United States Patent [19]

Bond

[11] **3,905,080**

[45] **Sept. 16, 1975**

[54] **ABRADING DEVICES**

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[73] Assignee: **Buckbee-Mears Company**, St. Paul, Minn.

[22] Filed: **Feb. 4, 1974**

[21] Appl. No.: **439,295**

Related U.S. Application Data

[62] Division of Ser. No. 237,734, March 24, 1972.

[52] **U.S. Cl.** ..... **29/76 R**; 51/374

[51] **Int. Cl.**[2] **B23D 67/08**

[58] **Field of Search** ..... 29/76 R, 78, 76 B; 51/309, 51/399, 374

[56] **References Cited**

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2,906,612	9/1959	Anthony et al.	51/309
3,045,321	7/1962	McDermott	29/78

Primary Examiner—Leonidas Vlachos

Attorney, Agent, or Firm—Jacobson and Johnson

[57] **ABSTRACT**

An improved abrading material and apparatus for utilizing an abrading drum is provided with the abrading material having non-clogging characteristics as well as improved cutting characteristics.

4 Claims, 8 Drawing Figures

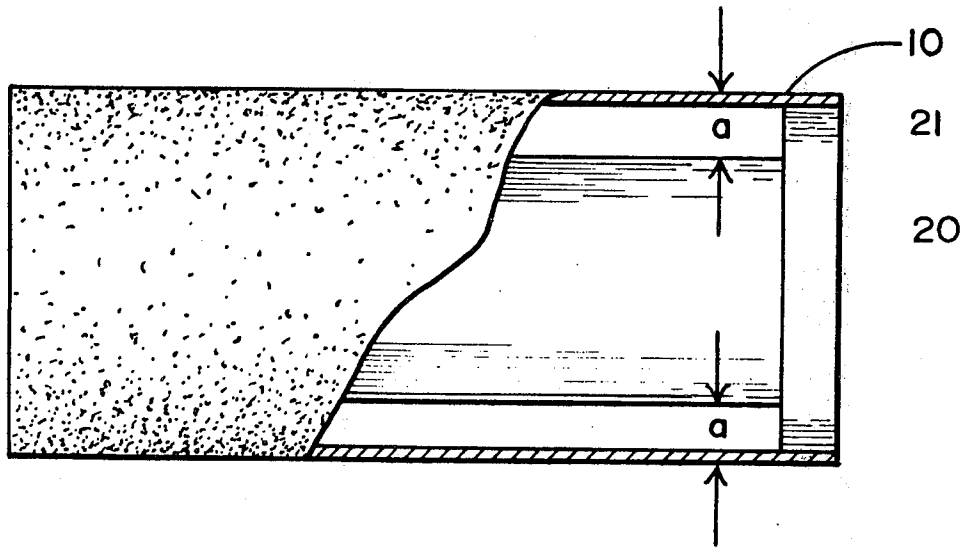
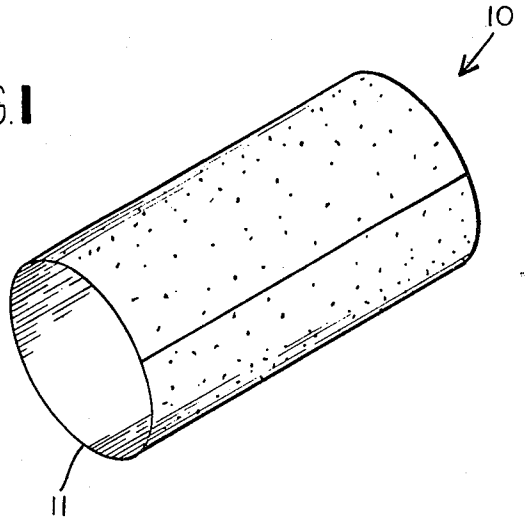


FIG. 1



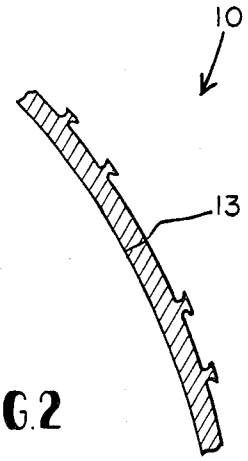


FIG. 2

FIG. 3

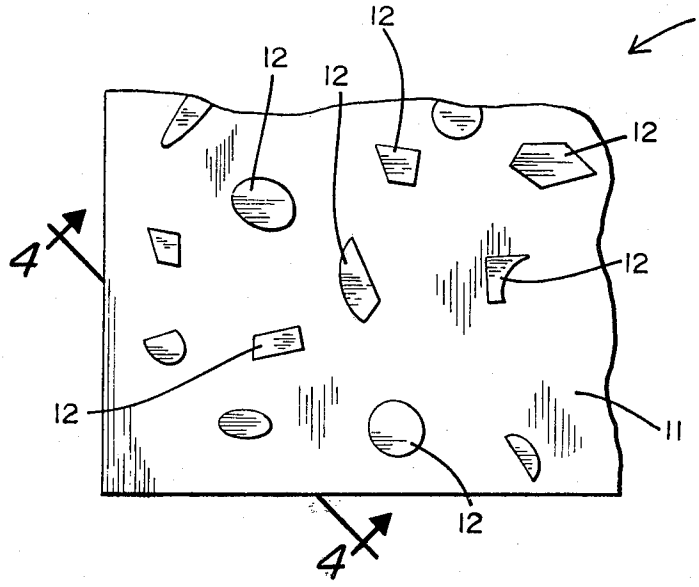


FIG. 4

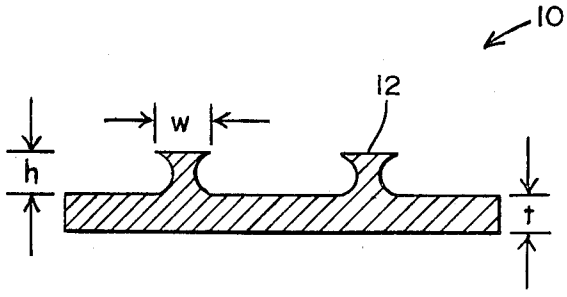


FIG. 5

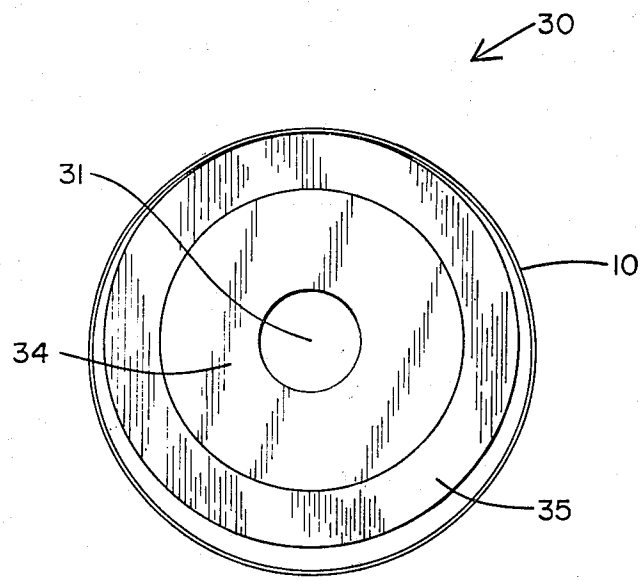
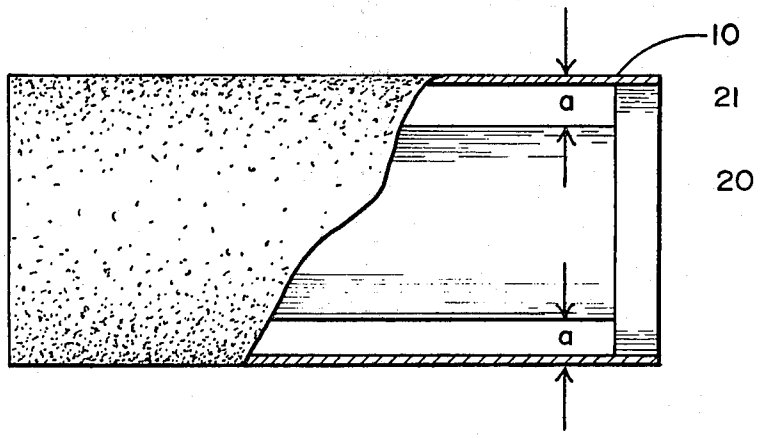


FIG. 6



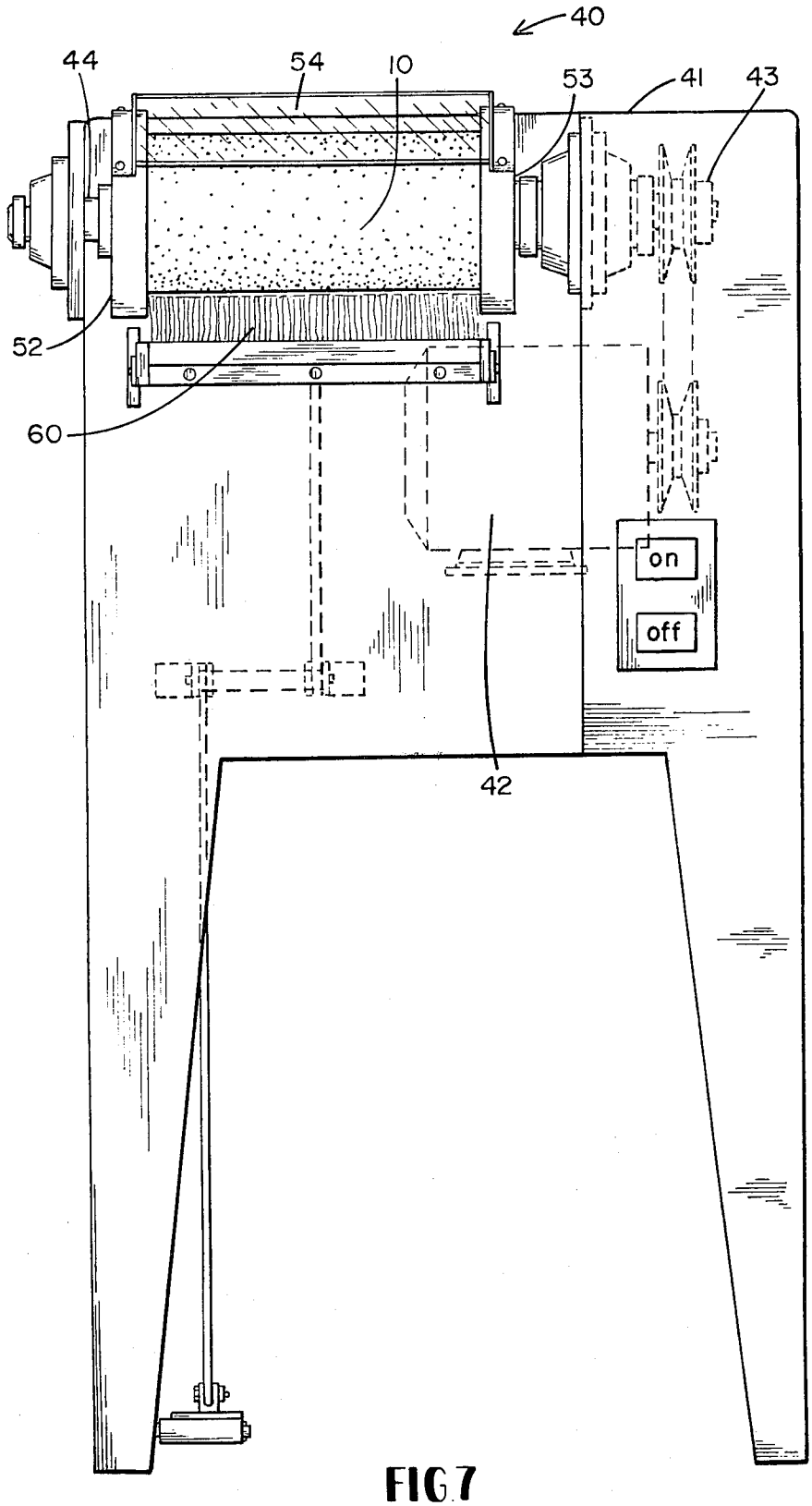


FIG.7

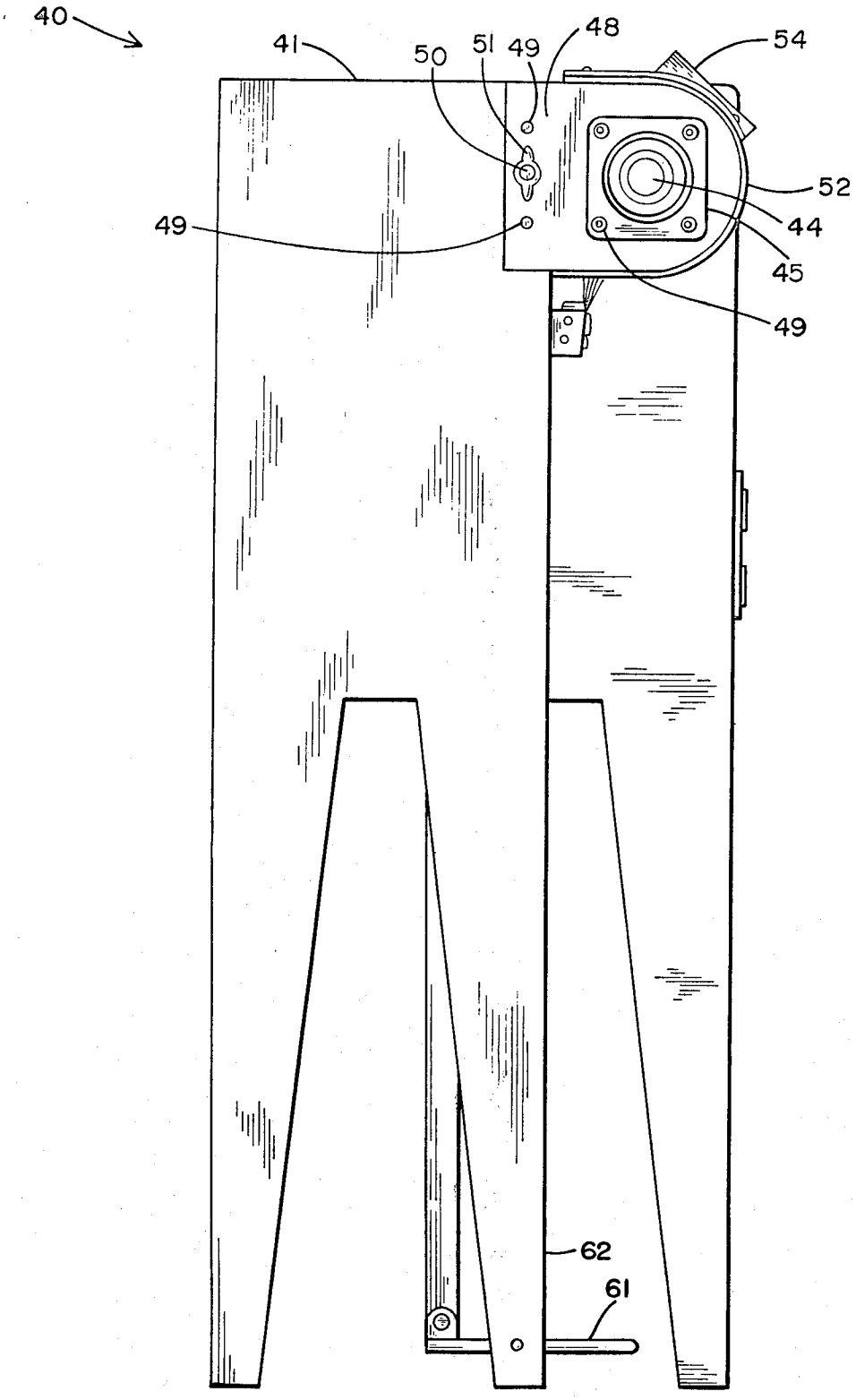


FIG.8

ABRADING DEVICES

This is a division of application Ser. No. 237,734, filed Mar. 24, 1972.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to abrading material and, more specifically, to metallic abrading sheets which are suitable for forming into cylindrical abrading drums for use on high-speed, rotary, abrading machines.

2. Description of the Prior Art

Abrading devices and methods of making abrading devices are well known and old in the art. Briefly, there are basically two general types of abrading devices, the metallic abrading devices and the non-metallic abrading devices. The non-metallic abrading devices are characterized by the sheet materials commercially known as the sandpapers. The metallic abrading devices are generally used for harder materials and include devices such as rasps, files and the like. Within this general category of metallic abrading devices there is one particular type which is capable of abrading much in the same manner as the sandpapers yet has considerably greater durability than sandpaper. A typical example of this type is shown in the McDermott U.S. Pat. No. 3,045,321 which is assigned to the same assignee as the present invention. Typically, the McDermott type of abrading material is made from metallic sheet material by forming an etchant resist pattern on top of the metallic material. The material in the uncovered portions of the metallic material is then etched away to leave a series of regular sharp points for use in abrading material away.

Another embodiment of this type is shown in a Davidson U.S. Pat. No. 852,873 in which a knife sharpener is produced by partially undercutting the resist layer to leave a series of regular or elongated undercut edges. Davidson suggests his elongated undercut edges can be used for sharpening knives and the like.

While the McDermott and Davidson type of prior art devices have been known for some time, they have not gained wide acceptance because of certain drawbacks such as the clogging of the abrading material during use and the inability of the abrading material to flex and withstand the stress encountered with high speed rotary abrading operations. A cutting tool such as Davidson, which is designed for slow speed operation, plugs up quite readily if used in high speed operation with a soft material. Furthermore, the Davidson device is inflexible and will not conform to the surface of the material to be ground. While abrading cylinders or drums can be made from flat abrading sheets such as McDermott, they do have a drawback as they are difficult to form into cylinders or drums for use in high speed operation. The main difficulty occurs because the high stress produced by centrifugal force on the rotating drum tends to rupture the seam on the drum thus causing the drum to fly apart. Thus, briefly, one of the aspects of my invention comprises an improvement in forming an abrading cylinder or an abrading drum out of sheet material.

Another aspect of my invention comprises improvements in abrading characteristics of metallic abrading materials.

Another aspect of my invention comprises an improved structural configuration of a sanding drum for high speed sanding operation.

Another aspect of my invention comprises a high speed sanding drum flexible enough to conform to arcuate surfaces without being destroyed by centrifugal forces.

Still another aspect of my invention comprises an apparatus for utilizing my abrading device.

Another aspect of my invention includes safety features on the apparatus to prevent the abrading device from flying off and injuring anyone should a drum break.

Another aspect of my invention comprises a critical relationship of sanding drum diameter to mandrel diameter in order to produce a drum that can abrade an arcuate surface.

Still another aspect of my invention comprises an apparatus for a sanding drum suitable for abrading soft materials such as shoe soles.

SUMMARY OF THE INVENTION

Briefly, the present invention comprises a metallic abrading material having improved cutting characteristics, an improved structural design to enable the abrading materials to be used in a high speed abrading drum, a metallic abrading drum capable of abrading a surface with a curvature thereon and a machine for supporting and holding my improved abrading drum.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of my metallic abrading drum which is suitable for high speed sanding;

FIG. 2 is an enlarged portion of the abrading drum which reveals details of the seam when the abrading material is welded together.

FIG. 3 is an enlarged view showing the physical appearance of the various cutting teeth on my abrading material;

FIG. 4 is a cross-sectional view taken along the lines 3—3 of FIG. 3;

FIG. 5 is an end view of a mandrel for supporting my abrading drum;

FIG. 6 is a cut away view showing an alternate embodiment of a mandrel for supporting an abrading drum

FIG. 7 is a front elevation view of a machine for utilizing an abrading drum; and

FIG. 8 is a side elevation view of a machine for utilizing an abrading drum.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1, 2 and 3, reference numeral 10 generally designates my improved abrading drum. Abrading drum 10 was formed from a sheet of metallic material 11 by utilization of etching techniques. Briefly, etchant resist is placed over selected areas of the material to prevent various regions from being attacked by an etchant.

FIG. 3 shows the various sizes and shapes of the protected areas which are spaced randomly throughout the material. These protected areas will be referred to as teeth. After subjecting the material to an etchant, the resist is removed thus leaving the numerous metallic projections or teeth having a partially undercut appearance as shown in FIG. 4. It is the utilization of teeth of

random sizes and shapes in the metallic abrading material as well as having approximately a **90** percent of the area of the abrading sheet without any teeth which produces a metallic abrading sheet having improved abrading characteristics.

The flat metallic sheet can be formed into an abrading drum by forming a butt joint such as shown in FIG. **2.** Typically, the edges of the sheet are ground to assure they will abutt together continuously. Next, the edges are held together while the weld is formed with an electron beam. In order to produce a strong butt weld by electron beam welding, it is preferred to have the thickness of the metallic sheet at the seam less than **0.004** of an inch for a **6** inch diameter drum.

Referring to FIG. **3,** there is shown an enlarged view of the cutting protrusion or teeth **12** on the metallic abrading material **11.** Note, teeth **12** are characterized by different sizes and shapes. The specifics as to how to etch the metallic material may be found in applicant's prior art McDermott U.S. Pat. No. **3,045,321** which describes the forming of the abrading material by the utilization of etchant resist. Applicant's present invention utilizes etchant resist in a similar manner to form metallic abrading teeth. However, there are several differences between abrading material in the present invention and the abrading material of applicant's prior art patent which enable the present abrading material to provide improved abrading qualities. For example, the present invention does not utilize any sharp points but instead utilizes irregular shaped teeth with flat tops that are partially undercut to form multiple cutting edges around the tops of the teeth. Also, the cutting teeth have irregular sizes and shapes with random distribution of the teeth; furthermore, approximately **90** percent of the sheet of abrading material contains no cutting teeth. These features have been found to provide uniform cutting edges that smoothly and rapidly cut away material. Typically, my drum is made from a material such as stainless steel. However, other metallic materials are also suitable.

FIG. **4** shows an enlarged sectional view indicating the width (w) of the teeth and the height (h) of the teeth. Typically, the width (w) ranges from **0.005** inches to **0.006** inches and the height (h) ranges from **0.0040** inches to **0.0045** inches. The thickness of the base material is designated by t and ranges from **0.0020** inches to **0.0015** inches. However, in order to produce a high speed abrading drum the thickness t should be less than **0.002** inches for a drum approximately **6** inches in diameter. Thus, the ratio of the abrading drum diameter to the thickness should be in the order of about **3,000** to **1** for a **6** inch diameter drum. With these relative dimensions, it has been found that the abrading drum can withstand severe use in speeds up to **900** RPM without rupturing the welded seam. However, with abrading material having a thickness larger than **0.002** inch, the formation of the metallic abrading drum becomes difficult and hazardous because the centrifugal forces can quite easily rip the weld apart thus presenting a hazard to an operator using the abrading drum on a high speed machine.

Referring to FIG. **5,** there is shown a mandrel **30** for use with the abrading drum **10.** Mandrel **30** typically comprises a solid core **34** and an opening **31** for receiving a driving shaft. Located outside of core **34** is a layer of resilient material **35.** Typically, resilient material **35** comprises a flexible elastomer such as rubber. The resilient material **35** is sufficiently soft so as to expand radially outward under centrifugal forces or compress radially inward in response to abrading a curved surface. Typically, drum **10** is slightly larger than the mandrel **30** so that the drum can be easily slipped over the mandrel. Typically, it is preferred to have at least a diametrical clearance on the order of about **0.010** of an inch. This clearance allows one to slip the drum over the mandrel and provide cushioning to allow the drum to conform to the curved surface.

One starts the abrading unit by rotating the mandrel **30** which causes elastomer material **35** to be forced radially outward by centrifugal force. This causes material **35** to frictionally engage the interior surface of the abrading drum **10.** This feature has been found to provide a cushion for the abrading drum **10** as well as sufficient positive contact to propel the abrading drum at the same speed as the mandrel. With the mandrel constructed in this manner, the abrading drum can conform to the surface of the material to be abraded as the elastomer material allows for inward flexing of the abrading drum when force is applied radially inward. Thus, a curved surface can be abraded on drum **10.**

In order to provide the desired conformity of the drum to the surface of the material to be abraded, it is preferred to use material having a durometer reading which ranges from about **18** to **22** on scale A as defined by ASTM standard ASTMD **2240-68.** However, this is only preferred for use in abrading material such as shoe soles. Other ranges are also suitable for abrading differently curved surfaces or non-curved surfaces.

Referring to FIG. **6,** there is shown another embodiment of my invention in which I also provide an abrading drum and mandrel that can conform to a curved surface on the material to be abraded. More specifically, FIG. **6** shows a mandrel **20** having an edge or rim that frictionally engages the outermost end of abrading drum **10.** Similarly, another edge or rim (not shown) is located on the other end of mandrel **20** to frictionally engage the opposite end of abrading drum **10.** In this embodiment, the frictional force for driving drum **10** thus is provided at the rims or edges that engage the end of abrading drum **10** rather than along the entire surface of the drum. Located between abrading material **10** and mandrel **20** is an air gap designated by a. The air gap is typically one-fourth to one-eighth of an inch and allows for radial inward flexing of drum **10** in order to allow the drum to conform to the curvature of the material to be abraded on.

Referring to FIG. **7** and FIG. **8,** reference numeral **40** generally designates my improved abrading apparatus for use with my abrading drum. Abrading apparatus **40** comprises a stand **41,** a motor **42** (partially shown) and a drive shaft assembly **43** for powering abrading drum **10** through a suitable member such as a V belt. Abrading drum **10** is located over the mandrel which is driven by a shaft **44** which connects to drive shaft assembly **43.**

Referring to FIG. **8,** end view of apparatus **40** shows the removable mandrel housing **48.** Mandrel housing **48** has a bearing **45** for supporting shaft **44.** Bearing **45** is mounted on member **48** by bolts **49.** Mandrel housing **48** is held in alignment with respect to frame **41** by a pair of dowel or aligning pins **49** and a bolt **50** that passes through matched openings in housing **48.** A wing nut **50** holds the mandrel housing end against frame **41.** This wing nut **50** can be tightened or loos-

ened to allow one to remove housing **48.** The removal of housing **48** allows one to slip the bearing **45** off of shaft **44** thus allowing one to place the abrading drum over the mandrel (not shown) on apparatus **40.**

Referring now to FIGS. **7** and **8,** located over each end of the abrading drum and attached to apparatus **40** is a safety member **52** and a safety member **53.** Safety member **52** and **53** are looped metal sections that cover the outermost ends of abrading drum **10.** These sections will prevent the drum from flying off and hit an operator should a tear develop in the drum. A safety cover **54** also joins safety members **52** and **53** in the form of a shield covering the top half of drum **10** to insure that any torn or damaged abrading drum would be directed downward away from the operator.

The invention also includes a device for removing material that may be adhering to the abrading drums through the utilization of a brush **60** which is forced against abrading drum **10** by downward motion on a foot pedal **61.** As foot pedal **61** is pivotally mounted in leg **62** of apparatus **41,** it causes brush **60** to engage the rotating abrading drum. The forcing of brush into contact with abrading drum **10** removes any material which is loosely held on the abrading drum.

I claim:

1. An abrading apparatus including a member for supporting a rotatable mandrel, a mandrel rotatably mounted on said member, means for rotating said mandrel, said mandrel operable for receiving an abrading drum of diameter D_1, said mandrel having diameter D_2 which is less than said diameter D_1 to thereby provide clearance between said abrading drum and said mandrel to thereby allow said abrading drum to flex radially inward in response to a radial inward force on said abrading drum, said abrading drum having an elastomer surface located on the ends of said abrading drum that is sufficiently soft to expand radially outward under centrifugal force to thereby frictionally engage the inside of said abrading drum and an air gap between said ends of said abrasive drum that is sufficiently large so as to allow radial inward flexing of said drum in response to a radial inward force to said drum without producing engagement of said abrading drum with said elastomer surface on said abrading drum.

2. The invention of claim **1** wherein there is a diametrical clearance between said drum and said diameter of said mandrel on the order of about **.010** of an inch.

3. The invention of claim **1** wherein said abrading drum comprises a metallic base material having a plurality of metallic cutting teeth projecting therefrom, said teeth characterized by irregular sizes and shapes, said plurality of teeth spaced randomly throughout said material, said teeth further characterized by covering less than **10%** of the area of said metallic base material.

4. The invention of claim **3** wherein said elastomer has a durometer ready which ranges from about **18** to **20** on scale A as defined by ASTM standard ASTMD **2240-68.**

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,905,080 Dated 9-16-1975

Inventor(s) Herbert M. Bond

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

In Col. 6, line 5, "abrading drum" (second occurrence) should be --mandrel--

In Col. 6, line 6, "abrading drum" should be --mandrel--

In Col. 6, line 10, "abrasive" should be --abrading--

In Col. 6, line 14, "abrading drum" should be --mandrel--

Signed and Sealed this

Fourteenth Day of December 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks