April 1, 1969 G. D. SJOSTRAND 3,435,716

APPARATUS AND METHOD FOR CUTTING SHEET MATERIAL

Filed Oct. 4, 1966 Sheet 1 of 2

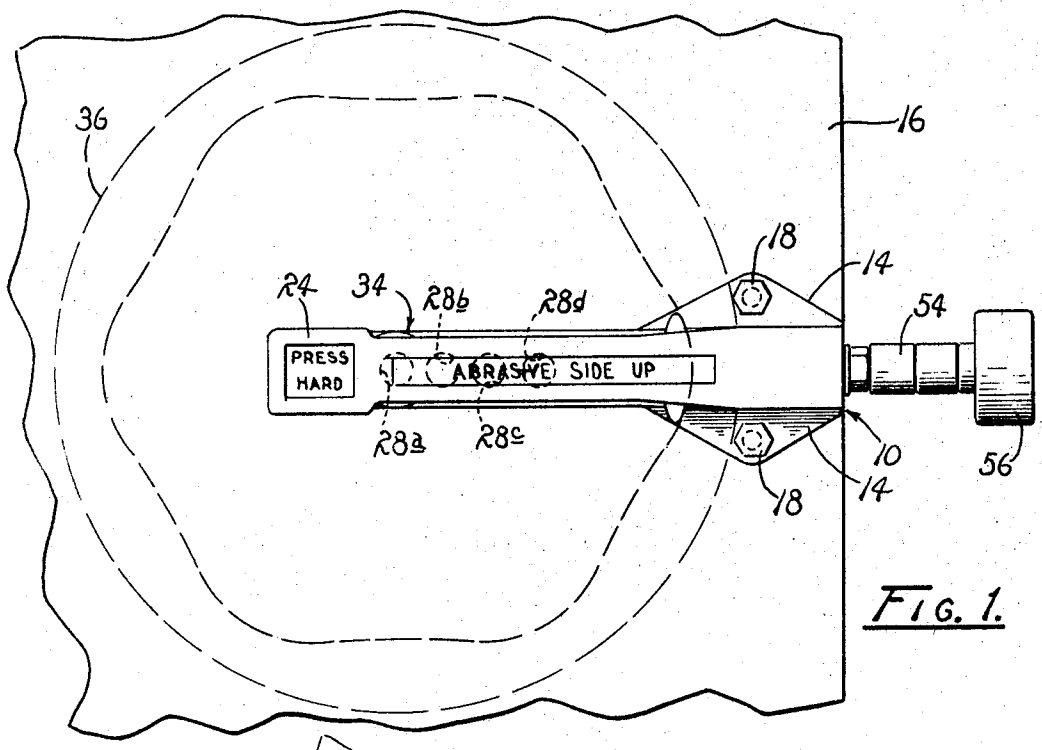


FIG. 1.

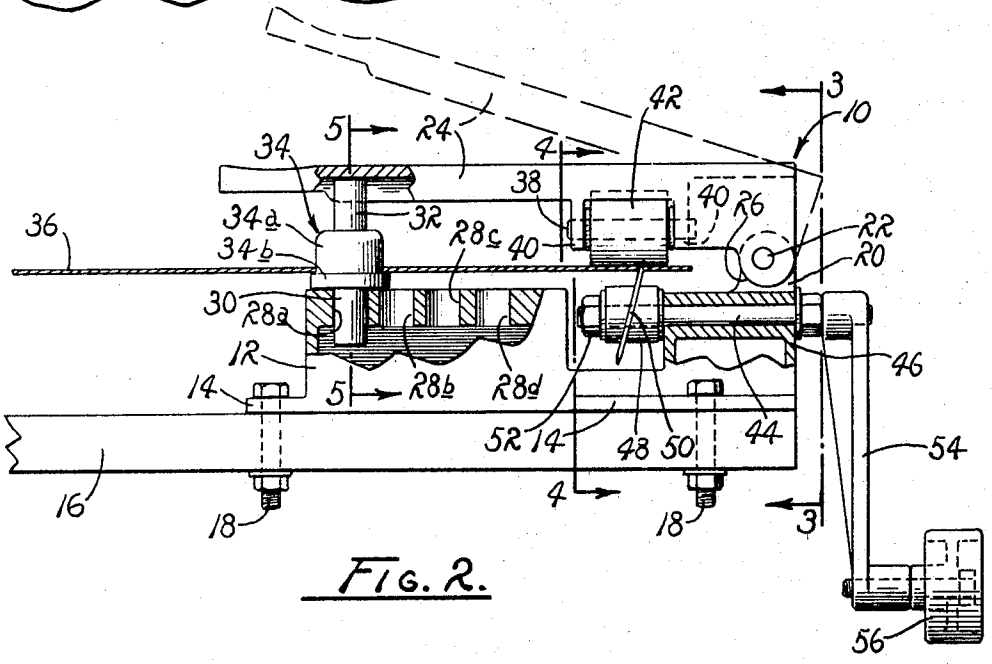


FIG. 2.

INVENTOR
GERALD D. SJOSTRAND
Kuehnen & Worel
ATTORNEYS

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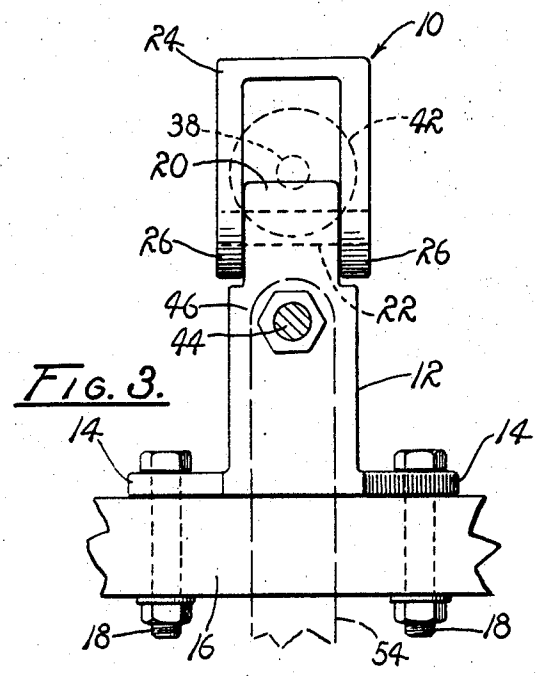


FIG. 3.

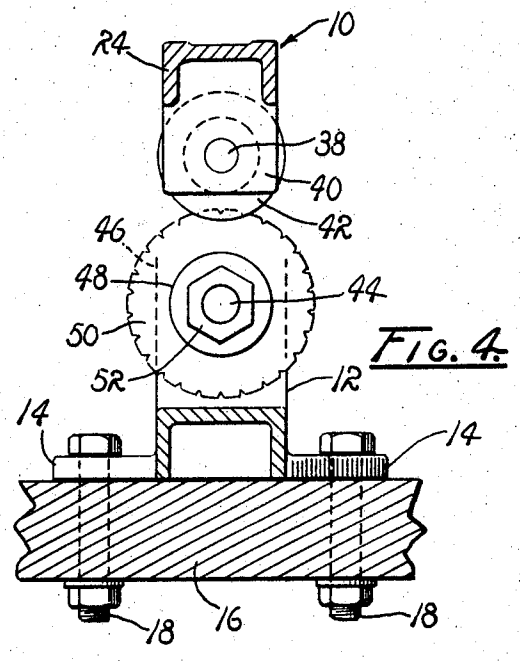


FIG. 4.

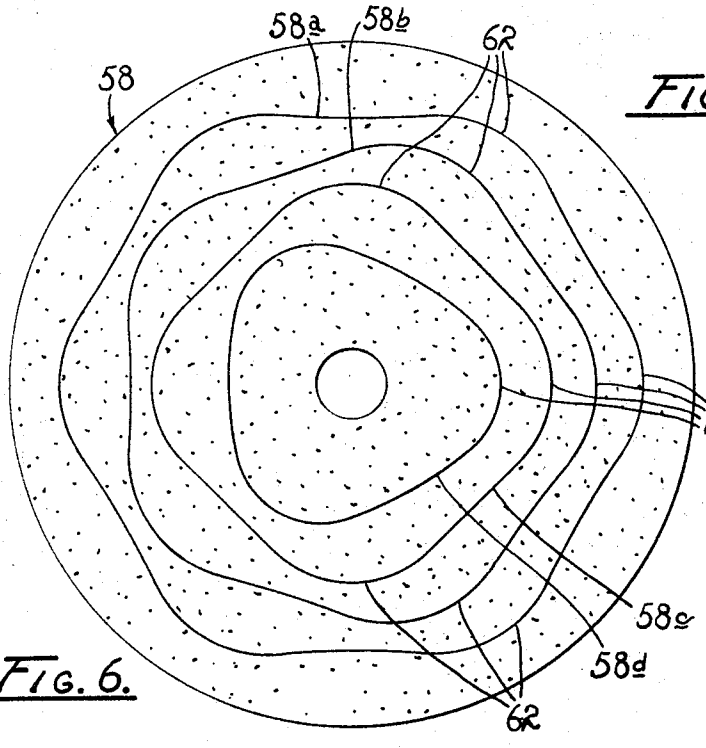


FIG. 6.

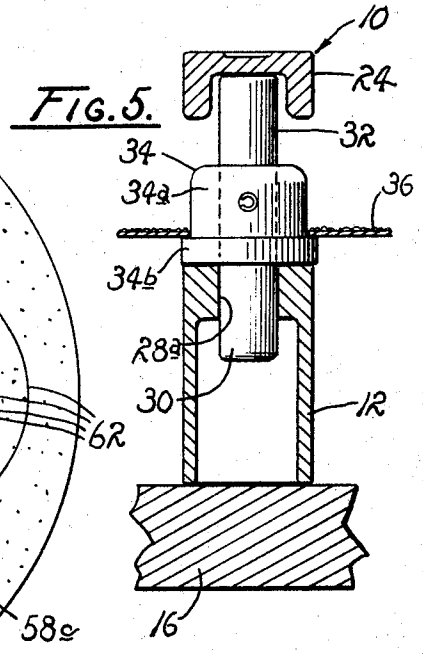


FIG. 5.

INVENTOR
GERALD D. SJOSTRAND
Huebner & Worrel
ATTORNEYS

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APPARATUS AND METHOD FOR CUTTING SHEET MATERIAL

Gerald D. Sjostrand, 5440 E. Lansing Way, Fresno, Calif. 93727

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U.S. Cl. 83—37 14 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for cutting sheet material to provide the same with a generally polygonal configuration including means for mounting sheet material for rotation about an axis and a cutting blade spaced from the mounting means engageable with the sheet material. The blade is mounted for rotation about an axis intersecting the rotational axis of the sheet material and is canted with respect to its own rotational axis and the plane of the sheet material. Rotation of the blade rotates the sheet material and varies the cant of the blade and the spacing of its cutting edge with respect to the rotational axis of the sheet material.

The present invention relates generally to a method and apparatus for cutting sheet material and the like into desired patterns or configurations.

More particularly, the present invention relates to a method and apparatus for trimming discs of material from a circular form into a non-circular peripheral configuration.

More specifically, the present invention relates to trimming of edges of abrasive sanding discs and the like, in order to trim off used edges of the material so as to permit a user of an abrasive disc more fully to utilize the abrasive area of the material of which the disc is made and/or to impart greater periphery flexibility to the disc.

In accomplishing the aforegoing objectives a non-circular substantially symmetrical peripheral edge is provided having a substantially polygonal form, wherein projections or tabs are formed on the periphery of the disc adapted more readily to conform to corners and indentations of areas to be sanded, and which results in a substantial saving of materials comprising the sanding discs.

As is well known in the art, and as is evidenced by U.S. Patent No. 2,066,381, abrasive sanding discs are normally susceptible to the greatest amount of use and wear at the outer edges of the discs, whereas the central portions of the discs remain substantially unimpaired during use.

The present invention is particularly useful in reclaiming abrasive sanding discs where the peripheral edges of the discs have been used and therefore worn beyond further practical usage under conventional practices. The present invention will be described with reference to the trimming of such worn edges from abrasive sanding discs, not only to prolong the practical use of the discs, but also to provide configurations susceptible of improved abrading, smoothing or polishing results particularly with reference to confined areas in the nature of corners, curved surfaces, indentations and the like.

In accordance with the present invention it is a primary object to provide a method and apparatus for cutting or trimming sheet material into desired patterns or configurations, providing an end product having a peripheral edge of non-circular shape.

Another object of the present invention is to provide method and apparatus for trimming sheet material in the

nature of an abrasive sanding disc to remove a used peripheral portion thereof, thereby to make usable inner or central portions of the disc having desirable sanding configuration and characteristics.

An additional object of the invention is to provide an improved method and apparatus which is adapted particularly for use in trimming abrasive sanding discs of various sizes to provide successively smaller sizes suitable for use with small supporting pads, and having non-circular peripheral edges which enhance the sanding characteristics thereof under operating conditions.

A still further object of the present invention is the provision of an improved method and tool useful for the cutting of abrasive sanding discs to a desired size and configuration which is of a simple, sturdy, and economical construction, and adapted for rapid and clean cutting or trimming of sheet material in the nature of abrasive sanding discs with small effort, which not only prolongs the useful life of a portion of a sanding disc but also incorporates therein, subsequent to cutting, an enhanced sanding edge of non-circular configuration.

In accomplishing the objects of the invention, as applied to abrasive sanding discs of initially circular peripheral configuration, the invention provides an abrasive sanding disc of smaller radius, subsequent to cutting or trimming, wherein the periphery is in a substantially polygonal form which provides greater flexibility to the abrasive sanding disc, and permits enhanced usage in confined areas such as corners of articles to be sanded.

It has been found that with a substantially polygonal form, the disc not only provides greater flexibility and conformity to work surfaces, but the disc during operation remains cooler because of resultant air spaces or gaps on the periphery thereof. This is particularly desirable when sanding surfaces containing, for example, acrylic resins, enamels, shellacs and the like which gum up with heat. Less heat is generated and, therefore, the disc is less susceptible of melting and picking up materials from a surface being worked. The disc in operation, performs better and lasts longer. When working bare metal, the cooler operation of the disc results in less warpage of the work material.

Additional objects and advantages of the present invention will be more readily apparent from the following detailed description of a preferred embodiment of apparatus for use in accordance with the present invention, reference being had to the accompanying drawings in which:

FIG. 1 is a plan view of apparatus in accordance with the present invention applicable for trimming of edges of abrasive sanding discs or the like;

FIG. 2 is an elevational view of the apparatus shown in FIG. 1;

FIG. 3 is a fragmentary enlarged sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a fragmentary enlarged sectional view taken on line 4—4 of FIG. 2;

FIG. 5 is a fragmentary enlarged sectional view taken on line 5—5 of FIG. 2; and

FIG. 6 is a schematic plan view of an abrasive sanding disc, showing the peripheral configuration resulting from successive trimming or cutting operations, in use of the present apparatus and method.

A preferred embodiment of the present invention, specifically applicable for cutting or trimming peripheral edges of abrasive sanding discs which is an illustrative use of the present invention and to which the invention is not to be considered as limited, consists of a tool generally designated at **10** including a hollow base portion **12** having attaching ears **14** extending therefrom adapted for mounting the tool on a work support **16** or the like by means of bolts, such as at **18**. An upstanding lug **20** is

provided on the base in proximity to one end thereof, and serves as a bearing block for a shaft **22** which movably mounts a lever arm **24**, in coaction with depending ears **26** having openings therethrough engaged over the ends of shaft **22**. The arm **24** is susceptible of rotational movement about shaft **22**, as will be apparent from the dotted line showing of FIG. 2 of the drawings.

The base **12**, in its upper surface, is provided with a plurality of openings **28***a*, **28***b*, **28***c* and **28***d*. Obviously, a greater or lesser number of openings can be provided depending upon the ultimately desired usage of the tool as will be more apparent from the following description. These openings are adapted to receive a stem **30** of a material positioning holder **32**, and which includes a stepped collar **34** having an upper portion **34***a* adapted for insertion into a hole or opening in material to be cut or trimmed, and a lower material supporting annular portion **34***b* adapted to receive on the upper face thereof, a work piece of sheet material, shown at **36**, which it is desired to cut or trim. The illustrative embodiment of the drawings shows an abrasive sanding disc mounted on the holder **32**, the present invention being particularly adapted for trimming or cutting an edge of such an abrasive sanding disc. A spindle **38** is carried by depending ears or lugs **40** on lever arm **24**. A resilient pressure roller **42** of compressible rubber, plastic or the like is mounted on the shaft **38** and is adapted for applying pressure to the upper surface of the material **36** during a cutting operation, and additionally provides functions in conjunction with a cutting mechanism, to be hereniafter described, which enhances the operation of the cutting or trimming device of the invention.

A spindle **44** is rotatably journaled in an upstanding bearing portion **46** on base **12**, as shown in more detail in FIG. 2, and carries at the end thereof a collar **48**, on which is fixedly positioned and carried a circular serrated cutting disc **50**. The collar, and accordingly the cutting disc, is attached to the spindle by means of a nut **52**, coacting with a screw-threaded end portion of spindle **44**. The cutting disc **50** is mounted with its plane oblique or canted to the axis of spindle **44**, and this obliquity or canting of the cutting disc is established in a predetermined appropriate angular relation to the axis to the spindle in conjunction with appropriate positioning of the openings **28** in base **12** to provide, as will hereinafter be described, a cutting of the rim portion of material such as a disc to produce discs of different effective sizes and configurations, having points or projections on the periphery repetitively and symmetrically formed with respect to the center of the disc or work piece being cut. The angle of the cutting disc can be appropriately adjusted with reference to its axis of rotation either in a fixed manner or, if desirable, by a suitable adjustable mounting means, which in conjunction with the positioning of the stem **30** in one of the openings **28***a*–**28***d* will determine the resultant size and peripheral configuration of the piece being trimmed or cut. The openings **28***a* through **28***d* are positioned in such spaced relation to the disc **50**, that the linear distance on the work piece traversed by the disc during one complete rotation of the work piece is an even multiple of the circumference of the disc. In the embodiment shown, these multiples are six, five, four and three, respectively to cut hexagons, pentagons, squares and triangles with rounded corners.

In operation a work piece **36** is mounted on the stepped collar **34**, and is supported in the desired horizontal plane by means of the annular portion **34***b*, and axially by means of the portion **34***a*. After the positioning of a work piece the lever arm **24** is pressed downwardly into the position shown in full lines in FIG. 2 wherein the stem **30** at its top end provides a stop means for the lever arm **24**. The height of the stem **30** is such that the outer periphery of cutting disc **50**, when the lever arm is downwardly positioned and pressed, penetrates through the material of the work piece, as shown in FIG. 2, and the

edge of the cutting disc indents the resilient material of pressure roller **42**. Coaction between the serrated edge of cutting disc **50** and the resilient material of pressure roller **42** results in a positive angular rotation of the work piece **36** upon rotation of the spindle **44** through the crank **54** and knob **56**, due to the frictional drive engagement between the cutting disc and the pressure roller in conjunction with the serrated edge of the cutting disc penetrating through the work piece **36**. The driven rotation of the cutting disc, in conjunction with the previous selective positioning of the holder **32** in any of the openings **28***a*–**28***d*, provides for an effective cutting radius change of the cutting disc **50** with respect to the work piece so as to symmetrically, repetitively cut or trim the peripheral edge of the work piece, or in the preferred described embodiment an abrasive sanding disc, to form a substantially polygonal peripheral configuration in successive cuts.

Referring to FIG. 6 of the drawings, an abrasive sanding disc of original circular configuration, as well known in the art, is shown at **58**. The arrangement and adjustment of the sanding disc, as determined by the selective positioning of the holder **32** in the openings on the base **12**, results in successive cutting or trimming outlines indicated at **58***a*, **68***b*, **68***c* and **68***d*. The precise configuration of the successive resultant cut or trimmed discs can be varied depending upon the angular disposition of the cutting disc **50** with respect to the spindle **44**, in conjunction with the positioning of stem **30** in one of the openings **28***a*–**28***d*, the number thereof being variable, to give any desired number of cuts and/or resultant discs of a desired configuration. It will be seen that the successive cuts result in polygonal configuration of the remaining disc portion, and in successive cutting steps the number of tabs or projections **62** on the resultant disc decreases in number with the final disc, as shown at **58***d*, nearing a circular configuration, with three lobes or projections as compared with the six lobes or projections in the first resultant disc following a first trimming or cutting operation. As pointed out hereinabove, the specific size and configuration will vary dependent upon the angular positioning of the cutting disc and the positioning of the supporting stem in base **12**.

Heretofore, as shown in the aforementioned Patent No. 2,066,381, devices have been provided for cutting circular discs. The present invention is particularly directed to mechanism and an arrangement for providing a symmetrical non-circular resultant disc, in the nature of abrasive sanding discs, of different sizes and peripheral configurations but having generally repetitive patterns.

Variables in the resultant disc cut, when practicing the present invention, are introduced by the effective radius of the holder stem **30** with respect to the cutting disc **50**, in conjunction with the radius and angular disposition of the cutting disc with respect to its axis of rotation. Indentation of the cutting disc edge into the resilient pressure roller **42** is considered highly desirable in order to effect a positive turning and cutting of the material of the sheet. If, however, penetration of the cutting disc edge into the roller is too deep it tends to break the abrasive. This likewise tends to force the abrasive disc back and forth, and can result in a non-symmetrical and undesirable peripheral configuration. The resilient material of the roller facilitates a constant feed of the material or disc to be cut, in conjunction with a positive feed resulting from the serrated blade edge coacting with the resilient roller. The use of the resilient roller decreases wear of the cutting disc, and the resiliency of the roller accommodates effective radius changes due to the angular disposition or cant of the cutting disc. It has been found in practice that the angular off-set or cant of the cutting disc with respect to its axis of rotation should be not less than 76° since otherwise the above aforementioned drawbacks are likely to ensue. In other words, the cutting disc should not be dis-

placed from a plane normal to its axis of rotation more than 14°.

The resulting cut disc polygonal peripheral configuration has been found to provide greater flexibility in an abrasive sanding disc, which facilitates use in removing surface coatings or the like from structural elements by enhancing applicability of the corners thereof in close work areas or at corners or indentations of the elements.

While the present invention has been particularly described with reference to the cutting or trimming of an abrasive sanding disc, to which the present invention is particularly adapted, it will be obvious that the apparatus and method of the invention have broader applicability in the trimming or cutting of edges of any configuration of sheet material, with a great range of variance in size and peripheral configuration of the resultant cut or trimmed piece of material. The application to abrasive sanding discs is illustrative only, as showing use of the invention in a particularly desirable application.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A method of trimming a substantially planar piece of sheet material comprising mounting the sheet of material for rotation about an axis spaced a predetermined distance from a cutting edge cantable with respect to the plane of the sheet material, engaging the sheet material with the cutting edge, and rotating the sheet material while simultaneously varying the cant of the cutting edge for varying the spacing of the cutting edge with respect to the axis of rotation of the sheet material.

2. The method of claim **1** in which the cutting edge is defined by a substantially circular blade mounted for rotation about an axis and lying generally in a plane canted with respect to its rotational axis.

3. The method of claim **2** in which the blade rotates a substantially whole number of times during one rotation of the sheet for providing the sheet with a substantially polygonal peripheral configuration.

4. The method of claim **2** in which the plane of the blade is progressively canted back and forth between extreme positions of cant.

5. The method of claim **1** in which the cant of the cutting edge is progressively repetitively increased and decreased between extreme positions for cutting the sheet along paths of curvature having varying radii.

6. An apparatus for cutting an edge of sheet material into a generally polygonal configuration comprising rotatable sheet material support means; cantable cutting means spaced from the support means; and means for varying the cant of the cutting means and its spacing with respect to the support means, while rotating the sheet material, for cutting the peripheral portion of the sheet material to provide the same with a generally polygonal configuration.

7. The apparatus of claim **6** in which the cutting means is a blade rotatable about an axis of rotation and lying in a plane canted with respect to its rotational axis.

8. An apparatus for cutting an edge of sheet material into a generally circular configuration comprising rotatable sheet material support means, rotatable material cutting means spaced from the material support means, means movably mounted above the sheet material and the cutting means including a resilient pressure roller adapted for coaction with the cutting means to provide positive rotation of the sheet material upon rotation of said cutting means and interengagement thereof with and through sheet material positioned between said cutting means and said resilient roller, said cutting means being a disc, the plane of said disc being canted with respect to its axis of rotation whereby the material is cut along a line substantially symmetrical with respect to the center of the material, but along a noncircular path, to provide a substantially polygonal peripheral outline to the sheet material.

9. Apparatus as claimed in claim **8**, wherein said disc has a serrated cutting edge thereon for positive intercoaction with said resilient pressure roller, when penetrated through the sheet material, to afford positive drive means for the sheet material.

10. Apparatus as claimed in claim **9**, said sheet material support means comprising a base member having a plurality of openings therein, and a rotatable stepped collar being positionally mountable in said openings for varying the effective cutting radius of said disc with respect to the center of said sheet material.

11. Apparatus as claimed in claim **10**, said disc being adjustably mounted for varying the canted position thereof with respect to its axis of rotation to thereby vary the geometrical path of cut effected by said disc with respect to the sheet material.

12. Apparatus as claimed in claim **11**, a pivotally mounted lever positioned above said base and said cutting disc, said resilient pressure roller being rotatably journaled in said lever arm, said lever arm being angularly movable to increase or decrease coacting pressure between said pressure roller and said cutting disc.

13. Apparatus as claimed in claim **12**, said material support means including an upper end adapted for limiting movement of said lever arm toward said base, and the disc support thereon, to limit penetration of said disc through said material and penetration of the edge of said disc into the material of said resilient roller.

14. An apparatus for cutting sheet material comprising a base, a substantially circular cutting disc mounted on the base for rotation about a predetermined axis and in a plane canted with respect to said axis, means mounted in the frame substantially in alignment with the axis of rotation of the disc adapted to mount sheet material thereon for rotation thereabout in a plane substantially tangential to the disc, said disc and mounting means being relatively adjustably positionable in the frame in increments substantially equal to multiples of the radius of the disc, means positionable to urge the sheet material into cutting engagement with the disc, and means for rotating thed isc in driving cutting engagement with the sheet material whereby said sheet material is cut along an oscillating path substantially symmetrical to the sheet material mounting means.

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JAMES M. MEISTER, *Primary Examiner.*

U.S. Cl. X.R.

83—333, 411, 430, 505, 564