

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

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[51] Int. Cl. **B23p 9/00**

[58] Field of Search 29/432, 445, 163.5; 51/170 R, 270, 273, 275; 93/1.1, 1 A, 1 D, 1 B; 156/253

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[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.

3 Claims, 9 Drawing Figures

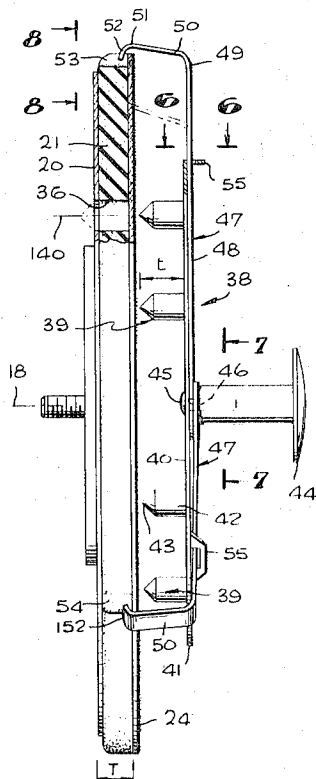


Fig. 1

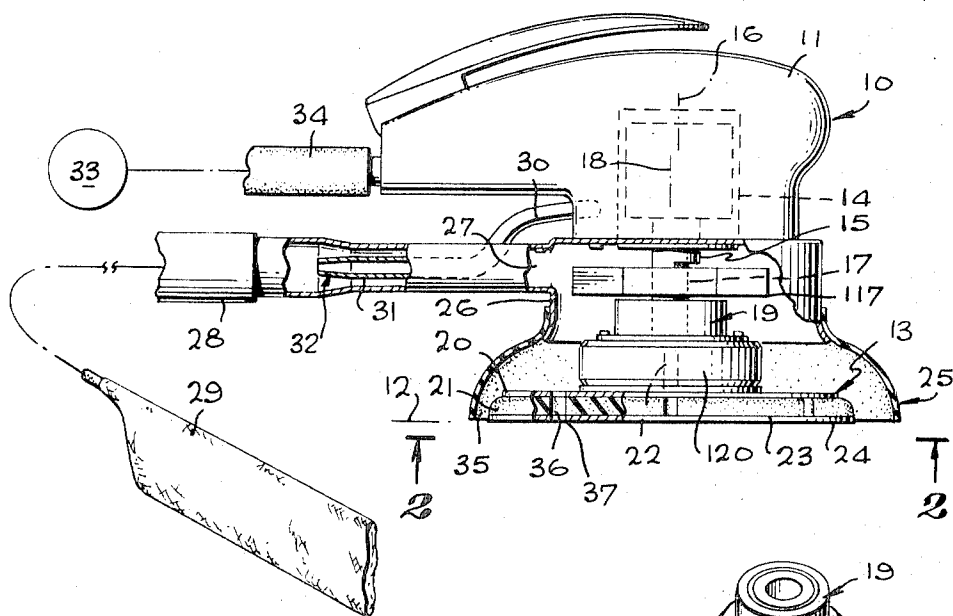
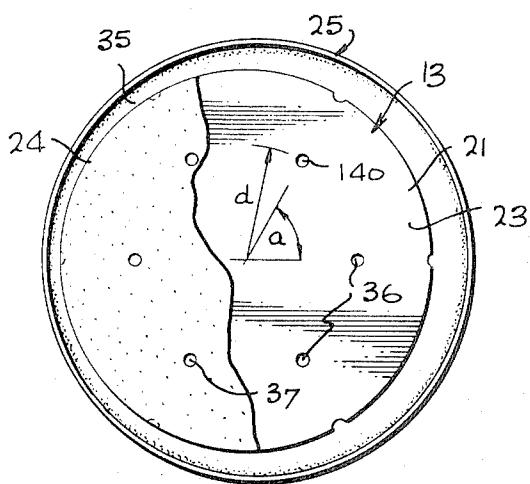


Fig. 2

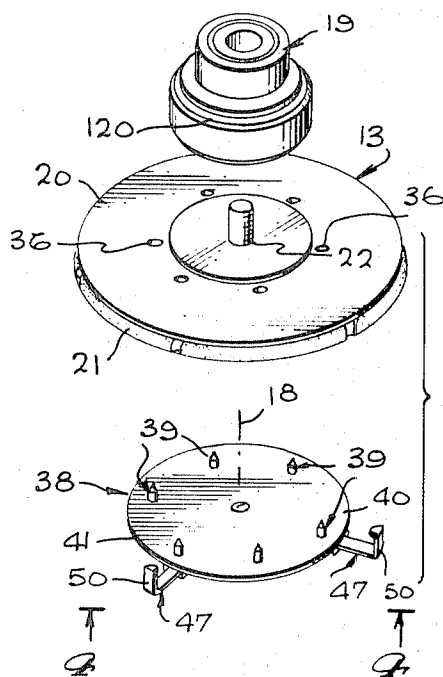


Fig. 3

Fig. 4

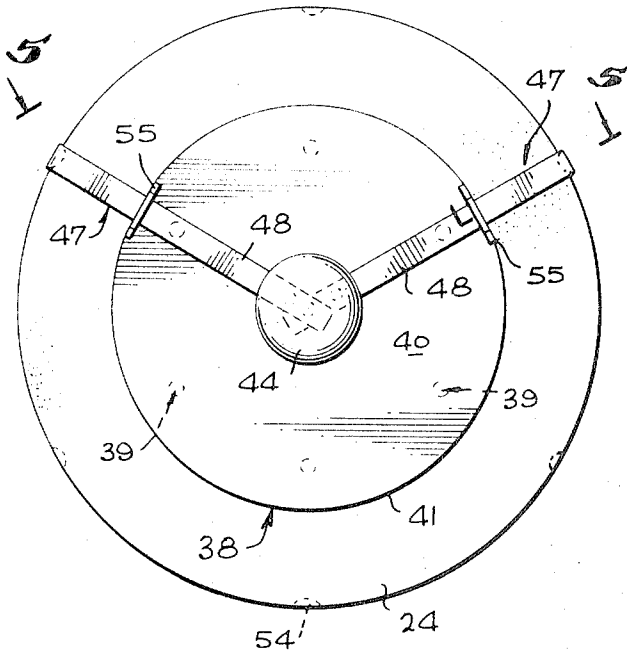


Fig. 5

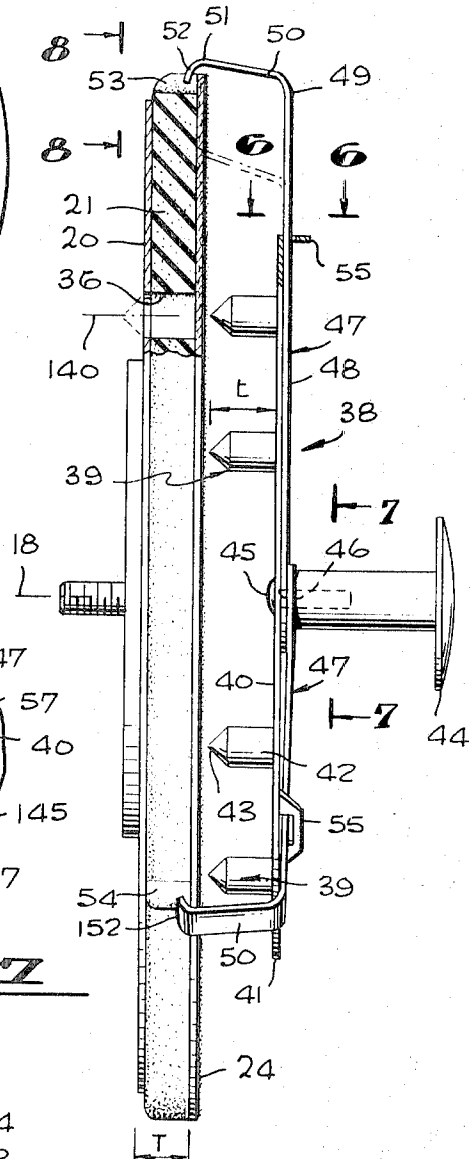


Fig. 6

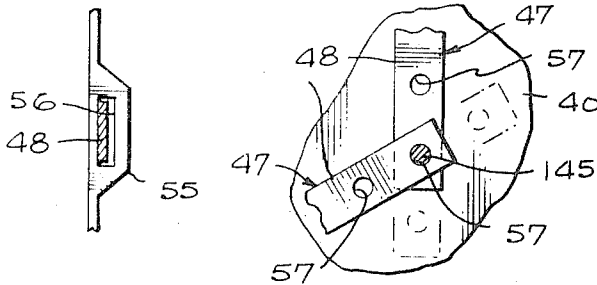


Fig. 7

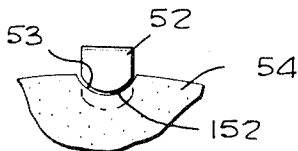


Fig. 8

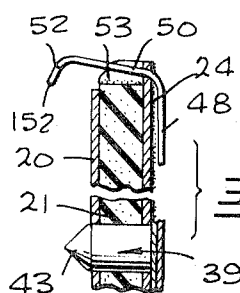
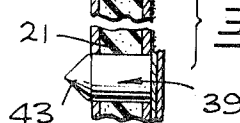


Fig. 9



METHOD OF PIERCING HOLES IN SANDING DISCS

CROSS REFERENCE TO RELATED APPLICATION

This is a division of application Ser. No. 282,348, filed Aug. 21, 1972.

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, now U.S. Pat. No. 3,785,092, on "Abrading Tool Having Suction System for Collecting Abraded Particles," and Ser. No. 282,155, filed Aug. 21, 1972, now U.S. Pat. No. 3,788,011, on "Piercing of Air Suction Holes in Abrasive Sheet Material."

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, now U.S. Pat. No. 3,785,092, 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. 213,018, 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 appear, 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 axi-

ally 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 embodiment 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 the 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 midday 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 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 method that comprises:

attaching an essentially circular sheet of abrasive material to an essentially circular power driven backing structure of a sander which contains suction openings in the backing structure for drawing air and abraded particles from a work surface,

positioning opposite said backing structure and carried abrasive sheet a piercing tool having projections arranged in a pattern corresponding to the pattern of said openings in the backing structure, and with the piercing tool turned about the center of said essentially circular backing structure and abrasive sheet to a position in which said projections are directly opposite said openings in the backing structure, and

moving said piercing tool and said backing structure relatively axially toward one another to pierce holes in the abrasive sheet by said projections at the locations of said openings in the backing structure.

2. The method as recited in claim 1, including locating said piercing tool relative to said backing structure by moving and turning the piercing tool to a position in which locating means on the piercing tool interfit in predetermined locating relation with coacting locating means on the backing structure.

3. The method as recited in claim 1, in which said tool is positioned by first engaging locating means on said tool with the periphery of said backing structure, and then turning said tool relative to said backing structure about the axis of said backing structure until said locating means interfit with coacting locating means on said periphery of the backing structure.

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