanding Diamond Blades

1. Diamond Blade Fabrication

Diamond blades consist of four components: diamond crystals, a bonding system, a segment, and a metal core.

Diamond Crystals

The diamond crystals in MK blades are synthetic (man-made) rather than natural. This gives them a consistency that can be relied upon during the enormous stresses they encounter while grinding. The foremost performance factor in diamond-blade sawing is the type, concentration and size of these diamond crystals. The extensive diamond aptitude and sawing expertise MK has acquired goes into the selection of the proper diamond crystals for our wide range of blades

Bonding Matrix

Diamond crystals are held in place by a sintering process of specially blended metal powders. This bonding matrix is crucial to the overall performance of the MK diamond blade and serves several vital functions:

- Disperses and supports the diamonds
- Provides controlled wear while allowing diamond protrusion
- Prevents diamond "pull-out"
- Acts as a heat sink
- Distributes impact and load as the diamond attacks the cutting surface

During the sawing action, the wearing away of the matrix exposes new diamond crystals providing fresh cutting points for the blade

diamond crystals providing fresh cutting points for the blade.

Metal Bonds
The diamond crystals and bonding matrix are heated and shaped into specially engineered rims / segments. These rims / segments are wider than the blade core to which they will be attached, and provide the clearance to promote material discharge and discourage blade binding. The rims / segments are specifically designed to wear at a rate appropriate to the material being cut. Large particles of soft, abrasive materials wear down the matrix faster than the small particles removed from hard dense materials. Therefore, softer, more abrasive materials require a "tough to wear" (hard) bond; less abrasive materials require an "easy wear" (soft) bond.

Premium Steel Core
The diamond saw blade cores are made from high alloy, heat-treated steel. Depending on the type of blade selected, the steel cores are specifically designed to support the appropriate rim or segment. About the periphery of the core, the various rims or segments are affixed through a brazing or laser welding process. An arbor hole is precisely bored in the center, and the entire core is "tensioned" or tuned so that the stresses of centripetal force are minimized, permitting the blade to spin true on the spindle.

2. Understanding Diamond Blades As Cutting Tools
In general, a diamond blade's performance is measured in two ways. The first is how proficiently the blade grinds through the material; the second is the life of the blade or total footage yielded by the blade. There are a variety of MK diamond blade models and designs from which to choose. Each blade is meticulously engineered to provide cutability, longevity and safety. When you select the best-suited diamond blade for the job / application / material, you will ensure peak performance and maximum investment return.

How the Diamond Blade Works
Diamond blades do not really cut, instead they grind material through an action of friction with the synthetic diamond-bonding matrix. The diamond crystals, often visible at the leading edge and sides of the rim / segment, remove material by scratching out particles of hard, dense materials, or by knocking out larger particles of loosely bonded abrasive material. This process eventually cracks or fractures the diamond particle, breaking it down into smaller pieces. As a result of this phenomenon, a diamond blade for cutting

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smaller pieces. As a result of this phenomenon, a diamond blade for cutting soft, abrasive material must have a hard metal matrix composition to resist this erosion long enough for the exposed diamonds to be properly utilized. Conversely, a blade for cutting a hard, non-abrasive material must have a soft bond to ensure that it will erode and expose the diamonds embedded in the matrix. These simple principles are the foundation of "controlled bond erosion."

Types of Diamond Blade Cutting
There are two basic types of cutting – dry or wet. The best choice of blade depends upon:

- The requirements of the job
- The machine / tool utilizing the diamond blade
- The preference of the operator

In the case of DRY cutting, the overwhelming popularity and quantity of hand-held saws and the flexible nature of MK Diamond blades to professionally handle most ceramic, masonry, stone and concrete materials, make the DRY cutting blade a very attractive tool.

When using a DRY blade, the user must be aware of distinct operating practices to ensure optimum performance. DRY cutting blades require sufficient airflow about the blade to prevent overheating of the steel core. This is best accomplished by shallow, intermittent cuts of the material along with periods of "free-spinning" for several seconds to maximize the cooling process.

For WET cutting applications, MK has the exact blade to complement both the material to be cut and the wet-cutting machine to be used. During cutting operations, liberal amounts of water act as a coolant to support the cutting effectiveness and longevity of the WET blade. Additionally, using water adds to the overall safety of cutting operations by keeping the dust signature down.

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Saw Tip Angles

Premium Quality Carbide Saw Tips

Large Range of sizes in grades for soft and hardwood and Non-Ferrous.

Shop for Saw Tips

Matching a Saw Blade to the Machine and Materials

(Note: The language is imprecise here and the same term can mean different things. Also different terms maybe used for the same thing.) Refer to our Saw Blade Glossaryfor definitions and Clarification, or browse our Saw Blade Index on other saw blade articles that may be helpful.

Considerations

1. Know what machine or machines you will be using. Some blades work on several machines however a rip blade designed to grab material and pull it into the cut may be very unsafe if used in a radial arm saw. Sliding miter saws and radial-arm saws have a tendency to self-feed which leaves the wood torn and ragged and can sometime even grab the stock which is dangerous. The negative hook angle of radial-arm and sliding miter saw blades pushes the stock downward and against the fence to provide an extra margin of safety.
2. Know what material or materials you will be cutting. Ripping clear Fir is much different than cutting Corian®.
3. Know what is important to you in saw blade results.
   - Typically more teeth mean cleaner cuts but a slower feed rate. See our formula for Calculating Saw Blade Tooth Quantitiy and Feed Speed.
   - A saw (or saw blade) has to make three kinds of cuts; the cut into the material the cut through the material and the cut as the blade exits the material. One of the toughest cuts to get right is cutting double-sided laminate on MDF so that the edges of the MDF are smooth and clean with no chipping on the laminate on either side

are smooth and clean with no chipping on the laminate on either side.

- How much cutting will you do? A blade with a narrow side clearance and ground shoulder will give smooth cuts one at a time but will heat up rapidly in any kind of sustained cutting.

Getting Clean Cuts

The edges of a saw blade can separate material by; shear, fiber pullout, chipping or cutting. The thinner and sharper the edge, the better it cuts.

High shear is like the blade of an axe. Low shear is like the back of the axe. A flat, square tip has low shear, is very strong and works well in soft materials. A tip with a point on one side has higher shear. The shear factor is even higher if the face is beveled. A pointed tip works better in hard or brittle material. Because there is a small surface doing the cutting, pointed tips wear faster and are more likely to break.

Number of Teeth

As we said above, more teeth generally give a smoother cut but cut more slowly. This is best seen in hard and brittle materials where you are forced to use a large number of teeth (high tooth count) and nibble your way through.

Basic Saw Blade Angles

types_of_saw_blades-2.jpg

Hook Angle Top Clearance

Hook Angles

The hook angle is the amount of forward or backward lean each tooth has. A hook angle can be thought of as the angle at which the tip enters the material. If the saw tip enters the material at an angle it will be more efficient than if it slaps down flat. A 20 degree positive hook angle is used on rip blades to pull the wood into the blade. Standard hook angles range from 5 to 15 degrees positive. Steeper angles, from 18 to 22 degrees, are most effective for ripping and cutting softer materials. Hard materials require a shallow angle such as 6 degrees. Negative hook angles, usually -5 degrees, are used to prevent self-feeding of materials and give the operator maximum control over the feed of cut.

Using a saw blade with a positive hook angle to cut metal, such as aluminum trim, can be

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dangerous because the blade will have a strong tendency to grab the material causing the operator to lose control. To prevent self-feeding, sliding miter saws and radial-arm saws require a blade with a negative tooth angle.

In general, a blade with a positive hook angle is a faster-feeding blade and one with a negative hook is less aggressive. One thing we need to add here is that you ALWAYS want a negative hook for cutting metal and the new SystiMatic Melamine blade is a negative hook - it seems to work better for cutting Melamine.

Tangential Clearance Angle (Side Clearance Angle)

You measure down the side of the tip and the difference it is the difference between front and back. As you cut material it gets compressed and springs back after the cutting edge passes. A steep side clearance angle gives plenty of room for the material to expand and prevents heating and burning. However a very flat side clearance angle gives a smoother cut

types of saw blades-

Top Clearance Angle

The Top Clearance Angle is the angle between the top of the tooth and an imaginary line tangent with the cutting circle of the blade. This angle varies according to the hardness of the material being cut, 12 degrees for hard and 15 degrees for softer materials

Cutting Angle: The angle between the upper face of the saw blade and the material being cut. Also known as a rake angle.

Clearance Angle

The angle between the lower face of a saw blade and the material being cut.

Radial Clearance Angle (Radial Side Clearance)

The clearance angle on the side of the tooth. You measure down the side of the tip and it is the difference between front and back.

Relief Angle

The angle the top of the tooth makes away from the cutting edge to a line tangent to the blades circumference.

Two Kinds of Grinds (tooth shapes or tooth configurations)

The tip on the left has a very narrow side clearance. This gives good cuts but heats up rapidly and wears a great deal compared to the more conventional grind on the right.

Saw Tip Configurations (also Styles or Grinds)

The overall shape of a saw tip is called the "grind" because it is ground in after the tip is put on the saw body.

FTG (Flat Top Grind)

Used on rip blades for fast, efficient cuts along the grain. A square (also Flat or Flat Top) Grind is durable and long lasting. It is used for ripping and can be used on general purpose, thin kerf saw blades.

Advantages: Strong, straight cutting and easy to maintain

Disadvantages: Takes a lot of force and likely to chip or tearout on exiting cut. Not a good design for chip removal.

ATB (Alternate Top Bevel)

The tops of alternating teeth are beveled to one side of the blade or the other at approximately 15 degrees. This creates a sharp point and a sharper cutting edge for better cut quality without chipping or splinters. ATB is generally used cross cutting wood, plywood, veneer, hardboard, fiberboard and particle board.

=

Advantages: Little or not tearout and easy chip removal

Disadvantages: Hard to sharpen without expensive equipment, easy to chip and wears rapidly.

ATBR (ATB with Raker)

High ATB (Alternate Top Bevel with steeper angles)

Steeper bevel than the standard ATB for chip-free cuts on Melamine and plastic laminate without the use of a scoring blade. A High ATB is generally a blade with an angle over 20 degrees. It is used on brittle materials.

=

ATAF (Alternate Top Bevel with Alternate Face Bevels)

Besides grinding the top at an angle you can also grind the face at an angle. When combined into an ATAF (Alternate top –Alternate Face grind) you get a sharper cutting, more pointed edge. This is used on the most brittle materials. You start with alternate slants on the tops then grind the faces of the tips so that they slant as well. Standard face left below and beveled face right.

Tops = --

Combination Tooth (4&1) - Planer / Combination

Planer Combination combines 4 Alternate Top Bevel Teeth with 1 raker. The basic function of the raker tooth, which is lower than the tips of the scoring teeth and narrower. It removes the V-shaped piece of material left in the center of the cut by the alternating top bevel teeth. This tooth configuration provides a very smooth cut. Often each group is divided by a large gullet on the saw blade. The design is used on combination blades for ripping and crosscutting. You can use a simple ATB when you cut clean through but an ATB will leave a ridge down the middle of a groove. The raker tooth is lower and narrower than the ATB tips and cleans up that ridge. The raker also helps keep the blade square in the cut and the blade running straight.

Advantages: Little tear out, good chip removal and straight cutting

Disadvantages: Hard to sharpen without expensive equipment, easy to chip and wears rapidly.

Hollow Ground (HG)

Hollow faced grind used for cutting melamine and other challenging materials. Most often used on vertical panel saws. Here we show three types. Hollow ground is most commonly the circular shape but not always. In this case 'hollow ground' refers to the grind on the top of the tip but the face can also be ground in one of these shapes.

TCG (Triple Chip Grind)

A Triple Chip Grind (TCG) has a trapezoidal tip that cuts a groove with slanting sides. This is followed up by a square top tip that makes the side of the groove square. The first tooth, or lead tooth, has a double 45 degree angle corner bevel. This is followed by a flat topped raker tooth ground lower than the lead tooth. The raker tooth removes the corners left on both sides by the beveled lead tooth. Triple Chip Grinds combines a balanced cutting force, low tooth drag and free chip flow. This helps to eliminate chipping in brittle material such as chip board, and laminates. This divides the chips to achieve smooth cuts in hard materials such as MDF, OSB, and plastics. This tooth design is also used on blades for cutting non-ferrous material. Use TCG grind when cutting plastics, aluminum, and non ferrous metals.

Advantages: Good wear, straight cutting, Low drag with good chip flow.

Disadvantages: Hard to maintain without precision equipment. Tends to produce chip outs.

California Triple Chip (C-TCG)

Specialty tooth design for miter saws. Used in picture frame shops, window and door manufacturers or anywhere that miter saws are used.

Solid Surface Scoring Blade

Commonly used when you need clean cuts on both sides of the material. The scoring blade cuts the underside of the material. It cuts just ahead of the main blade which cuts from the top. It must be precisely aligned with the top blade. It is best if the moan and scoring blades are treated as a set and are both sharpened at the same time.

Conical scoring tip

There are a great many other grinds and some of them are highly specialized. In a plant producing MDF or plywood panels the sides of the panel are trimmed after they are pressed and cooked. One side of the cut is the 4x8 sheet seen by the customer. The other side is scrap which gets reground. A saw blade in this application may have all the teeth cutting on one side.

Conclusion:

There are about a hundred parts to saw blade depending on how you break them down. These are the saw tip, braze alloy, gullet size and shape, shoulder size and shape, expansion slots and the saw plate or steel saw body.

There are over five thousand grades of carbide with some wearing longer and some being tougher. Some slide through the cut faster and last longer while others are much harder to break. The braze material is much like the suspension in a car. It keeps the tip on and can prevent or eliminate tip loss and breakage. The gullet has to be the right size and shape to handle all the material the tooth cuts but you need as much metal as possible for strong shoulders behind the saw tips. The size and shape of the shoulder can help control the feed rate and a bump on the shoulder can be an important safety feature to control kickback. As a saw blade heats up the outside grows more than the inside so you need expansion slots to keep the blade flat and true. Finally different saw blades are made of different kinds of steel to increase wear, toughness and flatness.

In addition to all the design considerations, some blades are just made much better than others. An easy measurement is side clearance or how far the tip sticks out from the steel body. Some blades may have a variation of as much as 0.005" from one tip to another while others will be at least ten times more precisely ground with a variation of 0.0004".

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SAW BLADES 101

POSTED ON JUNE 12, 2014 BY ROCKLER

Making smooth, safe cuts with your table saw, radial-arm saw, chop saw or sliding compound miter saw depends on having the right blade for the tool and for the type of cut you want to make.

There's no shortage of quality options, and the sheer volume of available blades could bewilder even an experienced woodworker. That's why we've put together this article. It's part glossary and part guide, with important basic information to help you make the right selection for your shop.

How do I choose the right saw blade?

A good way to narrow your options and focus your search is to answer a few key questions:

In what type of saw will the blade be used? Table saw? Compound miter saw? Sliding compound miter saw? Radial-arm saw?
Some blades are designed to be used in particular saws, so you'll want to be sure to get the right blade for the tool. Using the wrong type of blade for the saw is likely to produce poor results and might in some cases be dangerous.

What materials will the blade be used to cut?
If you need to cut a wide range of materials, that will affect your choice. If you cut a lot of a single type of material – melamine, for example – that specialization also might affect your choice.

What types of cuts will the blade be used to make?
Will it be used exclusively for crosscutting (cutting across the woodgrain)?
Will it be used only for ripping (cutting with the grain)? Will it need to produce good results in all types of cuts?

Related to that, are you looking to build a collection of specialized blades, or do you want one blade that can make all kinds of cuts?
Are you willing to change the blade every time you switch from one cut to another?

How powerful is the saw on which the blade will be used, and what size blade does the manufacturer recommend?
Is it a 3 hp cabinet table saw or a portable job-site saw? Is it a 10" saw or 12"?

Answering these questions will go a long way toward clarifying your best options. Understanding a little about the anatomy of a saw blade can help further narrow your search.Saw Blade Essentials
Many saw blades are designed to provide their best results in a particular cutting operation. You can get specialized blades for ripping lumber, crosscutting lumber, cutting veneered plywood and panels, cutting laminates and plastics, cutting melamine and cutting non-ferrous metals. There also are general purpose and combination blades, which are designed to work well in two or more types of cuts. (Combination blades are designed to crosscut and rip. General-purpose blades are designed to make all types of cuts, including in plywood, laminated wood and melamine.)
What a blade does best is determined, in part, by the number of teeth, the size of gullet, the tooth configuration and the hook angle (angle of the tooth).

Saw Blade Essentials

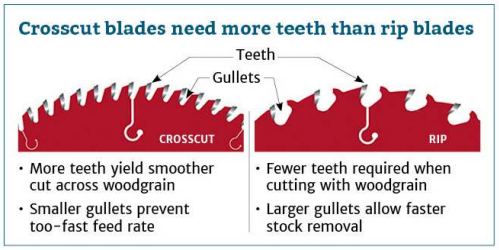
Many saw blades are designed to provide their best results in a particular cutting operation. You can get specialized blades for ripping lumber, crosscutting lumber, cutting veneered plywood and panels, cutting laminates and plastics, cutting melamine and cutting non-ferrous metals. There also are general purpose and combination blades, which are designed to work well in two or more types of cuts. (Combination blades are designed to crosscut and rip. General-purpose blades are designed to make all types of cuts, including in plywood, laminated wood and melamine.)

What a blade does best is determined, in part, by the number of teeth, the size of gullet, the tooth configuration and the hook angle (angle of the tooth).

Number of Teeth

In general, blades with more teeth yield a smoother cut, and blades with fewer teeth remove material faster. A 10" blade designed for ripping lumber, for example, usually has as few as 24 teeth and is designed to quickly remove material along the length of the grain. A rip blade isn't designed to yield a mirror-smooth cut, but a good rip blade will move through hardwood with little effort and leave a clean cut with minimal scoring.

A crosscut blade, on the other hand, is designed to produce a smooth cut across the grain of the wood, without splintering or tearing. This type of blade will usually have 60 to 80 teeth, and the higher tooth count means that each tooth has to remove less material. A crosscut blade makes many more individual cuts as it moves through the stock than a ripping blade and, as a result, requires a slower feed rate. The result is a cleaner cut on edges and a smoother cut surface. With a top-quality crosscut blade, the cut surface will appear polished.



Gullet

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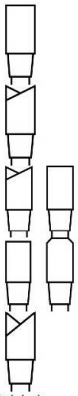
Gullet

The gullet is the space in front of each tooth to allow for chip removal. In a ripping operation, the feed rate is faster and the chip size is bigger, so the gullet needs to be deep enough for the large amount of material it has to handle. In a crosscutting blade, the chips are smaller and fewer per tooth, so the gullet is much smaller. The gullets on some crosscutting blades also are purposely sized small to inhibit a too-fast feed rate, which can be a problem especially on radial-arm and sliding miter saws. The gullets of a combination blade are designed to handle both ripping and crosscutting. The large gullets between the groups of teeth help clear out the larger amounts of material generated in ripping. The smaller gullets between the grouped teeth inhibit a too-fast feed rate in crosscutting.

Tooth Configuration

The shape of the saw blade tooth and the way the teeth are grouped also affect the way the blade cuts. The configuration of the teeth on a saw blade has a lot to do with whether the blade will work best for ripping, crosscutting or laminates.



Flat-Top (FT): Flat-top teeth are used on blades for ripping hard and soft woods. Because wood is much less likely to chip and splinter when it is being cut with the grain, a rip blade is designed to quickly and efficiently remove material. The flat-top tooth is the most efficient design for cutting and raking material out of the cut.

Alternate Top Bevel (ATB): This means that the blade teeth alternate between a right- and left-hand bevel. This configuration yields a smoother cut when crosscutting natural woods and veneered plywood. The alternating beveled teeth form a knife-like edge on either side of the blade and make a cleaner cut than flat-top teeth.

Combination Tooth (Comb.): Combination blades are designed to do both crosscutting and ripping. The teeth are arranged in groups of five – four ATB teeth and one FT – with a large gullet between the groups.

Triple Chip Grind (TCG): The TCG configuration excels at cutting hard materials such as laminates, MDF and plastics. Teeth alternate between a flat "raking" tooth and a higher "trapeze" tooth. The TCG configuration is also used for non-ferrous metal cutting blades.

High Alternate Top Bevel (Hi-ATB): The Hi-ATB configuration is used for extra-fine crosscutting and to cut materials surfaced with melamine, which is prone to chipping. The high bevel angle increases the knife-like action at the edge of the blade.

Hook Angle

On most saw blades, the faces of the teeth are tipped forward or backward, rather than being perfectly in line with the center of the blade. This is called "hook angle." On a blade with a positive hook angle, the teeth are tipped forward, toward the direction of the blade's rotation. A negative hook angle means that teeth tip away from the direction of rotation, and a 0° hook angle means that the teeth are in line with the center of the blade.

Hook angle has an important effect on blade operation. A blade with high positive hook angle (say, 20°) will yield a very aggressive cut and a fast feed rate. A low or negative hook angle will slow the feed rate and will also inhibit the blade's tendency to "climb" the material being cut. A blade for ripping lumber on a table saw will generally have a high hook angle, where an aggressive, fast cut is usually what you want. Radial-arm saws and sliding compound miter saws, on the other hand, require a blade with a very low or negative hook angle to inhibit overly fast feed rate, binding and the blade's tendency to "climb" the material.

What you need to know about hook angle

-5° hook 20° hook

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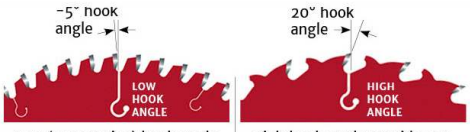


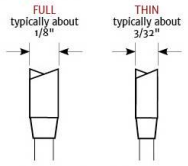
- Low (or negative) hook angle prevents overly fast feed rate and prevents blade from "climbing" stock being cut
- Good choice for sliding miter and radial-arm saws

- High hook angle provides an aggressive cut and allows a faster feed rate
- High hook angle is common on rip blades for use on a table saw

Kerf Width

The width of the "kerf" – the slot the blade cuts in the material – is another important

Full kerf or thin? How powerful is your saw?



- Because they take a wider bite and remove more material, full-kerf blades work best for saws with at least 3hp motors
- Thin-kerf blades won't bog down saws under 3hp. That means there will be less heat buildup, less burning and less wear on your saw. Thin-kerf blades also waste less material.

consideration. Many blade types are available in both full-kerf and thin-kerf varieties. Full-kerf blades typically cut a 1/8" slot and are intended for use on saws powered by 3 hp (or greater) motors.

Thin-kerf saw blades – blades with a kerf thickness of less than 1/8" – were developed for use on portable and contractor model table saws with motors of less than 3 hp. Because a thin-kerf blade has to remove less material than a full-kerf blade, it requires less power to operate and allows lower-powered saws to cut material at an appropriate feed rate without the risk of bogging down during the cut. (Bogging down causes excessive friction; as a result, the blade heats up and can become distorted or burn the cut surface.)

A potential trade-off for the thinner kerf is the fact that the blade plate is thinner and therefore might be expected to vibrate more than a thicker, more rigid plate. However, technological advances in blade design have generated thin-kerf blades that rival the best industrial-quality full-kerf saw blades. Vibration-dampening systems, like the one used with Freud thin-kerf blades, compensate for the slight loss of stability and make thin-kerf blades the optimum choice for lower-powered saws.

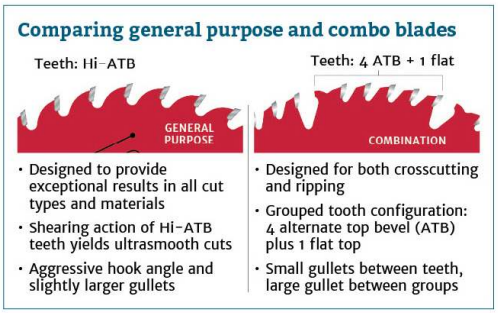
Teeth quality

The teeth on most high-quality saw blades are thick carbide tips that have been fused (or brazed) to the steel blade plate. How long the blade will stay sharp, how cleanly it will cut and how many re-sharpenings it will take all depend on the quality of the cutting tips. On some of the best blades, the carbide is formulated specifically for the application of the blade, and a tri-metal brazing process is used to attach the carbide cutters to the blade plate. This process, in which a layer of copper alloy is sandwiched between layers of silver alloy, provides extra flexibility and impact resistance. At a minimum, look for a blade with C3 grade micro-grain carbide teeth, which are thick enough to allow a number of re-sharpenings.

Bringing it all together

So which blade is right for you? Collect your answers to the questions at the beginning of this article and go to Rockler.com, where you can search our selection of blades by brand, blade type, blade diameter, material to be cut and price.

If you are planning to cut a variety of materials and prefer not spend time frequently changing from one specialty blade to another, a general-purpose blade is a good choice. Freud's new Premier Fusion blade combines an aggressive hook angle and large gullets with the clean cutting action of a Hi-ATB tooth grind for a blade with the widest range of excellent cutting capability.



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COMMENTS

20 thoughts on "Saw Blades 101"

Peter
March 15, 2014 at 2:43 am
This article is very useful for novice woodworker. I did not know what blade to get until I read this article. Thanks.

Angus A. Stevens
May 22, 2014 at 9:44 am
Dear sir or Madam:
I am looking for the highest quality thin curf radial saw blades you have around .0625in. thickness. It will be cutting hard wood about 5/8 in. deep down into the wood. It cut will going with the grain instead of a crosscut.
Thank you very much for your attention and time.

Sincerely,

Angus A. Stevens,

Joe Todor
July 13, 2014 at 4:23 am
I have purchased a new MAKITA compound miter saw and need a 12" blade to cut structural steel. I am a builder for General Steel and need to cut

metal angle and gerts to build a steel building. What blade can you recommend to do the job?

Augusto Ascanio
August 4, 2014 at 5:10 am
Excelente articulo, ayuda mucho al conocimiento tanto al principiante ,como al mas experimentado.

Gordon Bjerk
August 29, 2014 at 11:17 am
Do you sharpen blades on know of someone who does?

Jim W alker
September 18, 2014 at 7:06 am
Which 10" table saw blade(or blades) do you recommend to cut small pieces of various hardwoods for game calls? I want an extremely smooth cut. I will be ripping and crosscutting. I have an old Craftsman saw in excellent condition
My research points me toward Forrest and Freud blades. Naturally I want the most bang for the buck. (reasonably priced.

Mike H
December 23, 2014 at 4:34 pm
I rarely read forum comments regarding saw blades where the tooth leading edge is worn. The remaining area of the tooth, following the leading edge, is wider than the actual cutting surface due to wear. When the leading edge becomes worn the main shape or body of the cutting tooth is wider than the leading edge. This is microscopically small yet it leads to splintering even when the blade feels sharp. A new blade cuts well then begins to splinter or chip the material. Any sharpening of blades must remove enough material to remove worn areas. Another neglected comment is where the side and tops of blade teeth are ground to sharpen. I know sharpening the tooth side affects kerf. Yet until the tooth is sharpened where the leading cutting edge area exceeds the main tooth body the blade will drag like a wedge and pull a splinter.

Best knife sharpenerz
January 4, 2015 at 9:00 am
Thank you for this great and in depth review of the radial-arm saw blade. I have been looking to purchase an table saw blade for a couple days now, and was going back and forth among the different models have available – the highest quality thin curf radial saw blades used to be my favorite but now as i run into this edgeselect option i am reconsidering. Thank you for all the work you put into this.

James Marwitz
January 12, 2015 at 5:01 pm
Excellent publication. It seems I have been ripping with the wrong blade for many years.
Thanks
Jim

Gary Faulkner
February 9, 2015 at 2:46 pm
can you tell me the degree of the teeth of a 10" table
saw blade. I've been told that they are about 9 degrees

4.7 ★★★★★
Google
Customer Reviews

Thanks,
Gary Faulkner

BRUCE BESSERT
April 2, 2015 at 12:45 pm
How to round a circular saw after sharpening

Jenifer
May 8, 2015 at 10:37 am
A year ago I purchased the Ryobi Sliding Compound Miter Saw…with the laser. I just started using it and the laser really did ensure precise cuts. lol…Unfortunately, newbie that I am, I wasn't holding something tight enough and a piece of wood kicked the laser loose. Aaaack! Now trying to see where it was actually set so I can put back! Any experience with this?

Vasile Alistar
May 28, 2015 at 10:11 pm
I totally agree with you!

I always say that no mater how good your circular saw is, if you don't have a good saw blade you will not obtain the results you expect.

Mihaela
June 2, 2015 at 3:40 am
Such a helpful article! Thanks. It really helped me find more about saw blades. Now I think I can choose between different models of saw blades, for the aquisition of the most suitable one.

Lori
July 17, 2015 at 7:20 am
Nice share, I'm really appreciate your post. Thanks.

David Strong
July 18, 2015 at 1:35 pm
I have an old Dewalt radial arm saw that still works, that was purchased in the 60's. The guard only accommodates up to a 9 inch blade so I have to use an 8.25 inch blade that I found somewhere. Trouble is, I can't clear thicker standard wood sizes. Are there any 9 inch blades still available?

Bill Widlits
December 14, 2015 at 2:36 pm
Is Shopsmith the only place I can get a 10" blade with a 1-1/4" arbor?

Chris Schild
March 6, 2016 at 9:48 pm

4.7 ★★★★★
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March 6, 2016 at 9:48 pm
Typical Number cuts made for life of saw blade?

Using a 12" miter saw Dewalt blade, how many cuts can one expect to make per blade? I framed an entire basement and the blade is shot already. That seems too few. Not a big basement either...

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The Tool Corner

The Official Blog of KMS Tools

Diamond Blades – Blade guide 101

Posted on March 9, 2012 by Chris — 6 Comments ↓

Anyone who has done any tiling understands that the saw is just one piece of the puzzle. Certainly, with a saw moving at three to ten thousand rpms, putting a thin kerf blade might cut just about anything, but the quality of cut, longevity of the blade, and effect on the saw might encourage any wet saw user to have the proper blade for the task at hand. Considering the cost of blades, it is important to know what to look for when it comes to a diamond blade.

But why is there such a huge selection of different diamond blades out there, even within one brand? How does a person understand and differentiate between the hundreds of unique qualities and styles?

The Bond

First, a diamond blade is made from high quality steel, but as the name suggests, there are actual diamonds scattered throughout the blade. However, these are not the diamonds found in engagement rings – thank goodness. They are typically synthetic and produced through high-pressure, high-temperature synthesis in order to produce the most efficiency for cutting. The diamonds can

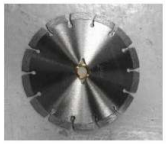
synthesis in order to produce the most efficiency for cutting. The diamonds can be bonded to the blade through a variety of different methods—typically with sintered metal powder—and these methods can affect the blade quality, but the bond is the most important thing to understand when it comes to diamond blade makeup. The bond varies between different levels of softness and hardness, and in addition to giving a base for the diamonds, the bond allows for a specific wear rate to match the material being cut. Often, ***the bond hardness is the inverse of the hardness of the material.*** For instance, with porcelain, the bond needs to be soft so that it will wear down proportionally in order to expose new diamonds and provide a clean cut.

If not for the longevity of the blade, almost all blades would use a soft bond, which would constantly expose new diamonds away from the bonded steal for a clean cut. However, this negatively impacts the lifetime of the blade, so almost all manufactures use a hard bond for softer materials to vastly increase the lifetime.

This is why companies have so many different types and qualities of blades. In general, higher quality blades will last longer due to the bonding matrix that is used. Although it is uncommon for companies to disclose the bonding method, it is important to look at the packaging to see what the manufacturer suggests in terms of each blade's cutting capability. This will tell you the blade's optimal performance and longevity. Moreover, if you are cutting hard materials and find that the blade is either sparking or bouncing, you have likely chosen the wrong type of blade for the material used, which can glaze the blade. Remember, it is an inverse relationship for cutting with a diamond blade: If you want to cut a hard material, you need a soft bond; for a soft material, you need a hard bond. If you cut a hard material with a hard bond, you will glaze the blade, and it will require dressing. Usually, to fix a blade you can use a dressing stick or just run the blade through a soft material like asphalt to expose more diamond material.

Blade Styles

There are three different types of blades



The Segmented Rim

The Segmented Rim blade gives the roughest cut and is used for concrete, brick, concrete pavers, masonry/block, hard/reinforced concrete, and limestone. This blade is usually referred to as a dry cutting blade. The reason that it can be used on dry applications without water is due to the cut outs—or segments—on the edge of the blade. These allow for air flow and cooling of the blade core. The

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edge of the blade. These allow for air flow and cooling of the blade core. The segments also allow for better exhaust of debris, allowing for a swifter cut. One of the risks to the lifetime of a diamond blade is overheating, which affects the bond and can warp the blade. Segmented blades are the best option when water is not available; however, if a person tries to use a segmented blade on, for example, a tile, more often than not that blade is going to chip the tile, leaving an awful finish.

The Turbo Rim

The Turbo Rim blade is specifically designed to cut faster in wet or dry applications. The smaller segments on the rim allow for cooling of the blade with an integrated interweaving diamond matrix. The turbo rim lets air pass through its smaller turbo segments, which has a cooling effect on the blade. You might notice the small holes scattered throughout the blade as well. This is a common practice for many manufactures to increase the cooling capabilities of their blades. This blade cuts faster due to the design of the turbo segments pushing the material out. This blade effectively cuts concrete, brick, and limestone materials.

The Continuous Rim

The Continuous Rim blade is most commonly referred to as a wet cut blade. There are a few advantages to using water when cutting material: Water significantly cools down the blade, allowing for longer life; it flushes out any debris to lessen friction in the cutting zone; and it reduces dust, thus preventing dust from building up in the cracks of the tool, which would decrease its lifetime. The continuous rim cuts the slowest of any of the different styles of diamond saw blades, but as a tradeoff it produces the best cut. Typically, the continuous rim is used for cutting marble, granite, porcelain tile, and ceramic tile.

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6 Replies to "Diamond Blades – Blade guide 101"

Robert Williams on **October 1, 2014 at 3:32 am** said:

Thanks for sharing this post. It is very informative. It is so descriptive that anyone can understand about the diamond blade. Few months ago I had taken the service of diamond blade from ERMRICH Inc. I am very satisfied with its products and services.

Reply ↓

RDL on **June 6, 2016 at 11:43 am** said:

basic but very important and clear information !

Reply ↓

uncle mo mo on **September 26, 2016 at 8:13 am** said:

excellent, thank you

Reply ↓

Claus on **June 2, 2017 at 1:40 am** said:

Very helpful.

Reply ↓

Pardip on **November 6, 2017 at 5:15 pm** said:

Helpful information

Reply ↓

Mike W on December 22, 2017 at 2:07 pm said:

Thanks! Very informative!

Reply ↓

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Circular Saw Blade Buying Guide

The right saw blade is a key part of a successful woodworking project. Learn how to find the best circular saw blade for your work.

Circular Saw Blade Types

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Different types of circular saw blades are designed to cut different materials and work with different power saws. Make sure the blade you choose is suitable for the material you need to cut. You also need to make sure it fits your saw. There are several specifications you should check.

Look at the **blade diameter** and **type** and compare these specifications with the capability of your saw. Acceptable sizes vary by saw model, but in general:

- **Handheld circular saws** accept smaller blades, those 4-1/2 inches to 7-1/4 inches in diameter. These are typically **carbide-tipped**.
- **Tile saws** use 7-inch or 10-inch **diamond** blades.
- **Table saws** and **compound miter saws** use blades 10 inches or 12 inches in diameter. Like those for handheld saws, the blades are usually **carbide-tipped**.
- Metal-cutting **chop saws**, also called **abrasive saws** or **cutoff saws**, take 14-inch **silicon carbide** or **aluminum oxide** abrasive blades.

Check the size of the **arbor hole** (the hole in the center of the blade). It must fit the arbor or shaft on your saw. Many blades with a circular arbor hole include a piece you can knock out to allow them to fit saws with a diamond-shaped arbor.

Note the **maximum RPM** (revolutions per minute) rating of the blade to make sure it's compatible with the tool you plan to use.

Shop for Circular Saw Blades & Sets

Learn how to choose the best power saw for your projects:

- **Circular Saw Buying Guide**
- **Table Saw Buying Guide**
- **Compound Miter Saw Buying Guide**

Good to Know

Blade diameter, arbor hole size, number of teeth and **kerf** — the thickness of the cut the blade creates — are typically printed on the face of a circular saw blade. You may also see a list of appropriate tool types as well as maximum RPM and application specifications.

Standard Circular Saw Blades

Standard circular saw blades are those you typically use to cut wood or wood composites. The number of teeth on the blade helps determine the speed, type and finish of the cut. Blades with fewer teeth cut faster but those with more teeth create a finer finish. **Gullets** between the teeth remove chips from the work pieces. **Expansion slots** cut into the rim help prevent the blade from warping as it expands and contracts during use. They reduce vibration, creating a straighter cut.

Rip-cut blades, those for cutting with the wood grain (along the length of a board), have fewer teeth (16 to 40). The teeth are designed to cut aggressively and deep gullets provide good chip removal. **Crosscut blades**, those for cutting across the wood grain (across the face of a board), have between 40 and

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wood grain (across the face of a board), have between 40 and 80 teeth designed for clean cuts. Smaller gullets separate the teeth. **Combination blades** can make rip cuts and crosscuts. They have multiple groupings of teeth separated by deep gullets. Each group has one tooth for ripping and four for crosscutting.

You may also see blades with other designations.

- **Framing blades** have 24 teeth and are effective for work — such as rough carpentry — where speed is more important than a clean cut.
- **Plywood blades** have 100 or more fine teeth designed to create a finish with minimal splintering.
- **Thin-kerf blades** have a narrow profile for faster, easier cutting and less material waste.
- **Hollow-ground** blades have a body that's thinner than the teeth — a design intended to help keep the blade from becoming pinched in the work piece.

Good to Know

Some standard circular saw blades can cut materials other than wood, such as plastic or aluminum.

Good to Know

Look for circular saw blade features such as **anti-kickback designs** and **friction-reducing coatings**.

Continuous-Rim Blades

Continuous-rim blades are a type of diamond-edged blades — sometimes called **diamond blades** — designed for materials such as tile and slate. Diamonds affixed to the edge of the blade cut through the material. These blades create a very clean finish. Some work in dry-cutting applications only, while others are for wet-cutting applications. Some work for either wet or dry applications.

Caution

While some blades are suitable for wet and dry applications, make sure your saw is suitable for the type of cutting you need to do.

Turbo-Rim Blades

Turbo-rim blades are diamond blades similar to continuous-rim blades, but with a serrated rim that cuts materials such as brick and concrete. These blades cut more aggressively than continuous-rim blades but don't leave as clean a finish. Some work for dry cutting only, but some are appropriate for both wet and dry applications.

Segmented Blades

Segmented blades also cut with diamond edges, but have a rim divided by gullets similar to those on a standard blade. The segments create the most aggressive cut of the diamond blades. These blades cut more quickly than the other types and can handle tough materials such as brick and concrete, but leave a rougher finish. Like continuous- and turbo-rim blades, some work for dry cutting, while others can handle wet or dry applications.

Abrasive Blades

Abrasive Blades

Abrasive blades can cut materials such as brick and concrete. Some abrasive blades are suitable for metal-cutting applications. Like the diamond blades, they don't have teeth. They cut with an abrasive material such as aluminum oxide or silicon carbide.

Stacked Dado Blades

Stacked dado blade sets are wood-cutting accessories that include two circular saw blades as well as several chipper blades and shims. By stacking the blades or combinations of the blades, chippers and shims, you can cut grooves of different widths. These sets aren't for use with handheld saws; they're designed for table saws.

Caution

Follow the blade and saw manufacturers' instructions for use and safety.

Shop for Circular Saw Blades & Sets

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- Other Diamond Blades

Diamond Segment
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- Gang Saw Segment
- Andesite Limestone Slate
- Sandstone Basalt
- Concrete Segment

Diamond Floor Grinding Tool
- Diamond Grinding Shoe
- Diamond Grinding Plate
- Diamond Grinding Cup Wheel

Abrasive Grinding
- Diamond Brushes
- Diamond Polishing Pads
- Diamond Grinding Wheel
- Diamond Frankfurt
- Diamond Fickert
- Bush Hammer

Diamond Saw Blade Buying Guide-the Difference of Segment Between Diamond Segmented, Continuous Rim and Turbo Blades

Diamond saw blades are available with different rim or edge configurations including segmented, continuous, and turbo with the type of rim affecting how the blade cuts. The diamond segments or rim are fixed to the blade through the process of brazing, laser welding, or sintering.

Diamond Segmented Blades

Segmented blades typically have medium to hard bonds for a range of wet and dry cutting applications. While these diamond saw blades can offer a relatively smooth cut with a fast cutting speed, chipping may still occur. They are durable and have a long blade life compared to other blades.

They are ideal for cutting marble and granite slabs, concrete, asphalt, brick, block, and other building materials. They are available in a wide selection of diameters from small to large and particularly dominate the 12" diameter and larger market. These diamond segmented blades are commonly used with masonry saws, concrete saws, and circular saws.

The spaces of air that separate the diamond segments are called gullets or slots. The slots are there to improve air flow, cutting materials dust, dissipate heat, and remove slurry from the cut, helping to maintain the saw blade's cutting performance. The size and shape of the gullets vary from blade to blade and will depend on the type of material the blade designed to cut.

For example, blades for cutting asphalt tend to have wider, U-shaped slots while diamond saw blades for concrete tend to have narrower U-shaped slots or Key hole slot. The more abrasive the material, the wider the slot should be to allow for better heat dissipation. Other slots shapes include teardrop and angled. Segmented diamond saw blades with narrow slots are generally for marble and granite while keyhole shaped slot blades tend to be for general purpose.

Diamond segmented blades for granite -Narrow U-shaped slots

Bush Hammer

Diamond Core Drill Bits

Diamond Drill Bits

Core Drill Diamond Segment

Diamond Wire

Diamond Wire Saw

Diamond Wire Bead

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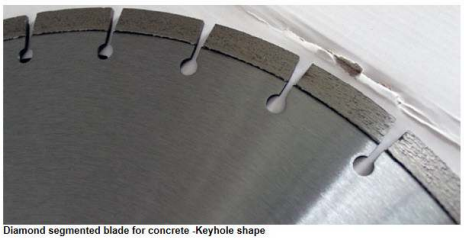

Diamond segmented blade for concrete -Keyhole shape

Diamond Continuous Rim Blades

Diamond continuous rim blades have softer bonds for cutting hard materials such as tile, porcelain, granite, ceramic, glass, and other materials that can chip easily. These diamond saw blades don't have individual segments but instead have a solid, continuous rim or edge. Most diamond continuous rim blades are designed for wet cutting applications, providing the smoothest, chip free cuts.

These diamond saw blades are most commonly available in 4" to 14" diameters. The smaller, 4" to 5" diameter saw blades are often used in hand-held grinders while the larger sizes are often used with circular saws and tile saws.

There are also variations of diamond continuous rim blades. The J-slot design is one variation that has J-slots around the edge of the blade to help dissipate heat for increased durability, extended blade life, and faster cutting speeds. Additionally, there are J-slot continuous rim blades available for dry cutting applications. People use J-slot diamond saw blade for cutting marble as well.

Diamond Continuous Rim Blades for tile

Diamond saw blade -J slot

Diamond Turbo Blades

Turbo blades typically have soft to medium bonds for a variety of general purpose to specific cutting applications. Diamond turbo blades feature a continuous rim with an edge that is serrated. This serrated edge is designed to the give the blade faster cutting speeds while maintaining a smooth cut, combining the best qualities from both segmented and continuous rim blades.

These turbo diamond saw blades are typically available in sizes that range from 4" to 12" diameters. They can be used in hand-held grinders, circular saws, and tile saws to cut a variety of materials including tile, stone, marble, granite, masonry, and other building materials. Turbo diamond saw blades are available for both wet and dry cutting applications.

Turbo diamond saw blades for granite

上一篇：Why select a diamond saw blade for granite is important? 下一篇：Russia Stone Industry International Exhibition 2017 Moscow

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Why Read This Article?

- Detailed saw blade information.
- Diagrams and specifications.
- Buying guide for matching blades.

Article Breakdown

- There is a long list of features that contribute to saw blade design.

Saw Blades 101

December 16, 2009

This article explains important details about circular saw blades, their parts, measurements, design features, and how to match saw blades to their applications.

"**Standard**" saw blades are circular blades used in a variety of saw types: table, circular, miter, radial arm, and rip saws are just a few that use standard blades.

The "standard" designation refers to the broadness of their application; it does not suggest simplicity. It takes an expansive list of blade design features and combinations for the tool industry to meet the long list of very specific saw blade uses out there.

For article about "Circular Saw Blade Types"-Click here.

Why Are Saw Blades So Complicated?

This is because standard blades are:

1. used, as mentioned, in **several types of saws** that sometimes require blade design changes or variations,
2. even within the same saw type, a large variety of blade designs can be used to optimize cutting through **different materials**, and
3. blade designs are also modified to suit them to a **certain types of cuts**.

These saw type, material type, and cut type demands are met in each specialized blade by a combination of several measurements and design

energy to cut, but are more resistant to heat and wear.
- Thinner kerf blades require less energy for cutting, but are less resistant to heat and wear.

Plate Width-

- This is a critical factor for matching a blade to its saw.

Diameter-

- A major measurement for matching blade compatibility.

Hook Angle-

- Hook angle describes the angle at which the cutting edge of a saw blade meets the material being cut.
- Hook angle variations change the aggressiveness of the cut, and suit blades for use on certain saws.

Bevel Angle-

- For bevel style cutting teeth, the bevel angle describes the steepness of the bevel cut on the tooth.

Saw Blade Materials

- Most circular saw blade teeth are made with carbide these days.
- The "Carbide Grade Scale" is not a scale of quality, but of function.
- C3 and C4 carbide types are best for saw blades.

Cutting Tooth Style

Tooth style refers to two things:

1. The shape of the cutting teeth, and
2. The pattern of their placement.

FT (Flat Top)

- Ripping blades for the fastest and coarsest cuts.

ATB (Alternating Top Bevel)

- For finer ripping and crosscutting cuts on natural woods

HiATB (High Alternating Top Bevel)

factors. Then, most commonly, the blade is advertised and named for either its application material, the type of saw it is used in, cut type, or any combination of those general features.

(***For Example***: a saw blade designed for cutting melamine with a miter saw might be advertised and named a "Melamine Blade," or "Melamine Miter Blade," simplifying how the blade is identified. What makes a melamine miter blade suited for its task is a negative hook angle, having a slightly larger than average tooth count, being designed with HiATB cutting teeth, and having a thin kerf.)

But **manufacturers** are **not always** so **specific**, requiring customers to be more familiar with all the ins and outs of standard saw blade design in order to make the best purchases.

This Bosch 10" ATB 5/8" Arbor 40 Tooth Table Saw Blade, for example, is a "general use" blade, but a shopper would have to know that this combination of measurements and features means, "for general use" when translated.

To get started, we discuss basic information about saw blade parts, blade measurements, blade materials, cutting tooth design, and other features. Understanding the effects of these design variations on blade performance and function make it possible to match a blade to a job by these criteria.

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Parts of a Saw Blade

The major parts of a saw blade are:

Cutting Teeth-

The **sharpened edges** of the blade. There are a number of different saw blade tooth designs, including ATB, ATB+R, HiATB, TCG and HR (see below).

Arbor Hole-

The **center hole** of the blade. Although an obvious feature, arbor holes must be very accurately sized and centered on the blade for the blade to perform well. Arbor hole size also plays a role in matching a blade to its work and saw type.

5/8" and 1" are the two most common arbor hole sizes.

Gullet-

These are the cut out swoops in front of each cutting tooth.

- For very fine cutting. Best for applications with softer materials.

ATB+R (Alternating Top Bevel + Ripping)

- A combination design with limited comprehensive performance.

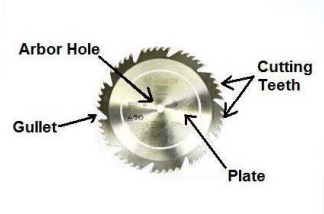
TCG (Triple Chip Grind)

- A very durable design made to tackle the hardest of materials, including metals.

Gullets allow saw dust and chips to be ejected from the blade and cutting area.

Plate-

The plate of a blade includes everything but the teeth of the blade. Quality plate manufacture, and correct plate-width-to-teeth-kerf ratio are important for good blade performance.



Expansion Slots & Holes-

Cuts in the blade that start from the outside edge are called "expansion slots," and they usually include small holes at the end of a curved shape. These **cuts give** the blade a little **room to expand** when heating up during use, **and** they help **dissipate** some of the **heat** in the blade.

Keeping heat down like this helps saw blades cut more efficiently and last longer. Expansion cuts also help **reduce** blade **vibration** a little.

Sometimes the holes at the ends of these cuts are filled with copper plugs. These are for reducing noise while the blade is in use.

Laser Cuts-

Laser cuts are one of the newer features added to saw blades to **reduce vibration**. By making microscopic cuts in the side of the blade, natural tension and rigidity in the blade's material is released.

One of the cool ways to distinguish this design difference is to find an old blade without laser cuts, dangle it between two fingers, and give it a whack your knuckles. An uncut blade with

fingers, and give it a whack your knuckles. An uncut blade with all that tension still in its material will sing a solid tuningfork-like ring when struck. Laser cut blades will make a dull thud, and that's a good thing.

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Saw Blade Measurements

Even minor changes in saw blade measurements will change the nature of the blade's specialty and performance.

Important saw blade measurements:

Number of Teeth-

Each saw blade has a fixed number of teeth, obviously. How densely or not densely packed those teeth are along the circumference of the blade determines some of the blade's characteristics.

How big a blade is (it's diameter) will partially determine the number of teeth. That is to say that blades of larger diameter have more teeth *on average* than smaller blades by virtue of simple physics and statistics, but the number of teeth for a specific blade is a very carefully chosen design feature.

Because of the varying blade sizes, **it's best to think about number of teeth in terms of how closely packed they are**, or #of teeth/inch.

Blades with fewer teeth per inch cut more aggressively, require less power to operate, and generally have a faster feed rate, but they also make rougher cuts. Blades with more teeth per inch than average will make smoother, slower cuts, and also require more horsepower.

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Kerf-

Kerf is the width of the cut that a saw blade makes, the width of its cutting teeth.

The most common kerf is 0.125" (1/8"), because, especially in woodworking, the "round" 1/8" figure makes it easy to adjust measurement lines to account for material loss. Because of this, we refer to 1/8" kerf blades as the average to functionally talk

we refer to 1/8" kerf blades as the average to functionally talk about saw blades.

There are pluses and minuses to thick- and thin-kerfed blades for a given application.

Blades with a **thicker kerf** need **more energy**, and, of course, take **more material** out of the work. But they also are more likely to withstand heat buildup, wear less, resist vibration, and are prone to make cleaner cuts in most materials. Thicker kerfs are typically for slower, more precise cutting.

Thinner kerf blades cut down on how much power is necessary to run a blade, and are generally great for **fast**, **abrasive** ripping **cuts**; however, their thin design makes them more susceptible to heat damage, vibration, and fast wear. Some blades are named and advertised specifically as "thin kerf" blades.

Blades advertised as "thin kerf" blades usually include specific design modifications that attempt to bridge the gap between thin kerf pros and cons, making the thinner blades adaptable to slightly harder materials and heavier workloads.

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Plate Width-

The measurement of a blade's plate width is separate from the kerf width, because the plates of most blades are slightly thinner than the blade's teeth (kerf). The difference between these two widths is called the radial side clearance, allowing material to more easily leave the work area and preventing the blade from binding in its cut.

Plate width is a determining factor for matching a blade to its tool. See a saw's user manual for this and other blade measurement specifications.

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Diameter-

Blade diameter is no mystery, but it is one of the major factors for identifying a compatible blade.

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Hook Angle-

One way or another, the cutting teeth of a saw blade are going to occupy *some* angle in relationship to the rotation of the blade. In other words, the sharp edges of a saw blade are designed to make contact with material at a specific angle for optimum performance, depending on a number of factors.

Hook angle is the angle measurement made between the situation of the blade's cutting teeth and an imaginary line drawn across the diameter of a blade.

Zero Hook Angle is one where the teeth cutting edges exactly line up with the blade's diameter line, and it is the least common.

Positive Hook Angle is one where the angle of the teeth lean toward the rotation on the blade and is the most common.

Negative Hook Angle is where the teeth of the blade are angled to lean away from the rotation of the blade.

This measurement is a little more complicated, but extremely critical. Each style is suited for either a certain type of material, saw, or some combination.

In all cases, the hook angle is designed to keep **put pressure on the work and pin it to the saw**, to prevent material bounce-back, and, in some cases, to prevent tearout.

Positive hook angle blades are generally for circular saws, table saws, and ripping saws. However, negative hook angle blades are sometimes used for cutting melamine on table saws, reducing the risk of chipping and tearout. For saws that use positive hook angle saws, a larger positive hook angle value on a blade means a more aggressive cut.

Negative hook blades are usually for miter saws, radial arm saws and their variations, because their opposing cutting direction requires an inverse angle to pin the work down.

Zero hook blades are most commonly used for metal applications.

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Bevel Angle-

This measurement only applies to blades with some "bevel" style tooth design (ATB, ATB+R, HiATB, etc.). A steeper bevel angle makes for a finer-cutting saw blade, such as in High Alternating Top Bevel (HiATB) blades.

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Saw Blade Materials

Although there are still some steel blades floating around on the market, most saw blades are manufactured today with carbide teeth.

Carbide is an extremely **hard but brittle** material that is actually a powder before it is infused with metals. Manufacturing processes fuse powdered carbide into steel blade teeth for exceptional strength, sharpness, and durability.

Because carbide is very difficult to sharpen, this also means that most blades must be taken to shops for sharpening these days, but those trips should be fewer and farther between.

Saw blade shoppers will no doubt run into the mighty "**Carbide Grade Scal**e" eventually, which can over-complicate itself in a hurry.

For most power tool accessory uses, the carbide scale advances from C1 to C4. This scale ***does not* suggest quality**, but rather, each type of carbide (C1, C2, C3, & C4) is suited for different work.

C1 and C2 carbides are coarser, more impact-resistant than others, but are more susceptible to grinding and friction wear. Because of this, it's most common to see this kind of carbide used in masonry equipment.

C3 and C4 carbides are finer, less impact-resistant, but much more durable against abrasive wear. Look for C3 and C4 carbide in saw blades for the best results.

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Cutting Tooth Style

Cutting tooth style refers to two major things:

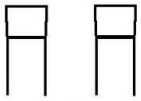
1. The **shapes** of the tops of a blade's cutting teeth (It's best to think of these shapes from a profile view of the blade), and
2. The **pattern** of differently shaped teeth situated along the blade.

Each of the specific designs of cutting tooth shape and orientation explained below is **suited for specific** kinds of **cuts**, **materials**, **and** sometimes, **saws**.

FT (Flat Top)

FT blades are the **fastest and coarsest-cutting** blades, and they are used exclusively for ripping cuts along the grain of the wood.

Flat Top (FT) Saw Tooth Shape and Pattern



Profile View of Teeth

FT blades are also called HR blades, short for "heavy ripping," and FTG blades for "Flat Top Grind."

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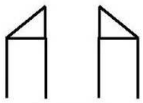
ATB (Alternating Top Bevel)

Alternating top bevel is a saw blade tooth design that alternates opposing bevel-cut teeth along the blade: one tooth's bevel will face one side of the blade plate, and then the next will face the opposite direction, and so on.

Alternating Top Bevel (ATB) Saw Tooth Shape and Pattern



Profile View of Teeth

The bevel design makes **cleaner edges** on the sides of the cut **than FT tooth style** blades. ATB blades are the most common, because their design puts them about in the middle range of suitable cut styles, and material hardness.

ATB blades are better for crosscutting, although they can handle *some* ripping as long as the material is not too thick or hard.

They are great for cutting most natural woods, but they can also cut

through some harder fabricated materials like plywood, particle board, and laminate, if the material is not too thick.

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HiATB (High Alternating Top Bevel)

High Alternating Top Bevel blades are the same as regular ATB blades except for one difference. The bevel angle on HiATB blades is at a sharper angle than the bevel angle of ATB blades.

High Alternating Top Bevel (HiATB) Saw Tooth Shape and Pattern

Profile View of Teeth

This small alteration makes for an **even finer, cleaner cut** in woodworking applications.

HiATB blades also encounter some limitations with this feature, in that that the steepness of the angle makes the cutting edges of the blade teeth much more susceptible to wear. Also, the fineness of the cut will slow down the feeding speeding of the blade, but these are hardly limitations when the delicacy of the blades is required.

HiATB blades are also commonly used for materials that pose a high risk of breakout and chipping like melamine and veneer. It's a good idea to choose HiATB blades made with the finest, C4 grade carbide for the smoothest cuts and better durability.

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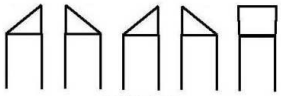
ATB+R (Alternating Top Bevel + Ripping)

Most "Combination" blades are some variation of an ATB+R cutting tooth pattern. The "combination" comes from combining the precision of ATB cutting teeth with an occasional ripping tooth (+R), an FT tooth.

This combination is, most commonly, a series of two pairs of ATB teeth (four teeth total), followed by one FT cutting tooth. Because of this, "Combination" blades are often called "4 & 1" blades as well.

Combination" blades are often called "4 & 1" blades as well.

Alternating Top Bevel + Ripping
Saw Tooth Shapes and Pattern
(Also called "Combination" and "4 & 1")



Profile View of Teeth

ATB+R blades are also manufactured with different tooth pattern variations. ATB+R also usually have larger gullets for ripping, although their ability to rip thicker material is limited.

Although "**all around blades**," "Combination" and other ATB+R blades are versatile-but-limited in each area, because they do not necessarily emphasize any one design feature.

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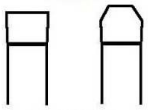
TCG (Triple Chip Grind)

The Triple Chip Grind saw blade design is made **for durability**. They alternate 1:1 between FT teeth and a special "trapeze" style tooth.

Triple Chip Grind (TCG)
Saw Tooth Shape and Pattern



Profile View of Teeth

The trapeze teeth on these blades are slightly raised to allow for cleaner cuts than a simple FT tooth can provide, but their low profile also makes them extremely less vulnerable to wear than, say, ATB teeth.

Because of this combination of durability and finer cutting, TCG blades are designed mainly **for hard materials** like laminates, solid surface, MDF board, plastics, aluminum, acrylic, glued materials, plastics, and other non-ferrous metal cutting. Trying to cut these materials with non-

other non-ferrous metal cutting. Trying to cut these materials with non-TCG blades risks poor cuts and heavy blade wear, unless such blades are specifically designed for some kind of specialty cut on harder material applications.

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Conclusion

Understanding the saw blade measurements and design features discussed in this article is critical when shopping for saw blades.

Each saw blade is designed for a specific kind of use or uses. Blade buyers will get the best work performance and longest life out of their saw blades when they match its features to the material, saw, and type of cut being made.

Visit our Standard Saw Blades page here at eReplacementParts.com to view our large selection of circular saw blades. Blade searches can be narrowed by the measurements and features discussed in this article for convenient matching.

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What we're about.

Saw Blade Types
Circular Saw Blades
Rip Cut
Crosscut
Combination
Thin Kerf
Sheet Goods
Hollow Ground
Dado Joinery
Non-ferrous Metals, Plastics and Glass

Tooth Shapes
FTG
ATB
HiATB
ATBR
TCG

Expansion Slots

An expansion slot is a laser-cut slot on the blade plate designed to disperse heat and prevent blade deformation caused by overheating. The process of cutting, even under ideal circumstances, involves a lot of friction. While the teeth of the blade are removing material, they are also rubbing against the sides of the kerf and the tip of the tooth rubs against the material in the path of the cut. This friction can generate an amazing amount of heat, enough to singe the wood and even warp the saw blade. The saw blade is quite hot even after cutting; you can easily get burned if you just tap it with your hand for a second when trying to unmount it off the circular saw. The best way to avoid burns is to leave blade running for a minute or two after cutting. However, this does not solve the problem with overheating.

High Temperature and Warping

As the temperature of metal increases, it tends to expand, obeying the laws of thermodynamics. However, the temperature of the blade will normally not be consistent across the whole area of the plate, forcing it to expand unevenly. Generally speaking, the plate of the blade gets hotter than the teeth, although the teeth are experiencing the majority of the friction. Even though the teeth have the most friction, they are also are cooled the most by air movement. So, as the plate expands, it needs somewhere to go. Since the outer edge of the plate, where the teeth are attached is not as hot, it isn't expanding as much. Most saw blades have coated teeth, meaning the outer edge is even more solid. That leaves only one direction for the plate to expand, deforming towards the side. This is what causes warping.

Laser-cut Slots

Warped saw blades become garbage, so it is helpful to be able

Saw Blade Parameters
Elements
Teeth Number
Tooth Design
Diameter
Kerf Thickness
Hook Angle
Gullet
Expansion Slots
Rotation Speed
Shoulder
Blade Plate
Coating
Vibrations
Noise
Capacity
Arbor
Feed Rate
Clearance

to prevent them from expanding unevenly, to avoid the risk of warping. One way in which this is done is to use denser alloys in the blade plate. Another is by laser cut slots periodically through the blade plate. Engineers thought of this idea to allow the expansion of the saw blade "inside" itself. Although these slots look like they are done for artistic purposes, they aren't; they are there so that they can absorb the expansion of the metal, preventing blade warping.

Against Vibrations

The blade rotation simultaneously means airflow through the laser-cut plate, which cools it rapidly. That's one benefit of laser-cut slots; they serve as the ventilation slots. If the blade is so hot after you finish the job, imagine what happens during the operation, at the moment when blade slices through the lumber or plastics! These expansion slots also play a part in reducing blade vibration. With many blade designs, the ends of the expansion slots are connected to holes in the center of a saw blade, positioned towards the arbor. These rounded holes are there to reduce vibration. At times, anti-vibration holes are filled with a softer metal, such as copper or brass inserts, which also helps to suppress the vibration of the blade by distributing shock over the entire plate. Such copper plugs inserted at the end of an expansion slot also reduce the noise and help to dissipate heat, extending the life of a saw blade. Vibration is a problem in saw blades, because it, along with warping, are what cause the curved cut marks you see in a freshly cut piece of wood. By reducing vibration and the risk of warping, a blade will run truer, with one tooth faithfully following the path created by the other. That ultimately results in a smoother finish, with less visible tool marking (those curved cut marks).

Heat Cautions

When handling saw blades, especially immediately after cutting, be extremely careful of heat. It is not uncommon for blades to become hot enough to burn your fingers. However, blades which are left running after the cut cook quickly; acting as their own ventilator. The expansion slots help with this, acting much like small fan blades to force the air to move. An ability to resist shocks, lower cooling time, less noise and power consumption are just some of the advantages.

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Concrete Saws & Saw Blades Overview

Concrete Saws & Saw Blades Home

Buyer's guide to concrete saw blades: 8 factors to consider before you buy

Concrete Saw Blade Products

Ultra early-entry concrete saws and diamond blades

Related Information:

Tips for cutting decorative joints in concrete

Concrete saw video demonstrations by Bob Harris

DIAMOND BLADES FOR CUTTING CONCRETE - BUYER'S GUIDE

How to Choose the Right Diamond Saw Blade for Cutting Concrete

By Anne Balogh, ConcreteNetwork.com Columnist

Diamond saw blades are typically the best choice when it comes to making clean, professional cuts in concrete. However, within this category, you'll find myriad blade options at a wide range of price levels. How do you choose the perfect blade for the job at hand?

To achieve optimum cutting performance for your investment, follow these eight steps before you buy a concrete saw.

Step 1: How Do Diamond Blades Work?

Understanding how a diamond blade works will help you choose a blade with the right characteristics and cutting quality for your needs. Here are the four basic blade components:

Procrete Resources, Costa Mesa, CA

- The metal core, a precision-engineered steel disk with a segmented rim that holds the diamonds.
- The synthetic diamond crystals, the sharp cutting teeth that slice through the concrete.
- The matrix, a metal bond that holds the diamond particles in place until they wear away.
- The weld, which attaches the cutting segments to the core (most segments are laser welded or soldered).

The exposed diamonds on the surface of each segment do the cutting, using abrasive action to slice through material as the blade rotates at high speeds. As the diamonds at the surface become dull through use, the matrix begins to shed away to release the worn diamond crystals and expose new, sharp diamonds embedded within the matrix.

The most important fact to know is that the hardness of the matrix controls how quickly a blade wears. Here's the basic rule: A diamond blade used to cut soft, abrasive materials (such as uncured, green

Here's the basic rule: A diamond blade used to cut soft, abrasive materials (such as uncured, green concrete) should have a hard metal bond so the exposed diamonds are fully utilized before they shed away. Conversely, a blade for cutting hard, nonabrasive concrete should have a soft bond to allow for easier erosion of the matrix, which will ensure exposure of new, sharp diamonds when you need them.

Step 2: Cut Concrete with the Right Diamond Blade

For maximum cutting speed and blade life, you should match the blade as closely as possible to the material you're cutting. Characteristics of the concrete you need to know include the compressive strength, the size and hardness of the aggregate, and the type of sand.

Blade manufacturers consider concrete with a compressive strength of 3000 psi or lower a soft material and concrete with a strength above 6000 psi a hard material. Therefore, you should use a blade with a hard bond to cut the lower strength concrete and a blade with a soft bond to cut high psi concrete. Similarly, hard aggregate (such as trap rock, basalt, and quartz) dulls diamond particles quickly, so use a blade with a softer bond to allow new diamonds to be exposed as needed.

The size of the aggregate in concrete primarily affects blade performance. When cutting through larger aggregate (3/4 inch and up), the blade cuts and wears more slowly. Pea gravel (smaller than 3/8 inch) is easier to cut, but the blade will wear faster.

The type of sand determines the abrasiveness of concrete, with sharp sand being the most abrasive and round sand the least. To determine the sharpness of the sand, you need to know where it's from. Crushed or river bank sand is usually sharp while river sand is round and nonabrasive. The more abrasive the sand, the harder the bond requirement.

What if you will be cutting more than one type of concrete? As a general rule, manufacturers recommend choosing the blade based on the material you'll be working with most often or the material for which top blade performance is most important. Most diamond blades can cut a range of materials.

Step 3: Cutting Concrete at the Right Time

If you're placing new concrete, you have the option of cutting control joints while the concrete is still green (about 1 to 2 hours after finishing) or the next day after the concrete has hardened. The timing of the cut will dictate the type of blade you select.

Some decorative concrete contractors prefer to cut concrete while it's still green because it minimizes the occurrence of ugly random cracking (especially in warm weather, when concrete hydrates faster) and permits shallower joint depths of an inch or less. However, green concrete will be softer and more abrasive than the same concrete in a cured state. That's because the sand in the mixture hasn't yet bonded to the mortar and it acts as an abrasive. Blade manufacturers offer hard-bonded diamond blades specifically for cutting green concrete.

Step 4: Wet Cutting Concrete vs. Dry Cutting

Concrete - How to Decide

Diamond Blade Dealer, Staten Island, NY

Often the decision of cutting wet or dry depends on your preference and job requirements. Dry cutting eliminates messy wet slurry and the need to equip saws with water tanks and hoses. Using a blade wet, on the other hand, reduces dust but makes it necessary to contain or clean up the slurry. For indoor jobs where you need to keep the work area dry, a dry-cutting blade and compatible saw may be your only option.

The main difference between wet and dry blades is the weld (as described in Step 1). Dry-cutting blades have segment welds that resist heat and don't require water for cooling. They are usually intended for intermittent cutting and for use on handheld, low-horsepower saws. If you're sawing decorative pattern lines in concrete, dry-cutting blades are often the best choice for making crisp, clean cuts (see Sawing and Patterning). These decorative cuts are typically only 1/16 to 1/4 inch deep and do not function as control joints.

Wet-cutting blades are typically used with walk-behind saws for cutting joints in cured concrete flatwork because water cooling permits deeper cuts. Although it's possible to use most dry-cutting blades with water, never use a wet-cutting blade dry. Always continuously cool the blade with water to avoid segment loss and blade warpage.

Step 5: Concrete Blades Compatibility with Sawcutting Equipment

Soff-Cut International, Inc. in Corona, CA

What type of handheld saw or flat saw are you using? What is the horsepower and operating speed (or rpm)? Blade manufacturers provide charts with recommended operating speeds and maximum safe operating speeds for their blades. You'll also find this information stamped right on the blade itself.

Always match the blade with the speed range of the saw. Operating the blade at a lower speed than recommended can diminish its cutting life and performance. Exceeding the blade's maximum rpm rating can damage the blade and risk injury to the saw operator.

Other factors to consider:

- Blades designed for wet use only must be operated by saws that can deliver a continuous supply of water to cool the blade.
- Most blades for cutting green concrete are designed for use with special early-entry saws that minimize joint raveling and spalling.

minimize joint raveling and spalling.

- Don't use a blade that exceeds the maximum blade diameter and cutting depth capacity of the saw.

Step 6: Concrete Cutting Blades - Performance vs. Cost

Manufacturers typically offer diamond blades at various quality and cost levels, ranging from basic economy to top-of-the-line premium or professional versions. Generally the key difference among these options is the diamond content, which is the greatest raw material cost in manufacturing the blade. Moving up from a standard to a premium blade may boost the cost 20% or more, but you'll get a higher concentration of diamonds and significantly longer blade life.

Basically, you need to decide what's more important: the initial cost of the blade or total sawing cost. For small cutting jobs where you won't be giving the blade much of a workout, you may save money by going with the economy blade. For large jobs or frequent use, a top-quality blade may actually be less expensive in the long run based on a cost-per-cut breakdown.

A premium-quality diamond blade isn't cheap. Expect to pay several hundred dollars or more, depending on the blade diameter. If that's more than you're willing to invest for an occasional cutting job, consider hiring a professional sawing contractor to do the work. To locate a contractor in your area, visit the member directory of the Concrete Sawing & Drilling Association (CSDA).

Alpha Professional Tools ®, Oakland, NJ

Step 7: Diamond Cutting Blades for Decorative Concrete

Want to achieve the look of a decorative hand-tooled joint without all the labor? It's possible by using beveled saw blades with a special cutting edge that produces chamfered or radiused cuts in green concrete. Learn more about the applications of these blades for decorative concrete projects.

Step 8: Concrete Blade Codes from CSDA

If you follow all of the steps, you will be armed with the information necessary to find exactly the type of diamond blade you'll need for your next sawing project. Now it will be easier than ever to identify whether a certain blade meets your requirements thanks to a new blade application code (PDF) developed by CSDA and endorsed by the Masonry and Concrete Saw Manufacturers Institute (SMI).

The code, which is in a three-letter format separated by dashes, will be permanently imprinted on the blade. And it will tell you at a glance whether the blade is for wet or dry use, what type of material it can cut, and the saw type it's designed to work with.

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