Aug. 30, 1960 J. F. WELCH 2,950,584

ACCESSORY FOR ROTARY POWER DRIVEN TOOLS

Filed May 8, 1958 3 Sheets-Sheet 1

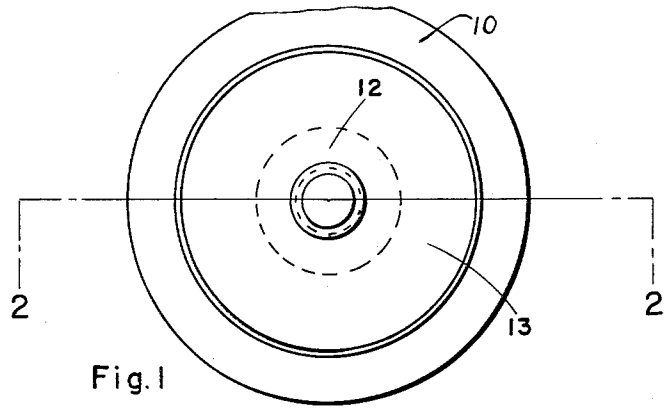

Fig. 1

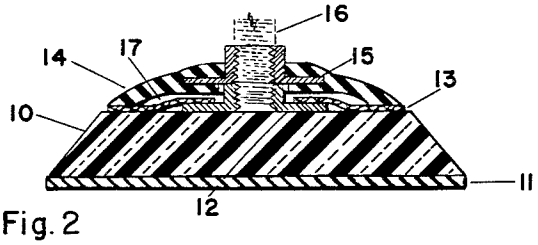

Fig. 2

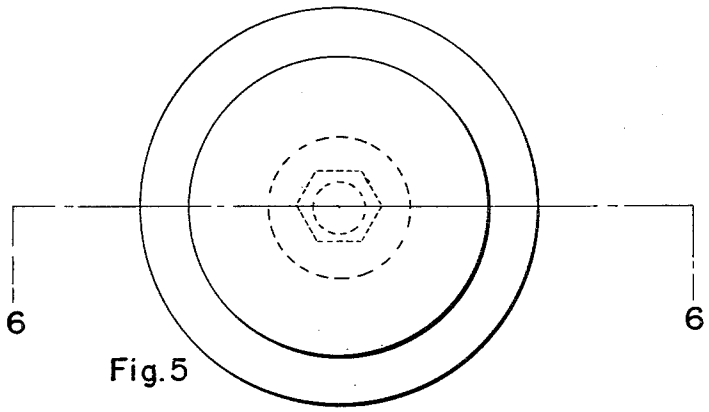

Fig. 5

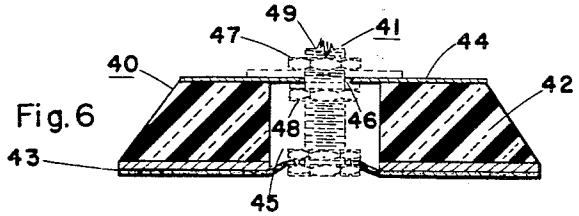

Fig. 6

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ACCESSORY FOR ROTARY POWER DRIVEN TOOLS

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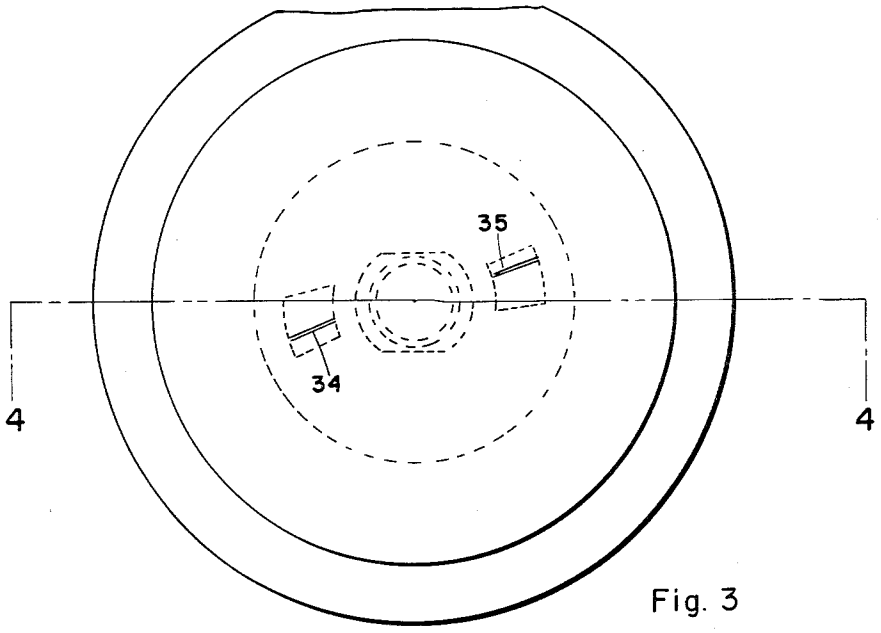

Fig. 3

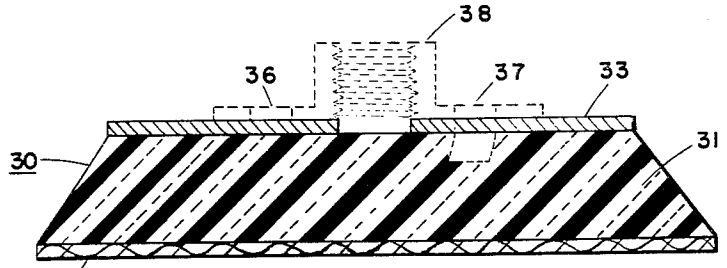

Fig. 4

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ACCESSORY FOR ROTARY POWER DRIVEN TOOLS

Filed May 8, 1958 3 Sheets-Sheet 3

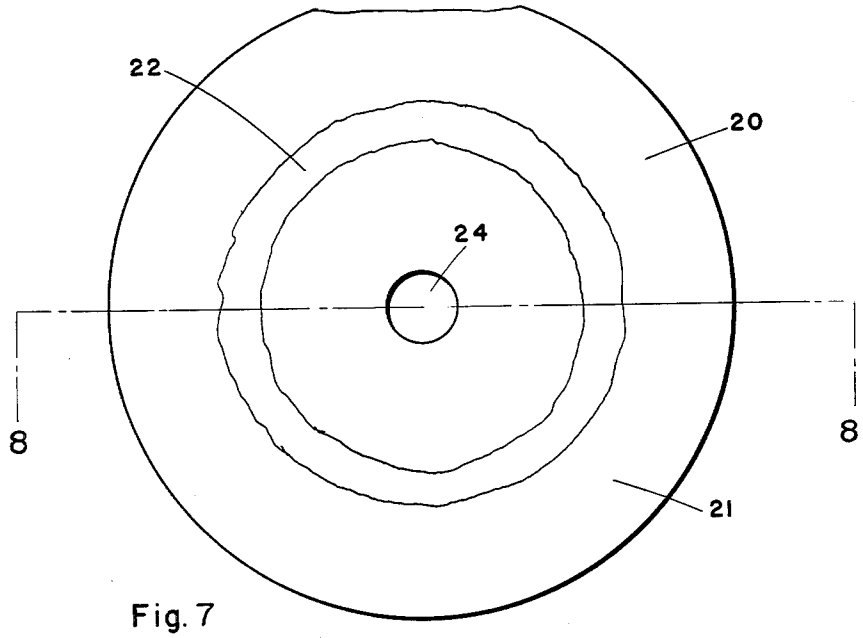

Fig. 7

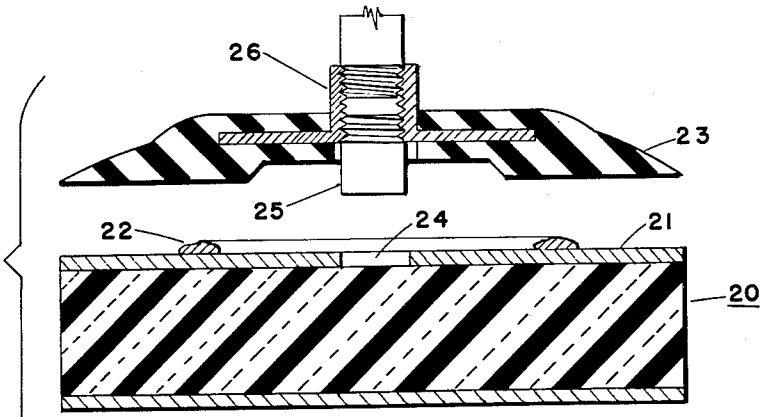

Fig. 8

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2,950,584

ACCESSORY FOR ROTARY POWER DRIVEN TOOLS

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Filed May 8, 1958, Ser. No. 733,910

13 Claims. (Cl. 51—195)

This invention relates to an accessory for power tools. It is more specifically concerned with a rotary smoothing unit for mounting abrasive sheeting driven by a power tool.

Preparatory to the application of protective coatings to the surfaces of metal, wood, or the like, a smoothing operation is carried out wherein the surfaces are contacted with an abrasive to wear down any irregularities and produce a smooth surface. In one of the conventional operations, an abrasive sheeting is used which can be employed on either wet or dry surfaces. Although aluminum oxide, silicon carbide, diamond dust, and other hard comminuted materials in addition to silica are used as the abrasive material, to facilitate a discussion of this invention surface smoothing by abrasives will be referred to as "sanding."

The sanding operation is carried out by putting a piece of abrasive sheeting on a rotating disk and applying it to the surface which is to be smoothed. The abrasive sheeting is mounted on a resilient "back-up" pad of a rotary sanding unit by the use of adhesives; a mounting arrangement using threaded fasteners which in cooperation with the threaded power drive shaft hold the abrasive sheeting between two collars; or, in the event of a wet sanding operation, the use of a surface tension phenomena whereby the abrasive sheeting adheres to the fabric facing of the back-up pad which is water wetted. The abrasive sheeting which is used can be either in the form of a solid sheeting surfaced with abrasive particles or a perforate sheet wherein the abrasive action is effected by a grid work of abrasive filaments.

Resilient back-up pads generally used in the prior art attachments have utilized sponge rubber in order to provide a resilient supporting surface which could conform with the contours of the surfaces of the material being smoothed. Sponge rubber pads were not satisfactory because the sponge rubber was usually too soft to permit the proper amount of surface pressure to be applied against the material being smoothed; they had only a short life; and the methods of installation required that the sponge rubber pads be cemented directly to a substantially inflexible, hard rubber back-up plate which was used to give support to the sponge rubber. In replacing the sponge rubber pads it was generally necessary for the heavy rubber back-up plate to be returned to the manufacturer for resurfacing with a new sponge rubber back-up pad. This was undesirable because of the nuisance of returning the disk as well as the added costs in handling the sanding disk.

According to this invention, a resilient back-up pad for mounting an abrasive sheeting which can be economically disposed of when worn out is prepared by employing a flexible, polyurethane foam as a cushioning material. The face of the pad to which the abrasive sheets are mounted is covered with a flexible fabric. The backing for the pad depends upon the type of tool mounting employed. It can be reinforced with a fabric backing which is adapted to integrate a mounting chuck with the smoothing unit or it can be in the form of a thin, hard board material which preferentially has been water proofed or made water resistant and provided with a means for attaching the pad to a power driven shaft.

Figure 1 is a top plan view of one embodiment of the disposable smoothing unit of this invention employed in conjunction with a substantially inflexible back-up plate;

Figure 2 is a cross sectional view of Figure 1 through line 2—2 illustrating the assembly of the back-up pad of this invention and the correlation of the smoothing unit with a conventional inflexible back-up plate shown in position;

Figure 3 is another embodiment of this invention employed in conjunction with a conventional mounting clip chuck;

Figure 4 is a cross sectional view of Figure 3 through line 4—4;

Figure 5 is a further embodiment of this invention employed as a back-up pad for dry sanding operations;

Figure 6 is a cross sectional view of Figure 5 through line 6—6 illustrating the type of arbor employed for attaching abrasive sheeting to the face of the back-up pad and for mounting the back-up pad to a rotating shaft;

Figure 7 is still another embodiment of this invention illustrating an alternative expedient for affixing the back-up pad of this invention to a conventional inflexible back-up pad;

Figure 8 is a cross sectional view of Figure 7 through line 8—8 illustrating the relation of the inflexible back-up plate and the flexible pad of this invention.

Referring to the drawings, in the embodiment illustrated in Figures 1 and 2, the flexible back-up pad of this invention comprises an intermediate, polyurethane foam disk 10. Cemented to the face of this disk is a rubber sheet 11. The flanged mounting chuck 12 is affixed to the back of pad 10 and cemented in place. Additional rigidity is provided by means of a flexible fabric backing 13 which is cemented to the back of pad 10 and overlies the flanged portion of mounting chuck 12 thereby forming an integral unit. In employing this embodiment of the invention, a conventional inflexible molded back-up plate 14, generally prepared from a hard rubber, is used. This back-up plate is provided with a threaded chuck 15 which can be fastened to the threaded shaft 16 of a power drive, not shown. The inflexible back-up plate 14 is attached to shaft 16 in such a manner that a stub portion of spindle 16 depends downwardly into the recess 17 provided in back-up plate 14. To the stub portion of shaft 16 is attached the flanged mounting chuck 12 in such a manner that the adjacent face of the inflexible back-up plate 14 and the backing fabric 13 affixed to the flexible back-up pad are in contiguous relationship. This arrangement provides the necessary support so that the proper amount of surface pressure can be applied against the surface of the material being smoothed.

The flanged chuck employed in fabricating the flexible pad illustrated in Figure 1 is preferably prepared from thin material so as not to add additional weight to the unit pad. From the standpoint of costs and ease in fabricating and other factors, the internally threaded sleeve portion can be drawn from a sheet metal disk about ⅛"–3/32" thick and the drawn portion threaded to provide a means for attaching the chuck to the protruding portion of threaded arbor. It is to be understood however that other methods of fabrication can be employed as well as other materials of construction such as molded plastics and the like.

An alternate embodiment of this invention which is

also used in connection with an inflexible rubber back-up plate **14** is illustrated in Figures 7 and 8. In this embodiment the polyurethane flexible back-up pad "sandwich" **20** is prepared by utilizing a hard board material for the backing **21**. The hard board backing **21** is provided with an annular ring **22** of a suitable adhesive for joining hard board backing **21** to the face of back-up plate **23**.

Only a narrow strip of adhesive is employed in order to facilitate the removal of pad **20** when it becomes worn. Using this expedient a sufficient manual force can be developed to separate the used flexible pad unit from the rubber back-up plate in order to permit its replacement. It is important that these flexible pad units be coaxially mounted with the rubber back-up plate to eliminate as much as possible any vibration during its use in a smoothing operation. To obviate this problem guide hole **24** is provided in hard board backing **21** in coaxial alignment with the transverse axis of pad **20**. Guide pin **25** is fitted into mounting chuck **26** of back-up plate **23** and depends downwardly therefrom beyond the face of back-up plate **23**. When fitting flexible back-up pad **20** to back-up plate **23** guide pin **25** coregisters with opening **24** to insure the coaxial alignment of back-up plate **23** and flexible back-up pad **20**.

In Figures 3 and 4 is shown an embodiment of this invention which is used in conjunction with a conventional mounting clip chuck. In this instance flexible back-up pad unit **30** consists of a flexible polyurethane foam pad **31** provided with a flexible canvas fabric facing **32** and a rigid, hard board backing **33**. Hard board backing **33** which provides the support for the flexible pad is provided with opposed slots **34** and **35** which engage the downwardly depending clip elements **36** and **37** of mounting chuck **38**. This mounting chuck which is shown in dotted outline is a conventional fitting and can be obtained from Behr-Manning Corporation. The hard board backing selected for use in fabricating this embodiment of the instant invention is selected to resist tearing in the slot area during use by the mounting clip used.

The embodiment illustrated in Figures 5 and 6 is employed in dry sanding operations wherein the abrasive sheeting is affixed to the face of the flexible back-up pad **40** by means of mounting arbor **41** shown in dotted outline. Flexible, back-up pad **40** consists of a flexible, polyurethane foam, intermediate pad **42** having a flexible vinyl fabric facing **43** and a rigid back **44** prepared from a suitable hard board material. An internal cavity **45** is provided coaxial with the transverse axis of pad **40**. Hard board backing **44** is provided with an opening **46** having a smaller diameter than the internal cavity **45**. Employing this arrangement, flexible back-up pad **40** is affixed to mounting arbor **41** by means of threaded fasteners **47** and **48** which hold flexible back-up pad **40** in place on the threaded shaft **49**. The abrasive sheeting which is laid on facing **43** is held in place by a suitable collar arrangement which is provided at the terminal end of threaded shaft element **49**. This type of flexible back-up pad is generally used for so-called edge sanding operations and its use is not effected by any protruding of the mounting arbor beyond the face of the flexible back-up pad **40**.

The polyurethane employed in fabricating the flexible back-up pad sandwich unit is a foamed, cellular, synthetic elastomeric, isocyanate reaction product produced employing conventional techniques to provide a yielding but supporting low density foam. The reaction mixture basically consists of a polymeric material such as polyester or polyol containing a free hydroxyl and/or carboxyl substituent group and a polyisocyanate. It may be desirable to include in the reaction mixture a constituent such as water which will react with the —NCO group of the polyisocyanate to generate a foam-inducing gas. A wide variety of polymeric materials can be utilized to produce the desired flexible foam. Generally polyester based flexible foams require 15–40 parts of diisocyanate to 100 parts of polymeric material. Foam density is regulated by controlling the extent of the reaction between the isocyanate and the reaction constituent used to generate a foam inducing gas. If water is employed about 0.5–10% is used based upon the amount of polymeric material employed. In the event that water is employed in conjunction with the preparation of polyether based flexible foams larger amounts of water in the nature of 10–50 parts water per 100 parts reaction mixture are utilized. Increased density and compressive strength, if desired for specific applications, can be obtained by using fillers such as metallic leafing powders. Foam stabilizers, accelerators, secondary blowing agents, and other known expedients can also be utilized to facilitate the preparation of the flexible foam.

The flexible polyurethane foam employed in preparing the flexible back-up pad in this unit should be formulated to provide a foam having yielding but supporting properties. Accordingly, the flexible foam employed should have the following characteristics.

	Range	Preferred
Density, lbs./cu. ft.	2–10	3–3½
Compression/deflection, p.s.i. (25%)	0.5–3	1–1.5
Tensile Strength, p.s.i.	15–50	20–25
Compressive set, percent (70° C.)	<20	10–15
Load Bearing Strength,[1] lbs.	40–60	50–60

[1] The amount of force required to depress an 8" foam disk 25% of its original thickness loaded over its surface area of 50 sq.in. by means of an 8" diameter metal plate to which the load is applied.

In preparing the polyether or polyester based flexible polyurethane foams representative polyhydric alcohols such as ethylene glycol, propylene glycol, trimethylol propane, pentaerythritol, sorbitol, mannitol, polyoxyalkylene glycols having molecular weights in the order of 750–6000 such as polybutylene glycol, polypropylene glycol, mixed polypropylene-polyethylene glycols and others can be used. Typical carboxylic acids include phthalic, succinic, sebacic, fumaric, adipic, citric, itaconic, oxalic, glutaric, azelaic, caprolactone, dimer acids, and others. The isocyanate employed can be selected from such isocyanates as 2,4-tolylene diisocyanate, hexamethylene diisocyanate, naphthylene diisocyanate, dimethyl diphenyl 4–4' diisocyanate and others. In preparing the flexible polyurethane foam, conventional processing techniques can be utilized such as those described in "Polyurethanes," Dombrow, Reinhold, 1957. The flexible foam pads can be either molded in a suitable disk shape or cut from sheet materials employing either straight or beveled sides. The flexible polyurethane foam pad thickness should be about 1"–2", and preferably 1"–1½", employing diameters of 3"–8".

To facilitate the mounting of the abrasive sheeting on the face of the flexible polyurethane foam pad the face of the flexible polyurethane foam disk is covered with a flexible fabric sheeting such as canvas, rubber, vinyl plastic or the like. To provide the necessary flexibility which will permit the face of the pad to conform with the contours of the material being smoothed, the fabric facing should be about 1/32"–3/32" thick. In utilizing the flexible polyurethane foam smoothing unit in so-called "wet sanding" operations, a rubber facing is preferred. By employing this facing it is unnecessary to utilize conventional adhesives for mounting the abrasive sheeting on the face of the flexible polyurethane foam unit. By wetting the abrasive sheeting and the rubber face of the flexible polyurethane foam smoothing unit sufficient surface tension is provided which will retain the abrasive sheeting in place during the sanding operation. Although a variety of abrasive sheetings can be employed it is preferred to utilize the abrasive screens hereinbefore mentioned.

The backing which is fitted to the back of the flexible polyurethane foam pad will depend upon the particular service for which the smoothing unit is to be used. Be-

cause an important feature of this invention resides in the "throw away" design of the smoothing unit which permits it to be discarded economically after a satisfactory service life, it is necessary that an inexpensive material be used for the backing. Generally a conventional hard board can be used. This hard board can be prepared from cloth, vulcanized fiber, or laminations of cloth with fiber or paper which have been fabricated to provide a stiff hard board material. In the event that the smoothing unit is to be employed in a "wet sanding" operation, it is apparent that the hardboard must be made water resistant to avoid deterioration upon contact with the aqueous environment. Sufficient water resistance can be provided by impregnating the hard board with a phenolic resin or by utilizing a hard board employing sheets of reinforced polyester plastics such as fiber glass, reinforced polyesters. Hardboards 1/16"–3/32" thick will provide sufficient rigidity when employed as a backing for the smoothing unit of this invention. When a smoothing unit such as that illustrated in Figure 1 is employed, a flexible fabric sheeting such as that discussed above is used. It is preferred in units of this type that a vinyl sheeting be employed.

The facing and backing are secured by suitable adhesives such as rubber base type adhesives containing 35–55% solids. Satisfactory adhesives are marketed by Minnesota Mining and Manufacturing Co. under the trademark EC 1577 A: Dural Company of Milwaukee, Wisconsin, also provides suitable adhesives for cementing the facing and backing materials to the intermediate flexible polyurethane pad. In certain instances it may be desirable to integrate these elements with the foam pad by molding them in place during the forming of the foam pad.

In one specific illustrative embodiment of this invention, a disk of flexible polyurethane foam 1½" thick having a truncated form with an 8" diameter face and a 7" diameter back is cut from a molded sheet. The sheeting is prepared by mixing 100 volume parts of polyester prepared from 1 mole of trimethylol propane, 16 moles of adipic acid, and 16 moles of diethylene glycol with 47 volume parts of tolyl diisocyanate (65% 2,4-isomer and 35% 2,6-isomer) in the presence of 10 parts by weight of a conventional activator mixture containing 1.5 parts of water. The reaction is allowed to go to completion and the flexible sheet foam produced is cut with a hot wire to provide the desired disk configuration. A phenolic impregnated hard board 1/16" thick and 7" in diameter is secured to the back of the flexible foam pad employing a rubber base type adhesive containing 35–55% solids (3M EC 1577 A). A canvas facing 1/32" thick is glued to the face of the flexible foam pad employing the same adhesive. To permit the attachment of the fabricated smoothing unit to a rotary shaft of a power drive, opposed slits 1" long positioned along one diameter of the hardboard are provided in the backing to receive a conventional Behr-Manning mounting clip chuck.

In another embodiment of this invention a polyester based foam having the following characteristics was utilized:

Density, lbs./cu. ft.	3.5
Compression/deflection, p.s.i. (25%)	1
Compressive set, percent (70° C.)	10
Load bearing strength, lbs	60

A disk 8" in diameter was prepared from this foam and a solid rubber facing 1/16" thick glued thereto with a rubber base type adhesive. To permit the attachment of the smoothing unit to the shaft of a power drive a flanged chuck having a drawn neck internally threaded to receive a 5/8" threaded shaft was provided. The flanged chuck which was 3" in diameter was cemented to the back of the flexible foam pad utilizing a rubber base adhesive and further secured by overlaying the flanged chuck with a vinyl fabric 1/32" thick having the same diameter as the back of the pad. The fabric was secured in place with a rubber base adhesive.

Although the foregoing invention has been illustrated by a number of specific examples, it is to be understood that these are only illustrative and do not have a limiting effect on the instant invention. It will be apparent from the foregoing discussion that a number of variations can be made in the smoothing unit of this invention without departing from the scope of the claims appended hereto. Accordingly I claim as my invention:

1. A disposable rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate yielding, supporting pad of flexible, polyurethane foam, a flexible fabric facing laminated to the face of said pad, a backing laminated to the back of said pad and a means for attaching said accessory to a rotary power drive.

2. A disposable, rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate yielding, supporting pad of flexible, polyurethane foam, a flexible water-resistant fabric facing which will retain said abrasive sheeting in place by water wetting said facing and said abrasive sheeting, a backing laminated to the back of said pad and a means for attaching said accessory to a rotary power drive.

3. A surface smoothing unit in accordance with claim 2 in which said water-resistant fabric facing is a solid elastomer sheeting.

4. A surface smoothing unit in accordance with claim 3 in which said solid elastomer sheeting is rubber.

5. A disposable rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate yielding, supporting pad of flexible, polyurethane foam, a flexible fabric facing laminated to the face of said pad, a water resistant hard board backing laminated to the back of said pad, and a means for attaching said accessory to a rotary power drive.

6. A disposable, rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate yielding, supporting pad of flexible, polyurethane foam, a flexible water-resistant fabric facing which will retain said abrasive sheeting in place by water wetting said facing in said abrasive sheeting, a water-resistant, phenolic resin impregnated hard board backing laminated to the back of said pad and a means for attaching said accessory to a rotary power drive.

7. A disposable rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate yielding, supporting pad of flexible, polyurethane foam, a flexible rubber fabric facing laminated to the face of said pad, a water-resistant phenolic resin impregnated hard board backing laminated to the back of said pad, and a means for attaching said accessory to a rotary power drive.

8. A surface smoothing unit in accordance with claim 7 in which said flexible, polyurethane foam has a load bearing strength of 40–70 pounds.

9. A rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises an intermediate, yielding, supporting pad of flexible polyurethane foam, a flexible fabric facing laminated to the face of said pad, a backing comprising a mounting chuck fitted to the back of said pad, said mounting disk comprising a thin rigid plate having an area substantially less than the back of the pad, an internally threaded sleeve integral with said plate and mounted thereon coaxially with the transverse axis of said flexible pad, a flexible fabric backing completely overlaying said rigid plate and the back of said pad and laminated thereto whereby an integral unit is obtained.

10. A rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises a circular, intermediate yielding, supporting pad of flexible polyurethane foam, a flexible fabric facing laminated to the

face of said pad, a backing comprising a mounting chuck affixed to the back of said pad, said mounting disk comprising a thin rigid, circular metal plate having an area substantially less than the back of the pad, an internally threaded sleeve integral with said plate and mounted thereon coaxially with the transverse axis of said flexible pad, a flexible fabric backing completely overlaying said rigid plate and the back of said pad and laminated thereto whereby an integral unit is obtained.

11. A rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises a circular, intermediate, yielding, supporting pad of flexible polyurethane foam, a flexible fabric facing laminated to the face of said pad, a backing comprising a mounting chuck affixed to the back of said pad, said mounting disk comprising a rigid, sheet metal, circular plate having an area substantially less than the back of the pad and having a drawn necked portion providing an internally threaded sleeve coaxial with the transverse axis of said flexible pad, a flexible fabric backing completely overlaying said rigid plate and the back of said pad and laminated thereto whereby an integral sandwich is obtained.

12. A rotary power tool surface smoothing unit for mounting an abrasive sheeting which comprises a circular, intermediate, yielding, supporting pad of flexible polyurethane foam, a flexible rubber fabric facing laminated to the face of said pad, a backing comprising a mounting chuck affixed to the back of said pad, said mounting disk comprising a rigid, sheet metal circular plate having an area substantially less than the back of the pad and having a drawn necked portion providing an internally threaded sleeve coaxial with the transverse axis of said flexible pad, a flexible vinyl fabric backing completely overlaying said rigid plate and the back of said pad and laminated thereto whereby an integral unit is obtained.

13. A smoothing unit in accordance with claim 11 in which said polyurethane foam has a load bearing strength of 40–70 pounds.

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