

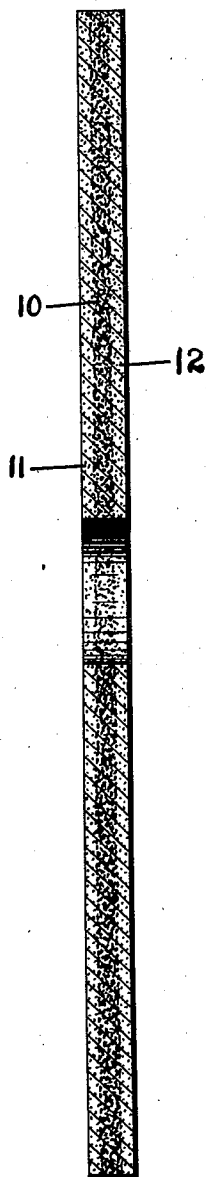
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CUTTING-OFF ABRASIVE WHEEL

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UNITED STATES PATENT OFFICE.

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CUTTING-OFF ABRASIVE WHEEL.

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My invention relates to the abrasive art and more particularly to an abrasive wheel adapted for special operations, such as cutting off lengths of objects.

5 Abrasive wheels used like a circular saw for cutting off pieces from articles made of metal, carbon, etc., are ordinarily made of abrasive grains bonded with an organic material such as rubber or shellac, these wheels
10 being approximately $\frac{1}{8}$ " in thickness.

The abrasive manufacturer is called upon to make a large number of wheels of different compositions and structures for cutting or grinding the almost endless variety of
15 materials which are now formed or finished with abrasive tools. These wheels which consist of abrasive grains held together by various kinds of bonds such as vitrified clays, rubber, resins, etc., are graded in a
20 series running from what is known as a "soft grade" to a "hard grade." To illustrate these limits of grade, a wheel of the softest grade contains a minimum of bond and is of such a character that it is just
25 barely possible to crumble away or break off the sharp edge of the wheel with the thumb nail, whereas a person cannot by muscular effort make an indentation into the hardest grade of wheel by means of a hardened steel
30 "grading tool" which is a tool shaped somewhat like a screw-driver. The "grade" hardness which includes such characteristics as toughness, tensile strength, compressive strength, coherence and resistance to frictional wear may be considered as indicating the degree of resistance which a bonded wheel structure has to the disruptive forces of grinding. The expressions "softer acting" and "harder acting" are often used in this
40 art as substitutes for "soft grade" and "hard grade," owing to the fact that the actual hardness of the bond itself is not of prime importance, it being merely its strength, toughness, etc., which give the rotating
45 wheel an apparent hardness by virtue of which it resists being broken down by the material ground upon.

The bond in a wheel of hard grade renders the wheel so resistant to disruption because
50 it holds the grains so firmly in place that there is a tendency for the grains to become dulled under long usage and for the wheel to acquire a glazed appearance. Hence, in

cutting extremely hard materials it is ordinarily desirable to use a "free cutting" 55 wheel or one having "softer acting" characteristics, so that the grains will break away from their setting before they become so dull as to lose their ability to cut efficiently, although a soft wheel tends to wear away rapidly and have a relatively short life. 60 The problem in making a wheel for a particular operation is therefore one which involves obtaining the maximum of service and efficiency for the longest wheel life. I have found that in cutting such materials as hard carbon, the harder bonded wheel tends to chip the carbon and so produce a rough and unsatisfactory cut, and if the wheel is sufficiently soft to prevent chipping it is 70 not economical and efficient.

It is therefore a prime object of this invention to provide an abrasive wheel which will be efficient and economical in use, which will give high production per life of wheel 75 and which will not injure the work or produce a badly appearing cut. Further objects will be apparent in the following disclosure.

As a result of my experimentation I have 80 discovered that a satisfactory grinding wheel for such purposes may be made as a laminated structure consisting of an inner disk forming on the grinding periphery of the wheel a central zone of hard bonded 85 abrasive grains which is able to withstand the stresses of hard usage and give high production for a long life, and outer layers integrally united therewith forming peripheral zones adjacent the wheel corners 90 which act softer than the central zone during use and are capable of grinding and clearing the sides of the cut without injuring the same.

One embodiment of my invention is shown 95 in the accompanying drawing which represents a section of a cutting-off wheel. As there illustrated one type of a hard centered, soft sided wheel may comprise a central portion 10 of abrasive grains, such as silicon carbide, bonded with a suitable, durable and hard medium, such as vulcanized rubber, to which are integrally united side layers 11 and 12 of abrasive grains bonded with a softer composition than the rubber bond of 105 the central portion. The bond for the outer

layers may consist of a suitable water-proof and heat set "abrasive bond", so called, such as a resin, either natural or synthetic, or a resin substitute, heat treated to unite the grains together and cause them to adhere to the inner layer. In other types of wheel, I may employ rubber vulcanized to a lesser degree of hardness for the outer bond, and in certain cases, I have found it feasible to make the whole wheel by means of a shellac bond, the inner layer being made harder by the addition of a hardening medium such as plaster of Paris or otherwise suitably treated to this end. Obviously, the laminae of the wheel may be made in accordance with various other methods and of many suitable compositions within the scope of my invention. One may also add soft sides to abrasive wheels of the usual types by slight modifications of the method herein described, as will be obvious to one skilled in this art, but such additions must be more than thin surface layers of abrasive grains cemented to the face of a wheel. They must be made up of disks of substantial thickness of abrasive grains bonded by hard and preferably heat set materials which are tough and capable of holding the grains in place under the severe strains of grinding, as well as resistant to heat and water.

As an illustration of one particular method in which the bonds are rubber and shellac, I may first form the central portion of a mixture of rubber and silicon carbide abrasive grains of a suitable size in accordance with well known practice. For example, sulphur, with or without a vulcanization accelerating agent, may be mechanically worked into the desired quantity of rubber bond, and the mass then mixed by means of rollers with a given amount of abrasive grains. This material, after having been passed through heated rollers a sufficient number of times, is then rolled out into strips of desired thickness and cut into a disk form corresponding with the diameter of the wheel.

The softer sides of the wheel may be added by placing the proper thickness of a mixture of silicon carbide abrasive grains and powdered shellac in a mold, the ingredients having been proportioned according to the degree of hardness desired. The rubber disk is then placed over the layer in the mold and a further layer of the shellac and abrasive mixture is then added above the rubber, after which the mass is subjected to pressure and heat in order to compact the sides and cause them to cohere and adhere to the central layer. The laminated wheel is subjected to vulcanization in a suitably heated apparatus in accordance with the usual practice. This heat treatment serves not only to vulcanize the rubber but to heat set the shellac and unite the grains into an in-

tegral mass in which the lines of demarkation between adjacent layers are not pronounced owing to the abrasive grains of one layer being pressed into the bond in the next layer and the intermingling of the bonds at the junction planes.

It is obvious that this invention is not limited in its application to the specific materials mentioned. One may select the various abrasives, such as silicon carbide and crystalline alumina, of such grain sizes as are deemed best for the particular operation to be performed. The type of the bond also depends upon the material to be cut and the service and production desired. It is also within the scope of my invention to utilize different sizes of grains in the different layers, either coarse in the center and fine in the sides or vice versa. It however is essential that the bond of the central portion be materially harder than that of the side layers or that, irrespective of the actual measured hardness and toughness of the bond, the side layers be bonded with such material that the grains will act softer in their cutting action and so not affect the work detrimentally.

In accordance with this method, I have thus formed an abrasive wheel made up of three separate laminae, each of which is a body of bonded abrasive grains of sufficient coherence and strength to serve by itself as a grinding wheel, provided the layer is thick enough for this purpose. It is my belief that, owing to the outer layer being softer than the inner hard layers, in actual use the central zone formed by the rubber bonded mixture does the major portion of the cutting, while the outer softer layers which form the peripheral corner zones become beveled or tapered so as to furnish means for gradually clearing the cut and smoothing its sides. I have found that the outer zones should have a substantial width and ordinarily have more than a single grain depth of material cemented to the wheel surface. If too thin and weakly bonded, this layer might be scraped off. Such outer layers function as they do, not because of essential differences in the abrasive grain but because of the characteristics of the bond employed, which make the peripheral corner zones act differently from the inner zone. I moreover employ for the outer zones bond materials which are not materially affected or changed by the heat generated during grinding or by any chemicals employed to lubricate or cool the surface of the cut.

Having thus described my invention, what I claim as new and desire to cover by Letters Patent, is:

A grinding wheel adapted for cutting off lengths of objects comprising a plurality of abrasive discs integrally united and each composed of abrasive grain of substantially

equal hardness united by a suitable organic bond, said discs being arranged to form a central zone having each side face covered by a disc in which the grains are united by a weaker bond than those of the central zone thereby forming a peripheral cutting surface, the outer portions of which are softer

acting and freer cutting than the central portion and form a substantial portion of the wheel periphery and serve to clear the cut during grinding. 10

Signed at Worcester, Massachusetts, this 3rd day of Aug. 1922.

CLARENCE R. KING.