Dec. 13, 1966 F. W. LINDBLAD 3,290,834

GRINDING WHEEL

Filed July 15, 1964

Fig. 1

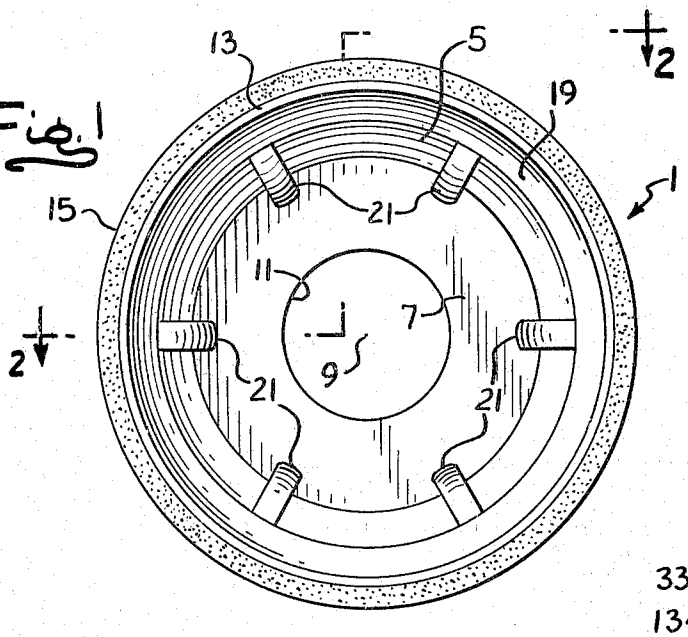


Fig. 4

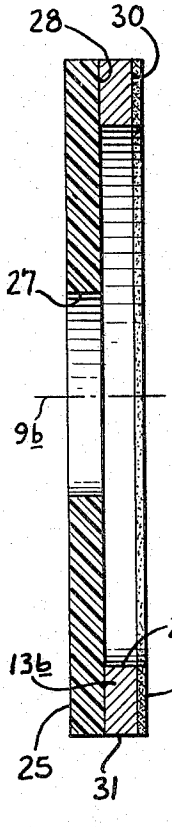


Fig. 2

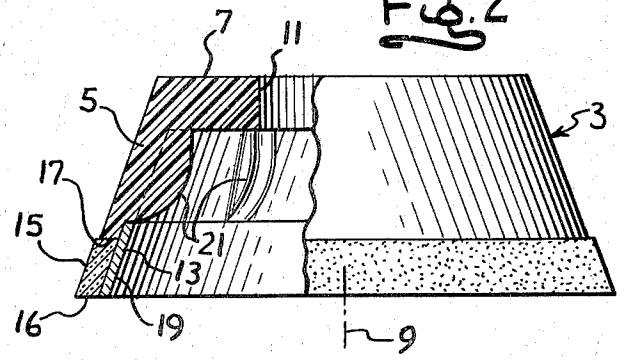


Fig. 3

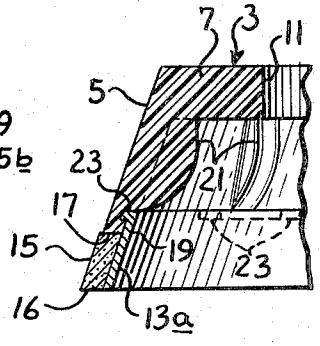
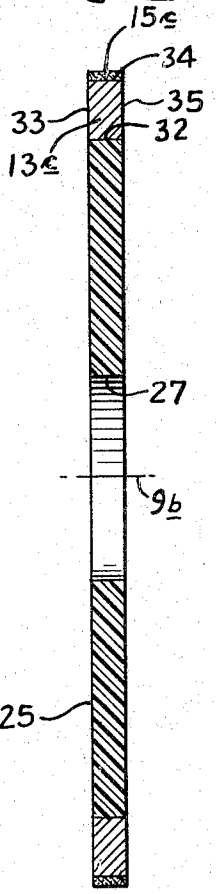


Fig. 5



INVENTOR
FREDERICK W. LINDBLAD

by: Morris Spector

ATTY.

United States Patent Office 3,290,834 Patented Dec. 13, 1966

3,290,834

GRINDING WHEEL

Frederick W. Lindblad, 835 Illinois Ave., Aurora, Ill.

Filed July 15, 1964, Ser. No. 382,831
15 Claims. (Cl. 51—206)

This invention relates generally to grinding wheels, and more particularly to a grinding wheel of the type in which the abrasive member that performs the grinding operation is secured to a body or core.

In grinding wheels of the foregoing type, there is a considerable amount of heat produced by the grinding operation with the result that both the abrasive member and core become heated. Furthermore, in many instances the abrasive member and core do not adequately dissipate the heat to the surrounding atmosphere. Expansion, caused by heat, tends to loosen the hold of the bonding agent on the individual diamond particles, thereby increasing the loss of diamond particles. It also tends to weaken the bond between the core and the abrasive member or abrasive wheel section, especially if the core or the adhesive used to secure the abrasive member section to the core is a plastic, such as a synthetic resin.

It is an object of the present invention to provide a grinding wheel in which a substantial amount of heat produced during the grinding operation is dissipated from the wheel so as to prevent overheating and the above mentioned weakening resulting from the overheating.

It is a further object of the present invention to provide a grinding wheel of the type stated which eliminates to a substantial extent the need for dressing the grinding wheel as the abrasive member wears during the useful life of the wheel.

In accordance with the objects of the present invention, the body has a seat which supports the abrasive member, the seat being of a material having a high thermal conductivity as compared to that of the abrasive member and the part of the body adjacent to the seat. The seat is of such size and shape as to present a substantial area to the atmosphere so that the seat conducts heat from the region of the grinding ring and in turn transmits heat to the atmosphere, thereby reducing the temperature build-up on the body. The abrasive member may be of a type having diamond abrasive particles and the body may be of a synthetic resin. The seat may be of copper or of aluminum, or may be a mixture of a major proportion of powdered copper or aluminum or even silver, and a minor proportion of a plastic binder.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof;

In the drawing:

FIG. 1 is a front elevational view of a grinding wheel constructed in accordance with and embodying the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view similar to FIG. 2 and showing a modified form of the present invention;

FIG. 4 is a sectional view through the axis of rotation of another form of grinding wheel embodying the present invention; and

FIG. 5 is a sectional view through the axis of rotation of still another form of grinding wheel that embodies the present invention.

Reference may now be had to the drawing, which illustrates a preferred embodiment of the present invention, and wherein like reference characters designate like parts throughout.

The grinding wheel 1 comprises a core or body 3 which may be a flared cup-shaped member molded or otherwise fabricated of any suitable material. For example, the body 3 may be formed of nylon or of a phenolic resin of the type disclosed in my U.S. Patent 2,703,437. The body 3 may have any suitable shape such as the frusto-conical shape shown with the frusto-conical side wall 5 terminating at its smaller diameter end in a body end wall 7, the latter lying at right angles to the central longitudinal axis 9 of the body and having a hole 11 centered on the axis for mounting the body 3 upon the arbor of a grinding machine.

At its larger diameter end, the side wall 5 has an outwardly flaring frusto-conical seat 13, the outer frusto-conical surface of which receives and supports a frusto-conical grinding ring 15. The seat 13 is of a material having a high thermal conductivity as compared to that of the grinding ring 15 and the body 3. For example, the seat 13 may comprise a mixture of in the order of 90% powdered copper or aluminum and 10% synthetic resin binder. The resin binder may be similar to the composition of the body 3. The grinding ring 15 abuts a shoulder 17 that is formed on the body wall 5 and lies substantially at right angles to the axis 9. The seat 13 supports the grinding ring 15 substantially up to its larger diameter end. The seat 13 is, therefore, in effect a reduced thickness continuation of the side wall 5 and the inner surface 19 of the seat 13 is exposed to the interior of the body 3.

The grinding ring 15 may be of any conventional type. One such type may be a ring having industrial diamond abrasive particles molded within a body of plastic. The grinding ring 15, seat 13, and body 3, may be molded or otherwise assembled together in any suitable manner so that the grinding ring 15 is bonded to the seat 13 and the shoulder 17.

When the griding wheel 1 is in use, heat is generated at the grinding surface 16 of the grinding ring 15. The grinding ring 15 and resin body 3 are relatively poor heat conductors as compared to the essentially metallic seat 13. However, heat is conducted away from the grinding ring 15 by the seat 13 and heat is radiated and conducted to atmosphere from the seat 13 from the inner surface 19 thereof. This reduces excessive temperature rise at the shoulder 17 and the bonded interface of the seat 13 and grinding ring 15 which might cause the resin of the body or the bonded interface of the seat 13 and grinding ring 15 to become charred or softened and thereby weaken the bond between the grinding member or ring and its supporting body. It also reduces the thermally caused expansion of the plastic or other material that has its locking hold on the individual diamond particles, thereby reducing loss of the individual particles from the abrasive ring member.

Vanes 21 may be integrally formed on the interior of the body 3 as at the juncture of the side and end walls, 5, 7. These vanes 21 are preferably circumferentially spaced about the axis 9 and may extend along the wall 5 up to the seat 13. The vanes 21 act as fan blades and maintain a flow of air across the inner surface 19 of the seat 13 to facilitate transfer of heat from the seat 13 to the atmosphere.

The powdered metal-resin mixture is sufficiently soft so that it eliminates to a significant extent the need for dressing the wheel as the grinding surface 16 of the ring 15 progressively wears.

The seat 13 may also have incorporated therein a secondary abrasive such as silicon carbide or alumina. A secondary abrasive of this type is helpful in grinding steel since the secondary abrasive helps prevent the steel from smearing on the diamond, which it does not do on the secondary abrasive.

A modified form of grinding wheel is shown in FIG. 3. In the grinding wheel of FIG. 3, the seat **13***a* is of a solid metal ring, such as copper or aluminum, and has circumferentially spaced fingers **23** which are imbedded in the plastic of the body to lock the seat **13***a* in place onto the body. Other suitable means may be used for securing the seat **13***a* to the body **3**.

In the grinding wheel shown in FIGS. 4 and 5, the supporting bodies may each be in the form of a cylindrical disc **25** of plastic or other suitable material. Each disc has a hole **27** centered on the longitudinal axis **9***b* of the disc for mounting the disc on a grinding machine arbor.

In FIG. 4, the cylindrical seat **13***b* is a ring bonded to one side face **28** of the disc **25** at the periphery thereof, and a cylindrical grinding ring **15***b* is bonded to the axially presented face **30** of the seat **13***b*. The bonds between the grinding ring **15***b*, seat **13***b*, and disc **25** may be effected in any suitable manner. Epoxy resin adhesives have been found suitable for this purpose.

The seat **13***b* may be of a composition similar to that of the seats **13** and **13***a* previously described and have a substantial thickness. It may be many times greater than the thickness of the grinding ring **15***b*. In any event, the thickness of the seat **13***b* is such as to provide radially inner and outer surfaces **29**, **31** that present a substantial area to the atmosphere so that heat from the grinding ring **15***b* will be dissipated and will not be destructive to the plastic disc or the bonds between the parts of the grinding wheel.

The grinding wheel of FIG. 5 is similar to that shown in FIG. 4 except that the seat **13***c* is a ring that is bonded to the outer cylindrical surface **32** of the disc **25**, and the grinding ring **15***c*, is, in turn, bonded to the outer cylindrical surface **34** of the seat **13***c*. The seat **13***c* is of sufficient radial thickness to provide annular side surfaces **33**, **35** on the seat **13***c* from which heat is dissipated to the atmosphere from the grinding ring **15***c*.

The diamond particles used in the grinding wheels are so hard that they are exceedingly resistant to wearing forces, even the extreme wearing forces of grinding cemented carbides, oxides, and ceramics. The wear on the diamond wheel is caused primarily by other than wear on the diamond particles. Heat is generated in the grinding process. This weakens the locking action which holds the individual diamond particles in place. When this happens, the grinding forces are sufficient to pull the partially used diamond particles from the bond. Proof of this can be seen in the fact that when the diamond is reclaimed from the grinding swarf, an appreciable percentage of it is of the same size as it was when it went into the diamond wheel.

For the above reason, it is important to provide a maximum rate of heat dissipation. Most diamond cup grinding wheels are made of a black mineral filled plastic core of material which is an excellent heat insulator. This retards escape of heat produced in the diamond section, with a resulting temperature increase in the diamond section. It has been this temperature increase that is responsible for excessive diamond wheel wear, as pointed out above.

When a cast or pressed metal aluminum core is used, the coefficient of the expansion of the aluminum is so great that it is difficult to hold the size of the core due to thermal expansion unless means is provided to facilitate heat dissipation. Copper, on the other hand, has almost twice the heat conductivity as aluminum and about one-half the linear coefficient of expansion. Copper would be too heavy to use in the whole wheel core, but the annular copper ring as used in the structure above described need not add any significant weight to the wheel. The small amount of added weight in the periphery of the wheel does, however, serve as a fly wheel effect for smoother grinding without adding dead weight to the whole wheel, which adversely affects the bearings of grinding machines. The annular copper ring in the diamond wheel core of the present invention backs up the diamond section, thereby absorbing grinding heat and conducting it readily into the areas of the surrounding moving, cooling air, thereby eliminating, or substantially reducing, the harmful effects that come from excess heat.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of the invention. It is, however, to be understood that the invention is not limited to the precise construction herein shown, the same being merely illustrative of the principles of the invention. What is considered new and sought to be secured by Letters Patent is:

1. A grinding wheel comprising a body having means for mounting the same for rotation about the longitudinal axis of the body, said body having a seat that surrounds said axis, a grinding ring bonded to said seat, said seat supporting the grinding ring over at least a portion of the axial length thereof, said seat being of a material having a high thermal conductivity as compared to that of the grinding ring and the part of the body adjacent to the seat, said seat being of such axial length and shape as to present a substantial area to the atmosphere so that the seat conducts heat from the grinding ring and transmits heat to the atmosphere.

2. A grinding wheel according to claim **1** in which said material includes a metal of the group consisting of copper and aluminum.

3. A grinding wheel according to claim **1** in which said material is a homogeneous mass that includes a major proportion of powdered metal and a minor proportion of a plastic bonding agent.

4. A grinding wheel according to claim **3** in which the grinding ring is a diamond matrix and the seat includes abrasive particles having a hardness less than that of the diamond abrasive.

5. A grinding wheel according to claim **1** further including means for imparting a flow of coolant over the seat as the wheel rotates.

6. A grinding wheel comprising a body having means for mounting the same for rotation about the longitudinal axis of the body, a seat secured to the body and being centered on said axis, and a grinding ring secured to the seat, said seat being of a material having a high thermal conductivity as compared to that of the grinding ring and the part of the body adjacent to the seat, said seat between the grinding ring and body being relatively thick as compared to the thickness of the grinding ring to provide sufficient surface area presented to the atmosphere to dissipate a substantial amount of heat from the grinding ring and thereby prevent an excessive increase in temperature of the grinding ring.

7. A grinding wheel comprising a hollow frusto-conical body having means at the smaller diameter end for mounting the same for rotation about the longitudinal axis of the body, the larger diameter end of the body having a frusto-conical ring that constitutes a seat for a grinding ring, an annular shoulder formed on the outer surface of the body adjacent to the smaller diameter end of the seat and facing in the direction toward said larger diameter end of the body, and a hollow frusto-conical grinding ring having an inner surface on the seat and its smaller diameter end abutting said shoulder and with the seat supporting the grinding ring over a major portion of its axial length, said seat being of a material having a high thermal conductivity as compared to that of the grinding ring.

8. A grinding wheel according to claim **7** in which the grinding ring is a diamond matrix, the body is plastic, and the seat is primarily a metal of the group consisting of copper and aluminum.

9. A grinding wheel according to claim **7** in which the material of the seat is powdered metal in a plastic matrix.

10. A grinding ring according to claim **7** in which the body is plastic and the seat is a preformed piece of metal having means embedded in the body.

11. A grinding wheel according to claim 7 in which the body has cooling vanes for imparting a flow of cooling air over the seat as the wheel rotates.

12. A grinding ring according to claim 9 in which the material of the seat also includes an abrasive that is softer than the diamond abrasive.

13. A grinding wheel comprising a hollow body having a frusto-conical wall, a frusto-conical grinding ring located on the surface of the wall at the larger diameter end thereof and supported by the wall over a major portion of the axial length of the grinding ring, the part of the wall that supports the grinding ring comprising as a major portion thereof metal having a high thermal conductivity as compared to the portion of the body adjacent to said part and the grinding ring, and cooling vanes on the body for maintaining a flow of cooling fluid over said part of the wall.

14. A grinding wheel comprising a hollow frusto-conical supporting body having means at its smaller diameter end for mounting the same for rotation about the central longitudinal axis of the body, said body having adjacent to its larger diameter end an annular shoulder formed on its outer surface and extending toward said axis, and a hollow frusto-conical grinding ring the smaller diameter end of which abuts the shoulder with said ring flaring radially outwardly from said shoulder toward its larger diameter end, said ring being backed at its inner frusto-

conical surface by a frusto-conical seat on the supporting body that extends from said shoulder to the larger diameter end of the body, said ring terminating at its larger diameter end in a grinding surface, the ring being of substantially smaller mass than the mass of the supporting body, said seat being a mixture of a minor proportion of plastic and a major proportion of metal to dissipate heat from the interfaces of the grinding ring and the shoulder and which may be progressively dressed away as the grinding surface is progressively worn whereby the edge of the seat at the larger diameter end of the body may be maintained in reinforcing position immediately adjacent to said grinding surface during progressive wearing away of the ring.

15. A grinding wheel according to claim 14 further including cooling vanes for imparting a flow of coolant over the inner frusto-conical surface of the seat to facilitate the dissipation of heat therefrom.

References Cited by the Examiner

UNITED STATES PATENTS

2,137,201	11/1938	Boyer	51—209
3,161,995	12/1964	Lindblad	51—209

ROBERT C. RIORDON, *Primary Examiner.*

L. S. SELMAN, *Assistant Examiner.*