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Hutchins

[11] **3,827,194**

[45] ***Aug. 6, 1974**

[54] **PIERCING OF SUCTION HOLES IN SANDING DISCS**

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[*] Notice: The portion of the term of this patent subsequent to Jan. 29, 1990, has been disclaimed.

[22] Filed: **Aug. 21, 1972**

[21] Appl. No.: **282,348**

[52] **U.S. Cl.** ..... **51/170 MT,** 51/275, 51/356

[51] **Int. Cl.** **B24b 23/00**

[58] **Field of Search** ..... 30/358, 360, 366; 51/170 R, 170 PT, 170 T, 170 TL, 170 EB, 170 MT, 262 R, 273, 275, 356

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Assistant Examiner—Mark S. Bicks
Attorney, Agent, or Firm—William P. Green

[57] **ABSTRACT**

A sanding tool having a power driven circular backing structure or carrier for driving a circular sanding disc, with the backing structure containing openings through which air and abraded particles can be drawn by suction from a work surface to a collection location, and with a piercing tool being provided and adapted to be positioned opposite the backing structure in a predetermined located relation with respect thereto and to pierce apertures in the sanding disc communicating with the openings in the backing structure.

12 Claims, 9 Drawing Figures

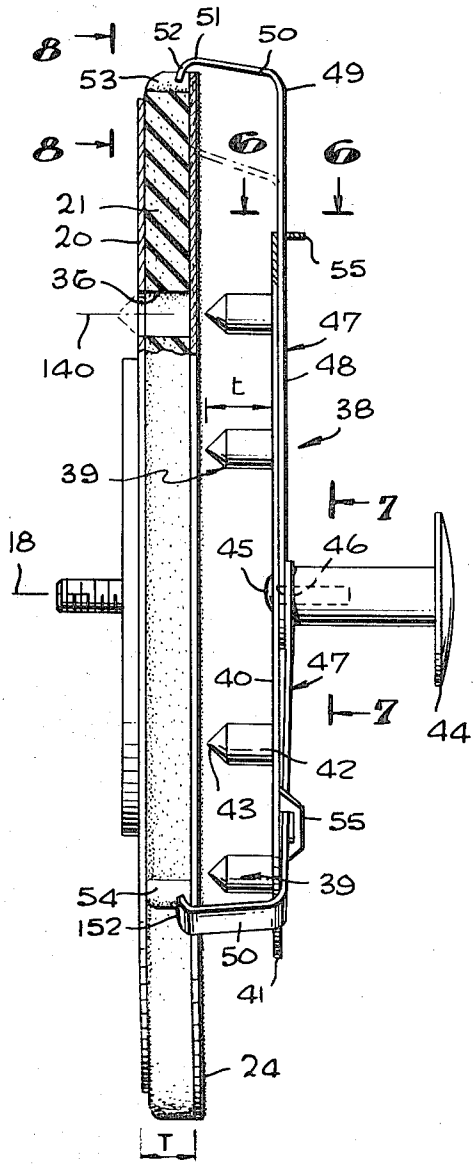
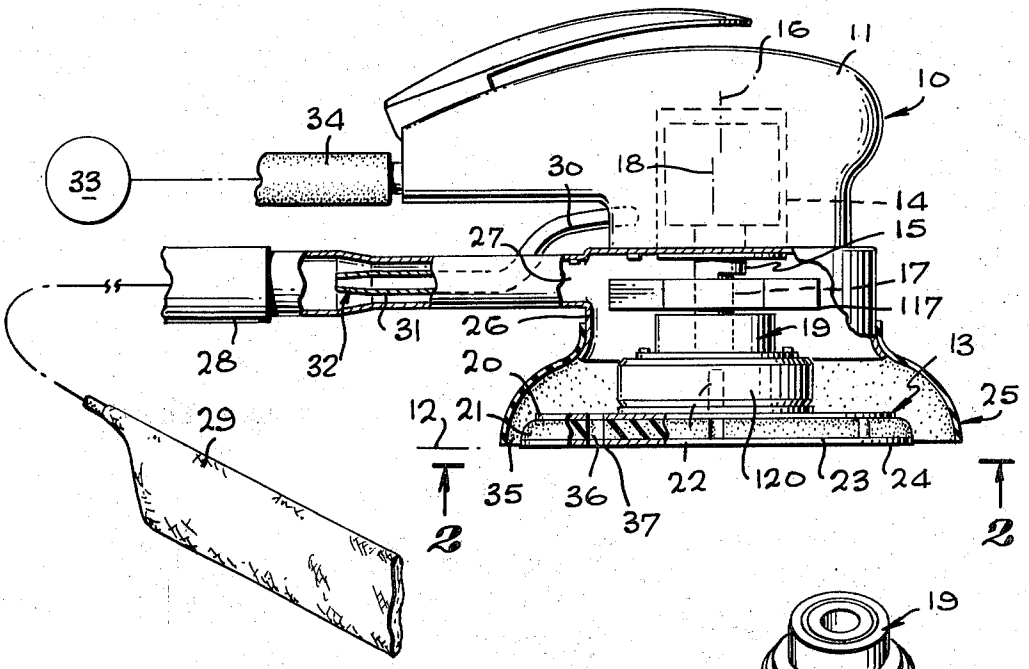


Fig. 1



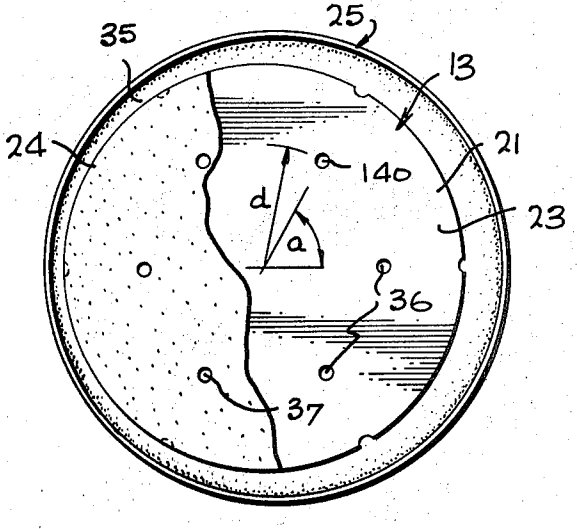


Fig. 2

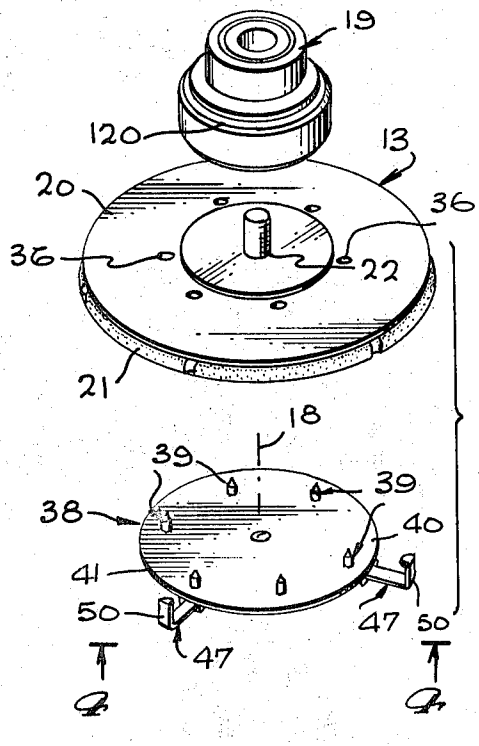


Fig. 3

Fig. 2

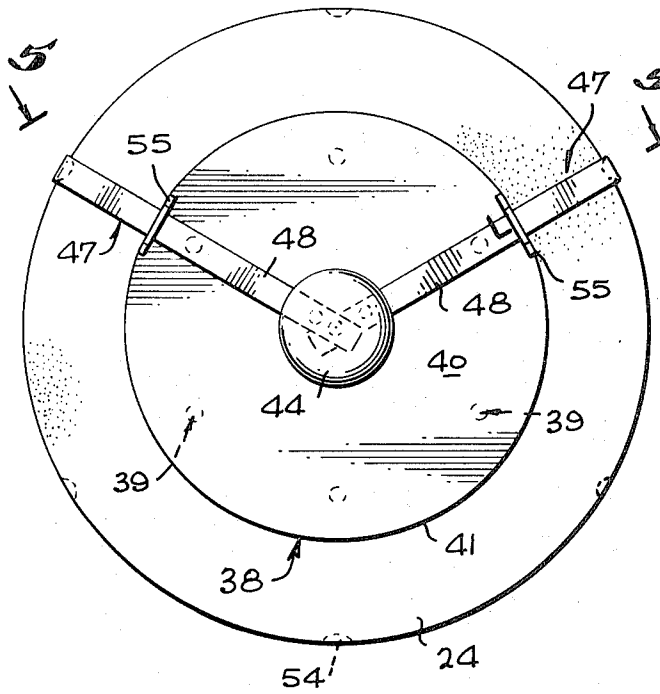
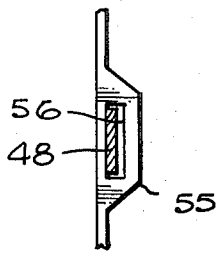


Fig. 6



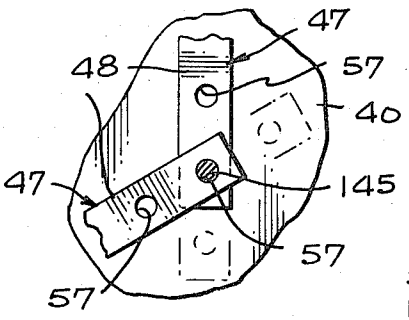
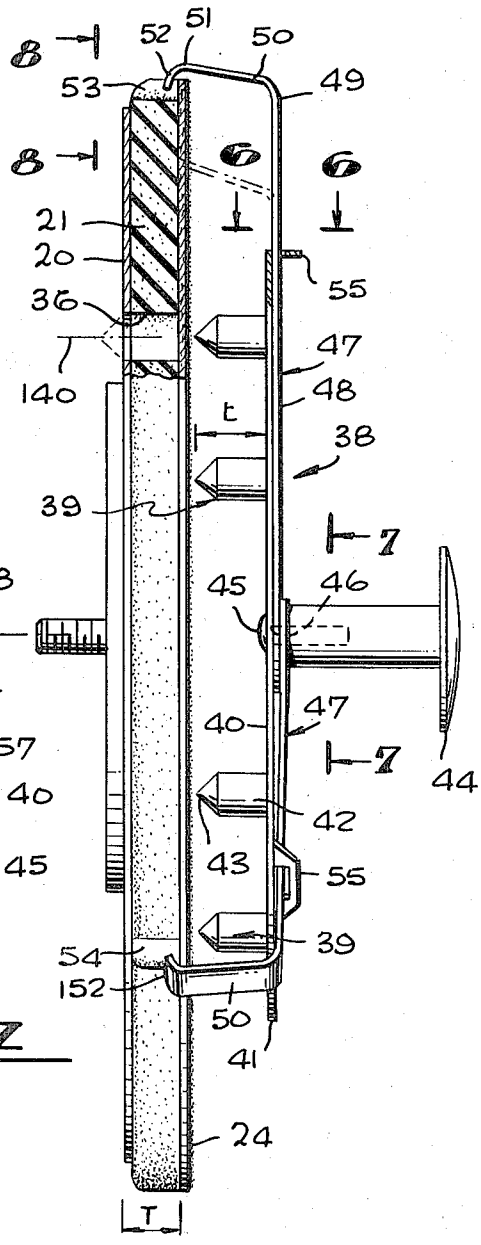


Fig. 7

Fig. 5



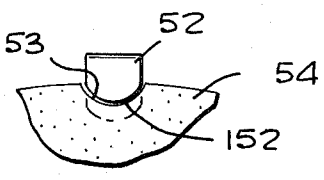


Fig. 8

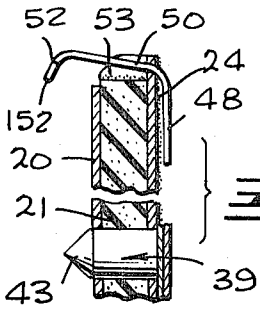


Fig. 9

PIERCING OF SUCTION HOLES IN SANDING DISCS

CROSS REFERENCE TO RELATED APPLICATION

Certain features of the apparatus and methods of the present application have been disclosed and claimed in my copending applications Ser. No. 213,018 filed Dec. 28, 1971 on "Abrading Tool Having Suction System for Collecting Abraded Particles," now U.S. Pat. No. 3,785,092, and Ser. No. 282,155 filed Aug. 21, 1972 on "Piercing of Air Suction Holes in Abrasive Sheet Material", now U.S. Pat. No. 3,788,011.

BACKGROUND OF THE INVENTION

This invention relates to portable power driven tools for abrading a work surface, such as for example powered sanding tools or the like.

My copending application Ser. No. 213,018 discloses certain unique sander type tools in which an air suction system is provided for drawing air and abraded particles from the work surface being treated, and delivering those particles to a collection bag, in order to prevent escape of the produced dust into the atmosphere. Preferably, the power driven carrier or backing structure of the tool which carries and drives the sandpaper or other abrasive sheet material is formed to contain openings through which some of the suction air is drawn, with the abrasive sheet itself also desirably containing suction openings registering with those in the power driven structure.

The second of my above mentioned applications, Ser. No. **282,155,** discloses apparatus and methods for forming such air suction apertures in a sheet of abrasive material, by means of a piercing tool which can be aligned with the power driven element which carries the abrasive sheet and will form the desired apertures after application of the abrasive sheet to that power driven element and in accurate registry with the apertures in the power driven element itself. The particular piercing tool there disclosed is best adapted for forming apertures in an abrasive sheet carried by a rectangular type sanding shoe, which may be driven either reciprocally along a straight line, or orbitally.

SUMMARY OF THE INVENTION

The present invention relates to the provision of additional piercing apparatus and methods, which fall within the scope of the broad generic invention of my above discussed prior application Ser. No. 282,155, but which also incorporate certain additional features not disclosed in my prior application, and particularly adapting the present apparatus for piercing holes in circular type abrasive sheets. As will apear, the piercing tool and a sander carrying such an abrasive disc may have coacting locating means adapted to interengage in a relation effectively positioning the piercing tool directly opposite a circular backing structure carrying the disc in precisely the right orientation for producing properly located apertures in the abrasive disc upon actuation of the piercing tool. The latter preferably has a number of projections arranged in a pattern corresponding to the pattern of apertures in the circular backing structure, and the locating means when properly engaged will position these apertures directly axially opposite the openings in the backing structure, so

that when the projections and backing structure are relatively moved toward one another the projections will pierce the desired apertures in the abrasive disc at precisely the locations of the openings in the backing structure.

The locating means may include an element or elements projecting from the piercing tool and engageable with coacting means preferably formed on the periphery of the circular backing structure. More particularly, the backing structure may contain a number of circularly spaced notches, into which locating elements carried by the piercing tool are received in a proper relative orientation of the parts. Also, to maximize the versatility of the apparatus, the locating elements or means may be adjustable generally radially relative to the remainder of the piercing tool, in a manner enabling adjustment of the tool to fit and coact with backing elements of two or more different sizes.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features and objects of the invention will be better understood from the following detailed description of the typical dembodiment illustrated in the accompanying drawings, in which:

FIG. **1** is a side view of a sanding tool embodying the invention, with the tool partially broken away to illustrate its interior parts;

FIG. **2** is an enlarged bottom view taken on line **2—2** of FIG. **1**;

FIG. **3** is an exploded perspective view showing the circular backing structure of the sanding tool, and showing also the piercing tool;

FIG. **4** is a view of the piercing tool and the backing structure of the sander taken on line **4—4** of FIG. **3**;

FIG. **5** is partially sectional and partially elevational view taken on line **5—5** of FIG. **4**;

FIGS. **6** and **7** are sections taken on lines **6—6** and **7—7** of FIG. **5**;

FIG. **8** is a fragmentary view taken on line **8—8** of FIG. **5**; and

FIG. **9** corresponds to a portion of FIG. **5,** with the piercing tool shown in its fully interfitting piercing engagement with the sander.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** shows a powered portable sanding tool **10** having a handle body **11** by which the tool is manipulated to perform a sanding operation on a typically horizontal work surface represented at **12.** The sandpaper carrying and backing unit **13** of the tool is essentially circular (see FIG. **2**), and is driven by a motor **14** contained within handle body **11.** Backing unit **13** may be driven either orbitally about the motor axis **16,** or rotatively about that axis, with the former type drive being typically illustrated in FIG. **1.** More specifically, in the illustrated arrangement, the driven shaft **15** of the motor is power rotated about the vertical axis **16,** and has an eccentric portion **17** turning about an axis **18** parallel to but offset from axis **16.** This eccentric portion **17** of shaft **15** is connected to and drives the inner race of a ball bearing assembly **19,** whose outer race is connected to and drives a head **120,** which therefore oscillates orbitally about axis **16** upon energization of the motor. Portion **17** of the shaft may also carry and drive a counterweight **117** shaped to counterbalance

the eccentricity of the unit **13** and its mounting parts.

Unit **13** includes a circular rigid backing plate **20,** to the front of which there is cemented or otherwise mounted a circular cushion **21** formed of rubber or other preferably elastomeric material, with both of these elements being centered about the orbiting axis **18,** and with the unit **13** being rigidly connected to and driven by element **20** through an externally threaded stud or screw **22** which projects rearwardly from plate **20** along axis **18** and is rigidly attached thereto. The undersurface **23** of cushion **21** lies generally within a plane disposed transversely of axis **18,** though this front face **23** may have small irregularities (not shown). Against the front face **23** of cushion **21,** there is provided a circular disc of sandpaper or other abrasive material **24,** also centered about axis **18,** and which may be detachably secured to the cushion in any convenient manner, as by an appropriate pressure sensitive adhesive substance.

The body **11** of the tool may carry a preferably circular and preferably slightly deformable shroud **25,** secured to and projecting downwardly from a cylindrical skirt **26** attached to body **11,** to provide an enclosure within which a suction is created for drawing abraded particles from the work surface through a tube **27** and hose **28** to a collection bag or other collection container. This flow of air may be created in any convenient manner, but is optimally developed by an aspirator action, produced by the emission of a primary flow of air through an inner tube **31** of an aspirator **32** into the surrounding outer tube **27** at **32,** to draw air through that tube **27** and to bag **29** by aspirator action. The primary flow of air in tube **31** may come from motor **14,** which in the presently preferred form of the invention is a rotary pneumatically driven motor receiving compressed air from a source **33** through a hose **34,** and discharging the air still under pressure from the exhaust side of the motor through a line **30** leading into the mentioned tube **31.** The rate of flow of this air is sufficiently great to draw air and abraded particles rapidly upwardly from the work surface **12** within shroud **25** and into tube **27** for delivery with the primary air stream to bag **29.**

Some of this suction air moves upwardly from the work surface through a space **35** radially between backing unit **13** and shroud **25.** Additional suction air moves upwardly through a series of circularly spaced apertures **36** extending axially through both the cushion **21** and backing plate **20** of circular unit **13.** To pass this air into passages **36,** the abrasive sheet **24** itself contains apertures **37** which are axially opposite and register with openings **36.**

For forming these apertures **37** in the sandpaper disc **24,** I provide a piercing tool **38** (FIGS. **3** and **4**), having a number of projections **39** which are arranged in a pattern corresponding to the pattern of openings **36** in unit **13,** so that when this piercing tool is properly positioned opposite unit **13** it can pierce holes in an initially imperforate disc of sandpaper at exactly the locations of the openings **36.** More particularly, as seen best in FIG. **2,** the openings **36** are desirably all located a common distance *d* from the axis **18** about which the circular unit **13** is centered. Also, all of the pairs of successive openings **36** are desirably spaced apart the same angular distance *a*, typically **60** degrees as shown, to desirably provide six evenly circularly spaced openings. These openings may be located approximately mid-day between axis **18** and the periphery of backing unit **13,** and may be shaped cylindrically about individual axes **140** extending parallel to axis **18.**

Piercing tool **38** may include a main rigid body or plate **40,** desirably formed of a suitable rigid metal such as steel, and which is preferably planar, and in the position of FIGS. **3, 4,** and **5** is disposed transversely of axis **18.** This plate may be circular, having a peripheral circular edge **41** centered about axis **18** and of a diameter smaller than the diameter of backing unit **13.** The six projections **39** are rigidly carried by plate **40** and extend along the previously mentioned individual axes **140,** and may be all identical, having first externally cylindrical portions **42** adjacent plate **40,** and pointed conically tapering extremities **43** for punching through the sandpaper. The axial lengths *t* of these projections **39** may correspond approximately to or be slightly greater than the axial thickness of unit **13** at the locations of openings **36.** The piercing tool may be manipulated by a handle knob **44** carried at the outer side of plate **40** and secured thereto by a screw **45** extending through an opening **46** in plate **40** for threaded connection into the handle.

The locating means for properly positioning the piercing tool preferably include two identical locating elements **47,** which are mounted to plate **40** at circularly spaced locations for engagement with the periphery of unit **13** at those two locations. Each of the locating elements **47** may be formed of an elongated strip of flat metal or other suitable material, which is essentially stiff and rigid to maintain the shape illustrated in the figures, but may be very slightly resiliently deflectible during positioning of the piercing tool in engagement with unit **13.** For this purpose, elements **47** may be formed of a very stiff spring steel.

As seen best in FIG. **5,** each of the elements **47** has a radially extending portion **48** located at and extending along the outer side of plate **40,** and projecting from the center of plate **40** to a location **49** generally opposite the periphery of unit **13.** From this location, each element **49** is bent to extend generally axially at **50,** but desirably at a slightly outwardly flaring angle as seen in FIG. **5,** to a location **51,** at which the extremity of element **47,** is turned generally radially inwardly at **52** to form a locating finger. The radially inner edge **152** of this finger may have the rounded configuration illustrated in FIG. **8,** corresponding to the shape of a series of axial grooves **53** formed in the generally axial cylindrical peripheral surface **54** of cushion **21.** These grooves **53** are formed at equally circularly spaced locations about axis **18,** desirably directly radially opposite the various corresponding openings **36.** The two elements **47** are so located as to properly position all of the projections **39** directly axially opposite corresponding openings **36** of unit **13** when the two elements **47** are received in any selected pair of the notches **53.** As seen in FIG. **4,** the elements **47** are desirably spaced apart circularly a distance of 120°, i.e. a distance twice as great as the spacing between successive ones of the grooves **53** and openings **36.**

Elements **47** are mounted to plate **40** for radial adjusting movement relative to plate **40,** so that fingers **52** may be properly positioned for engaging the peripheries of two or more different conventional sizes of backing units **13.** For this purpose, the periphery of plate **40** may form two axially turned ears or lugs **55,** containing

guide openings **56** shaped to slidably receive radial portions **48** of elements **47**, and to thereby guide elements **47** for only radial adjusting movement between the full line and broken line positions of FIGS. **5** and **7**. Near its inner extremity, each of the elements **47** may contain two or more radially spaced openings **57**, dimensioned to exactly receive and be accurately located by the shank **145** of screw **45**, and spaced apart to enable adjustment of element **47** by positioning of the shank of screw **45** within whichever of the two apertures **57** is desired. The spacing of these apertures is predetermined to accurately locate fingers **52** at the proper radii for engagement with the two or more selected known diameters of heads **13**.

To describe the manner of use of the illustrated equipment, assume that an initially imperforate disc of sandpaper **23** has been adhered to the forward face **23** of circular backing unit **13**, as illustrated in FIG. **5**. The operator then grasps handle **44** of piercing tool **38** with one hand, while holding the sander with the other hand, and moves the piercing tool to the position illustrated in FIGS. **4** and **5** directly axially opposite unit **13** and the sandpaper. In this position, plate **40** of the piercing tool is parallel to the sandpaper and to unit **13**, and perpendicular to axis **18**. The fingers **52** of the two locating elements **47** are moved behind the circular peripheral edge **59** of the sandpaper disc **24**, which edge may project as far out as the peripheral edge surface **54** of cushion **21**. After the fingers **52** have been moved to this position behind the plane of the sandpaper disc, the piercing tool is so held as to maintain fingers **52** in contact with the periphery of the cushion **21** while the operator turns the piercing tool **38** about axis **18** until he feels the fingers **52** fall into and engage two of the notches **53**. When this occurs, the piercing tool is in proper orientation to locate the various projections **39** directly axially opposite openings **36** in the circular unit **13**, so that the operator may then merely press the piercing tool leftwardly in FIG. **5** relative to unit **13**, to punch holes in the sandpaper as shown at **37** in FIG. **1**. That is, the piercing tool is moved from the full line position of FIG. **5** to the position shown in broken lines in that Figure, and shown fragmentarily in FIG. **9**, while maintaining fingers **52** at the locations of the contacted grooves. As stated previously, the positioning of the grooves and fingers is such that the piercing projections are properly located so long as fingers **52** are received within any two of the grooves spaced **120** degrees apart. The piercing tool is then withdrawn, and the sander is placed in operation as shown in FIG. **1** to sand the surface **12**, with air being admitted to motor **14** by actuation of a control handle **60**, and with the previously described aspirator induced flow of suction air moving upwardly through openings **36** and **37**, and through the peripheral space **35**, for delivery of abraded dust particles to collection bag **29**.

If it is desired to utilize the piercing tool with a sander having a smaller diameter head **13**, the elements **47** are adjusted to the broken line positions of FIGS. **5** and **7** so that fingers **47** will properly engage grooves such as those shown at **53** in the reduced size head.

While a certain specific embodiment of the present invention has been disclosed as typical, the invention is of course not limited to this particular form, but rather is applicable broadly to all such variations as fall within the scope of the appended claims.

I claim:

1. The combination comprising:
a portable sander including
a body,
an essentially circular backing structure which is power driven relative to the body and adapted to carry an essentially circular sheet of abrasive material for abrading a work surface, said backing structure containing suction openings opposite said abrasive sheet, and
suction means for drawing air and abraded particles from the work surface through said openings; and
a piercing tool having projections constructed to form openings in an essentially circular abrasive sheet carried by said essentially circular backing structure upon relative movement of the backing structure and projections toward one another,
said projections being arranged in a predetermined pattern forming openings in the abrasive sheet at locations opposite and in communication with said openings in the backing structure.

2. The combination as recited in claim **1**, in which said piercing tool has locating means engageable with said sander in a relation locating said projections opposite said openings in the backing structure as it and the projections are moved relatively toward one another to assure formation of the openings in the abrasive sheet in registry with said openings in the backing structure.

3. The combination as recited in claim **1**, in which said essentially circular backing structure has locating means near its periphery engageable by said piercing tool in a relation locating said projections opposite said openings in the backing structure as the latter and said projections are moved relatively toward one another.

4. The combination as recited in claim **1**, in which said piercing tool has locating means engageable with the periphery of said essentially circular backing structure in a relation locating said projections opposite said openings in the backing structure as the latter and the projections are moved relatively toward one another.

5. The combination as recited in claim **1**, in which said backing structure has an essentially circular peripheral edge portion with locating irregularities at predetermined circularly spaced locations along said edge, said piercing tool having circularly spaced locating elements interfitting with said irregularities in a relation locating said projections opposite said openings in the backing structure as the backing structure and the projections are moved relatively toward one another to assure formation of the openings in the abrasive sheet in registry with said openings in the backing structure.

6. The combination as recited in claim **5**, in which said irregularities are notches formed in said peripheral edge of the backing structure, and said locating elements of the piercing tool are receivable in locating relation within said notches.

7. The combination as recited in claim **1**, in which said piercing tool includes a first section carrying said projections, a locating element carried by said first section and engageable with said backing structure near its periphery in a relation locating said projections opposite said openings in the backing structure to assure formation of the openings in the abrasive sheet in registry with said openings in the backing structure, and means attaching said locating element to said first section for radial adjusting movement relative to the first section

between a plurality of different positions for engaging backing structures of different diameters in locating relation.

8. The combination as recited in claim **7**, in which said last mentioned attaching means include a guide element carried by said first section and guiding said element at a first location for radial adjusting movement, and a fastener for connecting said locating element at a second location to said first section and selectively connectible into different openings in said element to effect said radial adjustment.

9. The combination as recited in claim **1**, in which said piercing tool includes an essentially flat plate receivable opposite said backing structure and carrying said projections at circularly spaced locations, and two locating elements projecting from said plate at circularly spaced locations and projecting axially to positions for engaging said backing structure near its periphery at circularly spaced locations in a relation locating said projections opposite said openings in the backing structure.

10. The combination as recited in claim **9**, in which said backing structure has an essentially circular peripheral edge containing circularly spaced notches receiving said locating elements in locating relation.

11. The combination as recited in claim **10**, including means mounting said locating elements for essentially radial adjusting movement to coact with backing structures of different diameters.

12. The combination as recited in claim **11**, in which said mounting means including two guide elements carried by said plate at circularly spaced locations and guiding said elements at said locations for only radial adjusting movement, and a fastener at essentially the center of said plate selectively receivable in different apertures in said locating elements to retain said elements in different radially adjusted positions, there being a handle connected to said fastener for manipulating said piercing tool.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,827,194

DATED : August 6, 1974

INVENTOR(S) : Mr. Alma A. Hutchins

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the terminal disclaimer "Notice" near the top of the first page of the patent, the date beyond which the term of the patent has been disclaimed should be January 29, 1991.

Signed and Sealed this

Eighth Day of March 1977

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks