

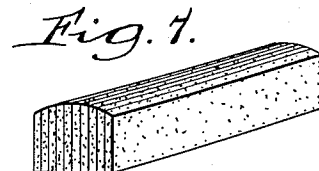
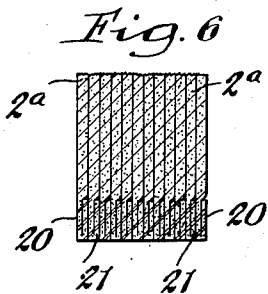
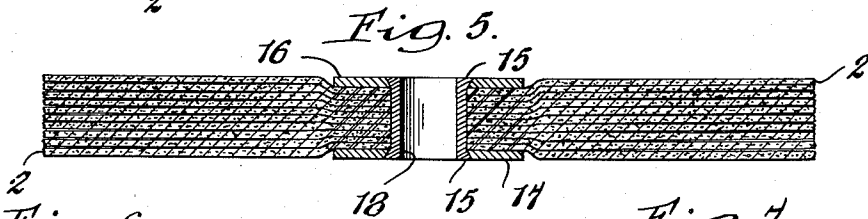
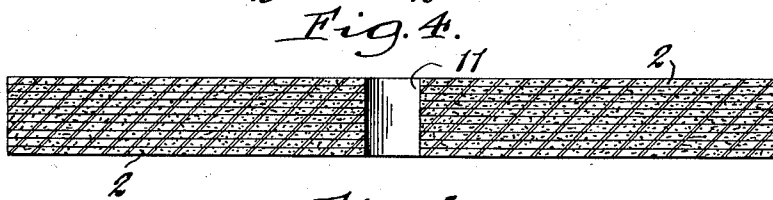
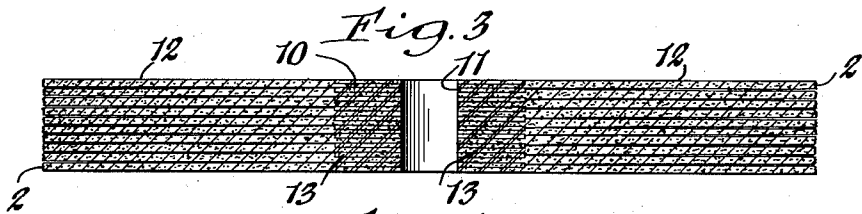
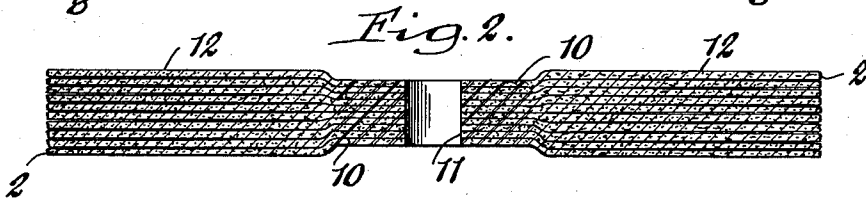
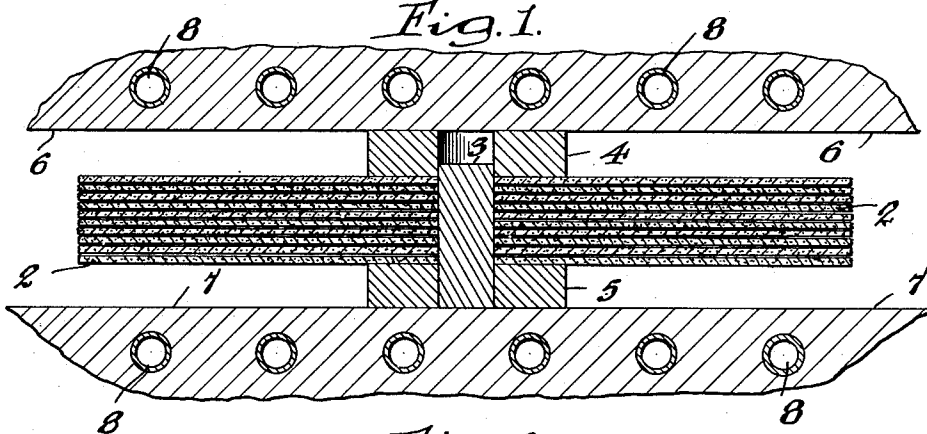
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R. L. MELTON ET AL

2,355,667

ABRASIVE ARTICLE

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ABRASIVE ARTICLE

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16 Claims. (Cl. 51—193)

This invention relates to abrasive articles and methods for their manufacture. More particularly, it relates to flexible or resilient abrasive articles having a mild or "soft" abrading action, and formed of a composite of felted fibrous sheets having abrasive grain and adhesive therefor included internally of the individual sheets. The invention especially pertains to abrasives made from a plurality of flexible, fibrous abrasive-containing sheets or webs which are superimposed and secured together to form various abrading devices, such as buffing wheels, "set-up" wheels, discs, blocks, pads, sticks and other shapes which provide a relatively resilient or "soft" abrasive action.

The invention is well adapted to the provision of permanently charged buffing wheels, polishing wheels, set-up wheels and the like, and will be described largely as it pertains thereto. However, many other resilient types of abrasive articles which provide a "soft" grinding action for numerous grinding purposes can be made in a similar manner.

Buffing wheels commonly in use are formed of layers of cotton cloth, duck or other fabric quilted or stitched together and superficially charged at the periphery with abrasive material in stick or paste form. Such wheels quickly smear and load in use and require frequent renovating and recharging for efficient operation. Other wheels have been made by building up alternate layers of fabric and abrasive, or by applying abrasive material to the surface of fabric layers. However, the abrasive articles heretofore provided have left much to be desired in the way of permanency of the abrasive content, uniformity of abrasive action, flexibility, resilience in action and other properties essential to effective use. Provision of satisfactory properties in one respect has usually been at a sacrifice of one or more of the other characteristics desirable in such products.

In accordance with the present invention, improved abrasive articles of the resilient type are made by a process which consists of two sequent steps or procedures. The first step is that of forming a satisfactory felted fibrous web material containing abrasive particles included internally thereof and retained by an adhesive binder also included therein. The abrasive and adhesive content of the fibrous material is incorporated and distributed through the fibrous web at the time of manufacture and constitutes an integral part thereof. This fibrous abrasive web material can be satisfactorily made in sev-

eral ways, as will be set forth later. The fibrous abrasive web material thus produced constitutes an intermediate product, i. e., the raw material for the second stage of the manufacture of the abrasive articles of the present invention. The previously-formed abrasive-containing fibrous web is cut into blanks of a required size and shape which are then assembled and either adhesively secured together or secured by mechanical means, such as arbor clamping means, to form various abrasive articles such as herein set forth.

In order to better understand the nature of the abrasive articles and methods of manufacture, reference is made to the accompanying drawing showing specific examples of such products, and in which:

Figure 1 shows, in vertical section, a number of blanks of abrasive-containing fibrous web material assembled on a mold with press platens for applying pressure and heat thereto;

Figure 2 shows a vertical diametrical section through an abrasive polishing wheel embodying the present invention;

Figures 3, 4 and 5 show sectional views through various modified forms of the abrasive article shown in Figure 2;

Figure 6 shows a vertical section through an abrasive block embodying the present invention;

Figure 7 shows a perspective view of an abrasive stick employing the present invention.

The abrasive-containing fibrous web material used in making the products of the present invention can be manufactured in several ways. A very satisfactory method of making included abrasive sheet material of the herein required type is that set forth and fully described in Patent No. 2,284,716, issued June 2, 1942. Briefly, the felted fibrous web is formed by feeding a plurality of thin carded fibrous membranes from a number of carding assemblies onto a moving endless support so that each membrane is deposited or superimposed upon the preceding membranes until a web of loosely felted fibrous material of the desired thickness is built up on the traveling support. A number of abrasive grain hoppers are also disposed between the carding assemblies and above the traveling conveyor. Abrasive grain is fed from the hoppers onto the fibrous membranes at various stages in the building up of the final web, so that, as a result, the abrasive material is applied between the individual membranes making up the web and so is internally distributed throughout the fibrous web or sheet. A suitable adhesive binder

is then incorporated within the fibrous-abrasive web, the web consolidated to a desired density and the web passed to a curing zone, where the adhesive is matured or set. The included abrasive web is then wound into rolls for use as an intermediate product or source for the manufacture of the products herein described.

In practicing the invention, any of the abrasive materials in common use may be employed, such as silicon carbide, diamonds, boron carbide, fused aluminum oxide, flint, corundum, emery, rouge and similar substances. The size of the abrasive particles may vary from the finest polishing or buffing powders to the coarser grit sizes used in grinding.

Other methods of incorporating abrasive material internally of the fibrous sheet material during its manufacture may be employed. For example, the abrasive particles can be thoroughly admixed with the adhesive binder and the mixture applied to the web by the usual adhesive-applying rolls. This method has been found to be particularly satisfactory for the inclusion of the finer abrasive materials of the size employed in buffing and polishing operations.

Another method is to project the abrasive material into the web or sheet after it has been built up to the desired thickness and immediately prior to consolidating the web. The projection of grain is suitably carried out by means of a blast of air or gas against one or both surfaces of the fibrous web, the air stream being laden with the abrasive material to be included internally of the web. The other steps in the formation and consolidation of the web are carried out in a manner similar to that used in the previous procedures.

Felted fibrous webs having abrasive material included within the web and which are suitable for use in the fabrication of the herein described products can also be made by a modification of the above processes in which the individual fibers are interwoven and interlocked by a gentle air or gaseous agitation of the thin carded membranes during their deposition. This process is termed "aerodynamic weaving" and is used to promote the strength and eliminate any laminations from the web. For a more complete description of the process, reference is made to copending application Serial No. 375,517, filed January 22, 1941, and Patent No. 2,284,739, issued June 2, 1942, in which further details are also given of the above procedures for including abrasive materials within the fibrous structures.

The felted fibrous abrasive-containing sheet material made as above described constitutes the raw material used for the making of abrasive articles in accordance with the present invention. The fibrous abrasive sheeting is cut into blanks of the desired size and shape and these blanks are assembled in piles or stacks and secured together by various means to form numerous types of abrasive articles such as are herein set forth. The drawings, in which like numerals in the different figures refer to similar parts, are illustrative.

Referring to the detailed drawings, Figure 1 illustrates one method of manufacturing a polishing or buffing wheel from a number of shaped blanks of abrasive-containing fibrous web material. Individual blanks 2 of such included abrasive fibrous material, which previously has been cut to proper size and shape, are assembled in superimposed relation on an arbor plug 3 and between molding plates 4 and 5. After building

up a stack of blanks of required thickness, the entire assembly is placed between the platens 6 and 7 of a suitable press and subjected to pressure and/or heat. The platens 6 and 7 may be heated by passing hot water or steam through the dusts 8. With the application of pressure and heat, that portion of the individual abrasive members 2 positioned between the plates 4 and 5, is formed into a solid central core containing an arbor hole for subsequent mounting. Those portions of the individual abrasive members 2 outside the area of the plates 4 and 5 remain individually separated and provide a highly flexible and "soft" abrading or polishing surface.

We have found that certain adhesives, generally employed in the manufacture of abrasive-containing fibrous materials, are satisfactory for self-bonding the central portion of the laminated stack by a hot pressing operation without additional adhesive or binder. This is particularly true with glue and thermoplastic resins, and also with latex and synthetic rubber-like materials. However, in some instances, we may apply additional adhesive, as a liquid, film or impregnated sheet material, between the adjacent layers of the included abrasive material to act as a bonding agent. Various adhesives may be employed for this purpose and include glue, natural and synthetic resin, rubber latex, sodium silicate, shellac and the like.

Obviously the pressure and temperature employed in the above bonding operation will depend upon the particular adhesive being used. With a plasticized animal glue, we have obtained satisfactory self-bonding results by applying a pressure of 250 to 500 pounds per square inch, depending upon the desired density of the finished article and a temperature of 300° F. for a period of 30 minutes. This time may be reduced with thinner articles. Polishing wheels of ¼ inch in thickness have been satisfactorily bonded in 15 minutes.

Figure 2 shows a polishing wheel made in accordance with the procedure described in connection with Figure 1. The application of heat and pressure to the central area 10 of the wheel has consolidated that portion of the article to a greater density and caused the adhesive binder included within the fibrous web to soften and bond the compacted section into a solid structure. An arbor hole 11 has been molded in the center of the compressed section of the wheel and provides a means for mounting on a suitable drive shaft. The outer portion 12 of the wheel, which was not subjected to pressure and heat, is very flexible and yielding due to the fact that the abrasive members 2 are individually separated and free to yield under pressure of the work being abraded. Thus a high degree of flexibility in operation and a "soft" grinding action is obtained. These characteristics are particularly suitable for polishing and burnishing operations. Furthermore, a polishing wheel of this type has an additional advantage in that it is permanently charged with abrasive material. Such abrasive material is uniformly and evenly distributed throughout the wheel structure and also retained therein by a bonding agent.

Figure 3 shows a modification of the wheel of Figure 2 and differs therefrom only in the compacted central portion 10. During the assembly of a wheel of this type, spacing members 13 are interleaved between the fibrous included abrasive members 2. These spacers may be relatively small sheets substantially coextensive with the

area 10 to be compressed and securely bonded. They may be of the same material as the abrasive elements 2 and may be previously formed blanks or produced from said elements 2 by cutting radial slots therein to form segments of the arbor hole area and then folding these segments back radially outward. Other materials may be used as spacers, such as, for example, thin sheets of thermoplastic or heat hardenable resin or resin-impregnated materials which, when subjected to pressure and heating, soften and bond the laminated layers together. The thickness and number of the spacers required will vary with the degree of consolidation of the central portion of the wheel. A sufficient number of spacers should be used to compensate for the tendency of a reduction in thickness of the wheel at the compacted portion.

Figure 4 illustrates a further modification of the wheel of Figure 2 in which the included abrasive-containing fibrous members 2 have been pressed and bonded together over their entire area. In fabricating this type of article, the plates 4 and 5, shown in Figure 1, are as large as the wheel diameter so that the entire wheel is compacted and formed into a more rigid type of abrasive article. The degree of rigidity can be controlled through a wide range by variations in molding pressure and temperature, as well as by the incorporation of an additional adhesive between the adjacent sheets of included abrasive fibrous sheets 2.

The relatively rigid abrasive articles, such as shown by Figure 4, are particularly useful in certain grinding or polishing operations. The nature of the fibrous structure, in which abrasive material has been included internally thereof, provides a much "softer" grinding action than that obtained with the ordinary bonded grinding wheels. Furthermore, the fibrous structure provides a cushioned seating of the individual abrasive particles so that a finer finish is obtained without deep scratches, gouges or other harsh action.

Figure 5 illustrates a further modification of the abrasive wheel of Figure 2 and differing therefrom only by the manner of securing the central portion of the abrasive-containing fibrous members 2. Blanks of included abrasive material, which previously has been cut to proper size and shape, are assembled on a spool formed by the core 15 and the end pieces 16 and 17. The stack of blanks is compressed to a desired degree and then held in such state of consolidation while the end pieces 16 and 17 are securely attached to the ends of the core 15. An arbor hole 18 is provided in the core 15 for mounting.

Many abrasive articles, other than grinding and polishing wheels, can be manufactured by the present process. One such article, in the form of a rectangular block or polishing rub, is illustrated by Figure 6 of the drawing. This abrasive block comprises a number of abrasive-containing fibrous sheets 2a, one edge of each of which is securely bonded together over a relatively limited area indicated by the reference character 20. These included abrasive sheets 2a are cut to proper size and shape, assembled in stacks of required thickness and then the area 20 subjected to pressure and heat in a manner similar to that described in connection with Figures 1, 2 and 3. Thus the abrasive members 2a are securely bonded together over a limited area 20, while the remainder of abrasive elements remain individually separated and free to yield

under pressure and provide a pliant abrading surface.

By folding over a portion 21 of the included abrasive members 2a, suitable spacers are provided so that the compressed and bonded section 20 of the block is not materially reduced in width.

Figure 7 is a modification of Figure 4 and illustrates an abrasive stick or cylinder honing stone made in accordance with the teachings of the present invention. A number of included abrasive sheets 2a are bonded together over their entire area to form a relatively rigid body. Due to its resilient character, this article has proven particularly useful in providing a smooth surface finish in cylindrical honing and polishing operations.

We have found that the character of the abrasive articles produced by the herein-described process can be altered to any desired degree by variations in the quantity and character of the adhesive binder employed in making the intermediate fibrous sheet material, and also by the optional use and choice of a supplemental or auxiliary adhesive substance between the fibrous sheets.

It is essential, however, in the selection of suitable adhesive binders for making the included abrasive sheet material for the aforesaid articles that the adhesive substance does not smear during grinding operations. This is especially true in the case of set-up, buffing and other polishing wheels and devices where smearing of the bond tends to produce a "hot cutting" or burning action which is ruinous to the finish being produced.

Among those substances which can be satisfactorily used as bonding materials herein and which are non-smearing, are included glue adhesives, particularly when treated with plasticizing agents such as ethylene glycol, dibutyl phthalate, glycerine and the like. The plasticizer may amount to as much as 40% by weight of the total adhesive binder. Other non-smearing adhesives which can be used are vulcanized latex, casein glues, urea resins, phenol-formaldehyde resins and various other resin adhesives having similar properties.

The term "textile" as used herein to describe the fibers employed in making our felted material is intended to define fibers of the character disclosed in said Patents Nos. 2,284,716 and 2,284,739 and which are capable of being carded into web form.

Having described and set forth the invention in detail, the scope of the invention is not to be confined other than by the appended claims.

We claim:

1. A permanently charged abrasive polishing wheel of high flexibility comprising a plurality of felted layers of textile fibrous material having a major portion of the abrasive polishing material and a non-smearing binder included internally throughout the individual fibrous layers, said abrasive-containing layers of fibrous material being adhesively united about the arbor of said wheel, said wheel containing interposed layers of spacing material between the fibrous layers of the article, said interposed layers being substantially co-extensive with the area of the wheel which has been adhesively united.

2. A permanently charged abrasive polishing wheel of high flexibility comprising a plurality of felted layers of fibrous material having abrasive polishing material and a non-smearing binder included internally of the individual fibrous layers,

said abrasive-containing layers of fibrous material being slit outwardly a short distance from the arbor and bent back upon themselves to form interposed layers of material about the arbor and superimposed one on the other and adhesively united about the arbor of said wheel whereby the remainder of the wheel is more flexible and soft in polishing action.

3. A flexible abrasive article comprising a plurality of thin felted, abrasive-containing layers of fibrous material superimposed one on the other, said layers being adhesively united over limited portions of their contacting surfaces, each of said layers being folded back upon itself to an extent substantially co-extensive in area and position with that area which is united.

4. A flexible abrasive article comprising a plurality of thin felted, abrasive-containing layers of fibrous material superimposed one on the other, said layers being compressed over limited portions of their contacting surfaces, each of said layers being folded back upon itself to an extent substantially co-extensive in area and position with that area which is compressed.

5. The method of manufacturing abrasive articles which comprises forming a sheet of felted, textile fibrous material, including abrasive particles and a suitable adhesive binder throughout the sheet material at the time of making the same, cutting blanks of the desired size from said sheet material, assembling a plurality of said blanks in superimposed relation and applying heat and pressure to the assembled blanks to unite and form an abrasive article therefrom.

6. The method of manufacturing abrasive articles from a felted, textile fibrous sheet material containing abrasive particles and an adhesive binder throughout the fibrous sheet material which comprises cutting blanks of the desired size from said sheet material, assembling a plurality of said blanks in superimposed position and applying heat and pressure to the blanks to unite and form an abrasive article therefrom.

7. The method of making flexible abrasive articles which comprises forming a sheet of felted, textile fibrous material, including abrasive particles and a suitable adhesive binder throughout the sheet material at the time of making the same, cutting blanks of the desired size from said sheet material, assembling a plurality of said blanks in superimposed relation and applying heat and pressure to a limited area of said blanks to be adjacent the support therefor to unite said blanks at those areas subjected to heat and pressure and leave the remaining area of said blanks individually separated.

8. The method of manufacturing abrasive articles from a felted, textile fibrous sheet material containing abrasive particles and an adhesive binder throughout the fibrous sheet material which comprises cutting blanks of the desired size from said sheet material, assembling a plural-

ity of said blanks in superimposed relation, interposing a combining adhesive within the stack of assembled blanks, placing the assembly upon a suitable form and applying heat and pressure to adhesively combine and shape the assembled blanks to form an abrasive article therefrom.

9. An abrasive article comprising a plurality of thin felted layers of textile fibrous material having a major portion of the abrasive material included throughout the fibrous layers, said fibrous layers being adhesively united.

10. An abrasive article comprising a plurality of thin felted abrasive-containing layers of textile fibrous material, the abrasive being distributed throughout the fibrous layers and said layers being compressed and adhesively united.

11. An abrasive article comprising a plurality of thin felted abrasive-containing layers of textile fibrous material having a major portion of the abrasive disposed throughout the fibrous material, the fibers of each layer being heterogeneously disposed within the layer, said layers being compressed in superimposed position and adhesively united.

12. An abrasive article comprising a plurality of thin felted layers of textile fibrous material having abrasive material included throughout the fibrous layers, said layers being superimposed one on the other and adhesively united over limited portions of their contacting surfaces.

13. An abrasive article comprising a plurality of thin felted layers of textile fibrous material having abrasive particles and an adhesive binder included internally throughout the material, said fibrous layers being superimposed and united by means of the adhesive content of the individual fibrous layers.

14. A permanently charged abrasive polishing wheel comprising a plurality of felted layers of textile fibrous material having abrasive polishing material throughout the layers and a non-smearing binder included therein, said abrasive-containing layers of fibrous material being adhesively united about the arbor of said wheel and individually separated throughout the remainder of the wheel.

15. A permanently charged abrasive polishing wheel comprising a plurality of felted layers of textile fibrous material having abrasive polishing material distributed internally throughout the fibrous layers and a non-smearing binder included therein, said abrasive-containing layers of fibrous material being compressed about the arbor by suitable clamping means and remaining loose and flexible throughout the remainder of said wheel.

16. A permanently charged abrasive set-up wheel comprised of a plurality of superposed thin felted sheets of textile fibrous material having abrasive material included throughout the fibrous sheets, said fibrous sheets being adhesively united.

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