Dec. 8, 1925. 1,565,008

C. H. HOWARD

MACHINE FOR APPLYING REENFORCING FILAMENTS TO FABRICS

Original Filed Aug. 23, 1919 3 Sheets-Sheet 1

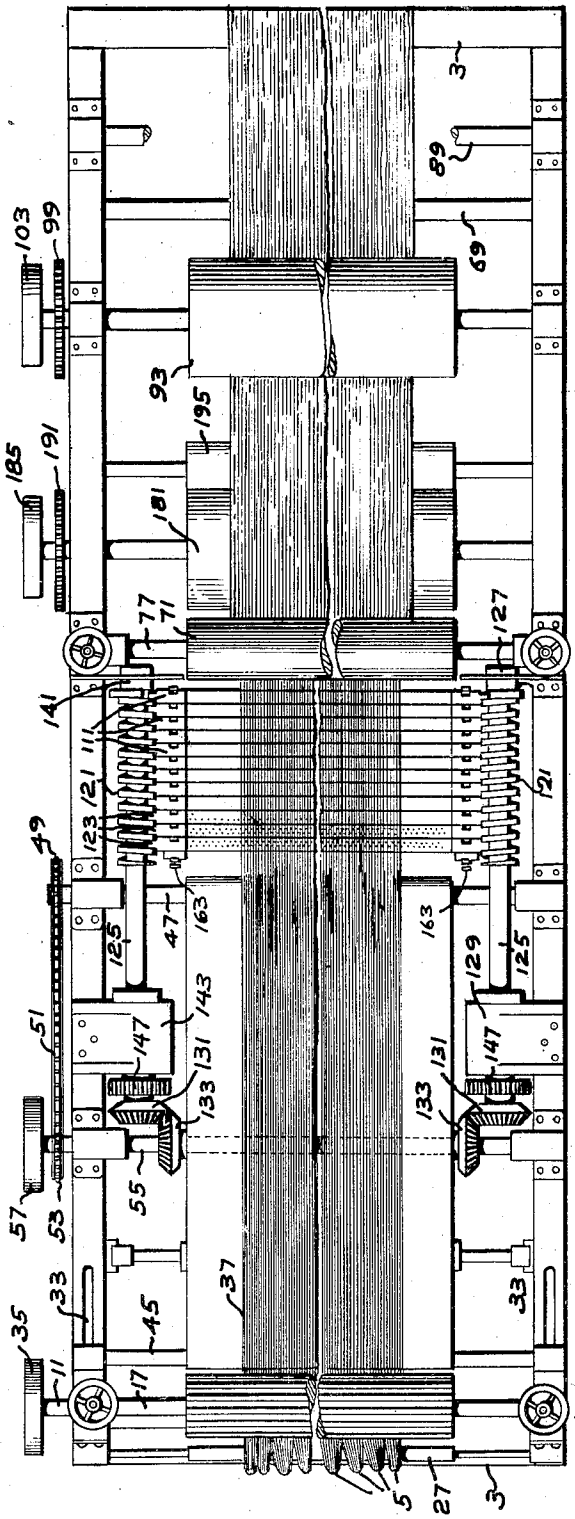


Fig. 1

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Original Filed Aug. 23, 1919 3 Sheets-Sheet 2

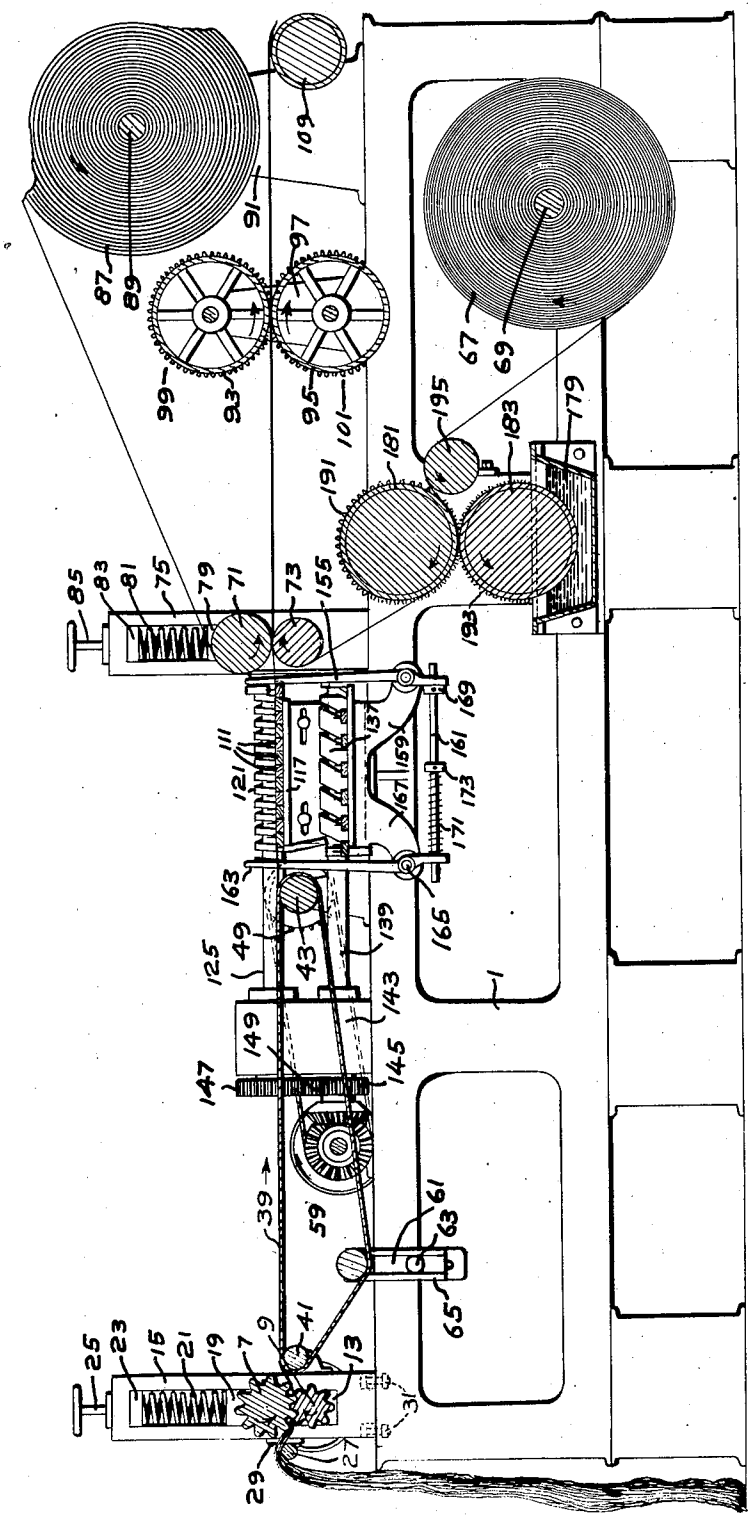


Fig. 2

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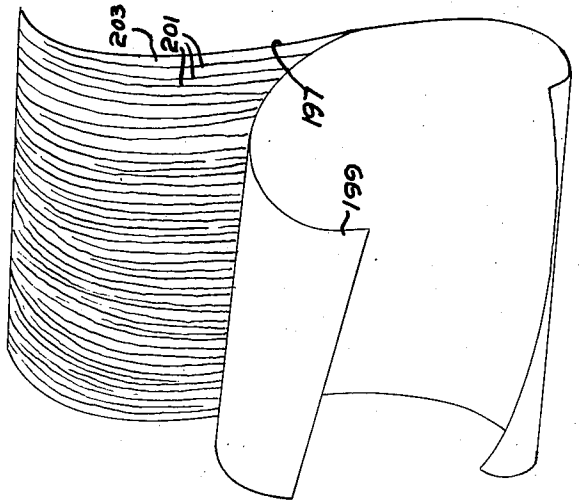


Fig. 4

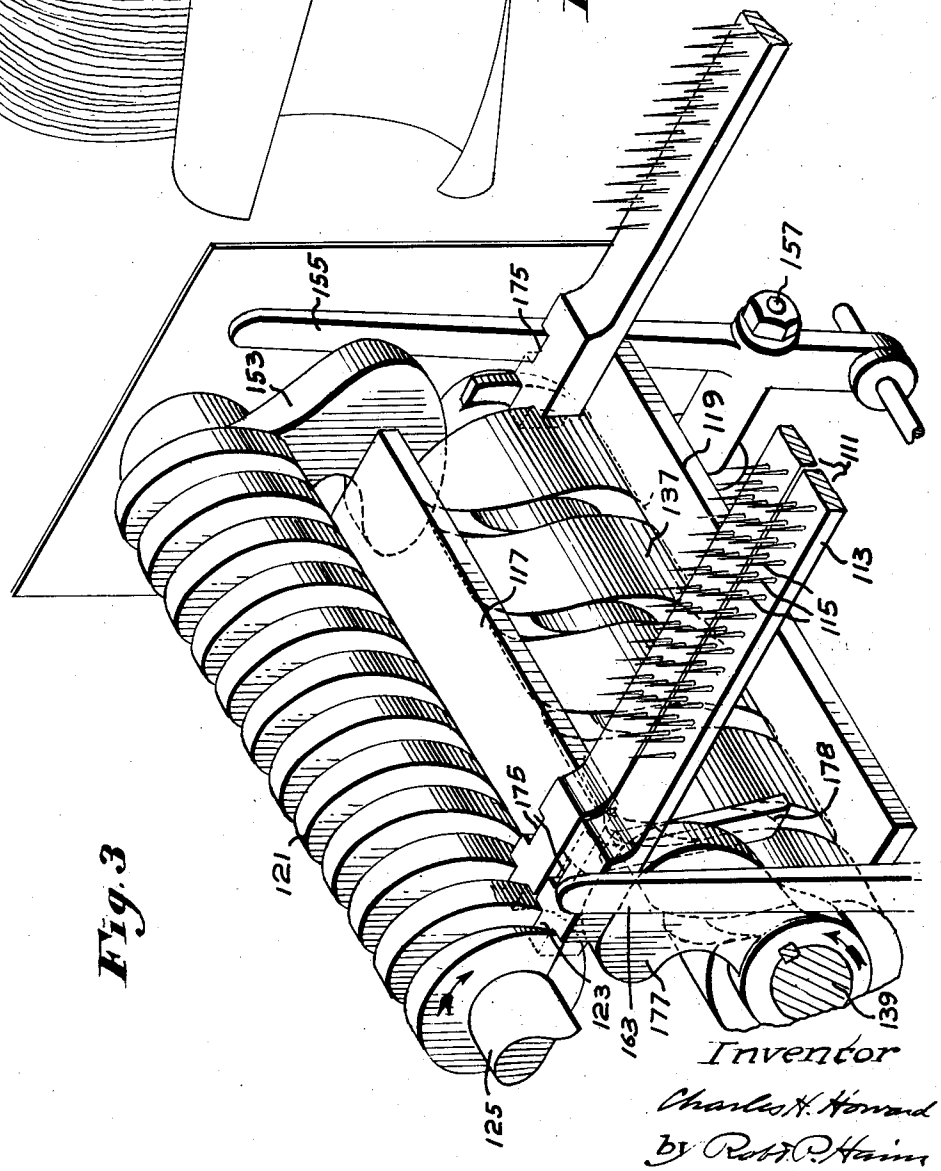


Fig. 3

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1,565,008

UNITED STATES PATENT OFFICE.

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MACHINE FOR APPLYING REENFORCING FILAMENTS TO FABRICS.

Application filed August 23, 1919, Serial No. 319,353. Renewed July 13, 1923.

To all whom it may concern:

Be it known that I, CHARLES H. HOWARD, a citizen of the United States, residing at Saugus, in the county of Essex and State of Massachusetts, have invented an Improvement in Machines for Applying Reenforcing Filaments to Fabrics, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

The invention to be hereinafter described relates to machines for reenforcing fabrics by applying reenforcing filaments thereto, and more particularly to machines for adhesively securing reenforcing filaments to paper fabrics.

The reenforcing filaments may be of any desired character which will impart the necessary or desired strength to the paper fabric when combined therewith, but isasmuch as unspun fibres, such for instance as hemp, sisal, flax, ramie, and the like, possess certain advantages over other forms of reenforcing filaments such as cords, threads, and the like, the machine of the present invention will be described in connection with the application of unspun fibres to the paper fabric, it being understood that the invention is not necessarily restricted thereto, but that the invention may be used to apply other forms of reenforcing filaments to the fabric.

The unspun fibres are usually prepared in roving or sliver form. That is, the fibres are reclaimed from the woody material or other foreign substance which naturally adheres to them, and are then formed into long untwisted ropings, rovings or slivers.

One of the problems presented in applying the fibres of rovings to the fabric to be reenforced, is the difficulty experienced in laying the fibres in an economically thin sheet, and in parallel relation on the fabric to be reenforced. It has been found, however, that by feeding rovings or moving them from a source of suppy and then distributing them in sheet form, the fibres, especially of long staple, may be adhesively secured to the surface of the fabric in substantially parallel relation longitudinally thereof. To insure that the fibres or roving shall be distributed with substantial equality throughout the width of the fabric or paper to be reenforced, the fibres of the rovings are flattened or made into a sheet-like form, and then the sheet of fibres is attenuated and the fibres adhesively secured to the surface of the fabric or paper in substantial parallelism, and in many cases, while they are under longitudinal pull or tension.

An important feature of the present invention, therefore, consists of means for feeding rovings for application to a fabric to be reenforced, and applying the unspun fibres in an attenuated sheet form to the surface of the fabric or paper.

In carrying this feature of the invention into effect, the rovings in the present invention are fed by feeding means and spread out or distributed into sheet form between the feeding means and the point of application to the fabric, and either at or before the time of its application to the fabric, the sheet of fibres is drawn out or attenuated. It has been found in practice that the attenuation of the sheet of unspun fibres may be effectively accomplished by running the paper-feeding means at a higher rate of speed than the rate of delivery of the fibres to the fabric, the consequence being that the ends of the fibres which are grasped by the adhesive surface of the paper as they are fed toward it, will be pulled by the adhesive surface of the paper lengthwise and drawn out or pulled from the associated fibres which have not yet reached the adhesive surface of the paper, the consequence being that the sheet of fibres will be attenuated and the fibres themselves will be laid in substantial parallelism longitudinally of the fabric or paper to be reenforced.

In reenforcing fabrics by unspun fibres it is desirable that the reenforcing unspun fibres be applied under lengthwise tension so that a force tending to tear or rupture the fabric will be resisted by the taut or tensioned fibres.

Another important feature of the present invention, therefore, consists of means for applying the reenforcing unspun fibre to the fabric or paper under lengthwise ten-

sion. This is accomplished by exerting a holding or retarding force upon the unspun fibres as they are drawn forward by and applied to the moving fabric or paper.

It has been found advisable, though not always essential in practice, to draw out or partially attenuate the sheet of fibres before the sheet is presented to the fabric or paper to be reenforced; and to then exert a retarding or holding force upon the fibres to tension them as they are drawn forwardly from the associated fibres by the paper to which they are adhesively secured. An effective means to this end has found its response in a combing device which is preferably placed between the feeding means for the rovings, and the point of delivery of the fibres to the adhesive surface of the paper. It may be desirable to move the comb somewhat faster than the feed rolls, and to move the paper-feeding rolls at a higher rate of speed than the comb, the consequence being that the sheet of fibres will be attenuated and a substantially uniform parallelism of the fibres be secured as they are adhesively placed upon the fabric or paper.

In some instances the reenforcing fibers may be applied to a single sheet of paper or fabric, and in some instances it may be applied between two sheets of paper or fabric either of the same or different thickness or body. The latter is a desirable product, since both the adhesive and the reenforcing fibers are enclosed between the sheets of paper or fabric and protected from contact with articles to which the material may be applied.

Unspun fibers such as described above tend to kink and curl up, and heretofore it has been a problem to so control the fibers as to maintain the same in general parallel relation while being fed longitudinally to the fabric to be reenforced. By the present invention, however, a simple and efficient machine is provided which will feed a sheet of unspun fibers to the fabric to be reenforced, and will apply the fibers thereto under lengthwise tension.

The character of the invention will be best understood by reference to the following description of one good form thereof, shown in the accompanying drawings, wherein:

Fig. 1 is a plan of a machine shown herein as embodying the invention;

Fig. 2 is a vertical longitudinal section through the machine;

Fig. 3 on an enlarged scale is a perspective view of a portion of the comb mechanism for feeding the fibers from the endless carrier to the fabric to be reenforced; and

Fig. 4 is a perspective view of a fabric which may be produced by the machine, one of the sheets of the fabric being pulled back from the other sheet to disclose the reenforcing fibers between the sheets.

The machine shown in the drawings presents a good practical form of the invention, and while it is especially adapted for the treatment of unspun fibres and their application to the paper layer or layers, and will hereinafter be described in that connection, it will be understood of course, that it is not limited thereto. The machine frame comprises the members 1 which are held in spaced relation by the transverse pieces 3.

The unspun fibers may be presented to the machine in the form of rovings 5, and suitable means may be provided for receiving these rovings and for feeding the same into the machine. This means, in the present instance of the invention, comprises a pair of upper and lower drawing rolls 7 and 9 having flutes extending longitudinally thereof. The lower drawing roll 9 has a shaft 11 journalled in boxes 13 mounted on the bottoms of guideways in uprights 15 mounted on the side frames of the machines. The upper roll 7 has a shaft 17 journalled in bearings in boxes 19 slidably mounted in the guideways of said uprights and urged downward by coil springs 21 confined between said boxes and the upper ends of said guideways. The tension of the coil springs may be varied by adjustment of followers 23 under the control of hand screws 25. To guide the rovings to the drawing rolls, a smaller roller 27 may be provided adjacent said drawing rolls and mounted in bearings in brackets 29 secured to said uprights.

It is desirable that the uprights may be adjusted longitudinally of the machine to conform to adjustment of an endless carrier to be described. To accomplish this, the lower ends of the uprights may be secured to the side frames of the machine by bolts 31 adapted to slide in longitudinal slots 33 in the tops of said side frames.

The fluted drawing rolls constitute efficient means for feeding the fibers into the machine, since the overlapping flutes of the rolls grip the fibers and insure positive feeding thereof into the machine. The fluted rolls may be driven by any suitable means. In the present instance, the shaft 11 for the lower roll has a pulley 35 fast thereon adapted to be driven by a belt from any suitable source of power. The upper roll will be driven from the lower roll by means of the overlapping flutes of the rolls. The rovings fed into the machine by the fluted rolls will be desirably spread out and flattened to the form of a sheet of fibers 37.

In reenforcing a paper layer or paper layers by filaments adhesively secured thereto, the desired character of product dictates that the reenforcing filaments whether of spun or unspun fibres shall be distributed over the surface of the paper in a substan-

tially single strata or layer, the effect being that the paper fabric is desirably strengthened without, at the same time, materially increasing the thickness or forming ridges in the finished fabric, or involving unnecessary waste of the reenforcing elements. The sheet of reenforcing fibres delivered by the feed or drawing rolls 7 and 9, is ordinarily too bulky and thick for direct application to the paper, and the present invention, therefore, provides for thinning, drawing out, or attenuating the sheet of fibres between the feeding rolls and the point where the fibres are delivered to the paper, and for causing the sticky or adhesive substance on the paper to further draw out or pull the individual fibres from the sheet as the sheet is advanced toward the point of delivery. The effect of this is that the reenforcing filaments are placed upon the adhesive surface of the paper in substantially a single layer with the fibres straightened and laid substantially parallel, and under some degree of lengthwise tension.

In some cases it may be desirable to interpose a feeding device between the rolls 7 and 9 and the drawing or attenuating means for thinning the sheet of fibres before it reaches the point of application to the paper, but this is not always essential so long as the fibres are relieved from the nip or bite of the rolls 7 and 9 when they pass into control of the attenuating or thinning means.

This feeding means, in the present instance, is in the form of an endless carrier or apron 39 guided by end rolls 41 and 43 on shafts 45 and 47, respectively. The shaft 45 is mounted on the uprights 15 and the shaft 47 is mounted in bearings on the side frames of the machine. It is desirable that the upper horizontal run of the apron shall be substantially equal to or not less than the length of the longest fibers fed into the machine and that the length of said run may vary according to different lengths of fibers. To this end the apron guide roll 41 may be adjusted toward or from the companion roll 43 with the uprights 15 and the fluted rolls carried thereby. The shaft 47 may be driven by a sprocket wheel 49 fast thereon and connected by a sprocket chain 51 with a sprocket wheel 53 fast on a shaft 55 journalled in bearings in the side frames of the machine. The shaft 55 has a pulley 57 fast on one end thereof adapted to be driven by a belt from any suitable source of power. When a feeding device, such as the endless carrier or apron 39 is employed, the supporting portion of the carrier or apron is preferably held taut, and as a convenient means to this end a tension roller 59 may be provided journalled in bearings in slides 61 adapted to be adjustably secured by bolts 63 in vertical guideways 65 mounted on the side frames of the machine.

The paper to be reenforced is furnished from a source of supply and fed through the machine by a train of mechanism which includes an element that presents the adhesive surface of the paper to the oncoming reenforcing filaments. In the present instance, a roll of paper or fabric 67 is shown on a supply roller 69 mounted in bearings on the side frames of the machine, and is conducted to and between upper and lower rolls 71 and 73. The lower roll 73 has a shaft journalled in bearings in uprights 75 mounted on the side frames of the machine and the upper roll has a shaft 77 journalled in bearings in boxes 79 adjustably mounted in guideways in said uprights and urged downward by coil springs 81 confined between the boxes 79 and followers 83 adapted to be adjusted by hand screws 85 to vary the tension of said springs.

In some cases it may be desirable to secure the reenforcing elements between paper layers, in which case an additional paper layer is furnished from a supply and passes between the rolls 71 and 73 where the reenforcing elements have their ends applied to the adhesive surface on one of the paper layers and are then drawn between the two paper layers and the rotating rolls, the effect being that the reenforcing elements whose ends engage the adhesive are pulled lengthwise individually, straightened, and laid between the paper layers under a degree of lengthwise tension. In the present instance, a second roll of paper or fabric 87 is shown on a supply roll 89 mounted in bearings on uprights 91 on the side frames of the machine. The paper or fabric is led from the supply roll over the upper roll 71 and between the upper and lower rolls 71 and 73. The two sheets of paper or fabric are fed thence toward the delivery end of the machine, and as shown in the present instance of the invention are fed by a pair of upper and lower calender rolls 93 and 95 journalled in bearings in uprights 97 mounted on the side frames of the machine. Fast on the shafts for the calender rolls are intermeshing gears 99 and 101 to rotate the upper roll shaft from the lower roll shaft. The latter has a pulley 103 fast thereon driven by a belt from any suitable source of power. The upper and lower rolls 71 and 73 may be rotated from the calender rolls. The reenforced paper fabric may be fed from the calender rolls over a roll 109 journalled in bearings in the uprights 91 at the delivery end of the machine.

As hereinbefore noted, one of the important features of the present invention consists in drawing out or attenuating the heavy sheet of fibres 37 and presenting the

ends of the fibres in the advancing attenuated sheet to the adhesive surface of the paper, which thereupon pulls the fibres lengthwise from the sheet, and insures parallel disposition of a single or thin layer of fibres on the paper to be reenforced. This feature of the invention is carried into practical effect, in the present instance by a combing device which engages the sheet of fibres delivered by the feeding rolls 7 and 9, and draws it out in the direction of the length of the fibres or attenuates the sheet and then delivers the leading ends of the fibres of the now attenuated sheet to the action of the rolls 71 and 73, and the adhesive surface of the traveling paper. This means, in the present instance, comprises a series of combs 111 extending transversely of the machine and each comprising a back or bar 113 having a multiplicity of teeth 115 projecting therefrom and preferably tapered to sharp points. The ends of the combs are adapted to rest on and be fed along upper and lower tracks 117 and 119 mounted on the side frames of the machine, the upper tracks being substantially on the same level as the upper horizontal run of the endless carrier 39, and the lower tracks being located a short distance beneath the upper tracks. The combing device may take various forms, but when it is composed of a series of separate bars each having comb teeth, it lends itself readily to movements which insure the fibres being engaged and disengaged by the teeth, and is consequently a preferred, though not a necessary, form of combing device. The bars of the combing device are given a movement toward the point of delivery of the fibres to the paper and travel at a speed in timed relation with the feeding rolls or feeding apron 39, such that the thick sheet of fibres 37 becomes thinned and attenuated as it is advanced. The leading comb bars successively withdraw from the attenuated fibres after the leading ends have been engaged by the adhesive surface of the paper and the fibres individually pulled lengthwise by the faster-traveling paper. The bars then successively drop to the lower track, where they are returned to initial position and raised to again engage the sheet of fibres. The actuating means for the comb bars, in the present instance, comprises a pair of screws 121 adapted to receive reduced ends 123 of the comb bars, said screws being mounted on shafts 125 extending longitudinally of the machine and journalled in bearings 127 and 129 mounted on the side frames of the machine. At the ends of the shafts 125 are beveled gears 131 meshing with and driven by bevel gears 133 on the shaft 55.

To feed the combs back along the lower tracks 119, a pair of screws 137 may be provided having a pitch substantially steeper than the pitch of the screws 121, in order that the combs on reaching the lower tracks may be quickly returned toward the endless carrier 39. The screws 137 are mounted on shafts 139 journalled in bearings 141 and 143 mounted on the side frames of the machine. Gears 145 on the shafts 139 are driven from gears 147 on the upper screw shaft 125 through intermediate gears 149 on stub shafts journalled in bearings between the upper and lower bearings 129 and 143.

As the combs or comb bars successively arrive at the terminal of their travel on the upper track or path, they are transferred to the lower track. In the present instance the upper screw shafts 125 are provided with cams 153 fast thereon adapted to engage the ends of the combs after they have passed the ends of the upper tracks, and to force the combs downward to the lower tracks. To guide the combs in their drop or transfer from the upper to the lower tracks, a pair of upstanding arms 155 may be provided fulcrumed between their ends on stub shafts 157 carried by brackets 159 mounted on the side frames. The lower ends of the arms are connected by rods 161 projecting loosely through the lower ends of said arms and the lower ends of a pair of arms 163 fulcrumed on stub shafts 165 carried by brackets 167 mounted on the side frames. Collars 169 are mounted fast on said rods and engage the lower ends of the arms 155. Coil springs 171 encircle said rods and are confined between collars 173 fast on said rods and the lower ends of the arms 163. The construction is such that the springs tend to rock the pair of arms 155 and the pair of arms 163 toward each other. Each of the comb bars has grooves 175 therein of a width sufficient to receive the arms 155.

When the combs have been fed by the upper screws along the upper tracks away from the endless carrier 39 and toward the rolls 71 and 73, they will finally reach the ends of said tracks. Thereupon said combs will engage the arms 155 and be limited thereby. After the combs are fed beyond their tracks, they will drop to the lower tracks, assisted by the cams 153. In dropping they will slide along the arms 155, and the coil springs 171 acting on the latter will press the combs toward the left of Fig. 3 so that the ends thereof will be caught by the threads of the lower feed screws 137. The latter will then quickly return the combs along the lower tracks back toward the endless carrier.

The combs are transferred from the lower track to the upper track by lifting means which in the present instance, comprises cams 177 fast on the screw shafts 139. On

arrival of the combs at the ends of the lower tracks, the cams 177 will come up beneath the ends thereof and elevate the same to the upper tracks. The arms 163 referred to, will limit the return movement of the combs along the lower tracks. Rails 178 depending from the upper tracks will be engaged by the comb grooves 175 and will guide the same in their upward movements. The arms 163 will press the combs toward the right of Fig. 3, and insure that the ends thereof shall be caught by the threads of the upper screws.

Thus, the combs are progressively fed along the upper tracks, dropped, returned along the lower tracks, and lifted to the upper tracks. The combs travel close together along the upper tracks and in effect constitute a carrier of substantial length having a multiplicity of pointed teeth rising therefrom. These teeth on elevation of the combs are thrust up through the sheet of unspun fibres delivered by the endless carrier and hold the fibres in their general parallel relation, and convey the same from the endless carrier to the upper and lower rolls 71 and 73. The effect of the comb and its rate of travel with relation to the feed of the fibrous sheet is to draw out or attenuate the sheet and finally present the leading ends of the fibres to the adhesive surface of the faster-traveling paper, whereupon they are drawn length-wise through the teeth of the combs and then into the nip of the rolls about which the paper is passed.

One of the paper layers is supplied with an adhesive which serves to not only draw or pull the fibres from the combs when the ends of the fibres engage the adhesive, but also to secure the fibres to the paper layer, and where more than one layer of paper is employed, as instanced in the illustrated machine, to additionally secure the paper layers together. Black asphaltum is preferably employed as the adhesive because it also possesses the quality of rendering the reenforced fabric waterproof. It may be applied to one of the paper layers while hot. As best indicated in Fig. 4, a trough 179 is supported by the machine frame, and a pair of rolls 181 and 183 having shafts journalled in bearings in the machine frame. The upper shaft may have a pulley 185 fast thereon driven by a belt from any suitable source of power. To rotate the lower roll 183 from the upper roll 181, their shafts may have intermeshing gears 191 and 193 fast thereon. Adjacent the rolls 181 and 183 is a guide roll 195 on a shaft journalled in bearings carried by the side frames of the machine.

The construction is such that the paper or fabric may be led from the supply roll 69 over the guide roll 195, and thence between the rolls 181 and 183 and thence to the rolls 71 and 73 referred to. The roll 183 which rotates in the adhesive in the trough 179, will apply the adhesive to the paper or fabric. The fibers delivered by the carrier combs to the rolls 71 and 73, will be caught by the adhesive and will be pressed by the upper roll 71 into the adhesive layer on the paper or fabric.

It is desirable that the fibres shall be drawn with a draft such that the fibres shall be in substantially parallel relation and in substantially straight condition when they are applied to the fabric to be reenforced. To this end the apron or carrier may be driven faster than the fluted rolls 7 and 9, the comb carrier in its upper horizontal run may be fed faster than the apron or carrier, and the calender rolls may be rotated to feed the paper or fabric considerably faster than the feed of the comb carrier. It will be understood, however, that the relative speeds of the rolls and carriers may be varied according to conditions as required, but the construction and relative speeds are such that the fibres are drawn, brushed or combed so that on arrival thereof at the material to be reenforced they are in a general parallel relation, and when the leading ends of the fibres are caught by the adhesive coating of the paper or fabric and between the rolls 71 and 73, their speed of feed is materially increased and they are drawn between the teeth of the combs and combed, brushed and straightened thereby, thus resulting in their application to the fabrics in substantially straight condition. The draft of the fibres as described may also result in attenuation thereof to a thin sheet of proper thickness to afford the desired reenforcement of and strengthening effect on the fabric, and in some instances the sheet of fibres may be of a thickness substantially equal to one of the fibres.

While the machine has been described more particularly with reference to unspun fibres, it will be understood that it is not limited in use thereto, but spun fibres and other filaments may be used by the machine in reenforcing fabrics if desired.

Referring to Fig. 4, the product there shown produced by the machine, comprises a sheet of paper 197, a sheet of paper 199 and unspun fibres 201 secured to the sheets of paper by a waterproof adhesive layer 203 of black asphaltum.

By my invention, a simple and efficient machine is provided for taking unspun fibers or other filaments, spreading them into a sheet, and applying the sheet in adhesive engagement with a sheet or sheets of paper or other fabric. The machine is capable of high speed, requires little attention on the part of the operator, and has a large capacity.

It will be understood that the invention is not limited to the specific embodiment shown, and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a machine for reenforcing a paper fabric, the combination of paper feeding means for feeding a paper fabric to be reenforced, means for applying an adhesive to the paper fabric, and means for advancing a sheet of reenforcing filaments at a slower rate of speed than the surface speed of the paper fabric that the individual filaments may be pulled lengthwise relative to the sheet by the adhesive surface of the paper fabric and applied thereto in attenuated condition.

2. In a machine for reenforcing a paper fabric, the combination of guides for directing a paper fabric, means for applying an adhesive to the surface of the paper fabric, means for feeding a sheet of reenforcing filaments for application to the adhesive surface of the paper fabric, and means for feeding the paper fabric at a greater speed than that of the sheet of reenforcing filaments that the individual filaments of the sheet may be drawn from the sheet and applied in attenuated condition to the adhesive surface of the paper fabric.

3. In a machine for reenforcing a paper fabric, the combination of means for forming reenforcing filaments into a sheet and presenting the filaments to the paper to be reenforced, guides for directing the paper, means for applying an adhesive to the paper sheet, means for moving the paper sheet past the point of presentation of the sheet of reenforcing filaments, and means for retarding the movement of the sheet of filaments in response to the pull of individual filaments when engaged by the adhesive surface of the paper fabric that the filaments may be drawn out and attenuated by the moving paper fabric.

4. A machine of the character described comprising, in combination, a pair of fluted rolls for receiving unspun fibres from a source of supply, an endless carrier for receiving the fibres from said fluted rolls, a comb carrier for receiving the fibres from said endless carrier, rolls for feeding a fabric for receiving the fibres from said comb carrier, and means for actuating said fluted rolls, carrier and fabric-feeding rolls at progressively increasing speeds to draw out and maintain the fibres in substantially parallel relation for presentation to said fabric.

5. In a machine for reenforcing a paper fabric, the combination of rolls for feeding the reenforcing filaments, a roll for directing the paper fabric for the application of the reenforcing filaments to an adhesive surface thereof, means for attenuating the reenforcing filaments and presenting the leading ends to the adhesive surface of the paper, and means for causing the paper to be moved faster than the reenforcing filaments that the filaments engaged by the adhesive surface of the paper may be further attenuated and laid in substantially parallel relation on the paper in a substantially single layer.

6. In a machine for reenforcing a paper fabric, the combination of means for feeding a paper fabric to be reenforced, means for drawing filaments from a source of supply and forming them into a sheet, attenuating means for thinning or attenuating the sheet and delivering the ends of the filaments to the adhesive surface of the paper, and a traveling apron between the drawing means and attenuating means for supporting a length of the sheet of reenforcing filaments equal at least to the length of the individual filaments.

7. A machine of the character described comprising, in combination, means for feeding a fabric to be reenforced by unspun fibres, means for applying an adhesive to the fabric, means for feeding a sheet of unspun fibres in substantially straight and parallel condition and presenting it to the adhesive surface of the fabric, and means for driving the fabric feeding means at a higher speed than said fibre feeding means to cause the adhesive surface of the fabric to draw the fibres and maintain the same in the aforesaid condition.

8. A machine of the character described, comprising, in combination, means for feeding a fabric having an adhesive surface to be reenforced by unspun fibres, means for feeding a sheet of substantially unspun fibres towards the fabric, means between said fibre feeding means and fabric for attenuating the unspun fibres and placing them under lengthwise tension on the fabric, and means for pressing the fibres into adhesive engagement with the adhesive surface of the fabric.

9. In a machine for reenforcing a paper strip, the combination of means for feeding a strip of paper having an adhesive surface, to be reenforced by reenforcing filaments, means for feeding a sheet of reenforcing filaments toward the paper strip, means between the filament feeding means and paper strip for attenuating the reenforcing filaments and placing them under lengthwise tension on the adhesive surface of the paper strip.

10. In a machine for reenforcing a fabric by applying reenforcing filaments to an adhesive surface thereof, the combination of means for feeding the fabric having an adhesive on one surface, means for feeding reenforcing filaments toward the adhesive surface of the fabric to be reenforced, in-

cluding a comb device for attenuating the reenforcing filaments and applying them to the adhesive surface of the fabric under lengthwise tension.

11. A machine of the character described comprising, in combination, means for feeding material to be reenforced by filaments, and means for longitudinally feeding the filaments toward the material including a pair of feeding-in rolls for the filaments, an endless carrier having means for varying the effective fibre supporting length thereof, and means to adjust said feeding-in rolls bodily to conform to the adjustment of said endless carrier.

12. In a machine for reenforcing paper fabric, the combination of guiding means for the paper fabric, means for advancing a sheet of reenforcing filaments toward the paper fabric, a device for applying an adhesive to a surface of the paper fabric, a comb device for attenuating the sheet of reenforcing filaments and applying them to the adhesive surface of the paper fabric, and means for moving the adhesive surface of the paper fabric at a higher rate of speed than that of the attenuated sheet of reenforcing filaments that the sheet of filaments may be applied to the adhesive surface of the paper in a single layer.

13. A machine of the character described comprising, in combination, means for feeding a fabric to be reenforced by filaments, means for receiving non-continuous unspun filaments from a source of supply, means for drawing out the filaments and attenuating them into a sheet of a thickness equal to the thickness of one of the filaments with the individual filaments disposed substantially parallel side by side in slightly spaced relation and delivering them to the fabric at a speed less than that of the fabric and means for adhesively securing the attenuated sheet of filaments longitudinally of the fabric.

14. In a machine for reenforcing a paper fabric, the combination of guides for directing a paper fabric having an adhesive surface, feeding means for advancing a sheet of reenforcing filaments from a source of supply toward the paper fabric including a comb device for attenuating the sheet of filaments and presenting the attenuated sheet to the adhesive surface of the paper fabric, and means for moving the paper fabric at a greater speed than the comb device, that the filaments may be laid upon the adhesive surface of the paper lengthwise thereof in a single sheet.

15. In a machine for reenforcing a paper fabric, the combination of means for feeding a paper fabric having an adhesive applied to one face thereof, means for drawing rovings of unspun fibres from a source of supply and arranging them in sheet form, means for advancing the sheet of fibres toward the paper to be reenforced and delivering the leading ends of the fibres to the adhesive surface of the paper at a speed less than the speed of the paper, including a sheet attenuating comb device for attenuating the sheet of fibres and applying it in attenuated condition to the adhesive surface of the paper fabric.

16. In a machine for reenforcing paper by the adhesive application of reenforcing filaments thereto, the combination of guides for directing a paper strip having an adhesive surface, means including a comb device for moving a sheet of reenforcing filaments toward the paper strip and presenting the leading ends of the filaments to the adhesive surface of the paper, and means for causing the paper strip to travel faster than the sheet of reenforcing filaments held by the comb device that the filaments may be drawn from the comb device by the adhesive surface of the paper strip and adhesively applied thereto in an attenuated layer.

17. In a machine for reenforcing paper by the adhesive application of reenforcing filaments thereto, the combination of guides for directing a paper strip, means for applying an adhesive asphaltum to the surface of the paper strip, means including a comb device for moving a sheet of reenforcing filaments toward the paper strip and presenting the leading ends of the filaments to the adhesive surface of the paper, and means for causing the paper strip to travel faster than the sheet of reenforcing filaments held by the comb device that the filaments may be drawn from the comb device by the adhesive surface of the paper strip and adhesively applied thereto in an attenuated layer.

18. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres for application to the paper strip, and means for attenuating the unspun fibres and placing them under lengthwise tension on the paper strip.

19. In a machine for reenforcing paper, the combination of means for feeding paper having an adhesive surface to be reenforced, means for feeding reenforcing elements for application to the paper including a comb device for attenuating the filaments and delivering them to the paper, a roll about which the paper is passed closely adjacent the ends of the filaments delivered by the comb device, and means for causing the paper and roll to move with a surface speed greater than that of the filaments on the comb to further attenuate the filaments and apply the attenuated filaments to the adhesive surface of the paper.

20. In a machine for reenforcing paper,

the combination of guides for directing two paper strips one of which has an adhesive surface, means for feeding a sheet of reenforcing filaments between the two strips of paper including a device for attenuating the sheet of filaments and delivering the ends of the filaments between the paper strips at the nip between two of the paper guides, and means for feeding the paper strips to cause the filaments to be pulled lengthwise by the combined action of the moving paper and guides for further attenuating the filaments and laying them in substantially a single layer between the paper strips.

21. In a machine for reenforcing a paper fabric, the combination of paper feeding means, means for feeding a sheet of unspun fibres at a slower speed than the paper is fed for adhesive application to the paper, means for attenuating the sheet of fibres with the fibres substantially parallel, and means for adhesively securing the fibres of the sheet to the paper in a single layer of substantially the same thickness of a single fibre and with the individual fibres spaced apart.

22. In a machine for reenforcing a paper fabric, the combination of means for feeding the paper fabric at a predetermined surface speed, means for feeding a sheet of reenforcing filaments to the paper at a slower speed and delivering them to the surface of the paper to be pulled lengthwise from the sheet and applied to the paper in a layer of substantially the same thickness as one of the filaments.

23. In a machine of the character described, the combination of means for feeding paper at a predetermined surface speed, means for feeding unspun fibres of long staple at a slower speed than the surface speed of the paper, and means for resisting the pull upon the unspun fibres by the paper as they are delivered thereto for attenuating the sheet of fibres and laying them under lengthwise tension in substantially parallel relation on the paper.

24. In a machine of the character described, the combination of means for feeding paper at a determined surface speed, means for applying an adhesive to the paper, means for feeding a sheet of unspun fibres of long staple for delivery to the paper at a slower speed than the surface speed of the paper, means for resisting the pull upon the unspun fibres by the paper as the fibres are delivered thereto for attenuating the sheet of fibres, and means for adhesively securing the fibres thereto in substantially parallel relation.

25. In a machine of the character described, the combination of means for feeding two paper strips, means for applying an adhesive to one of them, means for delivering unspun fibres between the paper strips and retarding the pull or draw on the fibres by the paper strips for laying the fibres under lengthwise tension in substantially parallel relation between the strips.

26. In a machine of the character described, the combination of a pair of rolls between which paper strips and a sheet of unspun fibres are fed, and means acting upon the sheet of unspun fibres to resist the drawing effect of the rolls on the fibres and cause the sheet of fibres to be attenuated and the fibres to be laid under a lengthwise tension in substantially parallel relation between the paper strips.

27. In a machine of the character described, the combination of a pair of rolls between which paper strips and a sheet of unspun fibres are fed, means for applying an adhesive to one of the paper strips, and means acting upon the sheet of unspun fibres to resist the drawing effect of the rolls on the fibres and cause the sheet of fibres to be attenuated into a single layer of the same thickness as a single fibre and the fibres to be laid in substantially parallel relation between the paper strips.

28. In a machine of the character described, the combination of paper feeding means, means for applying an adhesive to the paper, means for delivering long staple unspun fibre to the adhesive surface of the paper as it is being fed, comprising devices for retarding the free delivery of the fibres under the drawing action of the moving paper to attenuate the sheet of fibres and deliver the fibres in substantially parallel relation under longitudinal tension.

29. In a machine of the character described, the combination of paper feeding means, means for moving series of unspun fibres from a source of supply for application to the paper, means for distributing the fibres into substantially sheet form and attenuating the sheet and for delivering the attenuated sheet of unspun fibres to the paper in a single layer of the same thickness as one of the fibres under lengthwise tension and in longitudinal relation thereto.

30. In a machine of the character described, the combination of means for feeding a fabric to be reenforced, means for moving a series of rovings of unspun fibres from a source of supply, means for laying the fibres of the rovings into substantially sheet form and attenuating the sheet and for delivering the attenuated sheet to the fabric to be reenforced and means for applying an adhesive to the paper that it may further attenuate the fibres and secure them to the paper under lengthwise tension.

31. In a machine of the character described, the combination of means for feeding a fabric to be reenforced, means for moving a series of rovings of unspun fibres from a source of supply, means for laying

the fibres of the rovings into substantially sheet form and attenuating the sheet and for delivering the attenuated sheet of unspun fibres to the fabric at a slower rate of speed than the surface speed of the fabric to cause the sheet of fibres to be formed into a single layer and adhesively secured to the fabric.

32. In a machine of the character described, the combination of means for feeding a fabric to be reenforced, means for moving a series of rovings of unspun fibres from a source of supply, means for attenuating the rovings, and means for delivering the attenuated rovings to the fabric at a speed less than the speed of the fabric with the fibres of the rovings in substantially parallel relation.

33. In a machine of the character described, the combination of means for feeding a fabric or web lengthwise at a predetermined speed, means for feeding a sheet of fibres longitudinally at a slower speed than that of the fabric or web and delivering the fibres to the fabric or web, and means for retarding the movement of the fibres by the fabric or web to attenuate the sheet and lay the fibres on the fabric or web in parallel relation.

34. In a machine of the character described, the combination of a pair of paper feed rolls, means for applying an adhesive to one surface of a paper web passing between the rolls, a comb for delivering a sheet of fibres to the adhesive surface of the paper web at a speed less than the speed of the web for attenuating the sheet as it is delivered to the adhesive surface of the paper web.

35. In a machine of the character described, the combination of a pair of paper feed rolls, means for applying an adhesive to one surface of a paper web passing between the rolls, a comb for delivering a sheet of fibres to the adhesive surface of the paper web, and means for moving the comb at a slower rate than the paper feed that the sheet of unspun fibres may be attenuated by the pull upon the fibres as they engage the adhesive surface of the paper web.

36. In a machine for reenforcing a paper fabric, the combination of feeding rolls for feeding a paper web to be reenforced by the application of unspun fibres thereto, means for feeding a series of unspun fibre rovings toward the feeding rolls, and combs interposed between the paper feeding rolls and the roving feeding means for combing and attenuating the fibres of the rovings and for delivering the fibres to the paper web under lengthwise tension in a thin sheet of substantially the thickness of a single fibre.

37. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres for application to the paper strip, a series of combs for combing and attenuating the unspun fibres and delivering them under lengthwise tension to the paper strip, and means for introducing the comb teeth into engagement with the unspun fibres by relatively moving the combs and fibres in the direction in which the teeth of the comb extend.

38. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres for application to the paper strip, a series of combs for combing and attenuating the unspun fibres and delivering them under lengthwise tension to the paper strip, and means for removing the comb teeth from the fibres by moving the combs bodily in the direction in which the teeth extend.

39. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres towards the paper strip, a series of combs for attentuating the unspun fibres and placing them under lengthwise tension on the paper strip, means for successively lifting the combs into engagement with the unspun fibres, advancing the lifted combs towards the paper strip and then successively moving the combs downward out of engagement with the fibres, and means for maintaining the same face of the combs towards the fibres throughout the movement of the combs.

40. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres towards the paper strip, a series of independently movable combs for attenuating the unspun fibres and placing them under lengthwise tension on the paper strip, means for successively lifting the combs into engagement with the unspun fibres, means for advancing the lifted combs towards the paper strip, and means for imparting a dropping movement to the combs as they complete their advancing movement.

41. In a machine of the character described, the combination of means for feeding a paper strip to be reenforced, means for feeding unspun fibres towards the paper strip, a series of independently movable combs for attenuating the unspun fibres and placing them under lengthwise tension on the paper strip, cam means for successively lifting the combs into engagement with the unspun fibres, means for advancing the lifted combs towards the paper strip, and means for moving the combs out of engagement with the fibres as the combs complete their advancing movement.

42. In a machine of the character described, the combination of means for feeding paper having an adhesive surface, means for feeding unspun fibres of long staple at

a slower speed than the surface speed of the paper, means for resisting the pull upon the unspun fibres by the paper as they are delivered thereto for attenuating the sheet of fibres into a thin sheet of substantially the thickness of a single unspun fibre, and means for adhesively securing said thin sheet to the paper with the individual fibres in substantially parallel relation.

43. In a machine for reenforcing and strengthening paper, the combination of means for feeding a strip of paper to be reenforced and strengthened by individual unspun fibres of long staple, means for advancing unspun fibres from a source of supply, means for straightening the fibres and forming them into a layer of the thickness of a single fibre, and means for causing the individual fibres to be secured to the paper side by side in laterally separated relation to produce a strong reenforced paper of a thickness equal to that of the paper and a single fibre.

44. In a machine for reenforcing and strengthening paper fabric, the combination of means for feeding paper fabric to be reenforced and strengthened by individual unspun fibres, means for advancing unspun fibres from a source of supply, means for straightening the fibres into substantially parallel relation and forming them into a layer of the thickness of a single fibre, and means for causing the individual fibres to be adhesively secured to the paper fabric side by side in laterally spaced relation so that they are disposed at intervals over the face of the paper fabric to produce a reenforced or strengthened paper of a thickness equal to that of the paper and a single fibre.

45. In a machine for reenforcing and strengthening paper fabric, the combination of means for feeding a sheet of paper to be reenforced and strengthened by individual fibres, means for advancing unspun fibres from a source of supply, means for straightening the fibres and forming them into a layer of the thickness of a single fibre, means for presenting and adhesively securing the individual fibre to the sheet of paper side by side in laterally spaced relation to each other, and means for applying a second sheet of paper over the layer of fibres to form a two-ply sheet of paper with individual fibres adhesively secured between the sheets in laterally spaced relation.

46. In a machine for reenforcing and strengthening a paper web, the combination of means for feeding a series of unspun fibres from a source of supply, mechanism for drawing out the fibres into sheet form and in substantially parallel relation for presentation to the paper web to be reenforced having an adhesive surface, means for presenting the leading ends of individual fibres of the sheet to the adhesive surface of the paper web that such individual fibres may be secured to the paper web in laterally separated relation.

In testimony whereof, I have signed my name to this specification.

CHARLES H. HOWARD.