Nov. 30, 1965 A. BLOCK 3,220,810

FLAP-TYPE ABRASIVE WHEEL

Filed May 3, 1962

Fig. 1

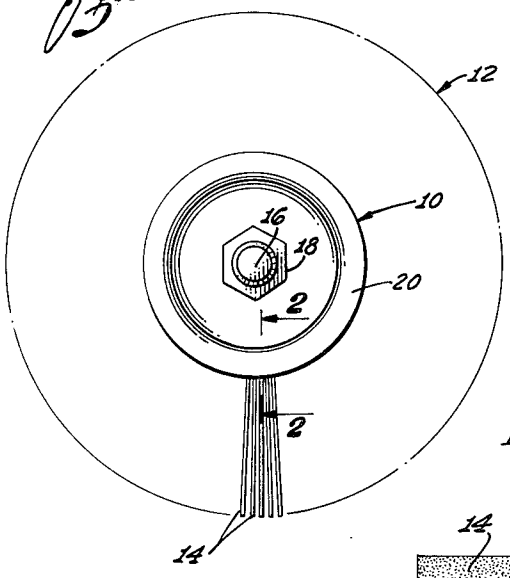


Fig. 2

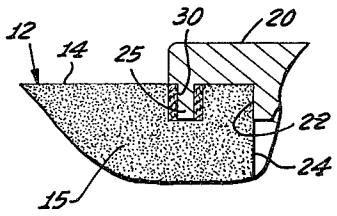
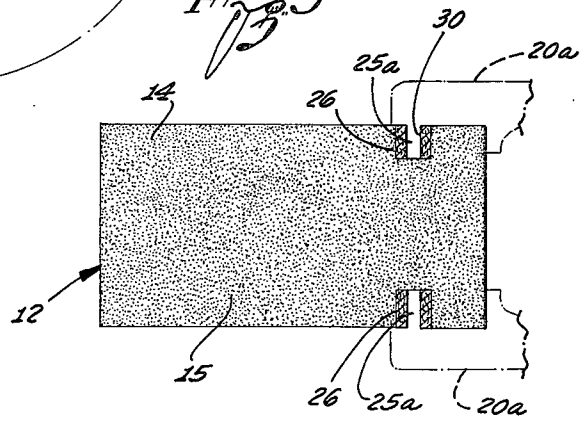


Fig. 3



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FLAP-TYPE ABRASIVE WHEEL

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This invention relates to a flap-type abrasive wheel comprising an annular array of radially positioned flexible abrasive leaves and a hub structure to support the annular array for rotation on its axis.

In the conventional construction of such an abrasive device, the inner ends of the leaves are adhesively bonded together to form a unitary annulus, usually by the application of an epoxy resin that is of low viscosity for ready penetration between the leaves. Concentric grooves are then formed in the unitary array of leaves on its opposite side near the inner ends of the leaves, each groove comprising concentrically aligned notches of the individual abrasive leaves. The hub structure on which the annular array is mounted includes side plates which have circular retaining elements in the form of flanges that extend into the annular grooves for interlocking engagement with the annular array and to anchor the leaves against centrifugal force.

It has long been known that the service life of such a unified annular array of abrasive leaves is reduced by loosening of the inner anchored portions of the leaves. Structural failure occurs in which cracks form at the corners of the notches of the leaves and then spread from the notches.

It has been discovered that such structural failure occurs because the circular flanges of the hub structure do not fully occupy the concentric grooves to eliminate clearance between the inner circumferential surfaces of the flanges and the inner circumferential surfaces of the grooves. Since the radially inner edges of the notches of the individual leaves do not snugly abut the inner circumferential surfaces of the circular flanges, there is clearance for radially outward movement of the notched portions of the brasive leaves. Because of this freedom for relative movement, the adhesive bonds along the inner ends of the leaves fail in response to centrifugal force and when these bonds fail, the individual leaves are subjected to concentrated stress of destructive magnitude.

With this discovery in mind, it might be concluded that the structural failure of the inner anchored ends of the abrasive leaves could be avoided simply by such close dimensional control of the notches and the hub structure flanges as to eliminate any freedom for radially outward movement of the inner ends of the abrasive leaves relative to the hub structure flanges. Such a solution is not satisfactory, however, for two reasons.

In the first place, it is difficult to achieve the required close fit and especially so because the grooves are cut in layer of fabric having discrete fibres. In the second place, the walls of the cut grooves are fibrous walls formed by exposed raw fabric edges of the abrasive leaves and the fibrous walls tend to yield under the pressure against the retaining flanges created by centrifugal force. The yielding action permits the individual leaves to creep radially outward against the retaining flanges and, of course, such radial shift tends to separate the leaves and cause rupture of the inter-leaf bonds. It is to be borne in mind that the cutting action to form the grooves cuts into the epoxy to fracture the epoxy at the edges of the leaves.

The invention solves this problem by a new fabrication approach. Instead of attempting to form the notches in the abrasive leaves at dimensions close to the cross-

sectional dimension of the hub structure flanges, the notches are deliberately cut substantially oversized in radial dimension relative to the radial dimension of the retaining flanges of the hub structure flanges so that the two flanges of the hub structure fit into the two annular grooves of the array of leaves with liberal clearance in both radial directions. To carry out this concept, the inner end portions of the brasive leaves are bonded together in the usual manner by epoxy resin of low viscosity to unify the array and then the oversized concentric grooves are cut into the opposite sides of the unified array.

The next step in the new fabrication procedure is to nearly fill the two concentric grooves with a highly viscous and highly adhesive cement-like material capable of forming a hard mass of high structural strength. It has been found that this purpose may be served by adding a suitable thickening agent to an epoxy resin. Various thickening agents may be used within the skill of the art, including finely divided inert material such as asbestos fibres or granular asbestos. A thickening agent found to be completely satisfactory is commercially available under the name "Carbosyl." The plastic material should be so highly viscous that when the material is newly applied it will not run out of the grooves even when the wheel is positioned upright.

The next step is to mold grooves in the applied thick plastic material to the precise dimensions of the hub structure flanges and then to let the plastic material harden. A high degree of accuracy in the forming of the grooves in the plastic is easily attained at low cost because a molding operation in a plastic is inherently conducive to accuracy in contrast to the operation of cutting a groove in fibrous material.

The final molded grooves fit the retaining flanges closely and have the further advantage of eliminating raw fabric edges. The raw fabric edges that are created and exposed by the cutting operation are embedded in the hard plastic, reinforced by the hard plastic, and protected by the hard plastic against direct yielding contact with the retaining flanges.

In one practice of the invention, the flanged side plates of the hub structure are not supplied with the annular array of abrasive leaves in permanent engagement therewith but accurately dimensioned duplicates of the side plate flanges are used at the factory to perform the grooves in the plastic material. The customer's flanged side plates fit the grooves as snugly as the prototypes used at the factory to form the grooves.

The features and advantages of the invention may be understood from the following detailed description and the accompanying drawing.

In the drawing, which is to be regarded as merely illustrative:

FIG. 1 is a side elevation of a flap-type abrasive wheel embodying one practice of the invention;

FIG. 2 is a fragmentary radial section taken along the line 2—2 of FIG. 1 showing how a side plate extends into the resin to mold a concentric groove in the side of the annular array of abrasive leaves; and

FIG. 3 is a similar view with the side plate withdrawn from the resin after the resin hardens in the factory fabrication of the annular array.

In the drawings, illustrating selected practices of the invention, FIG. 1 shows an assembled flap-type abrasive wheel comprising a hub structure, generally designated **10**, and a replaceable unit comprising an annular array **12** of radially disposed flexible abrasive leaves **14**. The leaves **14** are commonly of the character of emery cloth with a coating **15** of abrasive particles on one face of the fabric.

The hub structure **10** is mounted on a drive shaft **16** and is confined thereon between a pair of nuts **18**. The hub structure includes a pair of removable side plates **20** positioned respectively on the opposite sides of the annular array **12**. As indicated in FIG. 2, each of the two side plates **20** has an inner concentric shoulder **22** to abut the inner circumferential surface **24** of the annular array and each side plate is further formed with an integral concentric retaining flange **25** for interlocking engagement with the corresponding side of the array.

As heretofore stated, the inner end portions of the radially positioned abrasive leaves **14** are commonly bonded together by suitable adhesive material, such as epoxy resin, to unify the array of leaves and to form a solid annular core from which the individual leaves extend. Concentric grooves are then cut in the opposite sides of the unified array, the grooves forming concentrically aligned notches in the individual abrasive leaves **14**. As further stated heretofore, it has been conventional practice to dimension the concentric side grooves for snug fit by the retaining flanges **25** of the side plates **20**.

In the practice of the present invention the inner end portions of the abrasive leaves are bonded together to unify the array in the usual manner but in carrying out the next step of forming the grooves to receive the side plate flanges **25**, the grooves are cut oversize in width.

Thus in FIGS. 2 and 3 each of the two concentric grooves **26** in the two opposite sides of the annular array is substantially wider than the thickness of the corresponding retaining flange **25** of the side plate, there being liberal clearance in each groove on both the radially inward side and the radially outward side of the retaining flange. An adhesive cement-like material capable of curing to a hard and structurally strong mass is deposited in the two side grooves **26** of the array in preparation for the interlocking engagement of the two side plates with the array. An epoxy resin has been found to be highly satisfactory for this purpose but the resin must be highly viscous to remain in the two grooves without running out of the grooves even when the annular array is turned upright. If necessary to achieve the required high viscosity, a suitable thickening agent is added to the epoxy resin as heretofore stated.

While the epoxy resin in the two grooves **26** is still soft, the concentric flanges **25** of the side plates **20** are forced into the grooves **26**. The result is that the resin **28** and the concentric retaining flanges **25** completely fill the grooves **26**. It is apparent that the concentric retaining flanges **25** mold annular grooves **30** in the resin **28**, the annular grooves being of precisely the dimension in cross section of the retaining flanges **25** of the side plates.

The two side plates **20** are removed before the annular array is shipped from the factory. The purchaser, however, has a duplicate set of side plates **20*a*** which are shown in phantom in FIG. 3 and the concentric flanges **25*a*** of the purchaser's side plates **20*a*** fit the annular grooves **30** in the same snug manner as the flanges **25** of the side plates **20** used at the factory.

It may be readily appreciated that the presence of the hardened resin **28** in the annular grooves **26** effectively eliminates all voids in the grooves and insures positive anchorage of the individual abrasive leaves **14**. There is no freedom for the inner end portions of the abrasive leaves to shift radially outwardly relative to the retaining flanges.

There are no soft yielding raw fabric edges in abutment with the retaining flanges or the retaining rings. Instead, the fabric edges are embedded in thick annular bodies of hard plastic and it is the hard unyielding annular plastic bodies that engage the metal of the retaining flanges and retaining rings. The anchored inner ends of the leaves are not bonded merely by intervening adhesive that has been subjected to a cutting operation. The leaves are additionally bonded by the thick annular bodies of hardened plastic with the hard plastic bridging and bonding together the raw edges of the abrasive leaves. Consequently the inner annular portion of the annular array in the region of the engagement of the annular array by the side plates of the hub structure stands up without deterioration as long as the abrasive leaves are serviceable.

My description in specific detail of the selected embodiments of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

I claim:

1. A method of producing an abrasive wheel, including the steps of:

producing a concentric groove in at least one side of a plurality of leaves disposed in an annular array,

filling the concentric groove with a viscous adhesive material,

inserting an annular ring into the groove before the adhesive material has become hardened where the ring has particular dimensions, and

removing the annular ring from the groove to define the particular dimensions for the groove.

2. The method set forth in claim **1** wherein the leaves are bonded at their radially inner ends to unify the array.

3. A method of producing an abrasive wheel, including the steps of:

providing flexible abrasive leave in an annular array,

forming first particular grooves on the opposite sides of the annular array in concentric relationships,

disposed adhesive plastic material in the first particular grooves to fill the first particular grooves,

disposing circular elements in the first particular grooves while the adhesive material is still plastic to form second particular grooves with particular dimensions less than those of the first particular grooves, and

removing the elements to define the second particular grooves.

4. The method set forth in claim **3** wherein the leaves are bonded at their radially inner ends to unify the array.

5. The method set forth in claim **4** wherein the adhesive plastic material is an epoxy resin.

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