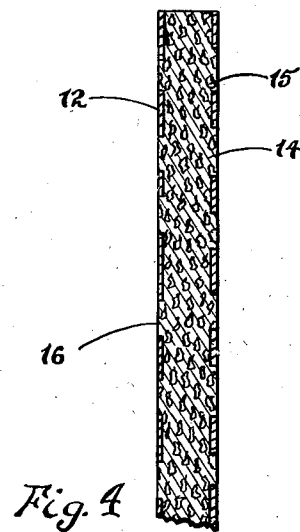
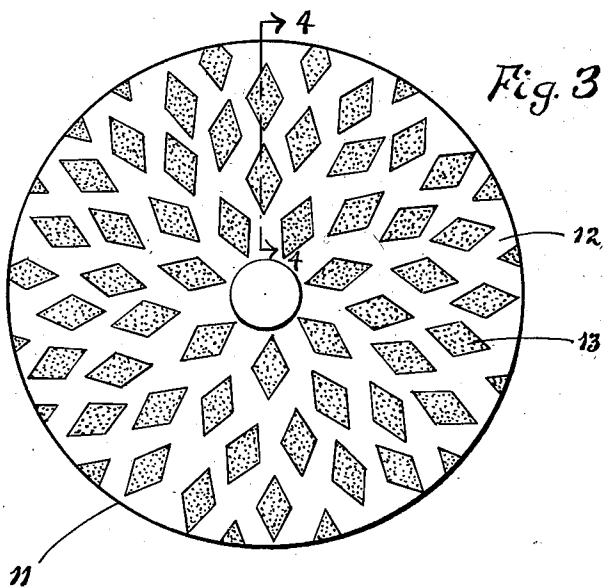
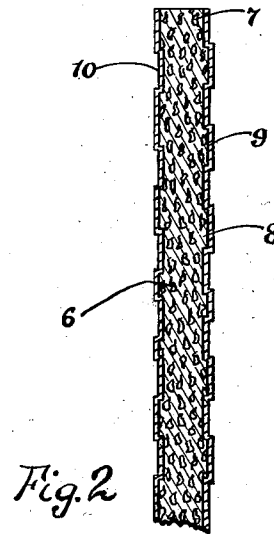
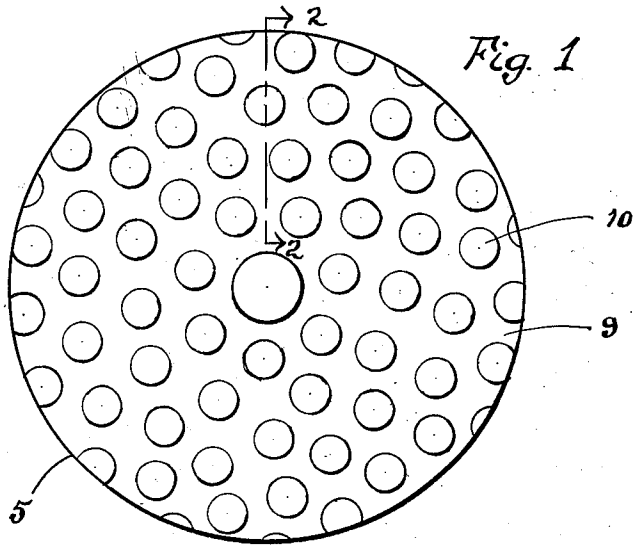


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ABRASIVE CUTOFF WHEEL
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ABRASIVE CUTOFF WHEEL

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18 Claims. (Cl. 51—206)

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This invention relates to organic bonded abrasive products of the grinding wheel type, and particularly to the form of grinding wheel commonly known as a cut-off wheel having relatively extensive opposing flat side faces and a thin peripheral cutting edge.

Cut-off wheels, as the name implies, are used for cutting through or making deep, narrow cuts or grooves in many kinds of materials which may be in the form of rods, tubes, bars or other strip stock of small or large cross-section, sheet or slab stock of any thickness, or material in otherwise massive form. Such cutting operation often involve the cutting of extremely hard and/or tough material, as for example, many of the recently developed ferrous alloys. Where the depth of cut on such materials is substantial, difficulties and problems have been presented which have not been fully overcome or solved by the cut-off wheels heretofore available. Under severe conditions of use many of the cut-off wheels of the prior art have failed to perform in an acceptable manner because of an inability to cut freely and effectively without binding of the wheel or overheating of the work. Other wheels have been unsatisfactory because of excessive wearing away of the grinding wheel with consequent short wheel life.

It is an object of the present invention to provide organic bonded cut-off wheels of improved cutting characteristics and longer life.

It is a further object to provide organic bonded cut-off wheels having greater versatility of use.

It is another object of the present invention to provide organic bonded cut-off wheels by which many of the difficulties and disadvantages heretofore encountered in the use of cut-off wheels are minimized or obviated.

Other advantages and objects accruing from the present invention will become obvious as the description proceeds.

Before proceeding further with the description of the present invention, reference is made to the drawings, in which:

Figure 1 is a top plan view of a cutting-off wheel made in accordance with the present invention;

Figure 2 is a cross-sectional view highly enlarged through the line 2—2 of Figure 1;

Figure 3 is a top plan view of another modification of the present invention; and

Figure 4 is a highly enlarged cross-sectional view through the line 4—4 of Figure 3.

I have found that improved organic bonded cut-off wheels as, for example, cut-off wheels comprising abrasive grain and a rubber bond, can be obtained by providing the flat side faces of the abrasive body structure of the wheel with a patterned contour and bonding a thin layer or sheet of organic material to those side sur-

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faces, all in the manner hereinafter more fully described. The patterned contour and surface coatings on the side faces of the wheel can be provided in several ways.

The main abrasive body structure of the wheel is usually first preformed by roll sheeting or otherwise molding a mass of abrasive grain and bonding ingredients to the desired thickness and then dieing out the sheet material into discs having a diameter and arbor of the desired size. However, if desired, the abrasive body of the wheel can be formed from a loose granular or other moldable mixture of abrasive grains and bond at the same time that the side facings are bonded thereto and the patterned sides are formed without departing from the spirit of the present invention.

Assuming, however, that the wheel is to be made by first sheeting or dieing out or otherwise molding the body structure of the wheel as a preform, one method of practicing the present invention is to hot or cold press the preform between thin layers or sheets of the desired organic facing material in a mold having plungers with patterned surfaces. The wheel can either be partially or completely cured in the mold or it can be pressed cold and given the final cure later in an oven as a separate operation. The resulting cut-off wheel is provided with patterned or indented side faces conforming to the pattern of the mold plungers, the patterned side surfaces having the thin layers or sheets of organic material adhered thereto in the form of permanent side facings, such a wheel being depicted in Figures 1 and 2 of the drawing. While the specific pattern on the wheel shown in Figures 1 and 2 consists of a plurality of evenly but heterogeneously distributed depressed circular areas equal in combined area to roughly one half the total area of the wheel sides the invention is not limited to any one particular configuration or pattern impressed on the wheel sides.

A wheel provided with similar patterned and coated side faces can also be made by pressing the preformed abrasive body between thin layers or sheets of the desired organic material in a mold having plungers with plain flat surfaces by placing temporary thin patterned discs of vulcanized fiber or other suitable material a few thousandths of an inch in thickness between the mold plungers and the sheets of organic facing material prior to pressing so that the pattern of the temporary fiber discs is impressed into the sides of the wheel and the adhering facings during the molding operation.

The wheel shown in Figures 3 and 4 is a still further modification of the present invention wherein the thin sheets of organic material applied as the side facings for the wheel are pre-cut in patterned or open-work configuration. The

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patterned sheets of facing material are placed in the mold between the mold plungers and the flat sides of the preform or the abrasive mixture which is to constitute the abrasive body structure of the wheel and the assembly subjected to the desired molding pressure whereupon the patterned sheets of facing material are impressed into the sides of the body structure of the wheel to give it a patterned contour conforming to the open-work pattern of the side facings which are permanently bonded to the wheel. Although in both modifications shown in the drawing the main abrasive body portion of the wheel is provided with patterned side surfaces and facings of organic material they differ slightly in that in the first described modification the entire surface is covered with a continuous organic facing whereas in the second modification the depressed or indented areas of the side patterns only are faced with the organic material.

Highly satisfactory results have been obtained using as the organic facing material a 48 pound "Solkacel" paper having a thickness of about .003" to .004" coated with a butadiene-styrene synthetic rubber latex, such as that known as GR-S, to the extent of around 1 to 4 pounds of rubber solids per ream of paper, giving a facing of .004" to .008" total thickness.

"Solkacel" is the trade-mark name for a type of paper sold by the Brown Company, of Berlin, New Hampshire; it contains a larger percentage of alpha cellulose than is present in the usual wood pulp papers. In preparing such papers, a kraft pulp is selected and subjected to special treatments for the purpose of reducing the quantity of impurities and providing a pulp containing upwards of 90% alpha cellulose as compared to around 85% alpha cellulose in the usual kraft paper. One way of treating the kraft stock to secure such a pulp high in alpha cellulose comprises exposing the pulp to the refining action of a comparatively strong alkaline liquor at about room or slightly elevated temperatures. The paper is also chemically treated to increase its wet strength such as by treatment with glycerine and other chemicals. The specific methods of manufacturing such papers are well-known in the art.

A sheet of regenerated cellulose of .001" to .002" thickness similarly coated with a natural or synthetic rubber latex has also been found highly satisfactory as the organic facing material for the patterned side faces of cut-off wheels made in accordance with the present invention. Regenerated cellulose in sheet form is sold by E. I. du Pont de Nemours & Company of Wilmington, Delaware, under the commonly known trade name "cellophane." Another organic material which can be used includes a type of paper made and sold by the Brown Company of Berlin, New Hampshire under the trade-mark name of "Duracel" which is similar to the "Solkacel" paper described above except that it is not given the chemical treatment for promoting wet strength which is given "Solkacel" paper. Other organic materials which can be used include kraft or other paper coated with a natural or a synthetic rubber, thin sheets of a rubber hydrochloride such as that known and sold by the Goodyear Tire and Rubber Company, of Akron, Ohio, under the trade-mark name of "Pliofilm," thin sheets of ethyl cellulose such as that made and sold by the Dow Chemical Company of Midland, Michigan, under the trade mark name "Ethocel," or the like. I have found it more convenient to use and have obtained most satisfactory results by using paper or other sheet

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material in the approximate ranges of thickness specified above coated with a thin film of natural or synthetic rubber latex. However, I have also succeeded in obtaining very good results by using paper or other organic fibrous sheet material in patterned form or on the otherwise patterned surface in uncoated condition. A thin film or a coating of a natural or synthetic rubber or rubber latex alone when applied to the patterned sides of a cut-off wheel is also effective although the inconvenience of handling usually makes it undesirable to apply the facings in that manner.

Referring further to the drawings, Figures 1 and 2 depict an abrasive cut-off wheel 5 made in accordance with the present invention and comprising a main abrasive body structure 6 comprising abrasive grains 7 and a rubber bond 8 and provided with continuous side facings 9 of organic material such as a rubber coated "Solkacel" paper, each side facing being several thousandths of an inch thick. Such a wheel is made by using mold plungers with patterned surfaces or by using plain surfaced plungers in conjunction with temporary, patterned inserts of vulcanized fiber or other suitable material. The organic side facings 9 are continuous and cover the entire side surfaces of the wheel. The pattern of the mold plunger or the pattern of the vulcanized fiber or other inserts used therewith is impressed into the sides of the abrasive body structure and the facing material adhered thereto. In the specific wheel shown the particular pattern consists of depressed circular areas 10 uniformly but heterogeneously distributed over the entire side areas on both sides although innumerable other patterns may be used in place of the specific one shown.

Figures 3 and 4 show an abrasive cut-off wheel 11 made in accordance with a modification of the present invention wherein the facings 12 of organic material are of open-work pattern consisting of sheets of organic material 12 provided with diamond-shaped openings 13. It will be noted that the main abrasive structure 14 of the wheel comprising abrasive grains 15 and bond 16 is provided with patterned or indented sides created by impression of the open-work patterned side facings into the body of the wheel during the molding operation.

As illustrative of the manner in which the present invention can be practiced, 16" diameter rubber bonded cut-off wheels of $\frac{1}{8}$ of an inch thickness and with 1" arbor, adapted for wet cutting of ferrous stock as, for example, cutting through 1" diameter rod stock of SAE 1020 steel, were made as follows:

Example I

	Formula	
	No. 1	No. 2
	Parts by weight	Parts by weight
60 Masticated smoked crude rubber sheets.....	6.0	-----
65 Butadiene-styrene copolymer sheet stock (such as that sold by E. F. Goodrich Co., of Akron, Ohio, under the trade-mark designation of "Hycar OS-10").....	-----	8.0
Sulfur.....	3.0	4.0
Commene-indene resin.....	1.5	-----
Dibutoxy ethyl phthalate.....	-----	2.0
Cryolite filler.....	20	25.0
70 54 mesh size fused alumina grain.....	69.5	61.0

Abrasive-rubber bond mixtures such as either that of Formula No. 1 or Formula No. 2 above are made up and sheeted out to the desired thickness on a pair of rolls in the manner well-

known in the art. In making a wheel $\frac{3}{4}$ " overall thickness in accordance with the teachings of the present invention, the material should be sheeted or calendered to approximately the desired thickness of the finished wheel. The calendered material is died out into disc shapes 16" in diameter provided with 1" arbors, hereinafter referred to as preforms. The organic facing material is prepared by coating a 48 pound "Solkacel" paper which has a thickness of .003" to .004" with 2 pounds per ream (based on the solids content of the latex) of a synthetic rubber latex such as GR-S, type III latex (a butadiene-styrene copolymer rubber) which produces a facing material having a total facing thickness of .06". The coated "Solkacel" paper is dried in an oven for one hour at 125° F., dusted with sulfur and the disc shaped facings cut from the resulting sheet material. The preform is then pressed in a mold with a layer of the above described facing material placed on each side of the preform between it and the mold plungers with the latex-coated side of the facings next to the preform. The mold plungers are provided with patterned surfaces similar to the pattern shown in Figures 1 and 2 of the drawing, the vertical depth of the pattern on each of the mold plungers being .010". The preform and facings are cold pressed for two minutes at 2000 pounds per square inch, removed from the mold and given an oven cure at 300° F. to 325° F. for 12 hours. The wheel which is removed from the oven ready for use is structurally like the wheel depicted in Figures 1 and 2 of the drawing in that the facings have become permanently bonded to the abrasive body portion of the wheel and the particular pattern on the surface of the mold plunger has been impressed upon the side facings and the abrasive body structure of the wheel in the manner shown.

Example II

A rubber bonded cut-off wheel composed of the same materials and having a structure the same as that of the wheel made in Example I and shown in Figures 1 and 2 of the drawing can be made by following the same procedure therein set forth except that plain flat surfaced plungers are used in place of the mold plungers with patterned surfaces. The pattern impressed upon the sides of the wheel is obtained by inserting a thin patterned vulcanized fiber disc of .010" thickness between each of the mold plungers and the facings prior to pressing the facings onto the sides of the abrasive preform. The open-work pattern of the fiber discs conforms to the particular pattern it is desired to impose upon the sides of the wheel, as for example, the pattern of distributed circular areas shown on the wheel of Figures 1 and 2. The vulcanized fiber discs which are removed when the pressed wheel is taken from the mold can be used repeatedly. Instead of vulcanized fiber the temporary patterned inserts may be made of any other material of suitable durability such as steel or other metals, resinoid, or other tough, substantially non-compressible material.

Example III

A rubber bonded cut-off wheel having the structure shown in Figures 3 and 4 of the drawing is made as follows:

First, a preform is made in accordance with the composition and procedure given in Exam-

ple I above. An organic facing material similar to that used in Example I is prepared in sheet form and disc-shaped pieces having a diameter the same as that of the wheel being made is cut therefrom, the disc-shaped pieces being provided with an open-work pattern conforming to the pattern shown in Figure 3 in which the disc-shaped facing material has open distributed diamond-shaped spaces similar to the diamond shapes 13 of the pattern shown in Figure 3. The preform is placed in a mold with one of the patterned disc-shaped pieces of organic facing material placed on each side of the preform between it and the mold plunger with the latex-coated side of the facings next to the preform. The preform and facings are then hot pressed for a few seconds at 2000 pounds per square inch, removed from the mold and given an oven cure at 320° F. for 12 hours. The wheel, which is removed from the oven ready for use, is structurally like the wheel shown in Figures 3 and 4 of the drawing in that the open-work facings have been permanently attached to the abrasive body portion of the wheel which has been provided with a patterned or contoured side surface by forcing of the abrasive body portion into the open spaces of the patterned side facings.

Example IV

Rubber bonded abrasive cut-off wheels have also been made in accordance with the procedures given in any one of the preceding examples and using the abrasive body compositions therein set forth but differing therefrom in that plain kraft paper of .066" thickness has been used as the facing material.

Although in the specific examples hereinabove set forth I have employed a masticated crude rubber or a specific butadiene-styrene copolymer synthetic rubber as the basic bonding ingredient for the abrasive body structure of the wheels it is not intended that the present invention should be so limited. Other organic bonding ingredients can be used in place thereof such as any of the synthetic rubbers found acceptable for the bonding of granular abrasives such as other butadiene-styrene copolymers, butadiene-acrylic nitrile copolymers, and the like, all of which may be otherwise modified by the use therewith of modifying resins such as phenolic condensation products and other resinous materials and the like. Also, organic resin bonds of the types used to bond abrasive grains can be employed.

Also, when the abrasive body is formed by molding procedures other than by roll sheeting the natural or synthetic rubber of the bond can be employed in the form of a latex or as a degenerated or melted rubber product in any of the ways common to the abrasive industry in the molding of rubber bonded abrasive wheels.

Similarly, instead of the butadiene-styrene latex used as the coating for the "Solkacel" facings in Examples 1, 2 and 3 other natural or synthetic rubber latices can be used as the coating material for the facings.

When the claims specify a rubber bond it is intended to embrace both natural and synthetic rubbers.

Having described the invention in detail, it is desired to claim:

1. A rubber bonded cut-off wheel comprising abrasive grains and a rubber bond and having bonded to the side faces of the wheel open-

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work layers of rubber coated fibrous sheet material wherein uniformly distributed areas of the side faces of the wheel are uncoated and exposed.

2. An organic bonded cut-off wheel having a thin peripheral cutting edge and two extensive, opposing side faces, said wheel comprising a main body structure comprising abrasive grains and an organic bond selected from the group consisting of rubber bonds and resin bonds, each of the side faces of the body structure of said wheel being provided with a thin open-work patterned layer of organic sheet material leaving distributed areas of said side surfaces uncoated, the outer surfaces of each of said patterned layers of facing material being in substantially the same plane as the surface of the uncoated areas of that wheel side.

3. An organic bonded cut-off wheel having a thin peripheral cutting edge and two extensive, opposing side faces, said wheel comprising a main body structure comprising abrasive grains and an organic bond selected from the group consisting of rubber bonds and resin bonds, each of the side faces of the body structure of said wheel being provided with a thin open-work patterned layer of rubber coated paper leaving distributed areas of said side surfaces uncoated, the outer surfaces of each of said patterned layers of facing material being in substantially the same plane as the surface of the uncoated areas of that wheel side.

4. An organic bonded cut-off wheel having a thin peripheral cutting edge of two extensive, opposing side faces, said wheel comprising a main body structure comprising abrasive grains and an organic bond selected from the group consisting of rubber bonds and resin bonds, each of the side faces of the body structure of said wheel being provided with a thin open-work patterned layer of rubber coated fibrous sheet material leaving distributed areas of said side surfaces uncoated, the outer surfaces of each of said patterned layers of facing material being in substantially the same plane as the surface of the uncoated areas of that wheel side.

5. A rubber bonded cut-off wheel comprising abrasive grains and a rubber bond, and having a thin peripheral cutting edge and extensive side faces, each of said side faces having bonded thereto a thin non-abrasive facing of organic sheet material selected from the group consisting of fibrous sheet material, rubber coated fibrous sheet material, rubber coated paper, rubber coated regenerated cellulose and rubber, each of said side faces having a relief pattern consisting of selected small plane areas distributed over the side face of the wheel and depressed out of the plane or level of the remaining area of that side face.

6. A rubber bonded cut-off wheel according to claim 5, in which the thin facing material is a fibrous sheet material.

7. A rubber bonded cut-off wheel according to claim 5, in which the thin facing material is rubber coated regenerated cellulose.

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8. A rubber bonded cut-off wheel according to claim 5, in which the thin facing material is rubber coated paper.

9. A rubber bonded cut-off wheel according to claim 5, in which the thin facing material is rubber.

10. An organic bonded cut-off wheel having a thin peripheral cutting edge and two extensive, opposing side faces, said wheel comprising a main body structure comprising abrasive grains and an organic bond selected from the group consisting of rubber bonds and resin bonds, the side faces of the body structure of said wheel being provided with patterned surfaces with the pattern thereof in relief wherein selected small plane areas distributed over the side faces of the abrasive body structure of said wheel are depressed out of the plane or level of the remaining areas of the flat side face of the abrasive body structure, at least the depressed areas of said body structure being coated with a thin layer of non-abrasive organic sheet material selected from the group consisting of fibrous sheet material, rubber coated fibrous sheet material, rubber coated paper, rubber coated regenerated cellulose and rubber.

11. An organic bonded cut-off wheel according to claim 10, in which the organic facing material is rubber coated paper.

12. An organic bonded cut-off wheel according to claim 10, in which the organic facing material is rubber coated fibrous sheet material.

13. An organic bonded cut-off wheel according to claim 10, in which the organic facing material is rubber coated regenerated cellulose.

14. An organic bonded cut-off wheel according to claim 10, in which the organic facing material is fibrous sheet material.

15. An organic bonded cut-off wheel according to claim 10, in which the organic facing material is rubber.

16. An organic bonded cut-off wheel according to claim 2 in which the organic facing material is rubber coated regenerated cellulose.

17. An organic bonded cut-off wheel according to claim 2 in which the organic facing material is fibrous sheet material.

18. An organic bonded cut-off wheel according to claim 2 in which the organic facing material is rubber.

KENNETH M. TAYLOR.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,564,217

August 14, 1951

KENNETH M. TAYLOR

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 13, for "operation" read *operations*; column 5, line 16, for ".06'" read *.006'*; column 6, line 36, for ".066'" read *.006'*; column 7, line 34, for "edge of" read *edge and*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of November, A. D. 1951.

[SEAL]**THOMAS F. MURPHY,***Assistant Commissioner of Patents.*