United States Patent

[11] 3,600,861

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[54] **ABRASIVE WHEELS**
7 Claims, 6 Drawing Figs.

[52] U.S. Cl. 51/334, 51/337, 15/230
[51] Int. Cl. B24b 9/02
[50] Field of Search 51/334, 337; 15/230, 230.12, 230.14

[56] References Cited

UNITED STATES PATENTS

2,808,689	10/1957	Thomson et al.	51/337
3,078,624	2/1963	Peterson	51/334

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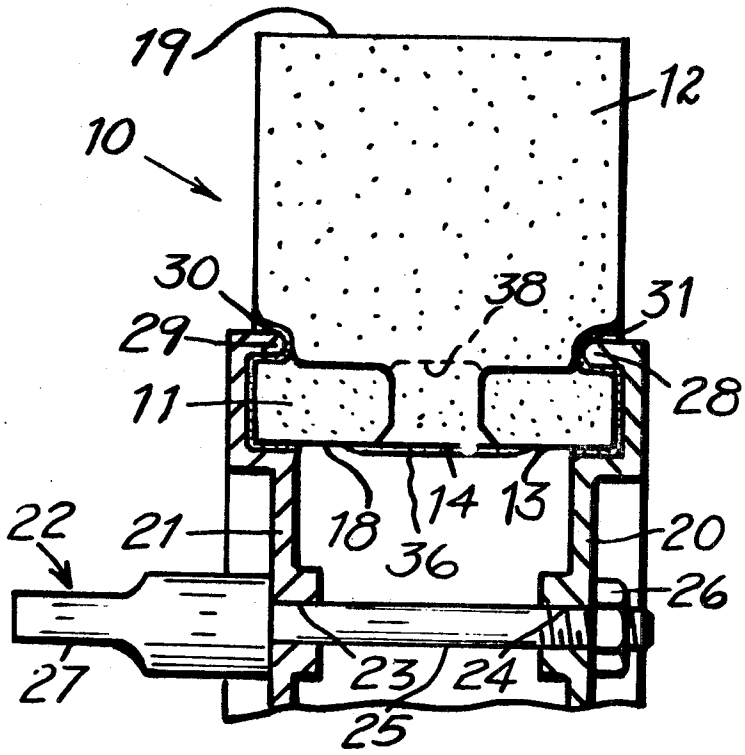
Attorneys—Hugh E. Smith and Herbert L. Gatewood

ABSTRACT: An abrasive wheel is provided wherein coated abrasive segments are arranged annularly in interlocking pairs. Such interlocking makes it possible to assemble a greater number of abrasive segments in the wheel thus providing an abrasive wheel of improved performance.



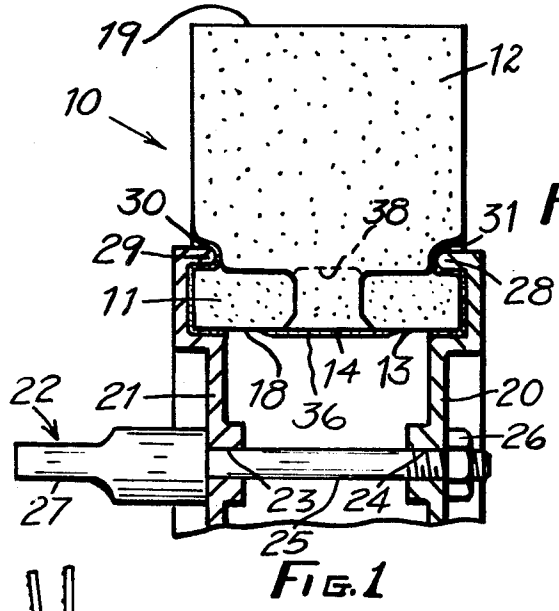


FIG. 1

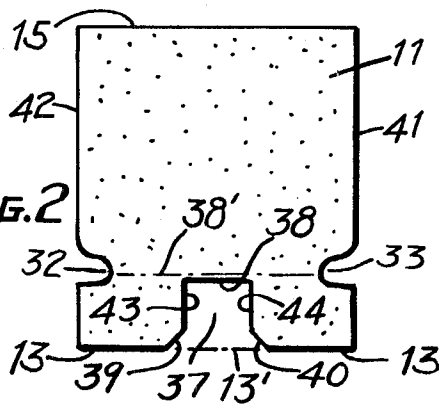


FIG. 2

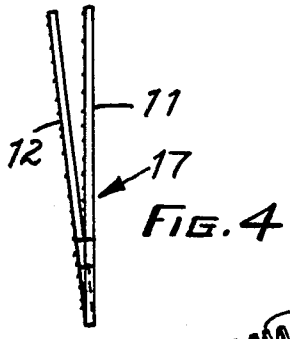


FIG. 4

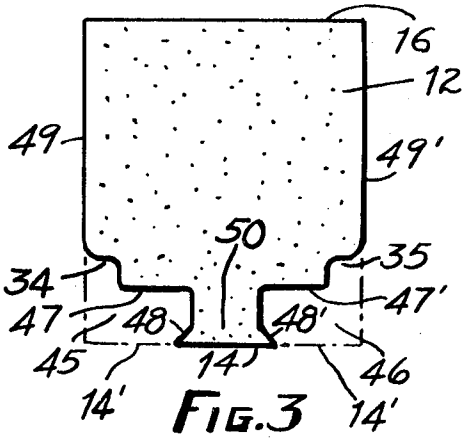


FIG. 3

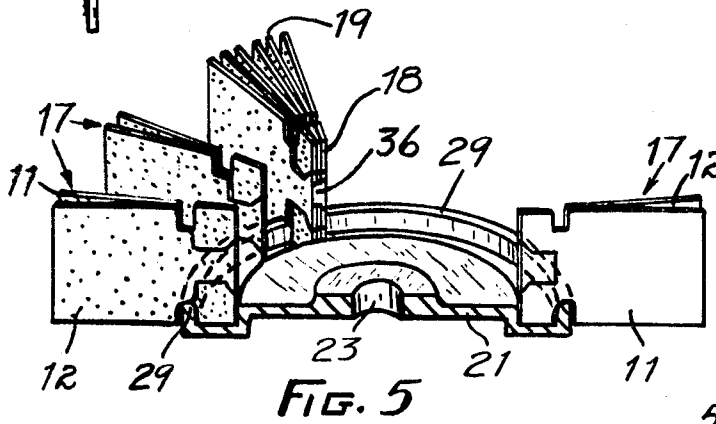
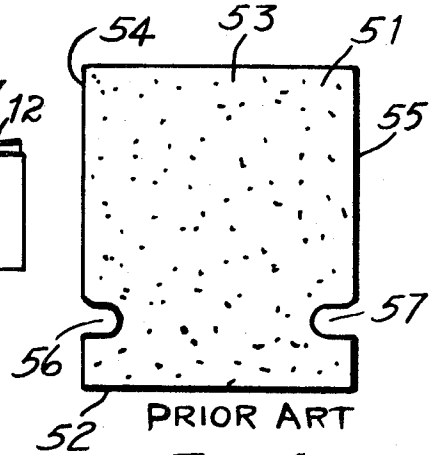


FIG. 5



PRIOR ART

FIG. 6

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ABRASIVE WHEELS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to flexible abrasive wheels and to their method of manufacture.

2. Description of the Prior Art

Flexible abrasive wheels, commonly referred to as "Flap Wheels" and made up of a plurality of annularly arranged coated abrasive segments, have found utility in a variety of abrading operations. In certain instances, however, such abrasive wheels have not been found totally satisfactory in their performance because they did not present the desired hardness or resistance of work surface.

The hardness or resistance of a "Flap Wheel" work surface is determined by the number of segment ends available at the outer periphery. In general, the greater the number of ends, i.e., the number of flaps or abrasive segments in a "Flap Wheel," the greater is the resistance and hardness of the abrasive wheel work surface at any given wheel speed. Thus, the more abrasive segments in a "Flap Wheel," the better it performs because such presents a harder, more resistant work surface and more abrasive wipings can be given to a workpiece per rotation of a particular wheel.

For these reasons, it has been suggested heretofore to provide abrasive wheels with the greatest number possible coated abrasive segments. Generally, attempts to provide such wheels involve merely compressing the segments together, sometimes mechanically, in closer relationship. However, one solution of which I am aware, disclosed in U.S. Pat. No. 2,808,689, suggests making flaps thinner at the inner end portion. To produce this result, the abrasive face of the coated abrasive segment or flap is skived at the inner end. Although this permits in an abrasive wheel an increased number of flaps as compared with an abrasive wheel where the flaps have not been skived, there are certain problems and disadvantages associated with the manufacture of such a "Flap Wheel."

Skiving of abrasive segments so as to prevent any damage to the underlying backing material is a difficult and time-consuming operation to perform. Moreover, it involves the extra handling of small workpieces and the performance of an extra operation. All of these operations contribute to increased costs in the manufacture of abrasive wheels.

SUMMARY OF THE INVENTION

In accordance with the general aspects of my invention, an abrasive wheel is provided having a working surface of improved hardness and resistance to deformation. This improvement is accomplished by providing in the abrasive wheel coated abrasive segments which are interlocked in pairs to provide a combined thickness of the base edge less than the sum of the individual segment thicknesses. Such reduction in thickness permits a greater number of coated abrasive segments to be assembled in an annular ring of any given diameter.

Quite advantageously, the invention permits the manufacture of abrasive wheels with a larger total number of abrasive segments without requiring any additional processing steps to the present method of manufacture and without requiring any mechanical compacting device.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood by referring to the drawing in which like numerals refer to like parts in the various views and in which:

FIG. 1 is a partial cross-sectional view of a completed abrasive wheel in accordance with the invention, the coated abrasive segments being shown in elevation for clearness in illustration;

FIG. 2 is a front elevation of one of the interlocking pair of abrasive segments of the invention;

FIG. 3 is a front elevation of the other one of the interlocking pair;

FIG. 4 is a side elevation of an interlocking pair of coated abrasive segments in accordance with the invention, such segments being dovetailed together at their base edges;

FIG. 5 is a view in perspective showing the assembling of interlocked pairs of segments on a sideplate in the manufacture of an abrasive wheel; and

FIG. 6 is a front elevation of a conventional coated abrasive segment, according to the prior art.

DETAILED DESCRIPTION OF THE INVENTION

Turning now to the drawing, there is disclosed in FIG. 1 thereof, in accordance with the invention, a completed abrasive wheel **10**. Coated abrasive segments **11**, **12**, having inner or base edges **13**, **14**, and outer or working edges **15**, **16** (FIGS. 2, 3), assembled in interlocking pairs **17** (FIG. 4) in an annular row, form an inner cylindrical periphery **18** and an outer cylindrical periphery **19**.

The assemblage of coated abrasive segments **11**, **12**, or "flaps" as they are commonly called, is clamped between sideplates **20**, **21**. The sideplates are held together and in contact with the abrasive segments by means of arbor **22** which extends through axially aligned bores **23**, **24** in the sideplates. The arbor is threaded at one end **25** to have screwed thereon a nut **26**. At the opposite end of arbor **22** is located spindle **27** by which means arbor **22** can be connected to a drive means (not shown) for rotation of the abrasive wheel.

Each of the sideplates **20**, **21** is provided with an annular protrusion or flange identified in FIG. **1** by reference numerals **28**, **29**. These flanges, as shown in FIG. **1**, intrude into annular grooves **30**, **31** formed by notches **32**, **33** and indentations **34**, **35** when the coated abrasive segments are annularly assembled. The size of these notches and indentations depends upon the size segment; however, for purposes of illustration, a notch or indentation ¼-inch × ¼-inch has been found satisfactory for a 2-inch wide segment. The corners of the notches and indentations, if desired, may be slightly rounded.

At the inner periphery **18**, the abrasive segments are bonded together by adhesive **36**. This adhesive may extend over the entire inner periphery; however, in the practice of my invention, I have found it entirely sufficient to provide adhesive **36** on the inner periphery only at the interlocking portion of the segments as shown in the drawing. The adhesive, which may be glue, or a curable synthetic resin composition preferably the latter, as desired, may be applied to the periphery by "painting." In addition to applying adhesive to the inner periphery, adhesive is generally also poured into the notches, and brushed, thereby providing a bond with the sideplates. A desirable manner of applying a curable resinous adhesive, e.g., a syrupy liquid epoxide to the entire inner periphery, is disclosed in U.S. Pat. No. 2,842,902. Therein the adhesive is disclosed as applied by centrifugal casting. Regardless of the manner of application, the adhesive should be applied in sufficient quantity to penetrate between and firmly adhere together at their base edges adjacent abrasive segments, thus providing a rigidified inner periphery. Because of the structural features of the segments of my invention, as hereinafter described, adhesive readily penetrates between adjacent segments thus providing for good anchorage.

Coated abrasive segment **11**, as shown in FIG. **2** of the drawing, is provided with cutout portion **37** extending away from base edge extended as shown by reference numeral **13'**. Cutout portion **37**, open at base edge extended **13'**, is defined by bottom edge **38**, in the preferred aspect of which is parallel to base edge extended and side edges **39**, **40** connecting the bottom edge to the base edge. Desirably, the side edges adjacent to base edge extended **13'**, as shown in the drawing, are tapered outwardly toward longitudinal edges **41**, **42**; however, these edges in the preferred embodiment are parallel to one another at their outer ends **43**, **44**. In the preferred embodiment of the invention bottom edge **38** extends no greater

distance from base edge extended 13' than an imaginary line (shown by dotted line 38') connecting together opposed notches 32, 33. Such line preferably bisects the notches. This feature lessens the chance of flap "throw out" due to flexing during use.

Cutout portion 37 desirably is centered between longitudinal edges 41, 42 thereby providing a coated abrasive segment of symmetrical construction. However, it will be realized by those skilled in the art that in abrasive wheels of greater width it may be desirable to have a plurality of cutout portions spaced equally along the base edge.

Coated abrasive segment 12, forming the other segment of the interlocking pair, is provided, in the preferred embodiment, with two cutout portions 45, 46, which extend away from base edge extended, as indicated by reference numeral 14', and are spaced apart from one another, as shown in the drawing. Cutout portion 45, as shown in FIG. 3, is defined by indentation 34, bottom edge or shoulder 47 and side edge 48. In the preferred embodiment bottom edge 47 is parallel to base edge 14 and extends no farther distant from such edge than does bottom edge 38 of coated abrasive segment 11. Side edge 48 of segment 12 complements side edge 39 of segment 11; thus, in its most preferred embodiment it tapers outwardly toward longitudinal edge 49. Cutout portion 46 is the mirror image of cutout portion 45, like parts being defined by adding a prime to the reference numerals used in the description thereof.

As seen from the drawing (FIG. 3) spaced-apart cutout portions 45, 46 define between them a tablike portion 50. When coated abrasive segments 11, 12 are assembled together in pairs tablike portion 50 dovetails into cutout portion 37 thus providing a pair of segments which at the base edge is less thick than the sum of the thicknesses of the individual segments.

Those skilled in the art will readily recognize that it is possible to provide in abrasive segment 12 a multiplicity of tablike portions to complement the above-mentioned multiplicity of cutout portions in abrasive segment 11.

The coated abrasive segments, which can be die cut, or the like, from any coated abrasive material, are arranged such that the abrasive surfaces thereof extend in the same direction around the wheel structure with the abrasive surface of one segment facing the back surface of the adjacent segment. If desired, however, coated abrasive segments may be used which are abrasively coated on both sides.

The following examples, which are given for purposes of illustration only and are not intended to be limiting of the inventive concept, will more clearly illustrate the preferred embodiments of the invention.

EXAMPLE 1

Abrasive segments 51 (FIG. 6), conventionally used in the manufacture of abrasive wheels, were die cut from Grit 60 RESINALL METALITE® cloth. Each segment had a base edge 52, a working edge 53, and longitudinal edges 54, 55. The segments were substantially rectangular in shape, as shown in the drawing being 2 inches (base edge) by 3⅛ inches. Opposed notches 56, 57 (¼-inch × ¼-inch) having slightly rounded corners were provided in the longitudinal edges 54, 55 of the abrasive segments three-eighths inch from the base edge.

According to usual techniques these segments were then assembled in an annular fashion (see FIG. 5) by placing sideplate 21 (3 inches diameter) on a supporting surface (not shown) with flange 29 upright and then placing the segments by hand on the flanged sideplate in such fashion that the matching flange projected into notch 56. Using only hand pressure, it was possible to assemble, on the average, only 181 segments in an abrasive wheel.

In a similar fashion, coated abrasive segments were assembled in an annular row on flanged sideplates having diameters of 4 and 5 inches. The maximum number of segments which could be assembled by hand pressure was, on the average, 250 and 319, respectively.

EXAMPLE 2

Coated abrasive segments 11, 12, having the shape of those segments shown in FIG. 2 and 3 respectively, were die cut from the same type coated abrasive cloth as the segments in example 1.

Segments 11, having cutout portion 37 therein (FIG. 2) measured 2 inches across working edge 15. Longitudinal edges 41, 42 measured 3⅛ inches. Opposed notches 32, 33 (¼-inch × ¼-inch) having slightly rounded corners were provided in the longitudinal edges three-eighths inch (bottom of notch) from base edge 13. Cutout portion 37, of irregular shape, extended away from base edge 13, i.e., toward working edge 15, and was divided in half by an imaginary centerline dividing the abrasive segment 11 laterally into two equal parts. The cutout portion, open at base edge 13 of the segment, as indicated in the drawing, was defined by a bottom edge parallel to the base edge. The bottom edge was three-eighths inch from the base edge and extended laterally for a distance of one-fourth inch on each side of the imaginary centerline. At that point side edges extended perpendicular thereto and toward base edge 13. These side edges at a distance from the base edge of one-eighth inch, taper outwardly at an angle of about 60°. Thus cutout portion was provided at the base edge with an opening of three-fourths inch.

Segments 12, having base edge 14, working edge 16, and longitudinal edges 49, 49' were die cut so as to provide at the base edge two spaced-apart cutout portions defining a tablike portion 50 (FIG. 3). The segment measured 2 inches (working edge) × 3⅛. Tablike portion 50 measured three-fourths inch along base edge 14 and was divided in half by an imaginary centerline which divided the coated abrasive segment 12 into two equal parts. The tablike portion tapered inwardly (60°) from the base edge such taper terminating about one-eighth inch distance therefrom. At that point, side edges parallel with respect to one another were extended perpendicular to the base edge terminating at shoulders 47, 47' parallel with the base edge and three-eighths inch distance from this edge. These shoulders extended approximately one-half inch joining at their ends with indentations (¼-inch × ¼-inch) provided in longitudinal edges 49, 49'. Such indentations correspond with notches 32, 33 in segment 11.

Die cut segments 11, 12 were matched together in complementary pairs 17 (FIG. 4), the tablike portion 50 interlocking with cutout portion 37. These pairs of segments were then assembled by hand in an annular row on a flanged end plate 21, as described in example 1.

As indicated in the table below, with the segments of my invention, an abrasive wheel can be produced having a substantial increase in the number of coated abrasive segments.

Flange Dia. (Inches)	Number Flaps Control Wheels (Ex. 1)	Number Flaps Interlocking Wheel (Ex. 2)	Number Flaps Gained	% of Gain
3	181	220	39	21.5
4	250	300	50	20.0
5	319	376	57	17.9

The improved performance of abrasive wheels produced in accordance with my invention is shown in the following comparative test.

EXAMPLE 3

Abrasive wheel segments, as in examples 1 and 2, were assembled in annular fashion, by hand, on a 5-inch diameter flanged end plate. After assembly, a liquid curable adhesive having the composition hereinafter described was applied as

follows: The adhesive composition was brushed onto the inner periphery (in the case of wheels utilizing abrasive segments according to the invention, the adhesive composition brushed onto the periphery of the dovetailed segments formed a bead about half the width of the adhesive layer shown by reference numeral **36**); next, the adhesive composition was poured and brushed into the annular groove defined by the notches in the sides of the segments. A second flanged end plate was positioned such that its flange fitted into the annular groove. The abrasive wheel was then turned over, the first positioned end plate was removed and adhesive was again applied to the inner periphery (bead forming other half of adhesive **36** shown in the drawing in the case of segments according to the invention). Adhesive composition was then poured into the groove defined by the notches after which the end plate was repositioned. After about 5 hours at room temperature, the adhesive composition (end plates compressed by arbor) was cured and the abrasive wheel was ready for use. The adhesive composition was observed to be penetrated between the segments of the invention at their base edges thus bonding the segments together and forming a rigidified inner periphery.

RESIN MIX

COMPONENTS	WEIGHT (LBS.)
Epon 815 (an epoxy resin which is the condensation product of epichlorohydrin and bisphenol –A)	23½
Santocel (silica aerogel)	1½

ADHESIVE COMPOSITION

COMPONENTS	WEIGHT (GMS.)
Resin Mix	100
Diethylene triamine	20

A 2-inch ring was cut from a 6-inch I.D. carbon steel pipe. This ring, suitably mounted for rotation, was rotated at a surface speed of 51 feet per minute (s.f.p.m.).

The abrasive wheels, rotating at a surface speed of 4,580 s.f.p.m., were urged in grinding contact with the steel ring using 5 lb./inch width dead weight pressure.

The abrasive wheel having interlocking segments in accordance with the invention (in a 30-minute test) cut 25 percent better than the control. Moreover, the wheel weight loss (shed) was 48 percent less than in the control wheel.

As many different embodiments of my invention will occur to those skilled in the coated abrasive art, it is to be understood that the specific embodiments of the invention as presented herein are intended by way of illustration only and not limiting on the invention but that the limitations thereon are to be determined only from the appended claims.

What I claim is:

1. Abrasive wheel comprising a plurality of flexible coated abrasive segments each of which has a working edge and a base edge, said segments being disposed in annular fashion defining by said base edges an inner cylindrical periphery and by said working edges an outer cylindrical periphery, said segments being paired together in interlocking relationship whereby to create in said pairs a base edge combined thickness less than the sum of the individual thicknesses of the segments, and being secured together at said base edges by a cured adhesive.

2. Abrasive wheel according to claim **1** wherein in said interlocking pairs one of said segments has at least one cutout portion extending radially from said inner periphery and the other of said segments has at least two spaced-apart cutout portions extending radially from the inner periphery, said spaced-apart cutout portions defining a tablike portion, said one cutout portion matching with the tablike portion whereby the segments are interlocked thus permitting a greater number of total segments to be provided in the abrasive wheel than in a wheel having segments not possessing such cutout and tablike portions.

3. Abrasive wheel according to claim **2** wherein said at least one cutout portion and said tablike portion are widest at the base edge of the segment and narrowest at some distance from said base edge.

4. Abrasive wheel according to claim **3** wherein in each of said segments having at least one cutout portion is located at a distance from the base edge opposed notches, said notches forming in said abrasive wheel annular grooves concentric with said inner cylindrical periphery, said at least one cutout portion extending to a distance no greater than an imaginary line connecting together said notches at their center.

5. Abrasive wheel according to claim **4** wherein in the other of said segments said spaced-apart cutout portions extends to a distance from the base edge no farther than does said at least one cutout portion extend from its base edge.

6. Abrasive wheel according to claim **5** wherein the segments have cutout portions and tablike portions such as shown in FIGS. **2** and **3**.

7. Abrasive wheel according to claim **2** wherein said at least one cutout portion is defined by a bottom edge parallel to the base edge of the segments, spaced-apart side edges extending perpendicularly therefrom for some distance toward the base edge and which taper outwardly at a distance more closely adjacent said base edge and said tablike portion in the other segment is defined by a complementing shape.