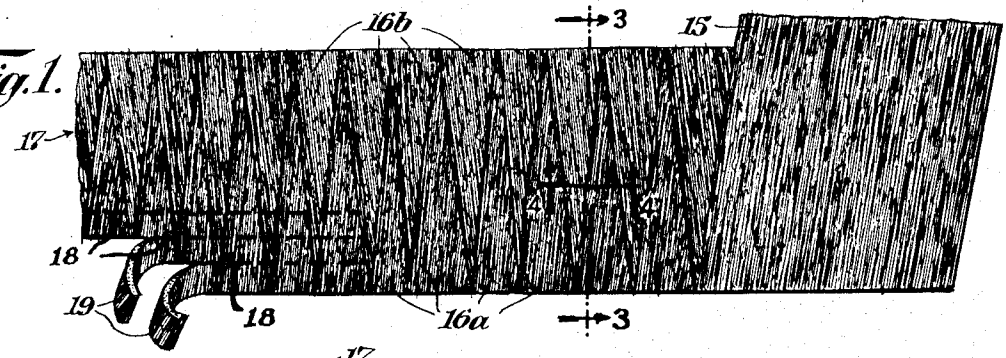
April 6, 1943. J. GOLDMAN 2,315,851

STAY STRIP

Filed Aug. 2, 1940

Fig. 1.



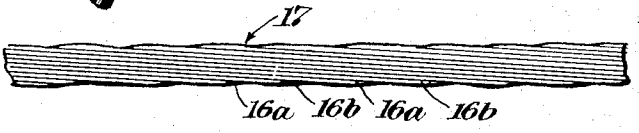


Fig. 2.

Fig. 3.



Fig. 4.

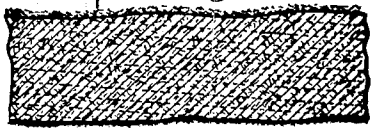


Fig. 5.

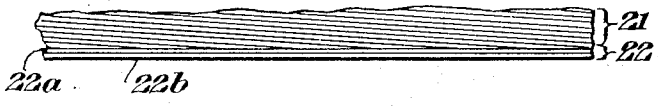
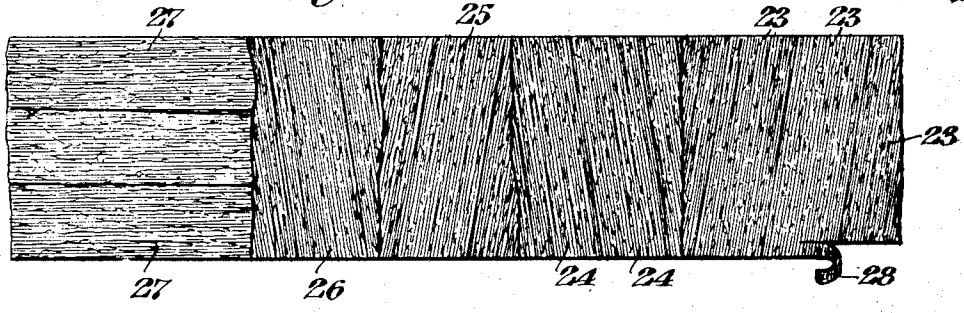


Fig. 6.



Fig. 7.



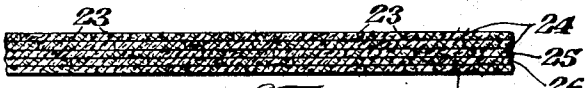
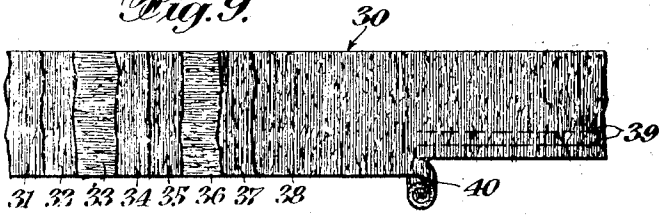


Fig. 8.

Fig. 9.



INVENTOR
Joseph Goldman
BY
Kenyon & Kenyon
ATTORNEYS

Patented Apr. 6, 1943

2,315,851

UNITED STATES PATENT OFFICE

2,315,851

STAY STRIP

Joseph Goldman, New Brunswick, N. J., assignor, by mesne assignments, to Santee Mills, a corporation of South Carolina

Application August 2, 1940, Serial No. 349,505

12 Claims. (Cl. 229—49)

This invention relates to stay strips. This invention relates particularly to stay strips suitable for reinforcing boxes, cartons and the like.

Heretofore the stay strips that have been in general use have had as a base material a woven fabric which may be filled with a suitable filler such as clay and a binder and which may be adhesively united to a paper sheet. On one side of the stay strip a water activatable adhesive such as glue has been used. The woven cloth for a stay strip is sleazy, curls and ravels and therefore must be reinforced by the addition of paper or by filling the interstices with clays and sizing material. The filler or paper or both also has the function of preventing the glue upon activation with water from striking through the stay strip and rendering the opposite side thereof sticky and adhesive. Moreover, in a woven cloth a large part of the cotton content is used for warp threads to bind the filling threads and since the warp threads do not perform any substantial strain resisting function the warp threads constitute a waste of fiber.

It is a purpose of this invention to improve upon prior art stay strips and materials therefor and to afford a more economical and better method of manufacturing stay strips and stay strip material.

According to this invention instead of using a woven fabric as a strain resisting base material, the strength and toughness necessary for stay strips and material therefor is provided by unspun long fibers disposed in the direction of the strain and integrally bonded in sheet material of substantial weight and thickness.

Some of the features of this invention relate to the disposition and orientation of the unspun fibers in the stay strip and stay strip material. Other features relate to the fabrication of the stay strip and stay strip material from a plurality of web materials and the character of said web materials and disposition of said web materials in a resulting composite sheet of stay strip material and in the finished stay strip.

Other features of this invention relate to the character and disposition of the binder material for bonding the fibers and the webs in an integral sheet and the character and disposition of the adhesive used in securing the stay strip to an article.

In preferred practice of this invention unspun long fibers are disposed and oriented so as to achieve in the finished product high strength characteristics for resisting the strains to which stay strips are subjected in use. To this end the fibers, preferably cotton fibers over about ¾ inch in length, are initially made up in the form of thin striated webs having a preponderant fiber direction. Preferably the fibers in the webs are substantially straight and are arranged approximately in one direction.

In my application Serial Number 349,311 filed August 1, 1940, for Fibrous structural material and method and apparatus for making same, I have described the manufacture of integrally bonded unspun fibrous webs which are characterized by the fact that fibers contained therein are arranged so as to have a preponderant fiber direction and so that at least a major proportion will be straight. Such web material, preferably when a high proportion of fibers is arranged approximately in one direction and is of substantially tensioned straightness, namely the straightness that the fibers assume when subjected to tension, may be used in the practice of this invention. It is not the intention, however, necessarily to limit the character of the web material that may be used in the fabrication of stay strips and stay strip material to web material made as shown and described in my said application although the use of such web material is to be preferred. The fibers in a web material that is used in the practice of this invention should, however, be arranged so as to have a predominant fiber direction by some suitable treatment such as drafting, combing or the like.

Unspun fibrous web material in which long fibers are oriented as above described is used in fabricating laminated composite sheet material, the web material preferably being plied in superposed juxtaposition; and by the disposition of the web material desired characteristics can be achieved in the resulting composite sheet and stay strip made therefrom. For example, in certain embodiments of this invention superposed laminations of fibrous web material are disposed so that as to a major proportion of the webs of long fiber the preponderant fiber direction lies transverse of the stay strip and preferably lies at a small angle with respect to the transverse dimension of the stay strip, e. g. between about 3° and about 15° of the transverse dimension, the webs having their preponderant fiber direction to one side of the transverse dimension preferably corresponding approximately in number and angular disposition to webs having their preponderant fiber direction on the opposite side of the transverse dimension. In one modification of this invention all of the webs are disposed in this manner. By this con-

struction very high capacity to resist tensile strains is afforded transversely of the stay strip especially when the binder that is used is somewhat plastic in character such as rubber or low softening point bituminous material. If the strain that is applied is sudden, the slight angular disposition of the bulk of the fibers in superposed webs permits a slight yielding action upon the initial shock which action is followed by a distribution of the tensile load over substantially all of the individual fibers disposed in the limited angular position mentioned so that great strength resistant to the strain is afforded. By disposing all or a major proportion of the webs so that the preponderant direction of the fibers is transverse of the stay strip within a limited angular disposition of the order mentioned exceedingly high resistance to shocks and tensile strains across the stay strip can be achieved. At the same time capacity to yield in the opposite direction without rupture can be afforded.

Other features of this invention relate to the straightness of the unspun fibers in individual webs and the extent to which the fibers are brought to one direction thereby securing maximum strength characteristics in component web material used in making stay strip and stay strip material.

The foregoing as well as additional controlled fiber structures that illustrate the practice of this invention will be described more in detail hereinbelow in connection with the drawing.

Unspun fibrous web material is bonded into coherent, integral laminated sheet material by means of a suitable binder. While any binder material appropriate for use as a binder for fibers may be used, in preferred practice a thermoplastic binder is used which is resistant to water, that is, which does not excessively rapidly dissolve, soften or deteriorate when subjected to water, dampness, or excessive humidity. Preferably such a binder is impregnated substantially throughout the stay strip material so that the fibers and the webs are strongly bonded in intimate association with each other. Moreover, a thermoplastic adhesive material adapted to be activated by heat to impart stickiness thereto is preferably carried on or at the surface of the stay strip so that merely upon heat activation of the adhesive material the stay strip can be bonded to the surface of an article.

The advantages of stay strips embodying this invention are several and all or part thereof may be availed of in practicing this invention. In the first place the stay strip is very tough for its weight and has very high resistance to strains in the direction that strains are applied to stay strips when affixed to articles, e. g., boxes and cartons. The new product is much superior in this respect to stay strips composed of fabrics filled with clay fillers and binders and coated with glue, which stay strips tend to tear extensively especially after any break is once started in the stay strip material. The new product is also non-ravelling.

The new stay strip is also advantageous inasmuch as it can be manufactured without utilizing the relatively costly operation of spinning and of weaving threads. A separate glue applying operation can likewise be eliminated when a binder is used that is also adapted to adhesively bond the stay strip to any article merely by heat activation to impart superficial stickiness to the stay strip and pressing the stay strip against the surface of an article.

A further advantage of this invention is that a stay strip is afforded that in preferred embodiments is adapted to become adhesively bonded to the surface of an article by a material, which, unlike ordinary glue for example is not softened by moisture or dampness. It has been a serious defect of stay strips used at the present time that when a box or carton on which a stay strip if this type is used becomes exposed to dampness the adhesive is softened and the stay strip comes off. Moreover, according to this invention a stay strip can be manufactured which is substantially waterproof and prevents moisture or dampness from penetrating through the stay strip.

Further purposes, features and advantages of this invention will become apparent in connection with the following description of certain illustrative embodiments of this invention in connection with the following drawing, wherein—

Fig. 1 is a plan view of one form of stay strip material embodying this invention, with part thereof incomplete to illustrate the fabrication thereof,

Fig. 2 is a longitudinal side elevational view of the completed portion of the stay strip material shown in Fig. 1 on a somewhat enlarged scale.

Fig. 3 is a transverse sectional view of the stay strip material shown in Fig. 1 on a greatly enlarged scale taken on the line 3—3 of Fig. 1,

Fig. 4 is a longitudinal sectional view of a fragment of the stay strip material shown in Fig. 1 on the same greatly enlarged scale of Fig. 3 taken on the line 4—4 of Fig. 1,

Fig. 5 is a longitudinal side elevational view of a modified form of stay strip material embodying this invention on the same somewhat enlarged scale of Fig. 2,

Fig. 6 is a perspective view of a stay strip embodying this invention, the thickness of the stay strip being shown on an enlarged scale for clarity,

Fig. 7 is a plan view of an additional embodiment of this invention with the upper layers broken away to show fiber disposition in lower layers,

Fig. 8 is a longitudinal sectional view of the stay strip shown in Fig. 6 with the thickness of the laminations exaggerated for the purpose of clarity, and

Fig. 9 is a plan view of an additional modified form of stay strip material embodying this invention with successive layers broken away to show the fiber structure.

Referring to the drawing and particularly to Figs. 1 to 4 one structurally simple and inexpensively manufactured embodiment of this invention will be described for purposes of exemplification. In order to afford a specific example the fiber used in the manufacture of the stay strip is cotton fiber at least about 70% of which is over 1 inch in length. The cotton is first formed into a thin web by repeatedly drafting and lapping the cotton after it has been carded until about 70% of the fibers 1 inch or more in length has been arranged approximately in one direction and is drawn to substantial axial straightness. This may be accomplished, for example, as described in my application Serial Number 349,311 filed August 1, 1940, referred to above, and as described in my application the fibers in the drafted web material are preferably bonded together while the web is under tension in the preponderant direction of the fibers so that the fibers in that direction may be bonded

together while in a condition of tensioned straightness. The web material preferably weighs about 100 to 250 grains per square yard.

The web material conditioned as above described is then fabricated by a plaiting operation into a laminated composite sheet as shown in Figs. 1 to 4. For example, a composite sheet may be formed that is about 40 inches wide by continuously plaiting an elongated conditioned web material about 16 inches wide back and forth on itself with a zigzag motion so that there will be about 9 transverse travels about 40 inches long for each yard of resulting composite sheet thereby producing a composite sheet having about 4 thicknesses or laminations of the original web at any one point. In order to minimize any tendency of the selvages to wrinkle, the material being deposited and the material already deposited may be turned relatively to each other at each change of direction so that the material will be laid down straight in each passage across the deposited material.

In Fig. 1 the conditioned web 15 is shown being laid in plaitings or laminations 16*a* and 16*b* which are also indicated on an enlarged scale in Figs. 2, 3 and 4, to form the composite sheet which is indicated generally by the reference character 17. It may be noted that the preponderant fiber direction of all of the laminations 16*a* is in one direction and that the preponderant fiber direction of all of laminations 16*b* is in another direction at a small angle, e. g., about 10° to the fiber direction of laminations 16*a* and that the fiber direction of none of the laminations is directly across the transverse dimension of the sheet 17, i. e. at a right angle to the longitudinal axis of the sheet 17. The laminations 16*a* and 16*b* are superposed in juxtaposition. The number of laminations 16*a* in this embodiment are the same as the number of laminations 16*b*. When the laminations are disposed at a small angle to each other, as in the embodiment shown, it is preferable that the number of laminations in one direction be at least approximately the same as the number of laminations in the other direction. It is preferable that fiber direction in the web laminations be less than about 30° to each other and less than about 15° to the transverse dimension of the material.

The drawing is not a scale drawing but has certain aspects exaggerated for purposes of clarity. In Figs. 2, 3 and 4 more than 4 laminations are shown to indicate the laminated nature of the composite sheet.

The stay strip material is impregnated with a suitable binder adapted to bond both the fibers and the fibrous webs together as an integral sheet. For the purpose of affording a specific example, the binder may be a bituminous binder preferably having a softening point, ring and ball, in the neighborhood of 140° to 175° F. Preferably also there is mixed or blended with the bituminous material some material such as coumarone resin that increases the natural adhesiveness or tackiness of the bituminous binder. Other agents to increase the adhesiveness or tackiness of the bituminous binder may also be used, such as latex.

The adhesive may be impregnated in the stay strip material so that preferably about 20% to 30% is incorporated, the adhesive being indicated by speckling in Figs. 3 and 4. No attempt is made to show the adhesive by speckling except in a general way on the smaller scale figures such as Fig. 1, although it is to be understood that the fibrous material in such figures likewise contains the binder. The binder may be applied in any suitable way depending somewhat upon the nature of the binder that is used. If a bituminous binder is used it may be applied in a heat liquefied condition as by immersing the stay strip material therein one or more times or by passing the strip between rolls carrying the heat liquefied bitumen. If desired in order to obtain a thorough penetration of the sheet without incorporating an excess of bitumen therein, the bitumen may be thinned with a volatile solvent or dispersed in an aqueous emulsion. Preferably the binder is applied to the web material before the web material is deposited in laminations as described in my application, Serial Number 349,311 filed August 1, 1940, inasmuch as by so doing the distribution of the binder throughout the composite sheet of stay strip material can be made more uniform, and the fibers can be bonded in the elemental webs in a condition of tensioned straightness. Moreover, it is also possible to bond the fibers of the elemental web material at the time that the web material is manufactured, e. g., by using about 1 or 2% of a binder so that the fibers which have been straightened may be bonded in a straightened condition as described in my said application and then apply the balance of the bonding material when the elemental web material is made up into stay strip material.

After the stay strip material has been formed and the binder has been incorporated therein, it can be cut into stay strips, e. g., by cutting along the dotted lines 18 indicated in Fig. 1. Portions of stay strips 19 are shown in Fig. 1 that have been cut free and in Fig. 6 a stay strip that has been cut from sheet 17 is shown, with the thickness thereof on an enlarged scale to indicate the disposition of the fibers. A suitable adhesive carried at the surface of the stay strip is indicated by the speckling in Fig. 6.

The stay strip manufactured as above described can be used for any purpose, e. g., to reinforce boxes, cartons or the like. Preferably advantage is taken of the fact that the stay strip is impregnated with a thermoplastic material that is activatable by heat to become sticky when applying the stay strip to the surface of an article. Merely by heating the stay strip immediately before application to an article so as to cause at least the surface that is to adhere to the article to become sticky the stay strip can be caused to adhere to an article. This can be readily done as by passing the stay strip over a heated roller and then pressing the stay strip against the surface of the article before the heat-activated binder hardens. Upon cooling to normal atmospheric temperature the stay strip remains adhered to the article. If it is desired a superficial coating 20 of thermoplastic binder can be applied to the surface of the stay strip material either before or after it is cut into stay strips so as to insure the presence of sufficient thermoplastic binder carried at or adjacent the surface to obtain a good bond with the surface of any article to which the stay strip may be applied. The thermoplastic material in coating 20 may be of a lower softening point than the thermoplastic material used in the body of the stay strip, e. g. about 120° F. to about 140° F. In this manner the softening of the adhesive can be facilitated and the danger of excessively softening the thermoplastic binder in the body of the stay strip is minimized. If desired the

stay strip before application to an article can be passed over a flame instead of over a heated roller to quickly heat the surface portion of the stay strip and render it sticky before the stay strip is applied to an article.

A stay strip constructed as above described has exceedingly high strength transversely. Inasmuch as stay strip for cartons and boxes is subjected for the most part to transverse strains the stay strip constructed as above decribed has much greater resistance to such strains per unit weight than do stay strips of the character heretofore used. Moreover, due to the small angularity of the disposition of the conditioned webs there is a slight giving action against transverse strains which is immediately followed by an unyielding resistance, thus increasing the resistance of the stay strip to sudden transverse shocks without undue stretching. In order to promote this effect it is preferable to employ binder material such as bituminous material of relatively low softening point, latex or the like which can "give" slightly without crumbling. Moreover, due to the angularity of the disposition of the conditioned webs, the stay strip has some strength longitudinally coupled with the capacity to stretch longitudinally without rupture. By the structure mentioned above a stay strip is provided which has great strength in resisting the type of strains to which stay strips are subjected in the most common uses thereof coupled with certain yielding capacity particularly longitudinally that minimizes the danger of rupture. It may also be added that since the stay strip is impregnated with a bituminous binder, the stay strip is resistant to penetration by moisture. It is of even greater practical importance that the stay strip can be affixed adhesively to the surface of an article by an adhesive that is not adversely affected by moisture. Notwithstanding that a box or carton to which a stay strip of the character described has been attached may be subjected to moisture or dampness, the stay strip remains securely affixed thereto.

In Fig. 5 a modified form of this invention is shown in which the composite sheet of stay strip material comprises a main body portion 21 that may be identical with the stay strip material 17 shown in Figs. 1 to 4 and described hereinabove. Integral therewith is another portion 22 which may comprise one or more laminations of conditioned web material in which a major proportion of the fibers are approximately straight and are disposed approximately in one direction longitudinally of the web material and of the composite sheet of stay strip material. In the drawing two such laminations 22*a* and 22*b* of web material are shown for purposes of examplification. A binder material such as a butuminous binder impregnates the entire composite sheet of stay strip material. The structure shown in Fig. 5 has greater resistance to longitudinal strains and less capacity to yield longitudinally than does the embodiment shown in Figs. 1 to 4.

The somewhat different embodiment of this invention is shown in Figs. 7 and 8 wherein elemental striated web material is disposed with the predominant fiber direction of the bulk of the web transversely of the stay strip material. The top lamination is composed of striated webs 23 about 15 inches wide, for example, composed of long fibers and disposed transversely of the sheet with the edges to the elemental webs abutting to form a top lamination of substantially uniform thickness. The webs 23 may be disposed with the preponderant fiber direction thereof at an angle of about 10° to the cross dimension of the sheet of stay strip material as a whole. Similar striated webs 24 are disposed with the preponderant fiber direction thereof at an opposite like angle to the cross dimension of the sheet as a whole in a lamination of substantially uniform thickness underlying the lamination composed of webs 23. Striated webs 25 are disposed similarly to webs 23 in a third lamination and webs 26 are disposed similarly to webs 24 in a fourth lamination. If desired a fifth lamination may be made of striated webs 27 extending longitudinally of the stay strip material with the edges of the web elements abutting each other. The cobonding of the fibers in the individual webs and the bonding of the webs into an integral laminated sheet of stay strip material may be accomplished in the manner described above in connection with the embodiments of this invention shown in Figs. 1 to 5. The binder is indicated by the speckling. An adhesive material can be applied to a surface of the stay strip material as above mentioned. Preferably the web elements are disposed in the different laminations so that the abutting edges do not directly overlie abutting edges of elemental webs in other laminations, particularly with regard to those laminations wherein the fiber direction is substantially the same. Thus a stagger arrangement such as shown in Figs. 7 and 8 is preferable. Alternatively the elemental web material in the different laminations can be deposited in ribbons of somewhat different width in the different laminations so as to accomplish this purpose. As aforesaid the lamination of webs 27 can be omitted if desired. Somewhat more generally the number of laminations of web material in which the fiber direction is either transverse of the stay strip material or longitudinally thereof can be varied as desired.

In Fig. 7 a stay strip 28 is shown partially severed from the stay strip material to illustrate the preferred disposition of the fibers in a stay strip cut from the laminated sheet material shown in Figs. 7 and 8.

The characteristics of the stay strip material shown in Figs. 7 and 8 are generally similar to the characteristics of the stay strip material shown in Figs. 1 to 6. The stay strip material shown in Figs. 7 and 8, can, however, be made with a somewhat smoother surface than the stay strip material shown in Figs. 1 to 6.

In Fig. 9 an additional modification of this invention is shown for the purpose of further examplification of the practice of this invention. According to this embodiment of the invention a plurality of webs of unspun long fibers which are straightened and are arranged approximately in one direction are superposed so that the preponderant fiber direction of some of the webs is disposed at approximately a right angle to the preponderant fiber direction of other webs in the composite laminated sheet. In the embodiment shown the composite sheet, which is indicated generally by the reference character 30, contains a total of eight laminations of the web material. In laminations 31, 32, 34, 35, 37 and 38 the preponderant fiber direction is directly across the sheet 30 while in laminations 33 and 36 the preponderant fiber direction is lengthwise of the sheet 30, and all of of these laminations are superposed in the body of the sheet and integrally bonded together by binder material which is impregnated throughout the thickness

of the sheet 30 and is indicated in the drawing by the speckling. An adhesive may be applied to the surface of the stay strip material as mentioned in connection with the other embodiments of this invention hereinabove described.

Stay strips may be cut from the sheet 30 along dotted lines 39, one such stay strip 40 being shown partially removed therefrom and being formed into a roll. In the resulting stay strip the fibers are arranged so that the preponderant fiber direction of part of the component webs is longitudinal of the stay strip and the preponderant fiber direction of the other part of the component webs is directly across the stay strip. In the embodiment shown the preponderant fiber direction of the major portion of the component webs is directly across the stay strip. The structure shown therefore has maximum strength transverse of the stay strip and at the same time has substantial strength longitudinally of the stay strip. It is not necessary that laminations be disposed in the precise location shown in Fig. 9. Thus a greater or lesser proportion of webs with the preponderant fiber direction longitudinally disposed in the stay strip or stay strip material can be used and a greater or lesser proportion of webs having the preponderant fiber direction transversely disposed in the stay strip or stay strip material can be used. For example, the number of webs with the preponderant fiber direction transverse the stay strip or composite sheet can be equal to the number of webs with the preponderant fiber direction longitudinally of the stay strip or composite sheet, thus affording a composite sheet material and stay strip having approximately equal strength longitudinally and transversely. It is preferable however, that a major proportion of the webs be arranged with the fiber direction across the stay strip. It is apparent that the strength characteristics of the stay strip can be varied in other ways according to the requirements of the use to which it is to be put in the practice of this invention.

The type of stay strip illustrated in Fig. 9 has less capacity to yield both longitudinally and laterally than do the stay strips shown in Figs. 1 to 4.

In the fabrication of the stay strip illustrated in the drawing and described hereinabove it is of great advantage to preliminarily form thin web material in which the fibers are arranged preponderantly in one direction and preponderantly straight in said direction and then fabricate a composite sheet from the web material so as to provide in the sheet a plurality of webs of controlled fiber orientation. The fibers can be brought into straightened condition and into a uni-directional condition to higher degree when working with a thin web than when working with a thick mass of fibers. Moreover, by building up the composite sheet from a relatively large number of thin superposed webs, the fiber disposition in the composite sheet can be controlled to much better advantage. It is preferable to make up individual webs which weigh about 100 to 250 grains per square yard and while somewhat heavier webs can be used it becomes difficult to work with webs weighing more than about 400 grains per square yard. From another point of view the webs preferably contain about 2 to 8 fibers in the thickness thereof. Sufficient webs of the thin diaphanous character mentioned are used to obtain in the finished composite sheet a weight of about 800 to 2200 grains per square yard. This usually requires about 4 to 12 superposed laminations in preferred practice. In this manner fiber disposition in the finished composite sheet can be controlled and at the same time bodies of fibers having a preponderant fiber direction are brought into integral superposed association with bodies of fibers having another preponderant fiber direction so that bodies of fibers while different in direction are nevertheless integrated into a unitary laminated sheet having great strength and minimum tendency to separate into component layers.

In the fabrication of stay strip material it is preferable to employ fibers that are about an inch or more in length. However, fiber which contains a major proportion of fibers over ½ inch in length is to be regarded as long fiber herein and may be advantageously used in the practice of this invention. A fiber such as cotton fiber which contains 60% or more of fibers over ¾ inch in length may also be advantageously used. Preferably, however, the proportion of short fibers, e. g., less than ¾ or ½ inch, is less than about 30% of the fibers. It is possible, of course, to reduce the proportion of short fibers to 10% or less by combing or the like, but usually it is not necessary to go to the expense of removing the proportion of short fibers that occurs in cotton or the like as ordinarily sold.

In the manner described in my application, Serial Number 349,311, filed August 1, 1940, one can readily form web material for fabrication into stay strips, which web material contains a major proportion of fibers that have a preponderant fiber direction and are approximately straight. By bonding the web material while it is under tension the fibers disposed approximately in the direction of the tension can be bonded together in a condition of tensioned straightness. Thus, in the practice of this invention, it is preferable to employ web material in which at least about 70% of the fibers are disposed in a preponderant fiber direction and are within about 15° of said preponderant fiber direction. While some of the fibers in the web, particularly the short fibers, may be somewhat indiscriminately disposed, such fibers merely act as a filler, and while the proportion of fibers indiscriminately disposed in the web material can be reduced as by repeated drafting and lapping operations or by combing, it is not necessary to do so unless optimum strength characteristics for weight of fiber is desired. When the web material is made as described in my application, Serial Number 349,311, filed August 1, 1940, one can readily produce web material in which over 70% or 80% of the fibers over ¾ inch in length are disposed approximately in one direction, e. g., within about 15° of the preponderant fiber direction, and the use of such web material, especially when such long fibers are in a condition of tensioned straightness, constitutes preferred practice of this invention inasmuch as very high strength can thereby be attained in the stay strip material. Somewhat more generally any of the web materials described in my application above mentioned may be employed in the manufacture of stay strip material according to the present invention. While I regard it as preferable to make stay strips and stay strip material from web material fabricated as described in my application, Serial Number 349,311, filed August 1, 1940, the present invention is not to be regarded as limited to employment of web materials thus made inasmuch as other web ma-

terials containing unspun fibers that have been arranged in a preponderant fiber direction by drafting, drawing, combing or the like, may be used.

It is advantageous in the fabrication of stay strips of the type shown in Figs. 1 to 4 that a multi-ply stay strip can be made using a single elongated web of unspun long staple fibers having preponderant fiber direction longitudinally of the web. It is desirable that 75% of each deposited layer of the web material be covered by a succeeding layer of the web material and in preferred practice about 85 to 90% is covered by a succeeding layer. In this construction it is to be noted that the laminations are disposed somewhat diagonally across the thickness of the stay strip material as is evident in Figs. 2, 4 and 5. The diagonal disposition of the laminations of web material minimizes any tendency for the laminations to separate. The operation involved in making stay strip material of this type may be performed continuously, rapidly and economically.

As mentioned above, it is preferable that the preponderant fiber direction of the webs be at a small angle with respect to a line directly across the stay strip or stay strip material, i. e., the transverse or cross dimension of the stay strip or stay strip material. While this angle is preferably relatively small, e. g., about 3 to 15°, webs thus disposed or disposed at any angle less than 45° to a line directly across the stay strip or stay strip material are regarded as transversely disposed in the stay strip or stay strip material. Preferably a major proportion of webs are arranged so that the preponderant fiber direction of some webs are at an angle with respect to the preponderant fiber direction of other webs but so that the maximum difference in fiber direction is less than 45°.

While reference has been made in the foregoing specific example of the practice of this invention to the employment of cotton fiber, other fibers may also be used such as jute, hemp, sisal, manila and the like. Moreover, a material such as Spanish moss can be used if preliminarily treated to arrange the strands thereof in a preponderant fiber direction and to cause them for the most part to be straightened in the preponderant fiber direction.

In the foregoing example bituminous material, such as asphalt having a softening point of about 140° F. to about 175° F. has been mentioned as desirable especially when blended with a material such as coumarone resin or latex is adapted to impart increased adhesiveness to the bituminous material. Other similar materials such as pitches and coal tar residues can be used. Moreover, other thermoplastic binder materials can be used such as thermoplastic cellulose esters and ethers, e. g. cellulose acetate, cellulose nitrate, ethyl cellulose, benzyl cellulose, etc. Thermoplastic synthetic resinous materials may also be used, such as vinyl acetate, vinyl acetate-vinyl chloride copolymer and the like. When a thermoplastic binder material is used advantage can be taken of its capacity to become sticky and adhesive upon heating to utilize the binder material to bond the stay strip to an article. While the same thermoplastic material may be used both as an adhesive to bond the stay strip to an article and as the binder incorporated throughout the body of the stay strip, this is not necessarily the case.

It is not essential that the binder for the stay strip be a thermoplastic material. Thus the stay strip material may be bonded with a vegetable or animal adhesive such as casein (e. g. milk casein), soya bean protein, glue, starch dextrine or the like. Such adhesives can be applied in the form of an aqueous solution, an emulsion or the like, to preformed composite stay strip material but is preferably applied to the web material before it is fabricated into the composite sheet or during the fabrication of the composite sheet. When adhesives of this character are employed it is preferable to cause them to "set" so as to have increased resistance to moisture. This can be done in any suitable manner as by treating the stay strip material after the binder material has been incorporated therein or in the component webs with a setting agent such as formaldehyde, tannic acid, alum or the like, e. g., in an aqueous solution. The binder and the setting agent can be applied as a bath with which the stay strip material or web material is contacted or by means of applicating rollers carrying the binder material or setting agent over or between which the stay strip material or web material is passed. In general, any treatment that bonds the fibers of the composite sheet together and bonds the web laminations together may be employed. It is preferred to bond the fibers in a condition of tensioned straightness in striated elemental webs, before the webs are made into a composite sheet of stay strip material. In such case the binder can be applied in a condition such that it can be activated to impart stickiness thereto to bond the webs together as a composite sheet and after the composite sheet material has been thus made the setting agent can be applied.

When a non-thermoplastic bonding means is employed a separate adhesive should be used to cause the stay strip to adhere to the surface of an article. This adhesive may be ordinary glue activatable by water. In such case it is preferable to fill the stay strip material with a water-resistant binder so that the stay strip material may be impervious or slowly impervious to moisture and so that the glue when applied will remain largely on the surface of the stay strip without excessive penetration and so that when the glue is subsequently activated with water the water carrying dissolved glue will not strike through the stay strip. It is preferable, however, in order to minimize difficulties such as these to use a thermoplastic adhesive, e. g., of the character above mentioned, even though a non-thermoplastic binder is used in the body of the stay strip material and it is also preferable for reasons mentioned hereinabove to employ a thermoplastic adhesive that is not soluble in, softened by, or deteriorated by, moisture or dampness.

Ordinarily the binder that is incorporated in the stay strip is less than 50% of the weight of the fiber in the composite stay strip material inasmuch as greater quantities of binder tend to make the stay strip material excessively stiff and boardy. Ordinarily only about 25% of binder material on the weight of the fiber is incorporated in the body of the stay strip material. Notwithstanding such relatively small quantities of binder stay strip material weighing from about 800 to 1200 grains per square yard can be made which has a tensile strength as high as 10 pounds per inch in at least one direction for each 100 grains per square yard of fiber. In other words, stay strip material containing about 1200 grains of fiber per square yard, for example, and containing less than 50% of binder incorporated in

the body portion of the stay strip material can be made according to this invention which has a tensile strength of 120 pounds per square inch transversely of a stay strip. Considerably greater strength per weight of fiber can also be attained in the practice of this invention. In conventional stay strip material the weight of fiber usually runs about 1000 to 2000 grains per square yard in order to obtain strength required to meet the strains encountered in use. Such material has a tensile strength transversely of the stay strip of only about 2 pounds per 100 grains of fiber. According to the present invention the amount of fiber that is required to withstand such strains can be very greatly reduced and the improved stay strip material can be made by a method which from the production point of view is much more economical.

While it is preferable to make stay strip and stay strip material made entirely of striated webs of long fibers, it is not essential to do so inasmuch as one or more plies or laminations of other materials such as coating films, thin sheets of paper or other fibrous material or the like may be included on one side or the other of stay strip or stay strip material or interposed between superposed laminations of striated webs of long unspun fibers in stay strip or stay strip material or otherwise used in conjunction with one or more striated webs of long unspun fibers.

If desired a suitable dye, pigment or other coloring material can be incorporated with the stay strip or stay strip material. This can conveniently be done at the same time that the binder is applied thereby eliminating a separate coloring or tinting operation.

While this invention has been described in connection with certain specific embodiments thereof it is to be understood that this has been done merely for the purpose of exemplification and that described embodiments may be varied without departing from the scope of the invention. Accordingly, the scope of the invention is to be governed by the language of the following claims construed in the light of the foregoing description of the invention.

I claim:

1. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long fibers, the fibers of said webs being arranged in thin striated web form in a preponderant fiber direction and said webs being disposed in a plurality of superposed laminations with the preponderant fiber direction of fibers in different superposed webs angularly disposed and with the preponderant fiber direc- of at least one of said webs disposed transversely of the strip within 45° of a line extending directly across the strip, said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

2. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long fibers the majority of which are over ¾ inch in length and are disposed substantially straight and in one direction in thin striated web form, the individual webs being in superposed juxtaposition with the major portion of the total amount of the fibers in all of said webs contained in webs having the preponderant fiber direction thereof, transverse of the strip within 45° of a line extending directly across the strip and with the preponderant fiber direction in juxtaposed webs angularly disposed, said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

3. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long fibers, the fibers of said webs being arranged in thin striated web form in a preponderant fiber direction and said webs being disposed in a plurality of superposed laminations with the preponderant fiber direction of fibers in different superposed webs angularly disposed and with the preponderant fiber direction in the webs containing a major portion of said fibers in the strip differing in direction by less than about 30° and disposed transversely of the strip within about 30° of a line extending directly across the strip, said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

4. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long fibers the major proportion of the fibers in the individual webs being substantially of tensioned straightness and arranged approximately in one direction in thin striated web-like form, said webs being in superposed laminations with the preponderant fiber direction in different superposed webs angularly disposed and with the preponderant fiber direction of at least one of said webs disposed transversely of the strip within 45° of a line extending directly across the strip, said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

5. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long fibers, the fibers of said webs being arranged in thin striated web form in a preponderant fiber direction and said webs being in superposed juxtaposition with the preponderant direction of fibers in juxtaposed webs angularly disposed and with the preponderant fiber direction of at least one of said webs disposed transversely of the strip within 45° of a line extending directly across the strip, said webs and the fibers of said webs being bonded together to form an integral composite stay strip and said stay strip carrying on at least one surface thereof a thermoplastic adhesive activatable by heat to impart stickiness thereto to bond said stay strip to the surface of an article.

6. A stay strip according to claim 5 wherein the fibers at the inner portion of the stay strip are bonded by a thermoplastic binder having a higher softening point than the softening point of the thermoplastic adhesive for bonding the stay strip to the surface of an article.

7. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of superposed webs of unspun long fibers, the individual webs being of thin striated web-like form wherein the fiber weight is about 100 to about 400 grains per square yard and a major proportion of the fibers are substantially straight and disposed approximately in one direction in individual webs, the major proportion of said unspun long fibers contained in said stay strip being contained in webs wherein the preponderant fiber direction is transverse of said stay strip within about 30° of a line extending directly across the stay strip, and said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

8. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun fibers including 60% of fibers at least

¾ inch in length, a major proportion of the fibers including at least 70% of the fibers over ¾ inch in length being substantially straight and arranged approximately in one direction in individual thin striated webs, subtsantially all of said fibers that extend transversely of the stay strip being in webs disposed so as to have the preponderant fiber direction thereof on opposite sides of the cross-sectional dimension and within about 3 to 15° thereof, and said webs and said fibers being bonded together to form an integral composite stay strip.

9. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of webs of unspun long cotton fibers, a major proportion of the fibers of each web being substantially straight and arranged in thin striated web form approximately in one direction and the major proportion of the total amount of fibers in all of said webs being in webs the preponderant fiber direction of which is disposed transversely of said stay strip within 45° of a line extending directly across the strip, said webs and fibers of said webs being integrally bonded together and the weight of fiber in each of said webs being about 100 to 400 grains per square yard and the total weight of the fiber in all of said webs being about 800 to about 2200 grains per square yard.

10. A stay strip according to claim 9 wherein the weight of any binder for said long unspun cotton fibers in said stay strip is not more than 50% of the weight of the said fiber of said stay strip and said stay strip has a strength transverse of the stay strip of at least 30 pounds per inch.

11. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of superposed webs of unspun long fibers, the fibers in individual webs being arranged in thin striated web-like form with a major proportion of the fibers substantially straight and disposed in approximately one direction, the preponderant fiber direction of some of said webs being substantially directly across the stay strip and the preponderant fiber direction of others of said webs being substantially parallel to the longitudinal axis of said stay strip, there being at least about four superposed webs at any one point and said webs and the fibers of said webs being bonded together to form an integral composite stay strip.

12. A stay strip in the form of a ribbon-like strip, said strip comprising a plurality of superposed webs of long fibers, the fibers in the individual webs being arranged in thin striated web-like form and in a preponderant fiber direction, said webs and the fibers therein being bonded together in an integral composite stay-strip containing not over 50% of binder material on the weight of the fiber, said stay strip containing at least one web wherein the preponderant fiber direction is transverse of the stay strip within 45° of a line extending directly across the stay strip, and said stay strip having a tensile strength transversely of the stay strip of at least 10 pounds per inch for each 100 grains of fiber per square yard.

JOSEPH GOLDMAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,315,851. April 6, 1943.

JOSEPH GOLDMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 9, for "if" read --of--; page 4, first column, line 58, for "examplification" read --exemplification--; line 59, for "butuminous" read --bituminous--; and second column, line 9, for "23" second occurrence, read --25--; line 10, for "25" read --23--; line 56, for "examplification" read --exemplification--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of January, A. D. 1944.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)