June 21, 1938. K. H. BOWEN ET AL 2,121,496

FIBER BODIES AND METHOD OF PRODUCING SAME

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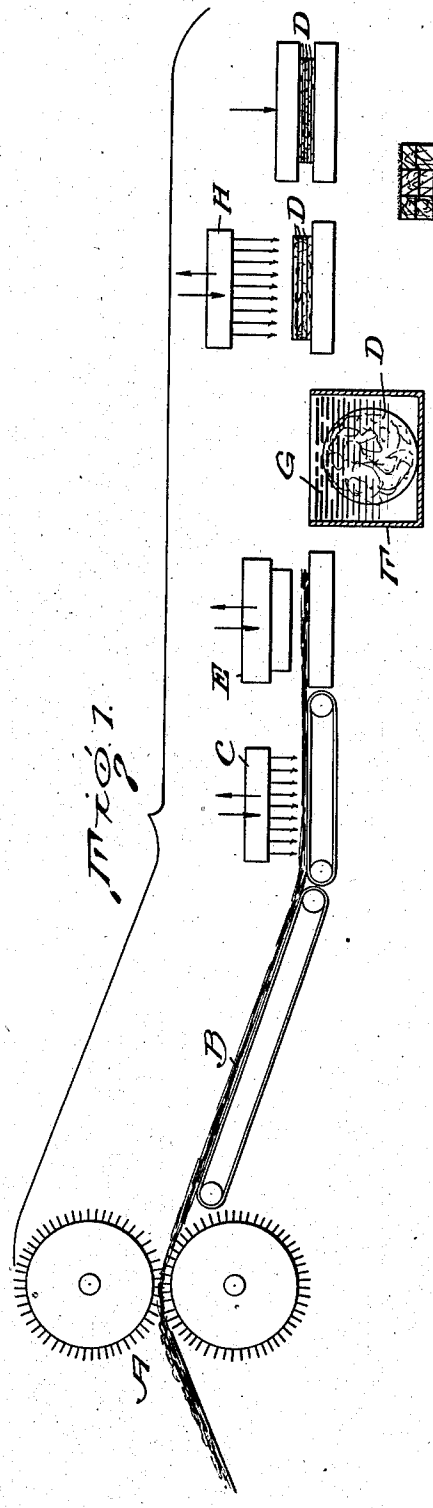


Fig. 1.

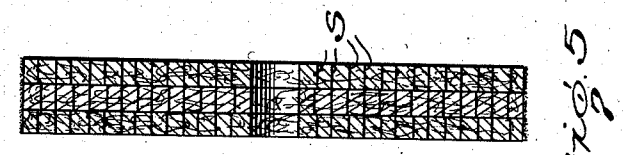


Fig. 5

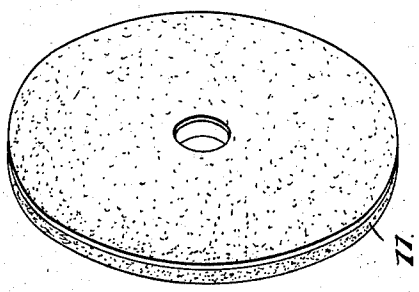


Fig. 4

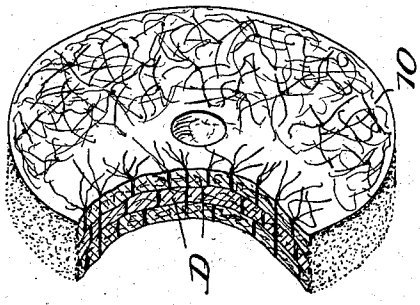


Fig. 3

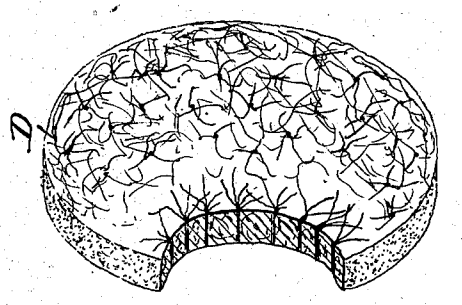


Fig. 2.

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Fig. 6.

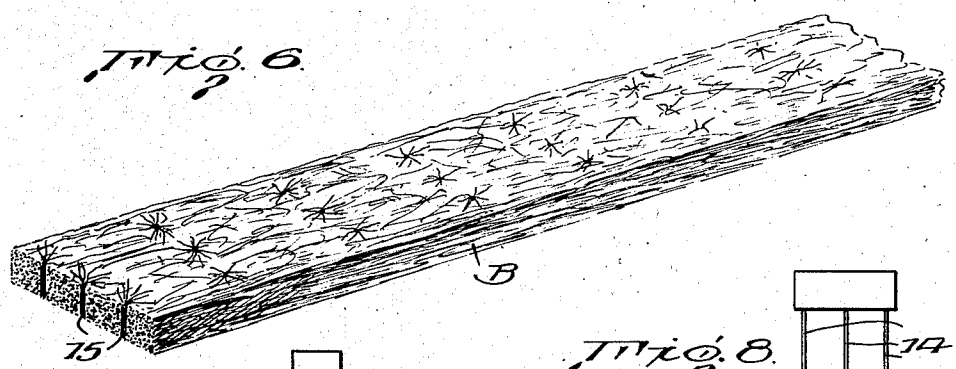
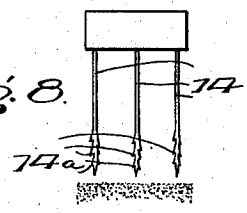


Fig. 8.



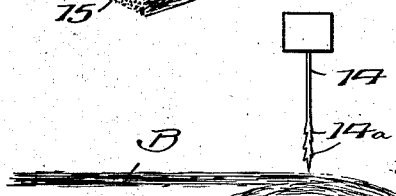
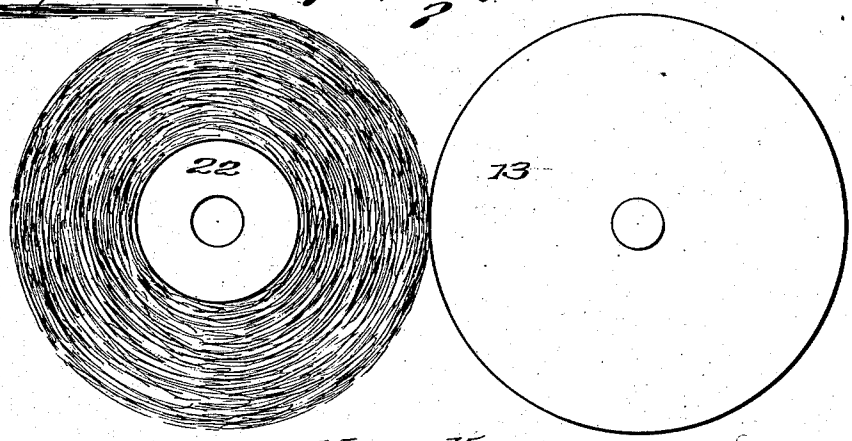


Fig. 7.



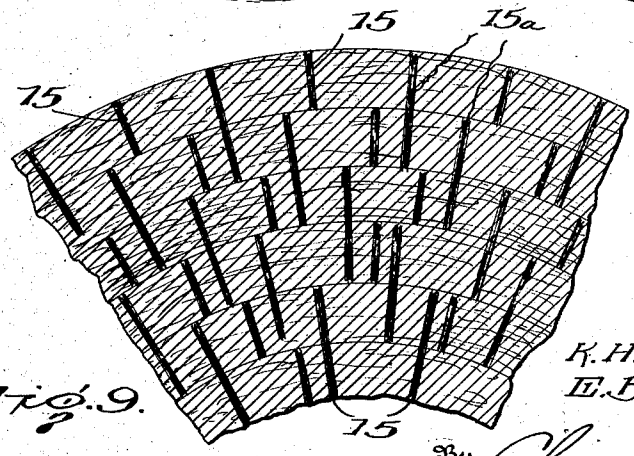


Fig. 9.

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UNITED STATES PATENT OFFICE

2,121,496

FIBER BODIES AND METHOD OF PRODUCING SAME

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Continuation of application Serial Nos. 124,876, February 9, 1937, and 138,649, April 23, 1937. This application November 18, 1937, Serial No. 175,335

15 Claims. (Cl. 51—193)

This invention relates to improvements in fiber bodies, and particularly bodies such as rolls or pads, used in abrading or polishing operations, and the method of producing such bodies.

One object is to provide a comparatively inexpensive method of forming such fiber bodies, and particularly a method wherein the density, and consequently the weight, of the finished article can be varied at will without affecting manufacturing costs, except as to the quantity of fiber and binder used.

Another object is to provide a method of forming such fiber bodies which will be of substantial minimum weight for a given density. This is important where the body is revolved at high speeds because the centrifugal force set up is minimized.

A still further object is the comparatively inexpensive production of such fiber bodies from fibers of substantial length with the fibers distributed with such uniformity throughout the body as to impart substantially perfect balance in the finished body.

A further object is to produce such bodies with the fibers so associated as to impart to the same maximum absorbent qualities whereby uniform and thorough impregnation of the fibers by the binder is obtained, thus further facilitating the production of a balanced body.

Another object is to provide a pad or wheel in which the resiliency of the body can be controlled in the sense that said body may be made of greater resiliency in a particular direction, either axially or radially, as desired.

More specifically, the invention contemplates the production of a balanced pad, wheel or roll, wherein the body is formed of one or more plies of fibers, each ply being formed of promiscuously disposed fibers and a suitable binder, the majority of fibers in the ply being of a length exceeding the thickness of said ply and, preferably, with small groups of the fibers projected transversely through the ply or plies to interlock the entire body of fibers in the ply.

The invention also contemplates the production of polishing wheels, or rolls, of the so-called "roughing-in" type. This type of wheel is provided with an abrasive surface formed of relatively coarse abrasive material and another object is to provide a comparatively light-weight, inexpensive roughing-in wheel or roll which will securely carry or retain on its working face the coarse, gritty material utilized as the abrasive.

In carrying out the present invention, the fibers, preferably of vegetable origin, after being cut or "stapled", if necessary, to the desired length, are first carded and reduced to a layer or web-like body. If desired, according to one form of the invention, circular blanks may then be cut or punched from said web or the web may first be "needled" by a series of barbed needles which are projected through and retracted from the web, before said blanks are formed. The blanks are then treated or impregnated with a binder, after which the pad or wheel is formed from one or more of said blanks, depending upon the thickness of the web and of the pad or wheel to be formed. On the other hand, the needled web may be wound to form an annular body composed of radially superposed layers or convolutions. The use of pressure and heat in forming up the finished article will depend upon the nature of the article produced and the type of binder, as will be more fully described later.

With these and other objects in view, the invention consists in certain details of construction and combinations and arrangements of parts, all as will hereinafter be more fully described, and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawings—

Figure 1 is a diagrammatical illustration of one form of apparatus which may be utilized for practising the present method;

Fig. 2 is a perspective view, partly broken away, of a blank before treatment with the binder;

Fig. 3 is a similar view of a "roughing-in" polishing wheel, partly broken away, produced in accordance with the present invention;

Fig. 4 is a perspective view of a so-called pad used in certain types of abrading operations;

Fig. 5 illustrates a wheel wherein the several plies are needled and stitched together;

Fig. 6 is a detail, perspective view of a length of the needled fiber web;

Fig. 7 is an elevational view, illustrating more or less diagrammatically, a modified arrangement for producing a plied body with the plies disposed circumferentially of the body;

Fig. 8 is a detail front elevation of the needle bar illustrated in Fig. 7; and

Fig. 9 is a sectional view, on a somewhat enlarged scale, illustrating the disposition of the fibers in a body or wheel made as shown in Fig. 7.

Preferably, the fibers are of vegetable origin and are first cut into desired lengths, if necessary, after which the latter are passed through a carding machine of usual construction, indi-

cated at A in Fig. 1. To facilitate handling of the fiber web B, the latter is preferably then passed through the needle felting machine C. As will be understood, in this machine the web is successively penetrated by a multiplicity of barbed needles. The length of the stapled fibers should at least be equal to the thickness of the web B, so that each needle entering the web will cause a small group or tuft of fibers 15 to be pushed or projected transversely through the web with the result that the entire group of fibers constituting the web are interlocked, so to speak, by the needled portions. Preferably, a hard fiber is used, the harshness thereof preventing undue slippage and thus aiding retention of this interlocked relationship. This web B formed by the carding of the fibers will be found to have the fibers promiscuously arranged but uniformly distributed, so that when a body, such as a pad or wheel is formed by plying circular blanks produced therefrom, or by winding the web spirally, such body will be found to possess substantially perfect balance, a feature of importance in view of the speeds at which the pads and wheels are rotated when in use.

For producing bodies formed of radially disposed laminations, circular blanks D are produced from the web B, either before or after the needling operation, although the inclusion of the latter step is preferred. Said blanks are then treated with a binder, the nature of the latter depending upon certain factors. For instance, if resiliency is desired in the finished article, a latex cement is preferred. On the other hand, casein or animal glue may be utilized. In any event, the distribution of the fibers in the blank is such as to render the latter rather porous and, as a consequence, the blanks can be rather easily impregnated with the binder. As illustrated, the blanks may be punched from the web by dies E, and placed in a receptacle F, containing the binder G of the desired type.

The blanks, thus treated with binder, are then formed into the ultimate article. If the thickness of the web or single ply of material is such that, when compressed to the desired density, it will form the article of desired thickness, only one blank need be used, but for thicker articles, for instance, a comparatively thick roughing-in wheel, a number of blanks are plied or laminated. A roughing-in wheel 10 is illustrated in Fig. 3 and a pad 11 in Fig. 4. This form of roughing-in wheel is formed of a number of laminations and is provided with a coarse abrasive material 12 on its peripheral surface. The pad is shown as made of a single ply or blank, although more may be used. However, as is well known, the pad is adapted to have an abrasive coated disk applied to one of its side surfaces and must be somewhat flexible in order to yield to a certain extent when the abrasive surface is forced against the work. In each instance, the blank or laminated blanks are compressed in a press of suitable form and when heat is desired or necessary for setting of the binder, the press will be heated in any desired manner.

If desired, a second needling step and/or stitching may be used for reinforcing purposes, particularly where two or more plies are used in making up the finished body. This second needling step is indicated at H in Fig. 1 and a plied article, needled as a unit, is shown in Fig. 5. The article of Fig. 5 is also illustrated as having stitching S through the several plies, but either step may be used without the other. Where the second needling step is used, the majority of the individual fibers should be of sufficient length that tufts of fibers of one ply will be projected transversely of the plies from one ply into a juxtaposed ply, as illustrated at 15a, thus interlocking the several plies. It will be understood that these steps, i. e., the second needling and the stitching are supplemental to the use of the binder and are used essentially as reinforcing means, but they may, in some instances, especially the stitching be used without the binder, depending upon the use to be made of the finished article.

The present method is not only inexpensive, but it facilitates, or rather insures, uniform distribution of the fibers in the blank or ply notwithstanding the fact that the fibers are comparatively long. Ordinarily, if fibers of the length used in the present case were treated with a binder while in an unassociated relationship and then deposited in a mold, it would be impossible to secure a uniform distribution of the fibers and balance could be imparted to the molded pad or wheel only by embedding extraneous bodies in the molded body. This uniformity of distribution of fibers is obtained in the present case regardless of the type of binder used, so that even in the case of molded material where a phenolformaldehyde resin binder of the heat-hardening type is used, the shock-resisting property of the finished material is substantially uniform throughout its entire area. While the needling step may be omitted, it is preferably included, because the needled portions not only serve as an interlock to facilitate handling the fiber web, but they also function more or less as wicks to augment absorption of the binder. In the case of the roughing-in wheels the use of the blanks cut from the web is advantageous in that the peripheral surface of the blanks is such as to insure retention of the relatively large particles of abrasive.

In the embodiment of the invention illustrated in Figs. 7 to 9, the laminations are disposed circumferentially of the body or wheel instead of radially, as in the previous instances. Preferably, the web is cut or formed to a width corresponding to that of the body or wheel to be produced and then wound on a core piece 22, as shown in Fig. 7, pressure being applied to the successive convolutions by a presser roll 13 to reduce the wheel to the desired density or compactness. In order to more or less interlock the successive layers of webbing, a second needling operation may be used. That is, a series of barbed needles 14, such as used in the "needling" machine previously mentioned, are intermittently advanced and retracted with respect to the web material on the core during the laying up of the successive layers or convolutions. The needles are of sufficient length to penetrate a plurality of the layers, two in the present illustration, and as the barbs 14a are projected through the laminated wheel, they cause small groups of the fibers of one layer to be carried radially inward through the next adjacent layer. This action is generally referred to as projecting the fibers through the layer or layers. These tufts or groups of projecting or radially extending fibers are indicated at 15a in Fig. 9 and, as will be appreciated, they serve to interlock the successive layers or convolutions. It has also been found that the voids left by the needles in the mass of fibers are never totally eliminated

and that they impart a certain degree of resiliency to the finished wheel. It will also be understood that this second needling operation is not essential, as the first needling of the web, before it is laminated in the wheel, will not only serve to retain the web intact, but will also result in a limited degree of resiliency in the finished wheel.

To secure the layers of web into a unitary mass a suitable binder, such as latex cement or animal glue, is applied thereto. Where the layers of web are needled after the laminating step, as in the preferred method, the binder is not applied until after the several layers are assembled into wheel shape, because, if the binder should be applied before this needling, it would interfere with the movement of the needles into and out of the laminated body. However, where this so-called second needling step is omitted, the binder can be applied either before or after laminating.

The density or degree of compactness of the laminations constituting the wheel can, of course, be varied, depending upon the use to which the finished articles are to be subjected, and it is to be understood that the several individual layers may not remain intact or be so readily identified as illustrated in Fig. 9. It will also be appreciated that the major portion of the wheel need not necessarily be composed of this fiber construction as, in some instances, it may be desirable to use a larger core and form only an annular portion, at the periphery, from the fiber web.

As previously indicated, the present wheel is comparatively inexpensive, due, not only to the cost of the materials used but, also, to the simplicity of the method involved. However, the efficiency of the wheel is not detrimentally affected. On the other hand, the needling of the fiber web aids in retaining the abrasive material, not shown, on the periphery of the wheel. In other words, the abrasive material is dusted or otherwise applied to the periphery of the wheel after the application of the binder and is retained on said surface primarily by said binder, but apparently the interstices or voids formed by the needling aids in retention of the abrasive, particularly where a comparatively heavy or coarse abrasive is used.

It will also be appreciated that the resiliency of the finished body can be controlled to a considerable extent by the disposition of the projected tufts of fibers 15, 15a. In those bodies, composed of plies or layers disposed radially of the body, the projected tufts extending transversely through the plies will cause the body to possess greater resiliency axially thereof, as compared to its radial resiliency. On the other hand, with the projected tufts extending radially of the body, the resiliency is increased radially of the body.

This application is a continuation of applicants' copending applications, Serial Nos. 124,876 and 138,649, filed February 9, 1937 and April 23, 1937, respectively.

What we claim is:

1. A disk-like polishing or abrading body comprising a ply of material composed of fibers and a binder, a majority of the individual fibers in said ply being of a length substantially at least equal to the thickness of said ply with groups or tufts of said fibers extending transversely through the ply.

2. A polishing or abrading wheel comprising a ply of material composed of fibers and a binder, a majority of the individual fibers being of a length exceeding the thickness of said ply with groups or tufts of said fibers extending transversely through the ply axially of the wheel, and the remainder of said fibers being disposed promiscuously with respect to one another throughout the ply.

3. A polishing wheel of the "roughing-in" type composed of a plurality of fibrous laminations, a binder for securing the fibers of individual laminations together and the several laminations into a unitary mass, each lamination being formed of fibers disposed promiscuously but substantially uniformly distributed throughout said lamination, groups of the fibers constituting the individual laminations extending transversely of the lamination axially of the wheel in the form of tufts of fibers, and a relatively coarse abrasive material on the working face of said wheel.

4. A polishing wheel of the "roughing-in" type composed of a plurality of laminations, each lamination being formed of fibers interlaced by groups or tufts of the fibers extending transversely of the lamination axially of the wheel, a binder for securing the fibers of the individual laminations together, and an abrasive coating on the working surface of said wheel.

5. The method of producing laminated fiber bodies which comprises forming a web of fibers, displacing groups of said fibers transversely through the web to form tufts of fibers extending through the web, cutting disk-like blanks from said web, applying a binder to said material, laminating a plurality of said blanks under pressure and allowing said binder to set.

6. A polishing wheel of the "roughing-in" type composed of a plurality of fibrous laminations, a portion of the individual fibers of each lamination being of a length greater than the thickness of the lamination, a binder for securing the fibers of the individual laminations together and the several laminations into a unitary mass, each lamination being formed of interlaced fibers disposed promiscuously throughout said lamination with groups or tufts of fibers of one lamination projected into a juxtaposed lamination, and an abrasive material on the working face of said wheel.

7. A polishing wheel composed of a plurality of fibrous laminations, a portion of the individual fibers of each lamination being of a length greater than the thickness of the lamination, with groups of fibers of each lamination projected transversely therethrough and the remaining fibers disposed promiscuously through the lamination, a binder securing the several laminations together, and reinforcing stitching extending through the several laminations.

8. A pad body of disk-like formation adapted to have an abrading substance applied to one side face thereof and to flex under lateral pressures imposed on the peripheral portion of said face, said pad body adjacent its periphery being formed essentially of promiscuously associated fibers with tufts of the fibers extending transversely axially through the pad body, and a binder uniting said fibers in a unitary mass.

9. A pad body of disk-like formation adapted to have an abrading substance applied to one side face thereof and to flex under lateral pressures imposed on the peripheral portion of said face, said pad body adjacent its periphery being formed essentially of promiscuously associated

fibers, the major portion of said fibers being of a length exceeding the thickness of the pad with tufts of said fibers extending transversely, axially through the pad body, and a binder securing all of said fibers in a unitary mass.

10. A pad body of disk-like formation adapted to have an abrading substance applied to one side face thereof and to flex under lateral pressures imposed on said face, said pad body adjacent its periphery comprising a ply of material composed of fibers and a binder, a majority of the fibers being promiscuously disposed throughout the ply with tufts of the fibers extending transversely, axially through the ply.

11. A body adapted to have an abrasive substance applied to the surface thereof, the peripheral portion of said body being formed of a series of radially superposed layers of fibers and a binder cementing said fibers into a unitary mass, the major portion of the fibers of each layer being promiscuously disposed therein and groups or tufts of the fibers extending through the mass of fibers radially of said body from one face of the individual layers to substantially the opposite face thereof.

12. A circular body adapted to have an abrasive substance applied to the surface thereof, said body comprising a plurality of convolutions of fibers with a majority of the fibers disposed promiscuously throughout said convolutions, groups or tufts of the fibers of each convolution being disposed radially of the body and projecting into a next adjacent convolution, and a binder securing said fibers into a unitary mass.

13. The method of forming a circular body for abrading and polishing wheels which consists in forming a web of fibers with a majority of the fibers disposed promiscuously therethrough, displacing groups of said fibers in the form of tufts of fibers through the web to interlock the fibers, winding said web in successive convolutions to form a wheel of the desired diameter, and applying a binder to said fibers to unite the latter into a unitary mass.

14. The method of forming a circular body for abrading and polishing wheels which consists in forming a web of fibers, displacing groups or tufts of fibers through said web, winding said web in successive convolutions to form a wheel of the desired diameter, again displacing groups of fibers of individual convolutions in the form of additional tufts radially into a next adjacent convolution, and applying a binder to said fibers to unite the same into a unitary mass.

15. The method of forming a circular body for abrading and polishing bodies such as wheels and pads which consists in forming a web of fibers, displacing groups or tufts of fibers through said web, assembling a plurality of radially superposed layers of said web material to form a body of the desired diameter, and applying a binder to said fibers to unite the latter into a unitary mass.

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