March 1, 1932. M. O. SCHUR 1,847,269

FIBER PRODUCT AND METHOD OF MAKING SAME

Filed March 13, 1929

Fig. 1.

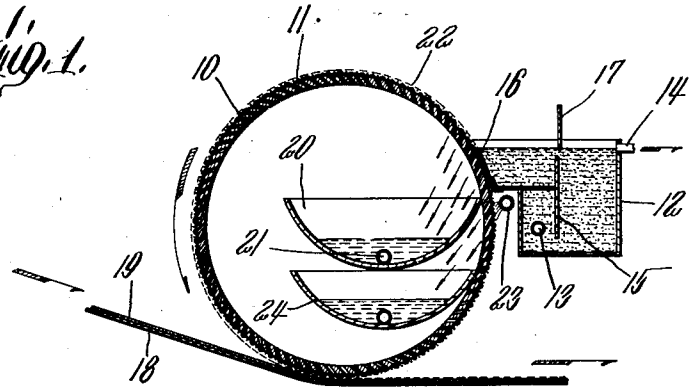


Fig. 9.

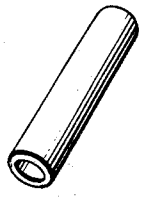
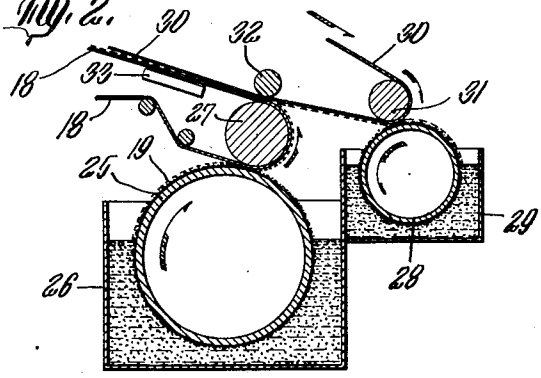


Fig. 2.



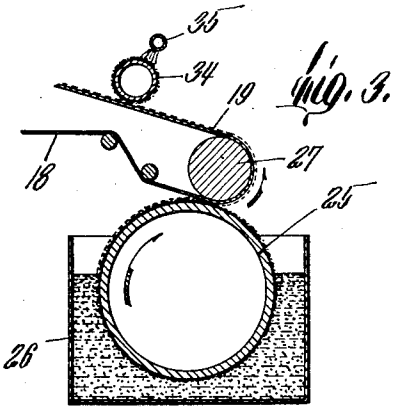
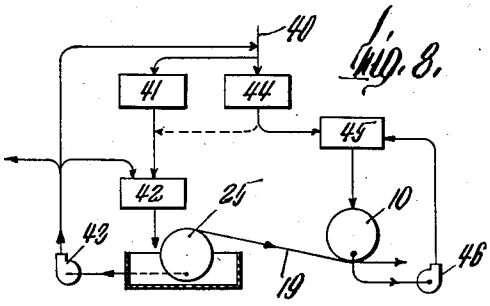


Fig. 8.



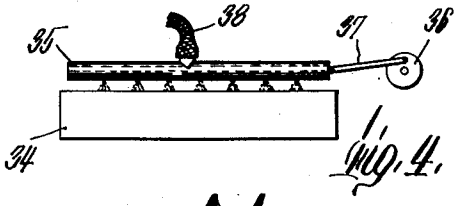


Fig. 4.

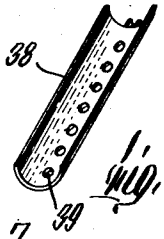


Fig. 5.

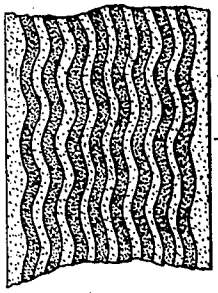


Fig. 6.

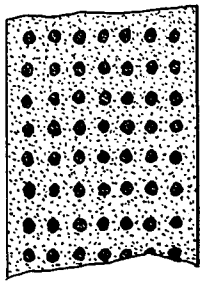


Fig. 7.

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UNITED STATES PATENT OFFICE

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FIBER PRODUCT AND METHOD OF MAKING SAME

Application filed March 13, 1929. Serial No. 346,648.

This invention relates to fiber products formed of a plurality of layers or laminæ of fibers, the fibers in some of the layers having characteristics differing from those of the fibers in other of the layers. The invention also relates to methods for making fiber articles of the type hereinafter described.

In making fiber articles which have considerable wall-thickness, it is usually desirable to build up such thickness by bringing together a sufficient number of thin webs of felted fibers and securing them together face to face. The webs for example may be composed of wet cellulosic pulp such as may be formed on the screen of a paper-making machine; or they may be in the form of sheets of damp or dry paper. The laminated structure will vary in its physical characteristics according to material or materials used, and the way in which they are put together. In articles made of cellulosic pulp for certain purposes, it is frequently desirable to secure a maximum strength of material consistent with other requirements. Taking as a secific example a fiber tube for use as a water pipe, it is desirable that the tube wall have as great strength as possible. It is essential, however, that the tube be thoroughly waterproofed since the fibrous structure loses a large percentage of its strength if permitted to absorb moisture. Where wood pulp is used in the manufacture of such articles as tubes for water pipes, considerable dry strength may be obtained by using a relatively "slow" stock, that is, stock which has been thoroughly beaten until the fibers are well hydrated. Such stock will stick firmly together, and in drying will shrink considerably into a hard compact structure possessing relatively great dry strength. This structure, however, is so dense that it is very difficult to saturate the article with waterproofing compound. If the usual molten pitch or asphalt be employed as a saturant, such material requires so high a degree of temperature for the saturant and/or so long a period of immersion to effect a thorough saturation that it is difficult to avoid charring of the fibers and consequent weakening of the article.

On the other hand if relatively "free" or lightly beaten stock is employed, the successive laminæ do not adhere to each other strongly, the aritcle tends to split on drying, and the strength of the article as a whole is relatively low, but it is porous and capable of absorbing saturant much more readily than if slow stock is used. It is an object of this invention to combine fibers of different characteristics in such a way that the advantageous features of the different bands of fibers are retained in the product. To this end I may build up a laminated pulp structure using laminæ of relatively free stock. Between successive laminæ I employ a very thin film of an agglutinant preferably in the form of a cellulosic gel, that is, a highly hydrated stock such as may be obtained by beating pulp thoroughly until it is very "slow", although I may employ other substances such as glue, starch or the like. The cellulosic gel is advantageous as an agglutinant since it exercises a minimum tendency to size the laminæ and thus to retard the penetration of a saturant. Furthermore, if moisture works its way into the finished article, it has much less effect on the holding power of the dried gel, whereas glue, starch and the like, unless given an auxiliary relatively expensive treatment, are readily dissolved by moisture and rendered ineffective. Highly hydrated stock, or gel, is an excellent adhesive and may be effectively employed not only with sheets of wet pulp but also as a binder between sheets of dry paper. This invention relates more particularly to the use of such gel with wet pulp sheets, although it is not limited thereto. The proportion of gel to free pulp may vary with the thickness of the laminæ, but excellent results are obtainable under ordinary conditions of practice by using from 2% to 20% of gel. The gel effectively cements together the successive layers of free stock and materially stiffens the article as a whole.

Instead of forming a laminated structure consisting of alternate layers of free stock and gel, I may mix the different pulps together and form the mixture into desired shapes. Furthermore, in the making of tubes of fiber, gel may be mixed in with free stock,

the mixture being formed into a web of wet pulp which is rolled up on itself under pressure into tubular form, the successive convolutions of wet pulp being pressed into intimate interfelting engagement so as to form a tube wall which is practically homogeneous.

The shrinkage of free stock in drying is considerably less than that of slow stock. Thus fiber tubes made according to the invention shrink relatively little in drying since they are made mostly of free stock. The relatively small drying shrinkage of free stock also means relatively small swelling of the article in case it becomes mositened. Hence if moisture succeeds in working into the walls of a tube made chiefly of free stock, the layers are disturbed much less by swelling than in the case of a tube made of slow stock.

In order to facilitate the penetration of a saturant through a laminated fibrous body having an agglutinant between the successive laminæ, I may apply the gel or other agglutinant in spots or lines, these being offset between successive layers to facilitate access of the saturant to all portions of the fiber body. For example, in making a tube, the cementing material may be applied in a number of narrow bands which travel back and forth laterally a distance approximately equal to that between bands.

In making laminated fiber articles according to the invention, a web of relatively free pulp may be formed simultaneously with a film of gel, the two being combined by suitable apparatus such as hereinafter described and as is illustrated on the drawings of which,

Figure 1 represents in section apparatus for carrying out the invention.

Figure 2 represents apparatus of modified form for carrying out the invention.

Figure 3 represents a further modification.

Figure 4 is a side elevation of a part of the apparatus shown in Figure 3.

Figure 5 is an additional member which may be employed with the apparatus shown in Figure 4.

Figures 6 and 7 are fragmentary plans of sheets of fiber with agglutinant applied thereto in different ways.

Figure 8 represents diagrammatically the arrangement of several pieces of apparatus which may be employed in practicing the invention.

Figure 9 is a perspective view of a fiber tube which may embody the invention.

Referring to Figure 1, 10 represents a cylinder mold having a Fourdrinier wire surface 11 as shown. The cylinder 10 is provided with a wall sufficiently thick to support the wire 11 without internal frame work leaving the interior of the cylinder free. Along one side of the cylinder 10 is mounted a suitable vat 12, this vat having a supply pipe 13 and an overflow pipe 14. The vat may conveniently be divided into two compartments by a suitable plate 15. One of these compartments is adjacent to the surface of the cylinder 10, the vat having a lip 16 which is approximately at the same level as the overflow pipe 14. A gate 17 is provided, this gate being to shut off the supply of pulp from the compartment adjacent to the cylinder, so that the supply of stock to the surface of the cylinder may be interrupted as desired. A suitable traveling felt 18 is shown in contact with the lower portion of the cylinder 10, this felt having a web 19 of cellulosic fiber thereon, this fiber having been deposited on the felt by a cylinder or other web-forming means not shown. The cylinder 10 is preferably operated so that its peripheral speed will be equal to the speed of travel of the felt 18. As the felt with its web of fiber passes the cylinder 10, the latter receives from the cylinder vat 12 a film of fiber which is deposited on the wire 11 as the white water drains through the apertures of the cylinder 10 and is caught by a suitable trough 20. The white water thus caught is drained off as by a suitable pipe 21 and is returned to the head box supplying the vat 12. The film 22 of fiber is carried around on the wire 11 until it is picked off at the point of contact of the felt 18 with the cylinder 10. Thus the film 22 of fiber is deposited on the web 19. The wire 11, after leaving the felt 18, is washed by a shower pipe 23, this wash water being caught by a trough 24 from which the shower water is drained directly to the sewer or to a save-all.

This apparatus may be used in conjunction with a tube machine, such, for example, as described in the patent to Parker No. 1,651,407 granted December 6, 1927. In machines of this type a web of fibrous stock is deposited on a traveling felt. After a considerable portion of the white water has been removed from the web, it is wound up on a mandrel in convolutions until the web attains a desired wall thickness. The formation of the pulp web is then automatically interrupted long enough to permit the removal of the tube and the substitution of a fresh mandrel. In the apparatus shown in Figure 1, 18 represents a felt, which may be the felt of a tube machine, carrying the web 19 which is preferably of free fiber, that is, fiber which has been beaten little, if any. The film 22, which is preferably of cellulosic gel, that is, cellulosic fiber which has been beaten until relatively slow, is deposited on the web 19 of free fiber. Since in the operation of a tube machine the web 19 is intermittently interrupted, the gate 17 may be automatically synchronized so as to cause interruptions in the film 22 which will approximately register with the interruptions in the web 19. This is desirable in order to avoid depositing the highly adhesive gel directly on the felt 18. The lip 16 of the vat

12 may be in the form of a straight edge so that a uniform continuous film of gel is deposited on the wire 11. If desired, however, the lip 16 may have alternate and laterally movable high and low portions to deposit the film 22 in the form of spaced bands which travel back and forth across the sheet to reduce interference in the pitch penetration as above discussed and also to insure a uniform thickness of tube wall in the finished product.

In Figure 2 is shown a paper making cylinder 25 which may be of any desired construction. This cylinder is mounted to rotate in the customary manner in a suitable cylinder vat 26 containing free stock for the formation of a web which may be wound up into a tube or may be formed to other shapes of laminated bodies. The web 19 is picked off by a traveling felt 18 as the latter passes over a couch roll 27. At the same time a second cylinder 28 is rotated in a separate cylinder vat 29 which contains highly beaten stock. A film of this stock is picked up by the cylinder and is transferred to a second felt 30 as it passes over a suitable couch roll 31. A guide roll 32 may be employed to bring together the felts 18 and 30 so that the respective webs thereon are brought into direct contact. As the felts travel along together, a suction box 33 may be employed on the face of the felt 18. This box acts to pull the film of gel away from the felt 30 so that the web 19 of free stock is retained on the felt 18 with the gel thereon. It furthermore serves to remove some of the water from the webs on the felt. The felt 18 thereupon travels to a tube-forming mandrel or other mechanism, not shown, by which the web is made into a laminated body.

Figure 3 shows a cylinder 25 in a vat 26, the latter containing preferably a free stock from which a web is continuously formed on the surface of the cylinder 25. This web is transferred to the traveling felt 18 as it passes around the couch roll 27. The felt 18 leaves the roll 27 with the pulp web on its upper face. This web is brought into contact with a suitable dandy roll 34 from which is mounted a spray pipe 35 adapted to spray a thin suspension of cellulosic gel on the dandy roll to be transferred to the web 19 on the felt. The concentration of the gel suspension thus sprayed on the dandy roll is preferably a little greater than that used in the vat 12 shown in Figure 1 or the vat 29 shown in Figure 2. A suspension containing about .5% is suitable for spraying on the dandy roll 34, a concentration of .1% or .2% being suitable for use in the vats 12 or 29. The apertures in the pipe 35 by which the gel is sprayed on the web 19 may be spaced so as to apply the gel in spaced bands. The pipe 35 may also be reciprocated longitudinally during the travel of the felt as by a wheel 36 and pitman 37, or other suitable means, the stock being supplied through a flexible connection 38, so that the bands of gel are deposited in zigzag or wavy form, as shown in Figure 6. This makes a more desirable distribution of the gel through the body of the tube which may be wound from the web 19. If desired, the gel may be deposited on the sheet in daubs or spots as shown for example in Figure 7 instead of continuous bands. To this end the apertures in the spray pipe 35 may be periodically opened and closed as by a slide 38 adapted to fit on a portion of the pipe 35 and provided with perforations 39 capable of registering simultaneously or otherwise with the apertures in the pipe 35. By mounting the slide member 38 in fixed position against the lower surface of the reciprocating pipe 35, the motion of the latter will cause intermittent jets through the apertures resulting in spaced daubs of gel on the sheet. The application of a discontinuous film of gel to the continuous web 19 of free stock facilitates the penetration of pitch or other saturant through the wall of a tube made of the web.

Figure 8 represents diagrammatically the circulation of the pulp stock and white water. The pulp is supplied unbeaten as through a supply pipe indicated by the line 40. This line is connected to a suitable beater 41 in which the pulp may be given a slight amount of beating. The relatively free pulp from the beater 41 is fed to a head box 42 which supplies the cylinder mold 25. The white water from the cylinder is circulated as by a suitable pump 43, some of the white water being fed back to the head box 42, some of it being returned to dilute the fresh stock coming through the supply pipe 40 and the remainder of the white water being sent directly to a save-all or to the sewer. A relatively small proportion of the pulp supply through the pipe 40 is diverted to apparatus indicated at 44 which may be a second beater, a Jordan, a colloid mill, or other hydrating device, where the pulp is thoroughly beaten and hydrated until quite slow. This beater thus supplies cellulosic gel to a head box 45 which supplies the cylinder mold 10. The white water caught by the trough 20 in the cylinder 10 may be recirculated as by a pump 46 back to the head box 45. The film 22 of gel retains a fairly large percentage of its water when deposited on the web 19. The web acts as a filter so that the water subsequently drawn therethrough from the film 22 is substantially free from fiber and can be sent directly to the sewer with practically no waste. A connecting pipe line is preferably fitted between the gel beater 44 and the head box 42. This may be used to supply a small percentage of gel to be mixed with the free stock to be deposited on the cylinder 25 for lamination with gel deposited on the cylinder 10, or the normal supply of gel to the head box 45 may be diverted to the head

box 42 to be mixed directly with free stock.

Thus the practice of the invention is possible not only simultaneously to obtain high strength and high absorptiveness, but the power expended in manufacturing the laminated product is reduced tremendously. While in the usual processes sufficient power must be expended in beating to develop enough gel within the pulp mass to give the necessary bonding between plies, in my process the minimum quantity of gel required is separately produced and is added in the most effective manner. In other words, in the usual process a large excess of gel is generated during beating in order that the requisite concentration of gel will be present on the surface of the individual laminæ, most of the gel within the body of the laminæ being unnecessary or actually detrimental because of its bad effect on absorptiveness. But by separately making the gel and adding where and as desired, the minimum power is used in beating and the optimum characteristics in the pulp article are realized.

Having thus described an embodiment of this invention, it should be evident to those skilled in the art that various changes and modifications might be made therein without departing from its spirit or scope as defined by the appended claims.

I claim:

1. A laminated fibrous body of which the laminæ are substantially composed alternately of relatively free fibers and of cellulosic gel.

2. A laminated fibrous body in which continuous laminæ of relatively free fibers alternate with discontinuous films of relatively slow fibers.

3. A laminated fibrous body in which continuous laminæ of relatively free cellulosic fibers alternate with discontinuous films of cellulosic gel.

4. A fiber tube comprising a convolute web of free fibrous stock and a film of slow stock between successive convolutions.

5. A fiber tube comprising a convolute web of free cellulosic stock with slow stock of cellulosic gel between successive convolutions.

6. A laminated fibrous body in which continuous laminæ of relatively free cellulosic fibers with separately prepared gel alternate with films of slow stock.

7. A laminated fibrous body in which continuous laminæ of relatively free cellulosic fibers with separately prepared cellulosic gel alternate with films of gel.

8. The method of making a waterproof fibrous body which comprises separately preparing pulps of fibers, said pulps having widely different average degrees of slowness, mixing the pulps, shaping the mixed pulp into a body of desired form and substantial wall thickness, drying the shaped body, and saturating said body with waterproofing compound.

9. The method of making a fiber tube, which comprises separately preparing relatively free pulp and highly beaten pulp, mixing said pulps, forming a web of said mixture, applying to said web a film of cellulosic gel, winding said web on a mandrel under pressure until the desired wall thickness is obtained, removing said tube from the mandrel, and drying the tube.

10. The method of making laminated fiber articles, which comprises applying wet cellulosic gel to a fibrous web and pressing together a plurality of layers of web thus treated.

11. The method of making laminated fiber articles, which comprises applying a film of wet cellulosic gel to discontinuous areas of a continuous web of free cellulosic fibers, and pressing together a plurality of layers of web thus treated.

12. The method of making a fiber tube, which comprises applying a film of wet cellulosic gel to a fibrous web, and winding the web upon itself into tubular form.

13. The method of making a fiber tube which comprises forming a web of free cellulosic stock, applying to said web a film of cellulosic gel, and winding said web into tubular form.

14. The method of making a fiber tube which comprises forming a web of free cellulosic stock, applying to the web a film of cellulosic gel in spaced wavy bands, and winding the tube into tubular form.

15. The method of making waterproof laminated articles containing a fibrous base which comprises forming webs of pulp having different degrees of hydration, the web of greater hydration being discontinuous, building up a laminated structure with alternate layers of the different webs, and impregnating the laminated body thus formed with a waterproofing medium.

In testimony whereof I have affixed my signature.

MILTON O. SCHUR.