Oct. 17, 1961 R. A. BROOKS 3,004,373

ABRASIVE DEVICES

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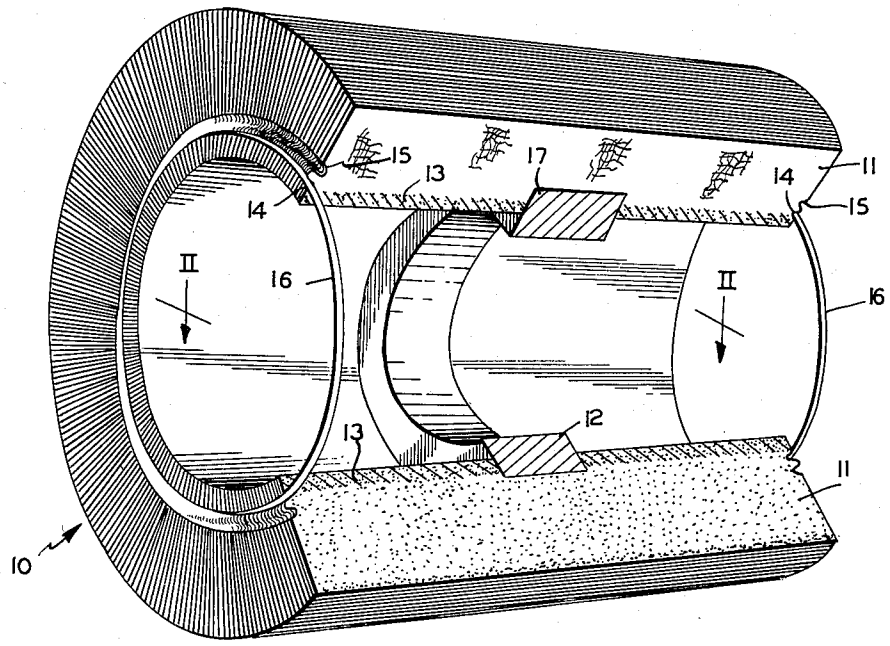


FIG. 1

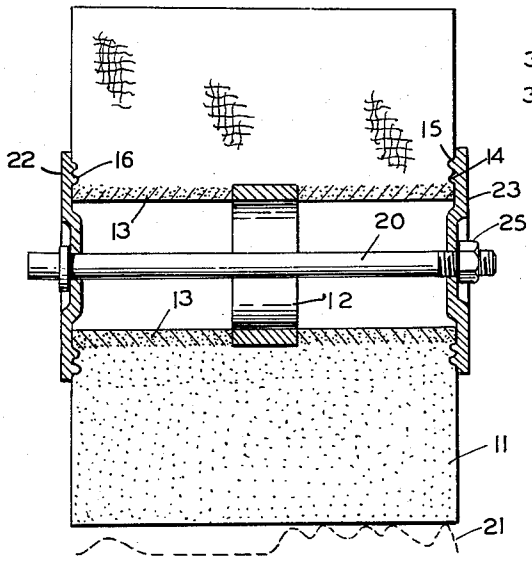


FIG. 2

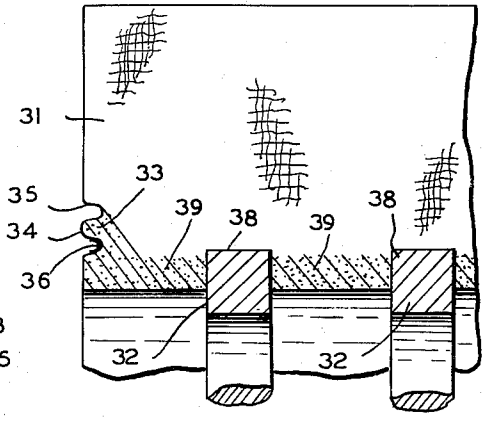


FIG. 3

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ABRASIVE DEVICES

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Abrasive wheels composed of an annulus of radially extending abrasive coated sheets have recently come into extensive use for polishing and abrading operations. In wheels of this nature the radially inner ends of the sheets are held together as by an adhesive and the wheel is mounted on a hub for rotation whereby the outer ends of the sheets contact the work to be abraded or polished. So-called flap wheels of this general type are described in U.S. Patents 2,651,894; 2,818,619 and 2,842,902.

Although relatively narrow wheels of the above type, hereinafter referred to as "flap wheels," may be constructed without serious difficulty, the construction of wider wheels presents problems, in that the inner periphery of the wheel is often not strong enough to hold the wheel together under high rotative speeds or rough handling. By the nature of these wheels, the individual flaps must be held together in or near the inner periphery only, permitting the major part of the sheets or flaps to be free from one another. Thus, a strong integral inner periphery having strength to support the wheel and resist disintegration at high rotative speeds is required.

One expedient for holding and reinforcing the inner ends of the flaps at the internal periphery of the wheel is to apply adhesive to the inner periphery of the wheel, preferably permitting the adhesive to penetrate radially outwardly between the individual flaps to provide an integral annular reinforcement of adhesive across the entire width of the wheel.

The strength of such wheels, reinforced by the ring of adhesive, is limited by the inherent strength of the adhesive and by the depth of penetration between the flaps of the adhesive.

Furthermore, it is sometimes difficult to be sure that the adhesive will penetrate deeply enough uniformly over the entire internal area of the wheel. Wherever insufficient penetration at any point takes place, the over-all strength of the wheel is correspondingly decreased. Still another disadvantage of relying on a single integral ring of adhesive for reinforcement of the wheel is that, should the ring fail, the failure of the ring ordinarily will continue across the width of the wheel, requiring replacement of the wheel.

In use, wheels of this nature are fitted on an arbor between flanges which exert compressive force on the wheel along its axis. Also, in operation against an irregular shaped work-piece, buckling force may be exerted on the wheel. The resistance of the flaps alone is often insufficient to prevent buckling of the wheel under these conditions. Thus it is the integral reinforced inner periphery of the wheel which must resist this buckling force. Obviously, the problem of buckling becomes more serious when wider wheels are employed, whether the buckling is caused by pressure on the flanges or by centrifugal force.

It is, therefore, an object of my invention to provide a flap wheel construction having high strength and resistance to buckling and disintegration.

It is another object of my invention to provide a flap wheel construction whereby a flap wheel of any desired width may be produced.

Other objects of my invention will be apparent from the following description and the accompanying drawings in which:

FIGURE 1 is a perspective view, partly broken away, of a flap wheel of my invention.

FIGURE 2 is a detail view taken on line II—II of FIGURE 1 of a mounted wheel.

FIGURE 3 is a view similar to FIGURE 2 of a modified wheel of my invention.

Referring now to FIGURE 1, **10** is the flap wheel of my invention with about ⅓ of the coated abrasive sheets **11** removed and the support ring **12** partially cut away to show the internal construction of the wheel. Annular side grooves **14** and **15** are formed by notches cut in each flap section **11** which are aligned to form the grooves. The grooves are so spaced to mate with corresponding annular projections on standard side flanges provided when the wheel is mounted on a spindle for rotation about its axis. Groove **17**, for receiving the support ring **12**, is formed by a notch cut at the inner end of each flap.

FIGURE 2 shows the arrangement of a modified wheel mounted on a spindle **20** for abrading a work-piece contoured, for example, as indicated at **21**.

The wheel of FIGURE 1 is rigidified and held together at the inner ends of the flaps **11** by a rigid core indicated at **13** of solidified adhesive applied in a liquid form to the inner periphery of the wheel when the wheel is formed. A simple method of forming the wheel is to assemble the die-cut sheets **11** around a vertical spindle upon which is mounted an end flange **22**. After assembling about one-third of the total number of sheets about the spindle, the support core **12** is inserted in the partially completed groove **17**. Upon completion of assembly of all of the abrasive sheets about the core **17**, a retaining ring **16** is preferably positioned in grooves **14** and **14'** at each end of the wheel in order to help form and hold the wheel in a circular configuration in the initial stages of manufacture. If desired the rings **16** may be permanently adhesively secured in the grooves to give added support and strength to the wheel.

After the flap sections **11** have been arranged the adhesive **13** may be applied by providing each end of the wheel with temporary walls or dams, such as annular plates, extending radially inwardly from the inner diameter of the wheel. After placement of the dams, adhesive is poured into the center of the wheel which is mounted horizontally and turned on a spindle to permit an even penetration of the adhesive between the flap sections about the inner periphery of the wheel on each side of the reinforcing core **12**.

However the adhesive may be applied, the final result should be as shown in FIGURE 1, wherein the adhesive core extends outwardly from the inner periphery a distance corresponding approximately to the outer diameter of support core **12**.

Support core **12** is of a material which is readily bonded by the adhesive **13** employed. A suitable material is wood, plywood, or other material such as composition board which forms a good bond with the epoxy or other adhesive employed.

The use of one or more supporting cores in the internal periphery of flap wheel construction provides a rigid support which resists deflections due to high rotative speeds or other stresses, otherwise occurring in wheels without such supporting means. In effect, it appears that while a flap wheel without a supporting core **12** is fixedly held at the ends of the wheel only, the wheels of the present invention are relatively rigidly held not only at the ends but at each supporting core.

In addition by employing core **12**, an internal resistance to twisting of the flap wheel is provided, which twisting can occur when the wheel is applied to an irregular contour of a work-piece such as is shown at **21** in FIGURE 2.

The core **12** also strengthens the wheel against compressive forces applied when the wheel is mounted between flanges **22** and **23** on a spindle **24** as shown in FIGURE 2, and the nut **25** is tightened.

In addition, the support ring provides a discontinuity in the adhesive reinforcement, in effect dividing the reinforcement into separate adhesive rings. By this expedient a fracture in one of the adhesive rings will be prevented from continuing across the width of the wheel, avoiding the necessity for discarding the wheel.

Referring now to FIGURE 3, there is shown a section partially broken away, of a wide flap wheel employing a plurality of support rings **32** fitted and bonded into notches **38** in flaps **31**. Side grooves **34** and **35** and ring **36**, similar to grooves **14** and **15** and ring **16** are shown. In terms of resistance to compressive forces and resistance to twisting, the wheel constructed in accordance with FIGURE 3 is outstanding. In the construction of FIGURE 3, each support ring or cylinder **34** separate sections of the wheel to effectively form two narrow flap wheels. Thus a flap wheel of whatever width desired may be formed by using the principles of construction taught by my invention. Heretofore, one expedient employed when a wide flap wheel was desired was to position a plurality of narrow flap wheels side by side upon a common spindle. When a wide, ganged wheel of this type was used, however, uneven polishing or grinding resulted producing a plurality of marks on the work spaced apart by the width of the individual wheels. Since no discontinuities are present along the width of wheels made according to my invention, a superior finish is produced on the work-piece, while the wheel, in strength, is equivalent to a plurality of ganged wheels.

The wheel of FIGURE 3, but for the use of a plurality of support rings **32**, is similar to the flap wheel of FIGURES 1 and 2 in that side grooves **34** and **35** are provided at each end of the wheel (only one end being shown in the drawing). At **36** is a metal ring **36** similar to ring **16** of FIGURES 1 and 2. At **39** the hatching indicates the adhesive extending between the flaps to a depth about equivalent to the outer diameter of the support rings. If desired adhesive can be applied at the ends of the wheel at the grooves **34** and **35**, to flow between the flap elements in the area adjacent the grooves **34** and **35** to provide additional reinforcement at this area on each end of the wheel. Such adhesive penetration is indicated at **33** in FIGURE 3.

It will be obvious that although I may employ relatively wide support rings to manufacture wide wheels, that in view of the consideration discussed above, a wheel employing a given total width of support ring structure may, in the case of wider wheels, be preferably made by employing a plurality of support rings so as to separate the wheel effectively into a plurality of adjacent independent flap wheel mounted about a common axis.

For wheels 10 or more inches wide, two or more support rings are desirable, although the particular width of wheel and number and width of support rings is widely variable. The particular support required for a given wheel depends upon the type and amount of adhesive employed, the strength and stiffness of the coated abrasive sheet material employed and the type of use to which the wheel may be put.

The bonding adhesive may be any resin or glue which when hardened provides a strong hub for the wheel. Epoxy resins (sold by Shell Chemical Co.) with suitable catalysts are satisfactory.

The support rings can be formed of wood, plywood, synthetic resins or other similar material. Preferably the rings should be of a fibrous or porous nature to ensure good adhesion of the bonding adhesive to the radial faces of the support rings in contact with the abrasive flaps.

Although I have shown the support rings to have an inner diameter smaller than the inner diameter of the flaps, obviously the inner diameter may be varied as desired and in accordance with the size of the spindle upon which the wheel is to be mounted. In some cases where additional support is required or deemed desirable, the inner diameter of the support ring is preferably of such a diameter as to provide a fairly snug fit on the cylindrical spindle upon which the wheel is mounted. By such an expedient the shaft itself gives added support to the wheel structure against failure at high rotative speeds. In other cases it may be desirable to make the inner diameter of the support rings flush with the inner ends of the flaps, where the reduced ring is of sufficient strength.

I claim:

1. An annular abrasive wheel comprising a plurality of flexible abrasively coated sheets formed in an annular row defining an inner cylindrical periphery and an outer cylindrical periphery, said sheets being secured together adjacent said inner periphery by a cured adhesive penetrating between adjacent sheet members, at least one annular groove in said internal periphery and a rigid fibrous annular core member bonded in said groove.

2. An annular abrasive wheel as in claim 1 wherein said wheel is provided with a plurality of said rigid annular core members, the inner periphery of the core members being adapted to snugly fit a mounting shaft for said wheel.

3. An annular abrasive wheel comprising a plurality of flexible abrasively coated sheets bonded together adjacent one end to form an annular row defining an inner and an outer periphery, said sheets being bonded at said inner periphery by a cured adhesive extending between said sheets adjacent said one end, at least one annular groove in said inner periphery defined by notches in said sheets, and a rigid annular core member in said groove having an inner and an outer periphery, the diameter of said outer periphery being equal to the diameter of said groove and said core member being bonded in said groove throughout its depth by said cured adhesive.

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