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M. B. LANE

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GRINDING WHEEL

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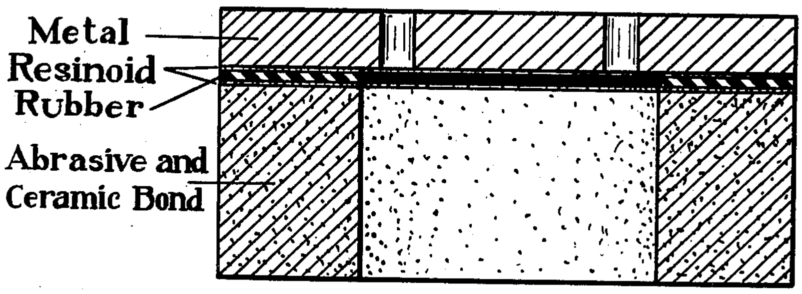

Fig. 1.

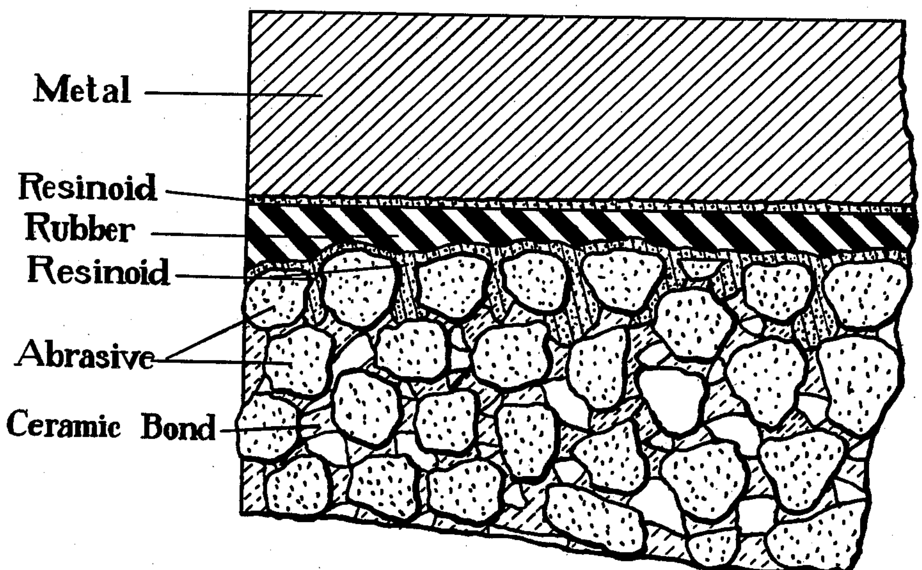

Fig. 2.

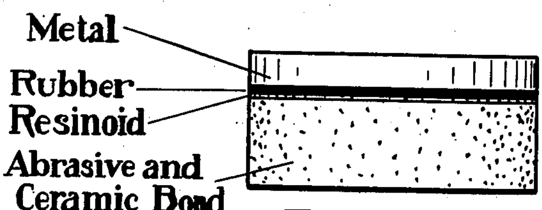

Fig. 3.

Inventor
Merton B. Lane

Witness
Robert G. Trumbull

By Clayton L. Jenks
Attorney

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GRINDING WHEEL

Merton B. Lane, Holden, Mass., assignor to Norton Company, Worcester, Mass., a corporation of Massachusetts

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7 Claims. (Cl. 51—209)

This invention relates to grinding wheels and particularly to that type in which an abrasive body is cemented to a backing plate.

It is customary to cement a vitrified grinding wheel to a metal backing plate by means of rubber vulcanized to both the plate and the abrasive body. It is, however, found that the rubber does not make a sufficiently strong union with the abrasive body and the backing plate for certain grinding uses. Also, a vulcanized hard rubber has been employed as the intermediate cementing material, but hard rubber tends to become soft at a high temperature.

The primary object of this invention is, therefore, to provide a grinding wheel of this type in which an abrasive body is united to a backing plate by a resilient cementitious rubber compound which permits the necessary expansion and contraction, but in which the rubber compound is itself secured to the abrasive body and/or the backing plate by an intermediate cementitious material which has the capacity of adhering firmly and strongly thereto and which is not thermoplastic or detrimentally affected by the high temperatures generated during a normal grinding operation and therefore serves to secure the abrasive body to the backing plate firmly and prevents its becoming dislodged and broken during use. Further objects will be apparent in the following disclosure.

In accordance with this invention, I propose to employ a vulcanized soft resilient rubber compound as the primary medium for uniting the abrasive body to a backing plate, and particularly to a metal plate, and to secure this rubber compound to the abrasive body and/or the backing plate by an intermediate layer of a resinoid which is not thermoplastic, but is in a hard and infusible condition, and particularly a resinoid of the type formed by the reaction of phenol and formaldehyde as sold on the market under such trade-marks as "Bakelite" and "Redmanol". In this case, the rubber gives the desired resilient mounting while the resinoid adheres firmly to the outer body and at the same time forms a strong union with the rubber.

For this purpose, I may employ a resinoid in what is known as the B stage or in that plastic condition in which the material may be caused to adhere directly to the abrasive body and which may be thereafter heat hardened to an infusible condition known as the C stage at the same time that the rubber is vulcanized. Of the various different procedures which may be adopted, it is preferred to use the resinoid in a liquid state, such as a solution of the B stage, or the B material may be a dry powder which may be made plastic by heat below the temperature at which the material is converted to the C stage. Only a thin layer of the resinoid needs to be employed, and just sufficient to adhere firmly and strongly with the abrasive body and preferably not to fill the surface pores thereof, although it need not form an outer smooth layer on the face thereof. Likewise, a thin film of the resinoid may be employed, if desired, in contact with the metal face to secure the rubber thereto. The intermediate rubber layer is preferably made up of a vulcanizable soft rubber compound containing a required amount of sulfur, such as 3%, as well as other desired ingredients which are well known in the industry.

I have illustrated in the drawing as a diagrammatic showing two embodiments of this invention in which:

Fig. 1 is a diametric sectional view of a grinding wheel mounted on a metal plate, in which the resinoid is located between the rubber and both the wheel and the metal plate.

Fig. 2 is an enlarged fragmentary section showing the relations of the parts; and

Fig. 3 is an elevation of another wheel in which the resinoid is located only between the rubber and the abrasive body.

The abrasive body may be made in accordance with standard procedure. For example, it may comprise abrasive grains, such as crystalline alumina, silicon carbide, quartz or any other suitable abrasive material, cemented together into an integral structure by means of a suitable bond, and preferably a vitrified ceramic bond which has been heat hardened to a vitreous or porcelanic conditoin. This wheel as made in accordance with standard procedure ordinarily comprises a considerable pore volume and a rough surface with which the intermediate cementing compound may interlock and so adhere firmly and rigidly thereto.

If a resinoid, such as a "Bakelite" liquid resinoid in the B stage, is to be employed, then this liquid material may be painted or sprayed or otherwise applied to the surface pores of the abrasive body which has been previously shaped as desired for mounting on the metal plate. The dry B stage powder may be mixed with the liquid to increase its resinoid content. A sufficient amount of the fluid resinoid is applied to the face of the abrasive body so as to fill or partially fill the surface pores to a desired extent and form a coating on the pore faces as well as the outer face of the wheel. This layer is of sufficient thickness and strength so that it will, in turn, adhere firmly to the rubber as well as to the abrasive body and make a desired strong union therewith. If a dry resinoid powder in the B stage is employed, then a layer of this material is sprinkled onto the surface of the abrasive body and then later plasticized by heat, during the rubber vulcanizing operation. The drawing is greatly exaggerated in order to show the layers, but it will be appreciated that these may be very thin, so that when the final product has been completed, the abrasive body is very close to its metal backing plate, but separated therefrom by sufficient thickness of rubber and resinoid to give the desired properties of resiliency as well as strength of union.

A layer of plastic unvulcanized rubber compound may be applied to the wheel face thus coated with the plastic or dry and unconverted resinoid or, if desired, the rubber coating may have been previously secured to the face of the metal plate. Various sequences of operations are feasible. I have found that excellent results follow from the use of compositions of the following formulae:

		I	II
Rubber	Parts by weight	29	40
Zinc oxide	do	63	52
Magnesia	do	3	3
Sulfur	do	3	3
Oil of petrolatum	do	2	2

Various solid materials, such as carbon black, clay, whiting, etc., may be used in addition to or in place of the fillers above noted to obtain desired properties. These materials may be compounded by standard procedure, such as by repeatedly passing a sheet of crude raw rubber of weighed amount between spaced heated pressure rollers while weighed amounts of the other materials are folded into the rubber and thus gradually worked into it. It is preferred that the rubber compound contain at least 40% by weight of zinc oxide, which improves the adhesive qualities of the rubber layer, and this content of zinc oxide may well go as high as 70% to advantage. The rubber compound preferably contains only sufficient sulfur to form what is called a soft resilient rubber when in a vulcanized condition. Hence, the final product is able to compensate for the differential expansion and contraction between the abrasive body and the metal plate as caused by heat changes.

The metal plate is to be thoroughly cleaned and preferably roughened, as by means of a sand blast so that the rubber compound or resinoid will make a very firm union therewith. The soft rubber compound in the unvulcanized condition is applied to the metal plate and the two then placed in contact with the resinoid coating on the abrasive body, after which the assembled parts are subjected to sufficient heat and pressure to vulcanize the rubber and to convert the resinoid. This vulcanization procedure will serve to render a dry "Bakelite" powder plastic and force it into the pores of the abrasive body before it is converted and thus cause an intimate union between the abrasive and the plastic unvulcanized rubber. Thereafter as the temperature rises, the reaction of vulcanization proceeds and the whole body is formed into an integral structure. Similarly, the liquid resinoid in the B stage is heat hardened to an infusible condition during the step of vulcanizing the assembled body under pressure and heat. This rubber vulcanization and resinoid curing operation may be accomplished by heating the assembled parts at a temperature of 160° C. for 16 hours and under a pressure of 30 lbs. per square inch, more or less.

In order that the invention may be more fully understood, the following examples are to be noted as showing various compositions and arrangements for mounting an abrasive body on a metal backed plate.

Example I

A steel plate was cleaned and sand blasted to provide a clean and rough surface, and a soft unvulcanized rubber compound containing rubber, sulfur, zinc oxide, magnesia, and petrolatum as defined in the first column of the above table was applied thereto in a layer $\frac{3}{32}$ inch thick. This compound was then cured at about 160° C. by a suitable vulcanization process to form vulcanized soft rubber and it was found to adhere firmly to the metal plate. Thereafter, the exposed surface of the rubber was cleaned and roughened as by means of a buffing wheel. Then the abrasive body of suitable composition and structure, which was to be cemented to the metal plate, was dusted heavily with a "Bakelite" resinoid powder in the B stage so as to provide the layer intended to interlock with the abrasive as well as adhere to the rubber compound. The rubber coated face of the metal supporting plate was then placed in contact with this thick layer of "Bakelite" powder and the assembled structure was gradually heated through a two-hour period to 160° C. and then was subjected for sixteen hours to heat and pressure, at a temperature of approximately 160° C. to convert the "Bakelite" resinoid to a hard infusible compound.

Example II

The above procedure may be modified by employing a single heat treatment operation instead of two. To that end, the abrasive body may be dusted over with the "Bakelite" powder and the plastic layer of unvulcanized rubber compound placed thereon with the sand blasted metal plate above it. Then, the rubber and the resinoid may be cured simultaneously under pressure at a temperature of 160° C. for sixteen hours.

Example III

In place of the "Bakelite" resinoid powder, one may employ a liquid "Bakelite" resinoid. In this case, the standard B stage liquid "Bakelite" of commerce is coated upon the abrasive body to fill the surface pores sufficiently and to form a thin layer on the outer surface of the body, but which need not entirely fill the outer pores and form a smooth surface, since the rubber will squeeze into the irregular surface of the abrasive body. The layer of rubber compound as above defined may be placed upon this abrasive body and the metal plate applied thereto, or the rubber may have been previously vulcanized to the metal plate. The assembled mass may then be subjected to heat for eighteen hours at a maximum temperature of 160° C. as above noted.

Example IV

Liquid "Bakelite" may be applied both to the sand blasted metal and to the abrasive body. A layer of soft rubber compound $\frac{3}{32}$ inch thick is placed between and in contact with the plastic resinoid coatings. Then the assembled body is subjected to a pressure and heat treatment as above defined to vulcanize the rubber and convert the resinoid. In this case, the intermediate layer of rubber does not contact with either the abrasive body or the metal plate, but only with the resinoid layers.

It is not known why the resinoid makes a strong union with the rubber compound, but it is to be noted that the standard resinoid contains a considerable quantity of hexamethylenetetramine, which is also an accelerator for rubber vulcanization. Hence, it is possible that this component of the resinoid in some way combines intimately with the rubber to form a very complete union between the two layers. However, the claims are not to be interpreted as limited to any particular theory of operation. It will be appreciated, also, that various other ingredients may be incorporated with the rubber or with the resinoid as desired to serve as fillers or to give other properties of usefulness. Also, solvents for the dry resinoid may be employed to aid in its penetration of the wheel pores, such as furfural or other materials capable of wetting the abrasive body and adhering to the resinoid, such as a neutral creosote oil known on the market as carbosota, or kerosene, gasoline and the like or mixtures of these with furfural and other materials.

It will thus be seen that there has been provided by this invention an article in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A grinding wheel comprising an abrasive body cemented rigidly to a backing plate by an intermediate cemetitious medium including a layer of vulcanized soft resilient rubber and a layer of converted resinoid between the rubber layer and one of the outer bodies.

2. A grinding wheel comprising an abrasive body cemented to a metal backing plate by a cementitious medium including a layer of converted resinoid coating and adhering to the surface of the abrasive body, a layer of vulcanized rubber compound adhering to the resinoid layer and a metal backing plate integrally connected with the intermediate rubber layer.

3. A grinding wheel comprising an abrasive body cemented rigidly to a backing plate by an intermediate cementitious medium including a layer of vulcanized rubber secured to the abrasive body and a layer of a resinoid between the rubber and the metal plate and adhesively securing them together.

4. A grinding wheel of the type covered by claim 2 in which a layer of a converted resinoid is interposed between the vulcanized rubber compound and the metal backing plate and insures firm union therebetween.

5. A grinding wheel having a porous body of ceramic bonded abrasive grains united to a metal backing plate by a cementitious medium comprising a layer of converted resinoid impregnating the surface pores of one side of the abrasive body, a layer of soft, resilient vulcanized rubber containing at least 40% by weight of zinc oxide which adheres both to the resinoid coating and to the metal plate.

6. A grinding wheel having a porous body of ceramic bonded abrasive grains united to a metal backing plate by a cementitious medium comprising an intermediate layer of soft resilient vulcanized rubber and layers of a converted resinoid which adhere to the metal plate and the surface of the abrasive body and are united with the rubber layer.

7. A grinding wheel of the type covered by claim 6 in which the rubber layer contains at least 40% by weight of zinc oxide.

MERTON B. LANE.