

Jan. 9, 1962

G. L. HAYWOOD
ABRASIVE PRODUCT

3,016,294

Filed April 21, 1959

2 Sheets-Sheet 1

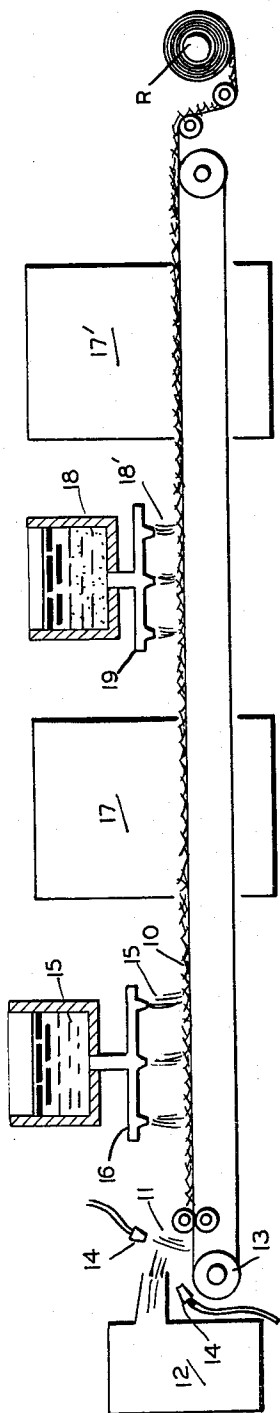


FIG. 1

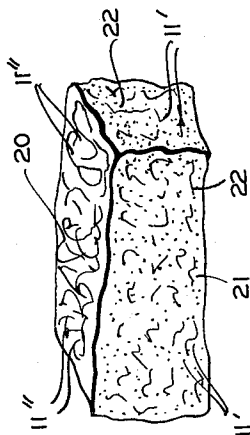


FIG. 2

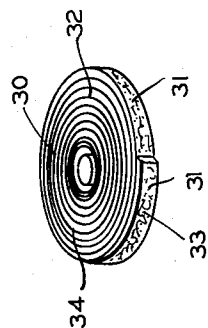


FIG. 3

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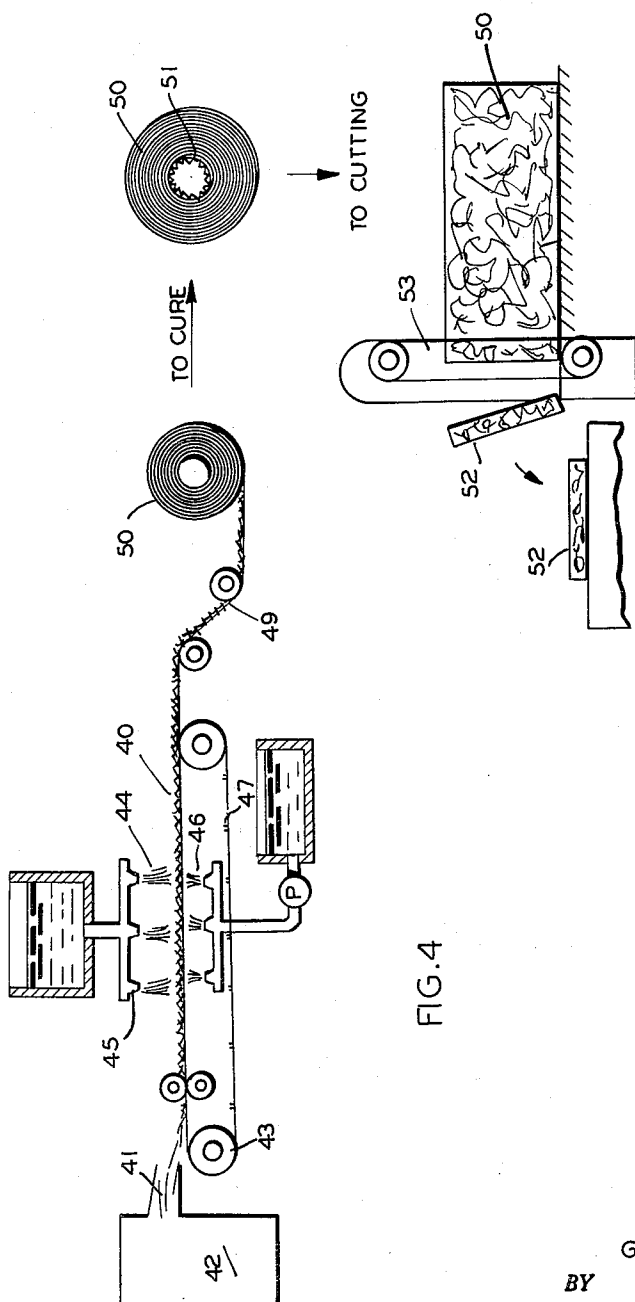


FIG. 4

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1

3,016,294

ABRASIVE PRODUCT

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3 Claims. (Cl. 51-297)

The present invention relates in general to abrasive products and in particular to an abrasive product utilizing a non-woven textile material as a backing and to methods of making the same.

This is a continuation-in-part of the copending application, Serial Number 782,689 of George L. Haywood, filed December 24, 1958.

It has heretofore been proposed to utilize non-woven, felted materials as a medium for carrying abrasive grain, the resulting product finding application as a component of a grinding wheel or as a polishing or scrubbing device. Examples of such products are disclosed in U.S. Patent No. 2,335,902, issued to Albert L. Ball, Raymond C. Benner and Romie L. Melton.

It has been found, however, that for severe abrading or polishing operations such products find little application although the economics of using a relatively thick (compared to a conventional piece of coated abrasive) backing impregnated with abrasive grain should make such products very desirable.

Accordingly, it is an object of this invention to improve the prior art methods of making and utilizing non-woven, abrasive-impregnated webs.

A further object of the invention is to provide a new abrasive product.

Additional objects if not specifically set forth herein will be readily apparent to one skilled in the art from the following detailed description of the invention.

In the drawings:

FIGURE 1 is a schematic illustration of one method of forming the non-woven, abrasive-containing material utilized in the present invention.

FIGURE 2 is a perspective view of a strip of material cut from the web 10 of FIGURE 1.

FIGURE 3 is a perspective view of one type of abrasive article formed in accordance with the present invention.

FIGURE 4 is a schematic illustration of the preferred method utilized in the present invention.

Generally the present invention involves the recognition that much of the difficulty in prior art attempts to utilize non-woven, abrasive-impregnated webs arose from the fact that while attempts might have been made to provide a non-planar type structure, predominantly all of the fibres or filaments tended to align themselves in a somewhat planar form, i.e. while the filaments or fibres might criss-cross one another, they tended to lie in a plane substantially parallel to the horizontal. This is due to the manner in which such felted, non-woven webs are generally formed. For example, U.S. Patent No. 2,335,902, referred to above, describes a felting operation in some detail, disclosing carded membranes being deposited upon a moving endless support to build up a layer of the desired thickness.

Webs of this type have been impregnated throughout or in some instances coated on one surface only with abrasive grain which is held to the non-woven web by an adhesive. The abrasive material, in adhering to the fibres or filaments making up the web, has necessarily tended to follow the somewhat planar structure of the webs.

The present invention requires that the fibres, be laid down in a random manner to form a non-felted, porous web or batt of the desired thickness. Again the fibres, which preferably are about 2 inches in length although longer lengths may be used if desired, tend to lie in a

2

somewhat planar relationship, i.e. the length direction of the fibres tends to be in the horizontal plane. However, the present invention then requires that the abrasive article formed from such non-woven web (after coating or impregnating the same with abrasive grain) be so disposed and arranged that the work contacting surface of said article presents the non-woven material at right angles to its normal horizontal plane, i.e. with the ends of the fibres or filaments projecting from the work surface. This innovation has very substantially improved the performance of such material and has given rise to a number of new applications for this type of product.

Preferably, in carrying out the present invention, a non-felted, non-woven material is utilized. Referring now to the drawings, reference numeral 10 designates a web or batt of non-woven material formed from preferably thermoplastic filaments 11 such as coarse nylon fibres having a diameter of up to about 300 microns. Other fibres or filaments or mixtures thereof such as rayon, silk, wool, hair, "Dacron" (a condensate of dimethyl terephthalate and ethylene glycol), "Orlon" (polyacrylonitrile) or "Dynel" (a copolymer of 40% acrylonitrile and 60% vinyl chloride) may be used as desired and the diameter of the fibres used may also be varied within wide limits, e.g. 40 to 300 microns. As will be seen from the schematic drawing of FIGURE 1, the fibres 11 are formed into desired lengths, e.g. 2 inches or so, by a suitable cutter device generally shown at 12 and deposited upon a moving endless support 13. As the fibres 11 fall to the surface of the support 13, they may be agitated by an air blast from nozzles 14. The fibres 11 tend to fall at various angles to one another and to criss-cross and interlace one with the other. However, it will be noted that the tendency still is for the length direction of the fibres to lie predominantly in the horizontal plane. A web 10 of the desired thickness is built up—either by regulating the speed of the support 13 and the rate of discharge thereon of the fibres 11 or by the use of additional fibre supplying stations (not shown). The fibres comprising the web 10 are then bonded to one another by any of several conventional methods, i.e. by the use of heat if thermoplastic filaments are used (autogenous bonding), by immersion in a saturant bath (saturation bonding) or by the application of adhesive material to the fibres by spraying (spray bonding) as illustrated. The adhesive 15 is applied, in the method illustrated, by spray nozzles 16 which may be stationary or preferably so mounted as to reciprocate back and forth across the web 10. The bonded web 10 then passes through a heating zone 17 to set or cure the adhesive 15, and then is subjected to an application of abrasive grain. As shown, a spray of abrasive grain-adhesive slurry 18 is directed into the surface of web 10 from nozzles 19. Alternatively, the adhesive may be applied first and then the abrasive grain coated if a surface coat is desired. Complete impregnation of the web 10 may be achieved by a single spray if the web is thin enough, although where a substantially uniform distribution of abrasive throughout the web is desired, it is preferable to first cure the one side of the abrasive sprayed web and then reverse it to receive a second spray application of abrasive slurry on the opposite side. After impregnation or coating with the abrasive grain the web is then preferably cured by heating as at 17'. The finished web may be rolled into jumbo roll form as illustrated at "R" or may be utilized in flat form for the formation of the desired finished article. It frequently is desirable to split the process into several steps, i.e. producing the web as one operation and subsequently applying the abrasive as a separate operation.

Many types of finished abrading articles may be made from the web material described above, but in accord-

3

ance with the present invention, all have one feature in common. In each instance the desired shape must be cut from the web material so as to leave what may be designated as the "original" surfaces of the web, i.e. the upper and lower surfaces of the web as formed (designated by reference numerals 20 and 21 of FIGURE 2) and the "cut" surfaces of the web, designated by reference numeral 22 of FIGURE 2. Contrary to established practice with material of this type, the present invention requires that the "cut" surfaces be the work contacting surfaces of the finished abrading article. As a result, and referring again to FIGURE 2 of the drawings, it will be seen that "cut" surfaces 22 are made up of primarily the ends 11' of the fibres or filaments 11 of the web whereas the "original" surfaces 20 and 21 are made of predominantly the lengths or sides 11" of the fibres or filaments 11.

The following example is furnished for purposes of illustration and no limitation is intended thereby other than as may be imposed by the appended claims.

Example I

A 40 inch wide web of non-woven scrap nylon filaments—average diameter of 123 microns—was prepared as described above, using a conventional Rando-Webber machine and applying a spray coating of a waterproof butadiene-acrylonitrile adhesive. The web, as prepared, varied in thickness from $\frac{1}{4}$ to $\frac{1}{2}$ inch and had an average weight of 3.4 oz./square yard. After curing to set the bonding adhesive, this web was sprayed on both sides with a slurry comprising:

200 gms. Epon ester (including tall oil acids) 70% solids
60 gms. xylene
3.5 cc. drier (solution containing 3% manganese metal)
130 gms. abrasive grain—(2/0 flint)

The amount of abrasive grain in the mix was about one-third of the total weight of the slurry and the slurry was applied to the web at the rate of 25.5 pounds/ream (solids). After coating the web as aforesaid, the material was cured for $\frac{1}{2}$ hour at 275° F. The material was then cut into a strip about $\frac{5}{8}$ inch wide. By virtue of this cutting operation, the ends of the fibres making up the web were exposed on the "cut" sides as described generally above. The strip was then laid on its side and wound on a $3\frac{3}{4}$ inch core to form a disc approximately 12 inches in diameter as illustrated in FIGURE 3 of the drawings. By processing in this fashion, the "original" surfaces 31 of the web were placed adjacent one another and both the upper 32 and lower 33 face of the disc 30 represented the "cut" surfaces of the web material. As the strip was being wound on the core, a light coating 34 of the Epon ester used in forming the abrasive slurry was brushed on the inner "original" surface of the web to facilitate bonding of such surface to the next adjacent convolution. After winding, the disc was placed between two cardboard strips and cured for one hour at 275° F. The finished product was utilized as a floor polisher and due to its convolute structure was able to be placed directly beneath the head of a conventional floor polisher without the necessity of any special driving pads or the like. The disc was used in the cleaning and polishing of vinyl tile floors with excellent results. The porous, open structure of the material made as described above permitted ready penetration by the water and detergent used in cleaning the floor and the disc was easily cleaned after use by flushing with water.

Example II

Utilizing a web, formed as in Example I, a plurality of circular discs having an outside diameter of 16 inches were formed. Contrasted with the disc formed as described in Example I, these discs were one solid piece die-cut from the web. A 3" diameter center hole was cut from each disc to permit mounting of the disc on a spindle. The resulting discs were used alone and "ganged" (a plurality

4

of discs mounted on a single spindle and clamped together with side flanges) to polish and grind steel castings. As in the case of the disc of Example I, the surface of the discs contacting the work presented a "cut" as distinguished from an "original" surface of the material to the workpiece and the action of the fibre ends present at such surface produced excellent cutting and polishing results.

Obviously, other types of adhesives, abrasive grains, and non-woven fabrics may be utilized in devices of the present invention. Likewise, the amounts of adhesive and abrasive grain used may be varied within wide limits. In the same manner, other shapes and arrangements of the abrasive-carrying, non-woven material may be formed, as for example rolls, solid discs or the like. The prime requisite in all cases is that the material be so disposed as to present the cut surfaces to the workpiece to be cleaned or abraded.

FIGURE 4 illustrates the preferable method for carrying out the present invention. In this method, the procedure for forming the web per se is as described above in connection with the method illustrated in FIGURE 1, i.e. the fibres or filaments 41 are formed into relatively short lengths by a cutter 42 and deposited upon a perforated moving endless support 43 which may be an open mesh screen or the like. The randomly disposed fibres 41 having their length directions predominantly in the horizontal plane are built up in depth to give a web 40 of the desired thickness as was earlier described. The web 40 is then subjected to a spray 44 of a slurry of abrasive grain and adhesive preferably applied to both sides of the web at the same time as by spray nozzles 45 and 46 mounted above and below the path of travel of web 40. The physical setup of the equipment to perform this portion of the method and the steps following may obviously be varied as desired. As illustrated, the perforated surface 47 of the conveyor belt 43 is treated with a suitable adhesive-repellent agent, e.g. silicone compound, to prevent adhesion between the adhesive coated web 40 and the surface 47 of the conveyor. If desired, the web may travel vertically at this point, i.e. as in a tower or the like, to permit at least partial drying of the adhesive prior to further contact between the web and any other part of the equipment. Obviously, the web 40 can be sprayed on only one surface if desired, the adhesive at least partially dried and then the web reversed, as described in connection with FIGURE 1 for the application of the adhesive-abrasive slurry to the opposite side. After coating on both sides with the adhesive-abrasive slurry which, due to the relatively open nature of web 40 and the fact that the slurry is sprayed onto the web under pressure, penetrates throughout the interior of web 40 as well as coating the surface fibres thereof, the material is rolled up on itself as shown at 49 to form a jumbo roll 50. The tension under which roll 50 is formed will determine the density of the finished roll and may be varied as desired. Once in roll form, the material is heated to cure or set the adhesive. This may be accomplished in a variety of ways ranging from mere exposure of the roll to the atmosphere of a warm room to the mounting of the roll 50 on a perforated mandrel 51 through which heated air is blown. Once the adhesive is set up or cured, the roll 50, now unified by the adhesive, is sliced into discs 52 of the desired thickness as by a band saw 53. The discs 52, so formed, have the convolutions thereof firmly bonded one to the other as a result of the winding up of the material in the wet or semi-wet state and the subsequent cure of the adhesive while the material was in roll form. An important aspect of this method is the almost complete elimination of waste since the only material to be discarded is that trimmed from each end of the roll 50 and that which is pulverized by the saw blade as it cuts the roll into discs.

I claim:

1. A method of making an abrasive article from a non-woven fibrous web, said article having at least one surface thereof containing predominantly the ends of the

5

individual fibres comprising such web which comprises: substantially saturating with a slurry of adhesive and abrasive grain a relatively thin wide non-felted, open, non-woven fibrous web, said web having the majority of the individual fibres thereof randomly disposed with their length directions lying more in horizontal than in vertical planes with respect to the plane of said web so that said individual fibers are coated upon their surfaces with said abrasive grain and adhesive; rolling said saturated web tightly upon itself to form a roll; curing said adhesive while said web is in roll form to produce a unified, self-sustaining structure; and then slicing said roll to produce said article.

2. A method of making abrasive articles which comprises: forming a non-felted, non-woven web of relatively short individual fibres by depositing such fibres upon one another in random relationship with the length of such fibres extending predominantly in substantially parallel planes; substantially saturating said web with a mixture of abrasive grain and adhesive to coat the surfaces of said individual fibers therewith; rolling said web upon itself under a controlled degree of tension to form a roll hav-

6

ing a plurality of adjacent convolutions; curing said adhesive on and in the convolutions of said material while maintaining said material in roll form to produce a unified, self-sustaining structure; and slicing said roll to produce a plurality of abrasive articles having at least one working surface thereof containing predominantly the ends of such individual fibres and the abrasive associated therewith.

3. A method as in claim 2 wherein said web is substantially saturated with said slurry of adhesive and abrasive grain as a result of applying said slurry to opposite faces of said web in the form of a pressure spray.

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