

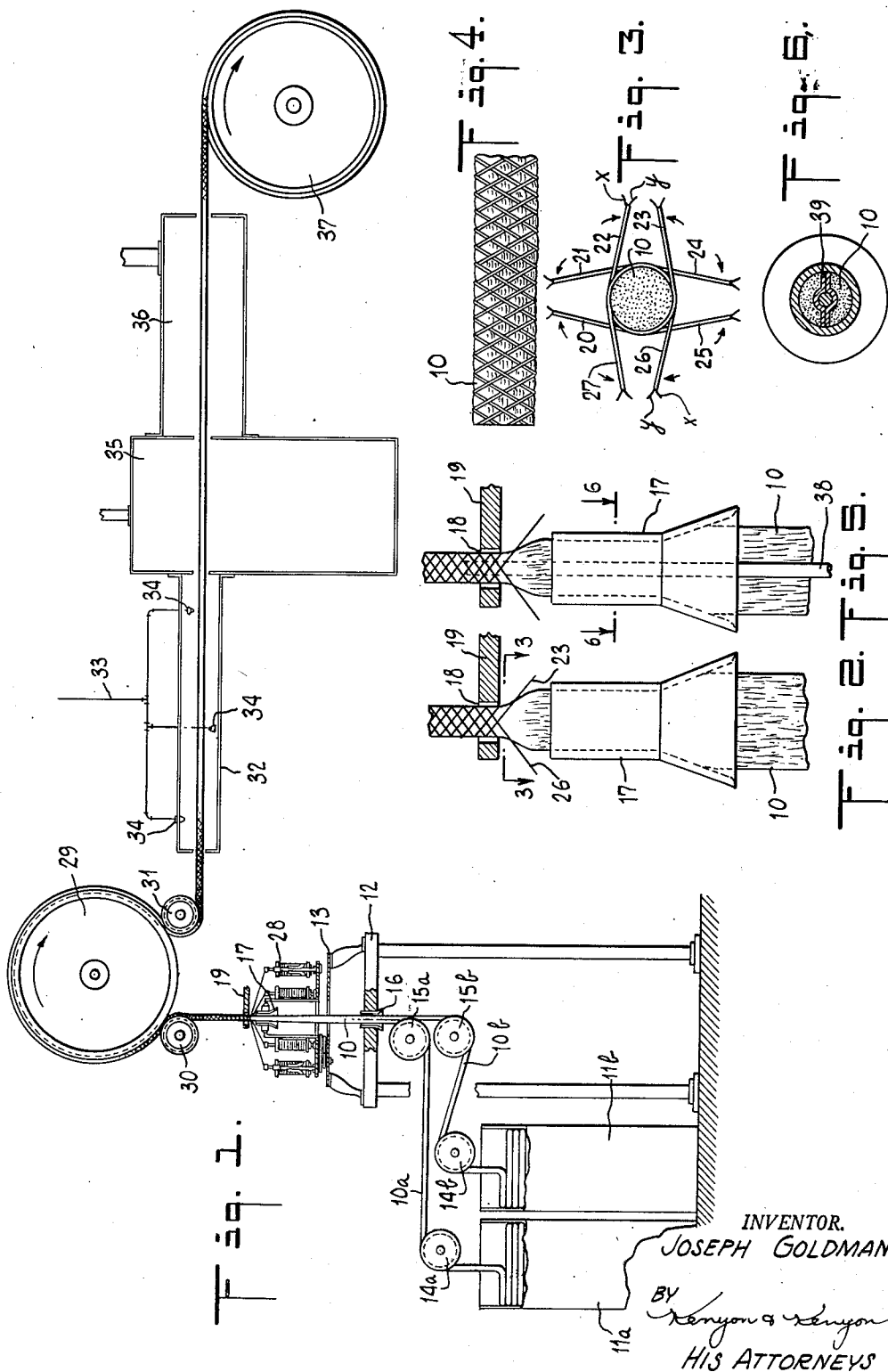
Sept. 2, 1952

J. GOLDMAN
CYLINDRICAL ABSORPTIVE FIBROUS BODIES
AND THE MANUFACTURE THEREOF

2,608,901

Filed Dec. 22, 1950

2 SHEETS—SHEET 1



INVENTOR.
JOSEPH GOLDMAN

BY *Kenny & Kenny*
HIS ATTORNEYS

Sept. 2, 1952

J. GOLDMAN
CYLINDRICAL ABSORPTIVE FIBROUS BODIES
AND THE MANUFACTURE THEREOF

2,608,901

Filed Dec. 22, 1950

2 SHEETS—SHEET 2

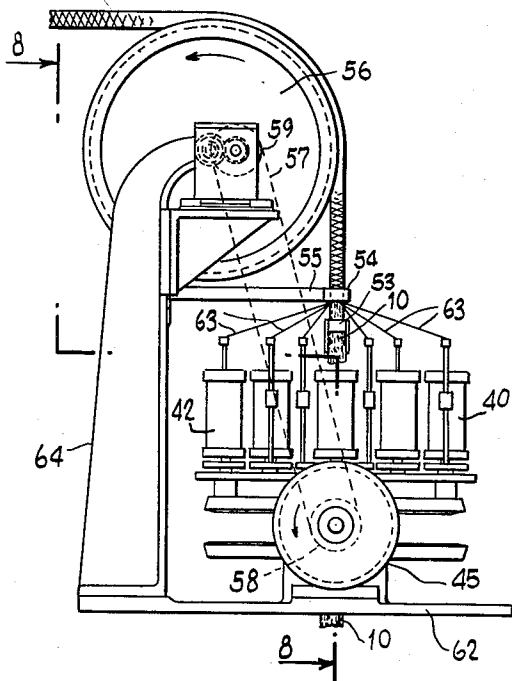


Fig. 7.

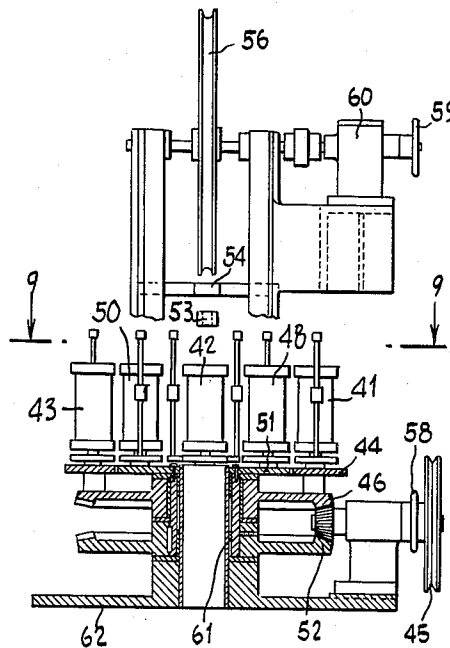


Fig. 8.

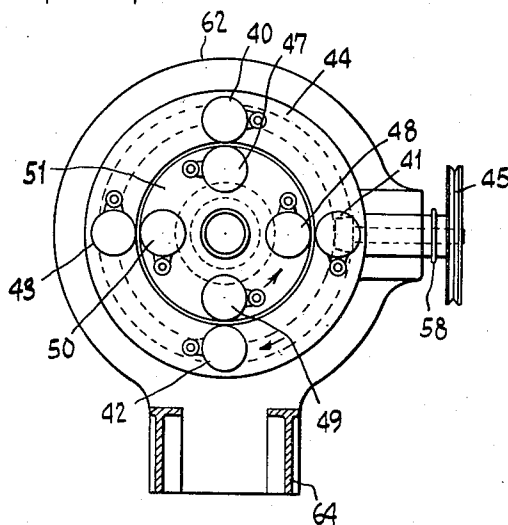


Fig. 9.

INVENTOR.
JOSEPH GOLDMAN
BY
Kenyon & Kenyon
HIS ATTORNEYS

UNITED STATES PATENT OFFICE

2,608,901

CYLINDRICAL ABSORPTIVE FIBROUS BODY
AND THE MANUFACTURE THEREOF

Joseph Goldman, Highland Park, N. J., assignor,
by mesne assignments, to Barnhardt Manufacturing Company, Charlotte, N. C., a corporation of North Carolina

Application December 22, 1950, Serial No. 202,365

12 Claims. (Cl. 87—6)

1

This invention relates to peripherally confined absorptive fibrous substantially cylindrical bodies and the manufacture thereof.

It is an object of this invention to provide peripherally confined fibrous substantially cylindrical bodies which exhibit a very high degree of absorbency and which exhibit in very high degree capillary action longitudinally thereof whereby a very pronounced wicking action is afforded. It is a further object of this invention to provide a method whereby such bodies may be manufactured very rapidly and at a very low cost.

While the new product of this invention is adapted for a number of different uses, one principal field of utility is in connection with dental work. In connection with dental work it is common practice to place a small roll of cotton or the like between the gums and the cheek or between the gums and the tongue so as to absorb saliva and keep the tooth on which the dentist is working as dry as possible. The new product of this invention is very well suited for such use and possesses the distinct advantage of being capable of absorbing large amounts of liquid and of directing the absorbed liquid longitudinally within the body by capillary action. The pronounced capillary action longitudinally of the new product of this invention is also of utility whenever a pronounced wicking action is desired. For example, the new product of this invention is very well adapted for use as a drain to be inserted in wounds in performing surgical operations.

It is a feature of this invention that the fibers used in the fibrous body are disposed in unspun relation with the fibers oriented predominantly longitudinally in the body. The fibers are preferably of substantial length and preferably consist predominantly, i. e. numerically in major proportion, of long fibers. Any fiber which is about $\frac{5}{8}$ " in length or longer is regarded as a long fiber as this term is used herein. The body may be composed entirely of the long fibers although a certain amount of shorter fibers may be blended therewith. It is particularly with regard to the long fibers that orientation predominantly (i. e. in major proportion numerically) longitudinally in the body is significant.

Further features of this invention relate to the manner by which the unspun fibers are peripherally confined. Preferably, the fibers are peripherally confined by wrapping a plurality of composite strands about the fibers as initially disposed in a substantially cylindrical condition so as to provide oppositely inclined helices having substantially spaced convolutions. If the strands

2

were merely wound about the fibrous body in a continuous condition the strands would immediately unwind whenever the fibrous body is separated into lengths for intended uses of the body. According to the preferred practice of this invention, a composite strand is made up using one or more strands composed of latent activatable adhesive material adapted to be activated to have adhesiveness imparted thereto as by use of a solvent or by application of heat. In conjunction with the strand or strands composed of latent activatable adhesive material there are one or more strands composed of material that is adapted to remain substantially unaffected when the latent activatable adhesive material of the other strand or strands in the composite strand is activated to impart adhesiveness thereto. After the composite strand has been wrapped about the periphery of the fibrous body, the latent activatable adhesive material in the composite strand is activated, thus bonding the second strand to the peripheral fibers of the fibrous body. In this way, permanent peripheral confinement is afforded so that the finished body can be severed into lengths without unravelling or unwinding at the ends. It is significant also that the confinement is provided by spaced convolutions provided by the strand material leaving the bulk of the peripheral surface of the body in porous absorptive condition and substantially free of any binder. While it is preferable to use composite strands in the manner aforesaid, it is possible to use strands composed entirely of latent activatable adhesive material and then merely subject the strands to sufficient activation to cause them to adhere to the peripheral fibers of the fibrous body without destroying their longitudinal continuity. Likewise, other expedients may be employed whereby the strands carry the latent activatable adhesive material so that the strands may be bonded to the peripheral fibers of the body.

The fibers contained in the fibrous body may be any fiber which preferably is relatively inexpensive and which may be available in substantial lengths of the order mentioned above. Ordinary cotton fibers ranging from about $\frac{5}{8}$ " to $\frac{3}{4}$ " in length, or longer, are very well suited for use according to this invention although in combination with the long cotton fibers a minor proportion of shorter cotton fibers such as cotton linters ranging from $\frac{1}{4}$ " to $\frac{3}{8}$ " in length may be used. Instead of cotton fibers, rayon fibers may be used when of the order of length above indicated. More generally, any type of fiber is suitable, although it is preferable for dental purposes

or the like to use fibers which are relatively soft and pliable, being comparable to cotton or rayon in this regard and which, when associated in loose unspun relation, are highly absorptive. Cotton which has been cleaned in the conventional way to remove naturally occurring waxes is ordinarily preferred because of its absorptiveness and wetability and because of its relatively low cost. Cotton which has been treated with caustic solution as in the preparation of absorbent cotton is suitable. For dental roll uses the fibers preferably should be free of objectionable odor or taste.

Further features of this invention relate to the manufacture of the bodies above described. Thus when cotton fibers are employed the fibers may be subjected to a carding operation which has the effect of orienting the cotton fibers predominantly in the machine direction of the carded fiber web. The carded fiber web material with the fibers oriented longitudinally therein may then be condensed into sliver form and one or more of the slivers when disposed in the form of an approximately cylindrical body may be continuously moved longitudinally while simultaneously wrapping the peripherally applied confining strands thereabout by an operation such as braiding or winding. After the strand material has been applied, the confined fibers in the cylindrical body are subjected to an appropriate operation for activating the latent activatable adhesive comprised in the strand wrapping so as to bond the strand wrapping to the peripheral fibers of the cylindrical body. These operations can be carried on rapidly and continuously and the product can be produced at a very low cost.

Further objects, features and advantages of this invention will be apparent in connection with the following description of the practice of this invention as exemplified in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation, largely schematic, showing one type of apparatus which may be employed in the practice of this invention;

Fig. 2 is an enlarged detail view partly in section of the portion of the apparatus of Fig. 1 at which the strands are applied to the fibrous body from the braider;

Fig. 3 is a plan view on a further enlarged scale showing the application of the strands to the fibrous body at and adjacent the line 3—3 of Fig. 2;

Fig. 4 is a plan view of the fibrous body with the strand braiding applied thereto;

Fig. 5 is similar to Fig. 2 showing a modification;

Fig. 6 is a plan view taken on the line 6—6 of Fig. 5;

Fig. 7 is a side elevation, largely schematic, showing an alternative type of apparatus which may be employed in the practice of this invention whereby the strands may be applied to the fibrous body by winding instead of by braiding;

Fig. 8 is a partially sectional view of the apparatus shown in Fig. 7 taken on the line 8—8 of Fig. 7; and

Fig. 9 is a plan view of the apparatus shown in Figs. 7 and 8 taken on the line 9—9 of Fig. 8.

Referring to Figs. 1 to 4, the practice of this invention is illustrated in connection with the manufacture of the peripherally confined absorptive body by the application of composite strands to a preliminary shaped cylindrical body of unspun cotton fibers consisting predominantly of long cotton fibers oriented predominantly longi-

tudinally in the cylindrical body, the strands being applied by a braiding operation.

In Fig. 1, the cotton fiber is shown as being taken in the form of slivers 10a and 10b from the cans 11a and 11b. The cotton fibers in these slivers are fibers which have previously been subjected to a conventional carding operation which has the effect of orienting the fibers predominantly in the machine direction of the web produced by the carding machine. In a carding operation the fibers are acted upon by the cylinder and doffer so that while many of the fibers occur so as to be hook-shaped in the web their direction is predominantly longitudinal in the web. This is the case particularly with regard to the longer fibers inasmuch as some of the shorter fibers may not be as effectively acted upon in their passage through the carding machine so as to orient them longitudinally in the web. By way of specific example, the cotton fibers may be mostly $\frac{3}{8}$ " to $\frac{3}{4}$ " in length and the action of the carding machine is such that at least about 65% of the long fibers are oriented longitudinally in the web. The web material produced by the carding machine is condensed into the slivers 10a and 10b that are stored in the cans 11a and 11b for feeding into the system of this invention and since the fibers have been oriented longitudinally in the web material taken from the carding machine they are similarly oriented in the slivers 10a and 10b.

In the specific example shown in Fig. 1, two slivers are employed, but if desired only a single sliver may be used or more than two slivers may be used. The number of slivers used will depend upon the desired diameter of the cylindrical body to be produced. For such uses as dental rolls or surgical drains, the diameter ranging from $\frac{1}{4}$ " to $\frac{1}{2}$ " is usually desired, although bodies of smaller or larger diameter can be readily produced in the practice of this invention.

Supported by the table 12 there is shown a braiding machine 13. Braiding machines are extensively used for many purposes and their construction is well known. For this reason, the details with regard to the construction of the braiding machine 13 are not shown and the braiding machine is merely indicated schematically in Fig. 1. The particular system shown is adapted to wrap eight strands about the body of unspun fibrous material in braided relation.

As shown in Fig. 1, the slivers 10a and 10b pass over the rollers 14a and 14b and over the rollers 15a and 15b so as to merge in the vertically disposed body 10 which is brought into an approximately cylindrical shape by the guide 16. The cylindrical body 10 passes up through the center of the braiding machine 13 and thence through the guide 17 which is of an inverted funnel shape. The eight strands are continuously applied in braided relation to the cylindrical body 10 immediately above the guide 17 and below the eye 18 in the arm 19 while the body 10 is being moved longitudinally upwardly. The strands are indicated in Fig. 3 by the reference characters 20, 21, 22, 23, 24, 25, 26 and 27. As shown in Fig. 3, the strands 20, 22, 24 and 26 are wrapped around the body 10 in a clockwise direction while the strands 21, 23, 25 and 27 are wrapped around the body 10 in a counterclockwise direction. The strands are fed from the bobbins 28 of the braiding machine and while only four such bobbins are shown in Fig. 1, it is to be understood that the total number of bobbins corresponds to the number of strands employed, namely, eight in connection with the

specific example described. Four of these bobbins are caused to rotate about the body 10 in one direction while the other four bobbins are caused to rotate around the body 10 in the opposite direction, and the bobbins collectively are guided in complementary in-and-out directions in the manner typical of a braiding machine. This motion of the bobbins with resultant braiding action occurs simultaneously with the longitudinal movement of the body 10 through the braiding machine under the influence of the driven wheel 29 which carries the body 10, with the braiding applied thereto, on its periphery as held thereagainst by the rollers 30 and 31. The speed at which the wheel 29 is rotated is such that the strands as applied to the body 10 form helices whose convolutions are substantially spaced as shown, for example, in Fig. 4. The amount of spacing between the convolutions can be governed by the relative speed at which the wheel 29 is rotated and the speed of operation of the braiding machine in wrapping the strands about the body 10. A fixed ratio for such speeds can be afforded, if desired, in any suitable way, such as that illustrated in connection with Figs. 7, 8 and 9, whereby the rate of operation of the braiding machine and the rate at which the body 10 is advanced are governed by a common mechanical control.

According to the illustrative example under immediate consideration, each of the strands 20 to 27 inclusive has a composite structure and, as shown in Fig. 3, is composed of two strands marked *x* and *y*. The strand *x* is composed of the latent activatable adhesive material. One of the preferred materials of this type is cellulose acetate and the strands *x* may be in the form of 50 denier cellulose acetate fiber. The strands *y* are composed of some suitable fiber which is adapted to remain unaffected when the latent activatable adhesive of the strands *x* is activated to impart adhesiveness thereto. For example, the strands *y* may be in the form of 100 denier rayon. The strands *x* and *y* may be twisted together to a greater or less extent, preferably to only a moderate degree, so as to facilitate their being wound on the bobbins 28 of the braiding machine and so as to facilitate their being taken off the bobbins and applied by braiding to the body 10. However, it is not necessary that the strands *x* and *y* be twisted together so long as they are contiguous as taken from the bobbins 28 and wrapped about the body 10.

By the foregoing operations, the body 10 composed predominantly of long cotton fibers oriented predominantly longitudinally has the wrapping of the braided strands applied thereto which peripherally confines the fibers in the form of a substantially cylindrical body.

The next step is to activate the latent activatable adhesive of which the strands *x* are composed. Preferably, this is accomplished by passing the body 10 with the braiding applied thereto into the chamber 32 into which a solvent such as acetone is directed from the supply line 33 and through atomizing nozzles 34. When the body carrying the braiding comes in contact with the atomized acetone, the acetone immediately activates the cellulose acetate of the strands *x*, thus imparting adhesiveness thereto whereby the strands *y* become adhesively bonded to the peripheral fibers of the body 10. After this step has been accomplished the body 10, carrying the braided strands comprising the essentially non-adhesive strength-imparting strands *y* adhesively bonded to the peripheral fibers of the body 10,

is passed through the solvent recovery chamber 35 and thence through the heated drying chamber 36. The finished product can then be wound on the reel 37 for sale in continuous form. Alternatively, the product may be severed into suitable lengths and sold in such form.

The typical appearance of the finished product is shown in Fig. 4 with the braiding applied to the peripheral surface of the body 10 for confinement of the fibers of the body 10 in substantially cylindrical form. The appearance is the same both after and before the strands are bonded to the periphery of the body 10. Except for the applied strands the peripheral surface of the body 10 is in porous absorptive condition so that fluids may be readily absorbed from the periphery into the interior. Due to the fact that the body 10 consists predominantly of long fibers which are predominantly oriented longitudinally, the structure of the body 10 is such that it exhibits an extremely large amount of capillarity in longitudinal directions. This is the case both as regards fluids absorbed into the body 10 from the periphery thereof and as regards any fluid which may enter the body 10 from either end. Thus, the new product is suitable both for effecting a very great amount of absorption of fluid from the periphery and is likewise adapted for use whenever a wicking action is desired, as, for example, a drain for draining fluid from a wound.

In Figs. 5 and 6 is illustrated the employment of a modification. The showing in Figs. 5 and 6 is identical with that of Fig. 2 except that the guide 17 is provided with a centrally located rod 38 which is held in position by the webs 39. The rod 38 extends up into the eye 18 of the arm 19 and extends a substantial distance below the guide 17. The rod 38 during operation of the device is of some advantage in maintaining the body 10 in alignment as it passes upwardly through the region where the strands are braided thereon. Thus, the rod 38 serves to prevent any inequalities in tension imposed by the applied strands from pulling the body 10 out of proper alignment during its passage through the braiding machine. However, the rod 38 serves a further function in that it occupies the interior of the body 10 at the time that the braiding is applied thereto. The application of the braiding effects some compaction of the unspun fibers and such compaction, using the modification shown in Figs. 5 and 6, is limited to the zone disposed about the rod 38. When the body 10 is moved beyond the upper end of the rod 38, then the fibers within the body are free to fill the hollow interior space which is produced when the body 10 passes beyond the rod 38. In this way, the strands can be applied under substantial tension and the compacting tendency resulting from the tension is relieved when the body passes the upper end of the rod 38 so that the fibers become free to assume a very loosely compacted and absorptive condition. The employment of the arrangement shown in Figs. 5 and 6 is especially desirable when the product produced is intended to be composed of very loosely compacted fibers in a highly absorptive condition.

An alternative method of producing the product will now be described in connection with Figs. 7, 8 and 9. In general, the product is produced as described in connection with Figs. 1 to 6, except that the strands are applied to the body 10 by a winding operation as distinguished from a braiding operation.

Using the apparatus shown in Figs. 7, 8 and 9, eight strands are again applied to the body 10,

7

each of these strands being indicated by the reference character 63. Four of these strands are fed from bobbins 40, 41, 42 and 43 which are carried by the annular plate 44 rotatably mounted about the bearing member 61 which is upstanding from the base 62. The annular plate 44 is rotatable in one direction from the driven pulley 45 through the bevel gears 46. The bobbins 47, 48, 49 and 50 are carried by the inner plate 51 which is rotatable in the opposite direction about the bearing member 61 from the same driven pulley 45 through the bevel gearing 52. The strands from the bobbins are wound about the fibrous body 10 which is continuously moved up through the winding machine in the region between the guide 53 and the eye 54 in the arm 55. The strands from the bobbins 47, 48, 49 and 50 are wound about the body 10 in one direction and immediately thereafter the strands from the bobbins 40, 41, 42 and 43 are wound about the body 10 in the opposite direction. The body 10 may be formed from slivers taken from cans in the manner shown in Fig. 1 and described hereinabove and may be moved upwardly through the machine by passage over the periphery of the wheel 56 that is rotatably mounted at the upper end of the frame member 64. The wheel 56 may be rotated simultaneously with the rotation of the plates 44 and 51 by means of the chain drive 57 between the sprocket gears 58 and 59. Appropriate reduction gearing 60 may be employed so that the speed at which the periphery of the wheel 56 moves will be in desired relation to the rate of rotation of the plates 44 and 51 about the body 10. This speed is regulated so that the convolutions of the strands wound about the body 10 will have the desired spacing between them and so that the body 10 after the strands have been wound thereon will have the same general appearance, for example, as that shown in Fig. 4 except that all of the strands wound in one direction will overlie the strands wound in the opposite direction at their points of intersection.

After the strands have been applied to the periphery of the body 10 in the manner described in connection with Figs. 7, 8 and 9, the body 10 with the strands wound thereon may then be subjected to appropriate treatment for activating the latent activatable adhesive material in the strands as described hereinabove and illustrated in connection with Fig. 1.

In Figs. 7, 8 and 9, the guide 53 is in the form of a simple aperture through which the body 10 passes, but, if desired, the guide 53 may be of the type shown in Figs. 5 and 6.

While a composite strand has been illustrated hereinabove as containing one strand of cellulose acetate and a second strand of rayon, it is apparent that other materials can be used in the composite strand in accordance with the practice of this invention. As the strand which remains substantially unaffected when the material of the other strand is activated to impart adhesiveness thereto, any suitable material may be employed and the one which is used will depend principally on the matter of cost. While rayon is suitable for the purpose, an ordinary cotton thread can be used. Any other material such as silk or wool may also be used. For use as the strand composed of latent activatable adhesive, other materials than cellulose acetate may be employed. The material may be such that adhesiveness can be imparted thereto either by the action of a solvent thereon or by the

8

action of heat. In this connection, cellulose acetate is not only readily activated by solvents such as ketones, alcohols, ethers, esters and aromatic hydrocarbons, but is also thermoplastic and can have adhesiveness imparted thereto by application of heat. Moreover, it is possible to use heat in conjunction with the use of a solvent. A material such as a polyethylene may likewise be used and this particular material can readily be activated to impart adhesiveness thereto by use of an aromatic hydrocarbon or by application of heat. Polyethylene has a relatively low melting point around 250° F. and is thus readily susceptible to activation by application of heat. The latent activatable adhesive of the strands x may also be composed of a material such as nylon which is not only thermoplastic but also can be activated by alcohol. Other examples of suitable materials are polyvinyl alcohol fibers, chlorinated polyvinyl chloride, polystyrene and ethyl cellulose. Ordinarily, the best results are obtained when the latent activatable adhesive is activated by use of a solvent and the solvent preferably is applied by atomization of the solvent into an atmosphere through which the wrapped body 10 is passed inasmuch as better control is afforded for keeping the latent activatable adhesive from migrating under the influence of the solvent away from the zone where the strand wrapping contacts the periphery of the body. However, the solvent may be applied in any other suitable way.

The composite strand may likewise be composed of more than two strands. Thus, there may be a plurality of strands of the latent activatable adhesive material or a plurality of the essentially non-adhesive strength-imparting strands. However, in any case the composite strand will comprise one or more strands which are capable of being activated to act as an adhesive binder and one or more other strands which, because of difference in solubility in a solvent or difference in thermoplasticity, or both, will not be substantially affected upon activation of the strand or strands of latent activatable adhesive material.

In the practice of this invention it is distinctly preferable to use composite strand material of the character aforesaid. However, it is possible to achieve some of the benefits of this invention, but to a lesser degree, by using a strand which consists entirely of latent activatable adhesive material. In such case, the strand used would be relatively somewhat heavier than the individual strands in a composite strand and, for example, a cellulose acetate strand of 150 denier is suitable, although any of the other latent activatable adhesive materials may be used. When such a strand is applied to the fibrous body, the external surface thereof can be activated either by use of heat or application of a solvent so as to cause its adhesion to the peripheral fibers of the fibrous body and if only the peripheral surface of the strand material is thus affected, the strand material will retain its continuity and provide the desired confinement of the fibers. The extent of activation of such a strand can be controlled by regulation of the time or the severity of action of the activating agent as by use of a relatively slow-acting solvent applied for a limited period of time. Another alternative would be to employ a coated strand, as for example, by applying to a strand such as above described in connection with strand y a coating of some latent activatable adhesive material such as those above mentioned for use as the strand x . However, use of coated strands is less desirable and involves the rela-

tively expensive coating operation which is avoided by the use of composite strands of the character above described.

While this invention has been described in connection with application of eight strands to the fibrous body, it is apparent that the number of strands employed may be varied so as to be either less than or more than eight. The number of strands employed will depend in part upon the diameter of the body, the spacing between the convolutions of the strands, and the speed at which the fibrous body is passed through the machine while the strands are being wrapped thereabout. By using a number of strands such as eight, the inclination of the convolutions may be greater than if a lesser number of strands were employed, thus enabling greater speed at which the operations may be carried out while maintaining desired spacing between the convolutions. Ordinarily, for bonding free unspun fibers that are oriented predominantly longitudinally and that comprise in major proportion fibers that are about $\frac{5}{8}$ inch in length or more, the convolutions of the strand wrapping are such that the maximum spacing extending longitudinally of the wrapped body will be $\frac{1}{2}$ to $\frac{1}{4}$ inch. The convolutions can be much more closely contiguous consistent with substantial spacing between the convolutions but this ordinarily is not desirable due to the added cost, a slower production rate and lessening of the peripheral area of the body that is left uncovered in porous absorptive condition. More generally, the maximum spacing between the strands of the strand wrapping preferably is less than the average length of the fibers employed while still leaving substantial spacing between the strands. Moreover, while the strands have been shown as wrapped about the fibrous body in the form of oppositely inclined helices, any other type of strand wrapping may be employed.

As far as the finished product is concerned, there is little difference whether the strands are applied by braiding as shown in connection with Fig. 1, or are applied by winding as shown in connection with Figs. 7, 8 and 9. However, it may be mentioned that the mechanical motions involved in the operation of a braiding machine are of such character as to impose a limit on the speed at which the braiding operation can be carried out and while the product of this invention can be produced very rapidly in this manner, much higher speeds of operation are possible when the strands are applied by a simple winding operation of the type illustrated in connection with Figs. 7, 8 and 9.

While reference has been made hereinabove to the employment of a carding machine for the purpose of orienting unspun fiber so as to be longitudinally disposed in a fibrous body, other expedients may be employed for the purpose, depending partly on the nature of the fibers being handled. Thus, there are a number of well-known devices for performing operations such as combing, drawing and the like which result in longitudinal orientation of the fibers in an elongated body. Moreover, while an ordinary carding operation is ordinarily sufficient, a carding operation may be supplemented by drafting to accomplish a still more complete longitudinal orientation of the fibers. In any case, however, the invention contemplates the orientation of the unspun fibers so as to occur predominantly longitudinally in a substantially cylindrical elongated body and the application of a strand wrapping in bonded relation to the peripheral surface

thereof as described hereinabove while the body is being moved longitudinally. By these operations, a product can be produced that is extremely absorptive and that is remarkable for its longitudinal capillary and wicking action. Moreover, the product can be readily produced so as to be essentially free of any binder that is water soluble or otherwise affected by application of water thereto and so the bulk of the peripheral surface or at least the major portion of the peripheral surface is porous and absorptive and so as to be essentially free of any surface application such as a binder. While the product of this invention has many different uses, it is of especial utility as a dental roll and for such use is notable for its capillarity, for its freedom from any adverse effect due to contact with moisture, and for its property of not sticking to the gums. In the past, dental rolls have been produced by taking a web of carded cotton or the like and rolling the web up in the machine direction of the web until a roll of desired diameter is produced. Such rolls are kept from unrolling by a peripheral overall application of a binder such as starch. Such binder interferes with the absorptiveness of the roll and, when a water-soluble binder such as starch is used, the binder is dissolved and its effectiveness is destroyed as soon as the roll comes in contact with the moisture. Such rolls have also been found to be objectionable in use due to their tendency to stick to the gums especially after prolonged application. Moreover, in such a roll, the fibers are not disposed predominantly longitudinally in the roll but are disposed predominantly transversely with the fiber direction following the spiral of the rolled-up web material and with the result that the roll has little capillarity in the longitudinal direction. It is also the case that the production of dental rolls in this manner inherently involves much more complicated, more time-consuming, and more expensive manufacturing operations as compared with the practice of this invention.

According to this invention, a new and improved product of the character described having unique properties and characteristics can be produced very inexpensively and at a very high production rate.

While the method of this invention is particularly adapted for the manufacture of substantially cylindrical bodies such as dental rolls wherein the fibers are predominantly long fibers disposed predominantly longitudinally, the method is also of utility in producing peripherally confined, substantially cylindrical bodies comprising unspun fibers of other lengths and disposition. Thus, this invention may be utilized whenever unspun fibers are disposed in an approximately cylindrical body that can be handled for bringing the body into operative relation for the application of strands thereto as by braiding or winding. While web materials produced by a carding or similar operation that is applicable to the longer fibers are especially suitable for condensation into an elongated, approximately cylindrical body for application of the strand wrapping thereto according to this invention, other materials such as flexible absorptive webs or soft tissues, e. g., composed of alpha wood pulp lightly bonded by hydration, may be similarly condensed into substantially cylindrical form and may have the strand wrapping applied thereto and caused to adhere to the peripheral fibers thereof according to this invention. When the unspun fibers are lightly bonded as by hydration as in the case of alpha wood pulp or the like, the cylindrical body will have suf-

ficient integrity even though it is porous and highly absorptive so that the spacing of the strand convolutions may be of the order of that above described as appropriate when the fibers are preponderantly long fibers, but if more firm confinement is desired, the strands may be more closely spaced while retaining substantial spacing between the convolutions. However, by employment of preponderantly long fibers disposed preponderantly longitudinally in the cylindrical body and by use of the self-bonding strands whose spacing is less than the average length of the fibers a further constructional principle is utilized whereby the fibers in the body not only are peripherally confined but also are peripherally anchored so that in effect the core or body portion is contained within a highly porous cylindrical shell which affords confining strength by virtue of the strands and which affords longitudinal strength by virtue of the multiplicity of the peripheral long fibers that are bonded to the strands between their ends. By this constructional principle, a much superior product is afforded providing optimum all-around strength characteristics in combination with optimum porosity, absorptiveness and longitudinal wicking action.

I claim:

1. A method of producing a peripherally confined substantially cylindrical fibrous body which comprises arranging unspun fibers in the form of an elongated substantially cylindrical body, said body comprising long unspun fibers oriented predominantly longitudinally in said body, moving said body longitudinally and while said body is being so moved wrapping a plurality of composite strands about said cylindrical body substantially in the form of oppositely inclined helices with the convolutions of said helices in substantially spaced relation, each of said composite strands comprising a strand of latent activatable adhesive adapted to be activated to impart adhesiveness thereto by application of a solvent thereto and a second contiguous strand which is adapted to remain substantially unaffected upon application of said solvent thereto, and, after said strands have been wrapped about said cylindrical body as aforesaid, activating said latent activatable adhesive comprised in each of said strands by application of solvent thereto, thereby bonding the second strand comprised in each of said strands to peripheral fibers of said cylindrical body.

2. A method according to claim 1 wherein said solvent is applied to activate the latent activatable adhesive comprised in said strands by atomization of said solvent into the atmosphere in contact with the periphery of said body.

3. A method of making a substantially cylindrical absorptive fibrous body which comprises disposing long unspun fibers in an elongated body of approximately cylindrical periphery with said fibers oriented predominantly longitudinally in the body, moving said body longitudinally and while said body is being so moved wrapping a composite strand substantially helically about said cylindrical body with the convolutions of said strand in substantially spaced relation, said composite strand comprising a strand of latent adhesive material adapted to be activated to impart adhesiveness thereto and a second contiguous strand which is adapted to remain substantially unaffected when said strand of latent activatable adhesive material is activated to impart adhesiveness thereto, and after said composite strand has been wrapped about said cylindrical body as aforesaid activating said strand of latent activatable material, thereby bonding

said second strand to peripheral fibers of said cylindrical body.

4. A method of producing a peripherally confined substantially cylindrical body composed predominantly of long unspun fibers which comprises orienting said long unspun fibers predominantly in one direction, disposing said fibers in a peripherally approximately cylindrical body with said long unspun fibers disposed predominantly longitudinally therein, wrapping a plurality of strands comprising latent activatable adhesive material adapted to be activated by application of a solvent thereto about said peripherally approximately cylindrical body substantially in the form of oppositely inclined helices having substantially spaced convolutions, and thereafter activating said latent activatable adhesive material to cause adhesion of said strands with peripheral fibers of said body by contacting the periphery of said body with strands wrapped thereabout with an atmosphere containing finely-divided droplets of solvent for said adhesive dispersed therein.

5. A method according to claim 4 wherein said wrapping of said body by said strands is performed continuously by a braiding operation while said body is being moved longitudinally.

6. A method according to claim 4 wherein said oppositely inclined helices are applied continuously by winding respective strands sequentially in opposite directions about said cylindrical body while said body is being moved longitudinally.

7. A method of producing a peripherally confined substantially cylindrical body composed predominantly of long unspun fibers which comprises orienting said long unspun fibers predominantly in one direction, disposing the so oriented fibers about a central member in the form of a peripherally substantially cylindrical body wherein said fibers are disposed predominantly longitudinally in said body, wrapping a plurality of strands comprising latent activatable adhesive material about the periphery of said body while said central member is disposed within said body, separating the resultant wrapped body from the central member to permit the fibers of said body to fill the space afforded by separation of said member therefrom, and activating said latent activatable adhesive material to cause adhesion of said strands with peripheral fibers of said body.

8. A method of producing a peripherally confined substantially cylindrical fibrous body which comprises arranging unspun fibers in the form of an elongated substantially cylindrical body whose diameter is at least of the order of about $\frac{1}{4}$ inch, wrapping a plurality of preformed strands comprising latent activatable adhesive material about the peripheral surface of said cylindrical body in the form of substantially spaced convolutions while said latent activatable adhesive material is in non-tacky condition, and thereafter activating said latent activatable adhesive material to cause adhesion of said strands with peripheral fibers of said body.

9. A method of producing a peripherally confined substantially cylindrical fibrous body which comprises disposing unspun fibers in the form of an elongated substantially cylindrical body, wrapping a plurality of strands about the periphery of said substantially cylindrical body substantially in the form of inclined helices having substantially spaced convolutions, said strands comprising composite strand construction wherein a strand of latent activatable adhesive material adapted to be activated to impart adhesiveness

13

thereto is contiguous to a second strand which is adapted to remain substantially unaffected when the strand of latent activatable adhesive material is activated to impart adhesiveness thereto, and after said strands have been wrapped about said cylindrical body as aforesaid activating said strand of latent activatable adhesive material thereby bonding said second strand to peripheral fibers of said cylindrical body.

10. A method according to claim 9 wherein said latent activatable adhesive is adapted to be activated by application of a solvent thereto and is activated by contacting the periphery of the body with said strands wrapped thereabout with an atmosphere containing finely divided droplets of solvent dispersed therein.

11. A method according to claim 8 wherein said latent activatable adhesive is activatable to impart adhesiveness thereto by application thereto of a solvent therefor and wherein said latent activatable adhesive is activated by contacting the periphery of said body with said strands wrapped thereabout with an atmosphere containing finely-divided droplets of solvent for said adhesive dispersed therein.

12. A dental roll consisting of a substantially cylindrical absorptive body approximately $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter and of predetermined length suitable for use as a dental roll composed predominantly of fibers selected from the group consisting of cotton and rayon fibers which fibers are predominantly at least about $\frac{5}{8}$ inch in length and are disposed predominantly longitudinally

14

dinally in said cylindrical body in unspun porous, absorptive and longitudinally wicking relation, the periphery of said body being confined by substantially spaced convolutions of oppositely inclined substantially helically disposed strands composed predominantly of fibers selected from the group consisting of cotton and rayon fibers with the maximum spacing of said strands longitudinally of said body of the order of $\frac{1}{3}$ to $\frac{1}{2}$ inch, and said strands being bonded to the peripheral fibers of said cylindrical body by a water-insoluble adhesive material which is adherent to said peripheral fibers of said body substantially solely where said strands overlie said peripheral fibers, the peripheral fibers of said cylindrical body between said spaced convolutions being in said porous and absorptive condition and essentially free of binder material.

JOSEPH GOLDMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,609,255	Koella	Nov. 30, 1926
2,098,995	Barrell	Nov. 16, 1937
2,217,826	Van Laer	Oct. 15, 1940
2,248,123	Sackner	July 8, 1941
2,281,647	Whitehead	May 5, 1942
2,313,058	Francis, Jr.	Mar. 9, 1943