March 27, 1962 W. OSENBERG 3,026,655

FACE GRINDING WHEEL

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Fig.1

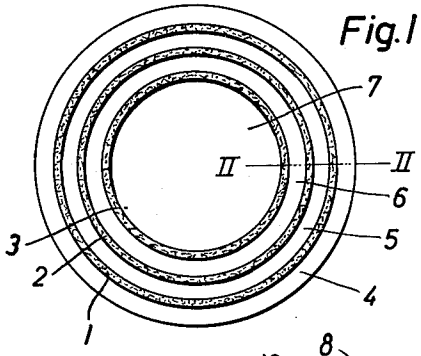


Fig.2

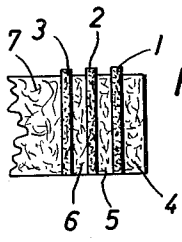


Fig.3

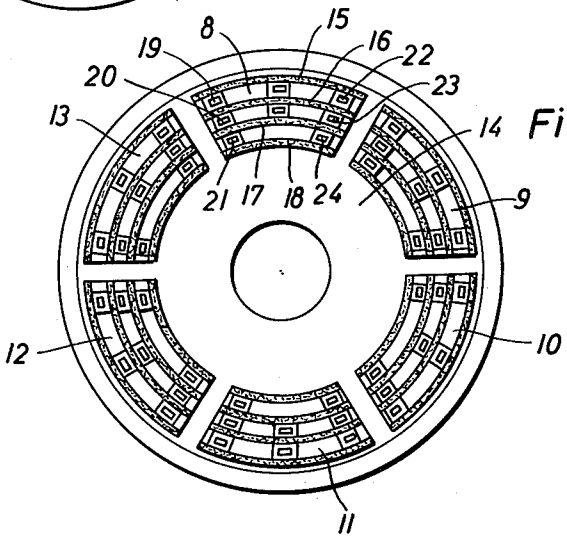


Fig.4

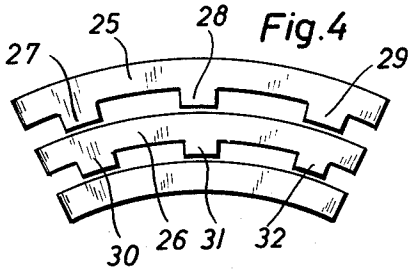
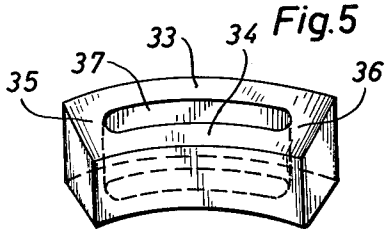


Fig.5



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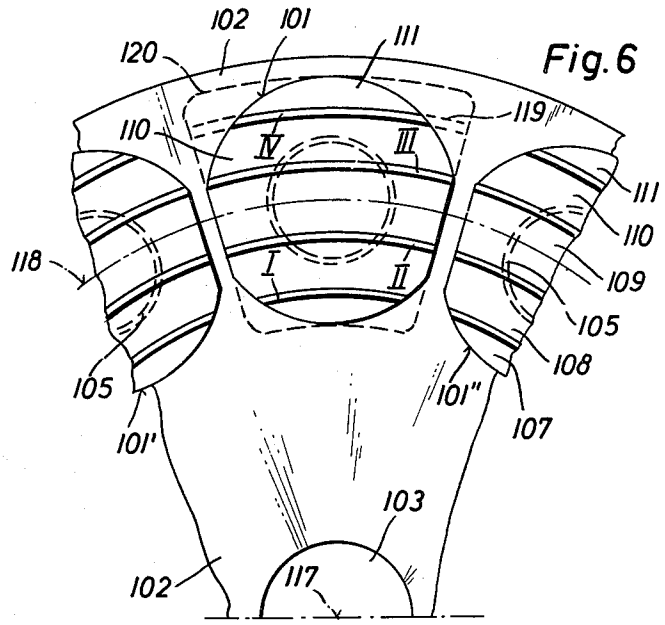


Fig. 6

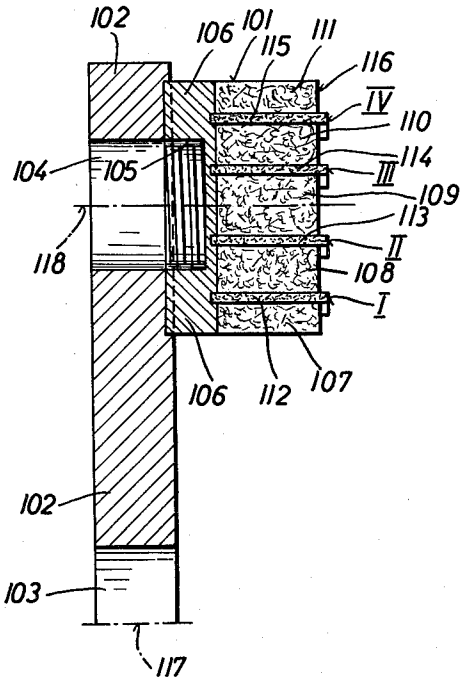


Fig. 7

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FACE GRINDING WHEEL

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6 Claims. (Cl. 51—209)

The invention relates to a multistage face grinding wheel which consists of a plurality of concentrically arranged, ceramic or plastic bonded grinding elements. By multistage is understood that the grinding wheel has two or more grinding edges which are relatively narrow as compared with the effective radius of curvature and which successively come into contact during the grinding operation like the teeth of a broach, by means of which the material is worked in stages in known manner. The grinding elements may be provided with abrasive grain, such as corundum, silicon carbide, or boron carbide, the grains being bonded either by ceramics or by means of rubber and/or a natural or synthetic resin. Any of the usual bonds employed in the manufacture of grinding or parting wheels can be used, if desired with the addition of metallic or non-metallic fibres, layers of fabric or the like.

Multistage grinding wheels composed of a plurality of concentrically arranged ceramic or plastic bonded grinding elements are known. For reasons of mechanical strength, however, the grinding elements are mostly of relatively great thickness in order to prevent them from becoming disintegrated by the stresses caused by high cutting performance or partly also by shocks or under the action of centrifugal force when the wheels are running. To ensure that sufficient grain fractures occur in the known grinding elements, which are necessary for sharpening the grinding elements, the grinding elements, owing to their thickness, must also be pressed against the workpiece with considerable force.

The object of the invention is to overcome the above-mentioned disadvantages of the known multistage grinding wheels composed of a plurality of concentrically arranged ceramic or plastic bonded grinding elements. This is attained in that the grinding elements are thin and embedded in a mass, such as synthetic expanded rubber or a porous ceramic material which serves as a support for the elements. The grinding elements, which have narrow edges, do not require to be pressed against the workpiece with great force for the abrasive grains to become exposed or to break through, thereby sharpening the wheel. As the stability of the grinding elements is relatively low, they are, according to the invention, embedded in a rigid mass free from abrasive grains, for example of the type mentioned above, so that they are capable of withstanding shocks and very strong centrifugal forces.

According to the invention, the concentrically arranged grinding elements consist of rings, ring segments or grinding ring sections. It is advantageous to arrange between the ring elements metallic or non-metallic bars which are preferably hollow. These bars can be connected to the ring elements bearing against them by means of an adhesive substance, such as thermo-setting resin. The bars can consist of projections which are pressed onto the ring elements or formed therefrom.

Several embodiments of the invention are illustrated by way of example in the accompanying drawings, in which:

FIG. 1 shows a grinding wheel composed of three rings impregnated with abrasive grain;

FIG. 2 is a section on line II—II of FIG. 1;

FIG. 3 shows a grinding wheel composed of four ring elements clamped in a carrier;

FIG. 4 shows ring elements with projections pressed thereon or formed therefrom;

FIG. 5 shows a two-stage grinding element;

FIG. 6 is a top plan view of a portion of a grinding wheel composed of ring sections, and

FIG. 7 is a side elevation showing a grinding body composed of grinding wheel sections.

According to FIG. 1, the grinding body consists of grinding rings **1**, **2** and **3** having narrow edges and embedded—depending upon the kind of bond of the rings—in expanded synthetic material or in a very porous ceramic bonding mass forming a skeleton of great strength. The zones serving for embedding the rings are designated by **4**, **5** and **6** in FIG. 1 and a disc **7** composed of solid porous substances is located in the middle. The grinding body illustrated in FIG. 1 can be clamped in a carrier body, as shown in FIG. 3—set with ring elements—or be fixed on a steel disc, for example by sticking.

When using the grinding bodies illustrated in FIG. 1, as well as the grinding bodies constructed according to the invention and shown in the other figures, the bedding mass is rubbed or flushed away during the grinding operation by the material being worked, as shown in exaggerated manner in FIG. 2, so that the narrow grinding edges of the individual rings or ring elements project slightly from the bedding mass and perform the grinding work.

According to FIG. 3, the grinding body consists of four grinding rings built-up of sections and arranged concentrically to one another and having narrow edges. Again each four concentrically arranged elements form a grinding body segment. The grinding body illustrated in FIG. 3 consists in all of six such segments **8**, **9**, **10**, **11**, **12** and **13** which are clamped in a carrier body **14**. In FIG. 3 the bedding mass between the individual ring elements is not shown so that the bars situated between the individual ring elements can be seen. The grinding body segments **8**, like the other grinding body elements, consist of four ring elements designated by **15**, **16**, **17** and **18**. Near the two ends of the ring elements bars **19**, **20**, **21** and **22**, **23**, **24** respectively are arranged between the ring elements. These bars are firmly connected with the ring elements by an adhesive substance, such as a thermo-setting synthetic resin. If the hollow bars serving as spacers possess sufficient resistance to pressure the bedding mass mentioned above can be omitted.

In the case of the grinding body illustrated in FIG. 3, the outermost ring represents the first stage, the following the second, the next following the third and the innermost ring the fourth stage, and these stages act successively, that is in stages, on the material to be worked, during the grinding operation.

According to FIG. 4, the ring segments **25** and **26** are provided by projections **27**, **28**, **29** and **30**, **31**, **32** respectively which maintain the spacing and are either pressed on the ring elements or can be formed, for example even subsequently, by partly cutting away the ring elements.

According to FIG. 5 of the drawings, each two ring elements **33** and **34** each with two bars or webs **35** and **36** constitute a one-piece grinding element. Such grinding-elements can be produced from the outset in a mould with the hollow space designated by **37** in FIG. 5. It is, however, also possible first to make, for example a solid, ceramic-bonded grinding element in the shape illustrated in FIG. 5 and to form the hollow space **37** subsequently before the final vitrification. So as to give the element sufficient total strength, a bottom can be allowed to remain. Then it is again possible to dispense with the connecting bars **35** and **36**, so that the grinding elements consist solely of the ring elements **33** and **34** and a bottom connecting these. In this case the element is of U-shaped

cross-section and in the case of a relatively large number of ring sections it will have a comb-like cross-section.

The above-mentioned bottom need not be adapted to the shape of the multi-stage segments and the ring segments can be stuck or cemented in the grooved metallic or non-metallic bottoms, plates or the like after the elements have been made.

The total strength of a plastic-bonded grinding element produced in a mould according to FIG. 5, can be increased by embedding therein very strong steel wool, wire fabric or the like. By this measure it is possible to subject the grinding elements to heavy centrifugal forces, that is to allow them to work at a high cutting speed.

The grinding element illustrated in FIG. 5 represents a two-stage grinding element which, like the grinding body segments shown in FIG. 3, can be fitted in a tool or fixed on a carrier disc. However, two grinding elements of the type illustrated in FIG. 5 can also be united in a single grinding body segment with the result that a four-stage grinding body is formed. The working of annular hollow spaces mentioned in the description of FIG. 5 is evidently possible not only in the case of a single element as shown in FIG. 5, but also in the case of a composite wheel. Thus concentric, narrow grinding edges are produced which, for the purpose of increasing the resistance to bending fracture, can, in this case and also in the case of the closed rings shown in FIG. 1, be interconnected by webs (**35** and **36** in FIG. 5).

The grinding paths of the grinding tool are designated by I to IV in FIGS. 6 and 7; they form the faces of the grinding ring sections **112** to **115** which are inserted standing on edge into the cylindrical body **101**. This has a bottom **106** composed of metal or plastic substance having a bore **105** provided with a screw thread serving for fixing the grinding body on a carrier disc **102**. For the purpose of receiving fixing bolts (not shown in the drawing) bores **104** are provided in the carrier disc **102** and are located on the pitch circle **118**. Another bore **103** serves for connecting the carrier disc with a shaft, the central axis of which is designated by **117**.

To impart the greatest possible strength to the grinding ring sections **112** to **115**, grooves are provided in the bottom **106** in which the grinding ring sections **112** to **115** partly engage. The grinding ring sections having the grinding paths I to IV are thus assembled in a grinding body **101** forming an integral part, and mass free from grain, for example expanded synthetic substance, surrounds these sections and holds them firmly. The body **101** including the grinding ring sections **112** to **115** is connected to the bottom **106** by a very strong adhesive, by the expanded substance itself or the like.

In the figures, this mass which will be rubbed or swept away during the grinding operation, serves as support for the grinding sections and is designated by **107** to **110**.

The grinding bodies **101**, **101'**, **101''** and so forth with cylindrical external contours are inserted in the carrier disc **102** in the manner above-described so that the grinding ring sections **112** to **115**, as also their paths I to IV on which they contact during the grinding operation, extend concentrically to the central axis **117** of the carrier disc **102**.

During the grinding operation the mass, free from grain and serving as support like that designated by **116** in FIG. 7, is swept away by the material being worked. As a result the grinding ring sections **112** to **115** are partly exposed so that their whole end face can come into contact with the surface of the workpiece and carry out the cutting process progressively.

The grinding body may also be of a shape similar to that designated by **120** in FIG. 6. The grinding ring sections would then be given a greater volume and the grinding paths a greater length. The grinding ring sections, like the outermost illustrated in dotted lines in FIG. 6 project beyond the contour of the circular ring by an amount designated by **119**. The ring segments and grinding ring sections may have any radius of curvature which is adapted to the diameter of the carrier body. As relatively large grinding wheels or carrier discs fitted with grinding elements are used for very high cutting performances, the radius of curvature of the ring elements must analogously be adapted to these conditions. The radius of curvature can, for special purposes, for carrier discs of large diameter, such as 120 or 200 cms., be unlimited. The grinding segments would in this case be built up from flat plates impregnated with abrasive grain which are naturally held at a distance apart by interposed bars, porous substances and the like.

I claim:

1. A radial face grinding wheel comprising a supporting disc, a plurality of concentrically spaced thin walled grinding elements secured to said disc having a uniform curvature for the elements equally spaced from the center of said supporting disc and axially extending and circumferentially spaced means which easily wear out during the grinding operation located between said grinding elements maintaining the radial spacing between said elements and defining cavities between said elements.

2. A radial face grinding wheel in accordance with claim 1 in which said spacing means are bars.

3. A radial face grinding wheel in accordance with claim 1, in which said spacing members are hollow bars.

4. A radial face grinding wheel comprising a supporting disc, a plurality of concentrically spaced thin walled grinding elements synthetically bonded secured to said disc having a uniform curvature for the elements equally spaced from the center of said supporting disc and bars secured to radially adjacent grinding elements maintaining the radial spacing between said elements.

5. A radial face grinding wheel comprising a supporting disc, a plurality of concentrically spaced thin walled grinding elements secured to said disc having a uniform curvature for the elements equally spaced from the center of said supporting disc and a spongy synthetic material maintaining the radial spacing of said elements during the grinding operation located between said grinding elements.

6. A radial face grinding wheel comprising a supporting disc, a plurality of concentrically spaced thin walled grinding elements secured to said disc having a uniform curvature for the elements equally spaced from the center of said supporting disc and means maintaining the radial spacing of said elements during the grinding operation located between said grinding elements, said means including axially extending radial projections upon said elements.

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