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H. R. STRATFORD

2,317,650

COATED ABRASIVE

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Fig. 1.

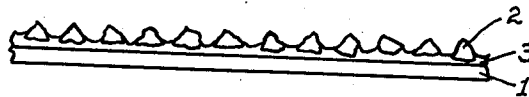


Fig. 2.

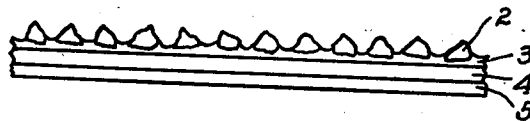


Fig. 3.

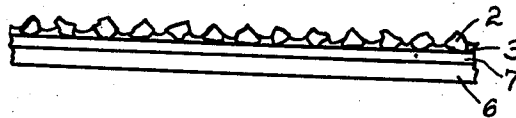
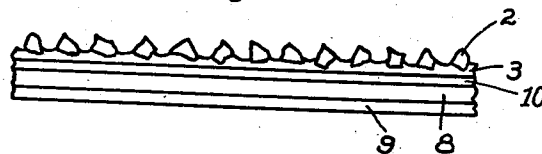


Fig. 4.



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COATED ABRASIVE

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4 Claims. (Cl. 51—298)

This invention relates to abrasive articles, and more particularly coated abrasive, and it is among the objects of the invention to provide an abrasive-faced article of water-resistant sheet material of certain definite hardness and capable of withstanding stresses of compression and tension as subjected to relative motion with respect to a work surface, even at high rates of speed. Other objects and advantages will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention then, consists of the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

The invention has been illustrated by a drawing, in which—

Figure 1 is a side elevation of one embodiment of the invention;

Figure 2 is a side elevation of a second embodiment of the invention;

Figure 3 is a side elevation of a further modification of the invention; and

Figure 4 is a side elevation of still another embodiment of the invention.

Referring to the drawing, Figure 1 illustrates an abrasive article made in accordance with the invention, comprising a backing 1 of specially treated paper 1 having abrasive grains 2 attached to a surface thereof by an adhesive 3.

In Figure 2, the article comprises a backing of paper 4 having its back surface specially treated to provide a hardened surface 5. Abrasive grains 2 are attached to the untreated side of the backing by an adhesive 3.

In Figure 3, the backing comprises a paper layer 6 having its upper surface 7 specially treated to harden it and a coating of abrasive grains 2 which rest directly on the layer 7 attached to the backing by the adhesive 3.

In Figure 4, the paper 8 has both surfaces treated, the lower surface being 9 and the upper surface 10, the adhesive grains 2 being attached to the upper surface by the adhesive 3.

In accordance with my invention, I provide a facing of granular abrasive on a support or backing sheet of felted cellulose or paper board rendered water-resistant and capable of withstanding stresses of compression and tension even as encountered, for instance, in power-driven grinding and polishing discs, belts and the like. Such sheet material may be of cellulose of any convenient source, a rag stock well beaten and properly laid on the machine in accordance with the features hereinafter set forth is quite characteristic as set forth hereinafter, forming

one advantageous type. Again sulphate-processed stock, properly sheeted in accordance with the features hereinafter set forth is quite desirable in many respects; also soda-processed and sulphite-processed stock, provided sheeted within the range of characteristics to be referred to. Certain minimum standards are important to attainment of a product affording satisfactory action in usage. For example, for tensile strength, a piece of such test cut one inch wide and tested in a breaking machine in which clamps grip at each end of the test sheet, such as to give a uniform pull throughout, the resistance of the sheet should be such as to break at not less than 50 pounds tension. The sheet material or paper board so provided, furthermore when subjected to a fatigue or repeated bending test should not break when subjected to 2,500,000 successive bendings. In such test, a standard dimension piece in exposure one inch square is gripped at opposite ends in clamps, one of which is stationary while the other reciprocates with a stroke of 0.6 inch to sharply bend the paper board centrally on each reciprocation. With such properties of tensile strength and with suitable stiffness, the thickness of sheet will in general amount to not less than 0.007 inch and the unit weight (rated in ounces per square foot) in general not less than 0.5.

I have found that sheet material used in the manufacture of coated abrasives depends, as regards the life of the composite sheet, upon the hardness of the sheet. A coated abrasive article when operated against a surface or piece of work to be abraded must stand up to the work, holding the abrasive grains relatively rigidly and resisting yielding in the sheet which would permit the abrasive grains to give instead of cutting into the surface being operated upon. The rigidity, lack of yield, or hardness of the sheet has a great influence both upon the effectiveness of the coated sheet as an abrading medium and also on the life of the coated abrasive and the ability of it to retain the grains and prevent their being worked loose and "shed" from the paper.

There being no standard method of testing papers of the type here under discussion for hardness, I have devised a method of testing which consists in reversing the procedure which is carried out in the so-called Rockwell testing machine and have employed this method to determine the kinds of paper stock capable of resisting strains to which coated abrasives are put in operation. The following results were determined in an apparatus designed to show the load required to produce a definite impression following the impression made by an initial smaller load for the purpose of eliminating an error due to surface irregularities. Obviously, an appa-

ratus to carry out this method of determination may take various forms, none of which form any part of the present invention and hence need not be described. The method employed, however, consists in first applying a load of exactly ten grams upon a $\frac{1}{8}$ " ball resting on the sheet and the subsequent application and measurement of a sufficient load to produce a further depression of .001".

Using this method of testing, I have found that it is essential that sheets for use in coated abrasives for severe operations have a hardness as measured in grams necessary to produce the impressions referred to above of approximately 100 or more, and while it is not essential that the hardness as so measured be far from 100, it is still desirable for ultra-severe operations that the hardness range from 130 upward, while for lighter operations hardnesses ranging around 100 are sufficient.

For heavy duty work it is desirable that the paper board have a tensile strength of over 90, a unit weight of at least 0.8, a thickness of at least 0.01 inch, and a hardness of 140.

Depending somewhat upon the particular duty contemplated and the extent of water resistance desired, there may be some variation in the treatment of the cellulose sheet material. I may treat the sheet material with a protein solution, such as glue, and insolubilize the protein by chemical action, as for instance by formaldehyde, tannic acid, chromate or bi-chromate, etc. A chromatized protein is in general advantageous, being of reasonable cost, and the degree of water resistance may be readily gauged in accordance with the strength of chromate solution. Sodium bichromate may be employed in amounts of 1 to 10 or even more per cent, for example. I may also employ metallic resins, as sodium or aluminum resins, flexible synthetic resins such as oil-modified alkyds or phenolics, etc. Again, in some instances, oils which may be drying, semi-drying or non-drying, oil varnishes, waxes, asphalts, cellulose derivatives and the like may be used as impregnants or treating agents. Asphalts as from natural deposits or from petroleum may be applied in molten condition, excess being removed by squeeze rolls; or where preferred, the material may be thinned with a volatile solvent, such as naphtha and be applied in such form, alone or with admixture of such materials as resin or resin oil, etc., in amounts of ten to twenty per cent. In some instances, for example, I may directly treat the cellulose sheet to effect a more or less thoroughgoing chemical change therein as, for instance, by cupro-ammonium treating, nitrating, acetylating and the like, the extent of treatment depending upon the ultimate degree of water resistance desired. The treatment may be so severe as to extend throughout the sheet or a sheet may be formed and then treated superficially to develop the desired properties on the surface only, the inner part of the sheet being chemically or physically unchanged. For example, a sheet of paper of suitable thickness may be treated with zinc chloride or sulphuric acid to hydrolyze the surface and develop a desired hardness on the surface while the inner parts of the sheet are unaffected.

While in general, such treatment is desirably carried out before assembly with the adhesive and the abrasive grains, in some instances I contemplate applying this step in conjunction with the assembly, or subsequently. In any case, a sheet abrasive is had, presenting tensile strength

and sufficient stiffness to facilitate drastic mechanical drive and yet without undue thickness or weight of material or undue costs.

As abrasive material there may be employed natural or artificial granular abrasives as, for instance, emery, corundum, garnet, silica, silicon carbide, etc. The abrasive may be secured in place on such backing sheet with a suitable adhesive, for instance, an animal glue or vegetable adhesive of sufficient strength, or a binder of oxidized or oxidized and polymerized drying oil base, with or without resinous addition, or with a synthetic resin such as a phenol-formaldehyde condensation product or an alkyd resin.

The abrasive sheet articles so contemplated may further be made in the form of discs and the like, or endless articles, such as cones, sleeves, belts, etc., for effective drive by mechanical means, the belts being mounted in use on pulleys with a work-engaging run therebetween and the discs, for instance, being mounted on an arbor for portable or stand usage as in any instance preferred.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described and provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. An abrasive article comprising a disc of felted cellulose having a tensile strength of not less than fifty pounds per inch width, a facing of granular abrasive on said cellulose sheet, and a waterproof adhesive agent adhesively attached to said grains and to a surface of said sheet, said sheet being impregnated with a synthetic resin to give the sheet such a hardness that an additional weight of at least 100 grams is required to force a $\frac{1}{8}$ inch diameter ball an additional 0.001 inch perpendicularly into the sheet after the ball has been inserted a smaller distance into the sheet by means of a preload of 10 grams on the ball.

2. An abrasive disc comprising a supporting web impregnated with a synthetic resin and cured to produce a certain hardness of not less than 100 grams which represents the additional weight that is required to force a $\frac{1}{8}$ inch diameter ball an additional 0.001 inch perpendicularly into such web after the ball has been inserted a smaller distance into said web by means of a preload of 10 grams on the ball, and an abrasive coating strongly attached to said web.

3. A flexible abrasive sheet comprising a backing of cellulose sheet material which has been hydrolyzed until an additional weight of at least 100 grams on a $\frac{1}{8}$ inch diameter ball which has been previously inserted into the sheet material by a preload of 10 grams is required to produce a further penetration of 0.001 inch, and a synthetic resin coating attached to the hardened backing and serving to bond abrasive particles thereto.

4. The method of making flexible abrasive sheets which comprises hydrolyzing the surface of a felted cellulose sheet until an additional weight of 100 grams is required to force a $\frac{1}{8}$ inch diameter ball which has been inserted into the sheet by a preload of 10 grams an additional 0.001 inch perpendicularly into the sheet, and attaching abrasive particles to said hardened sheet by means of a synthetic resin.