June 22, 1926.

1,590,167

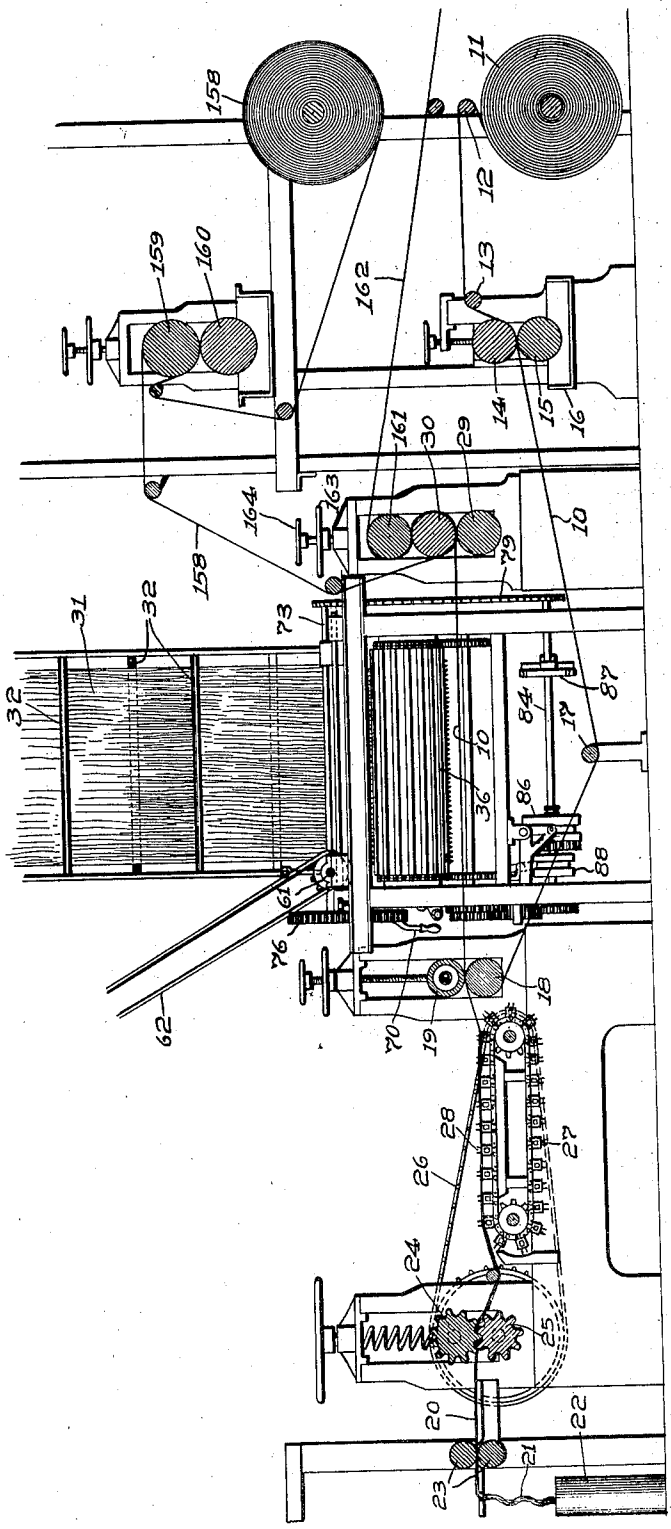
C. H. HOWARD

MACHINE FOR REENFORCING PAPER

Filed June 7, 1924

6 Sheets-Sheet 1

Fig. 1



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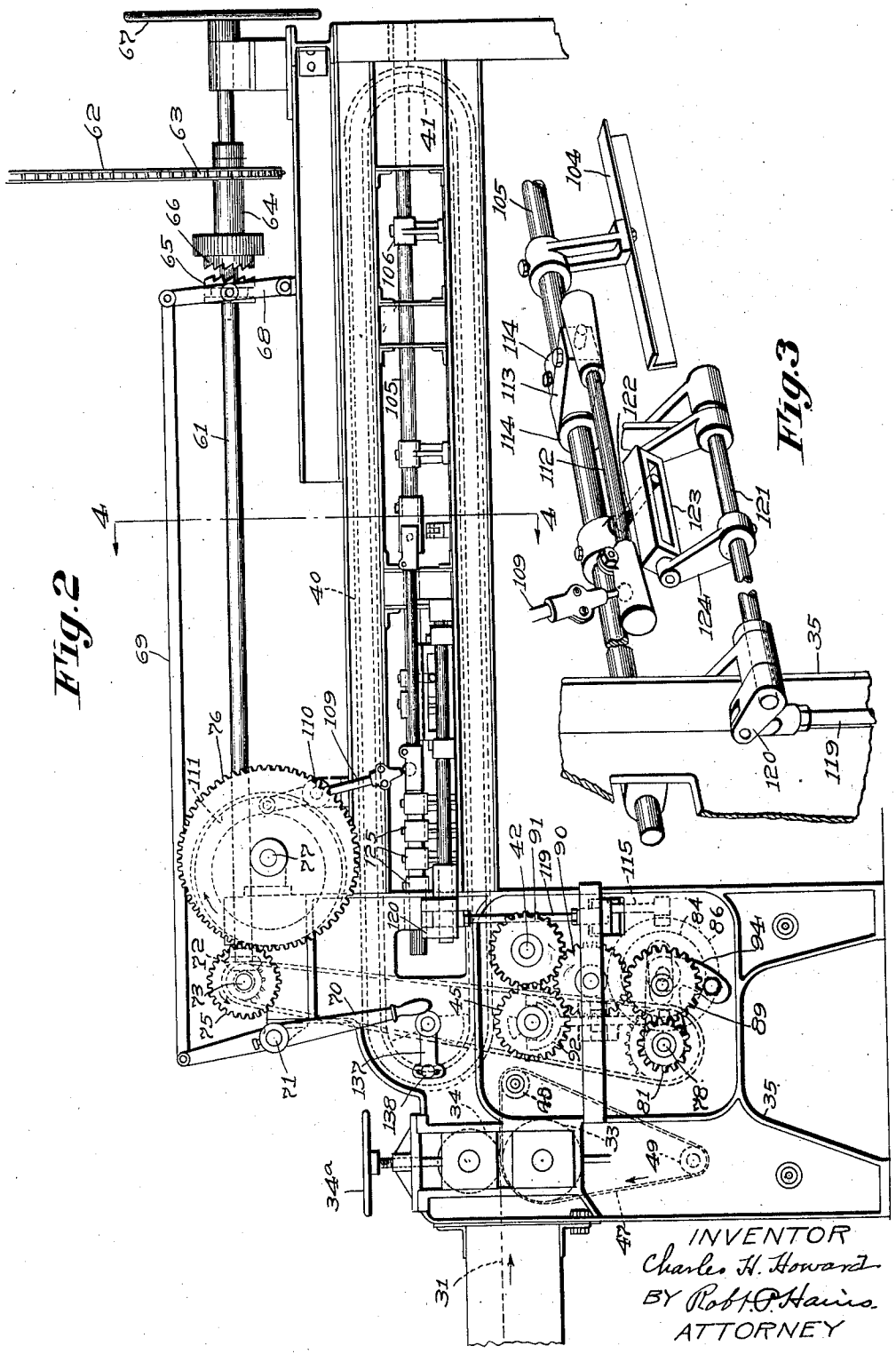

Fig. 2

Fig. 3

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Fig. 4

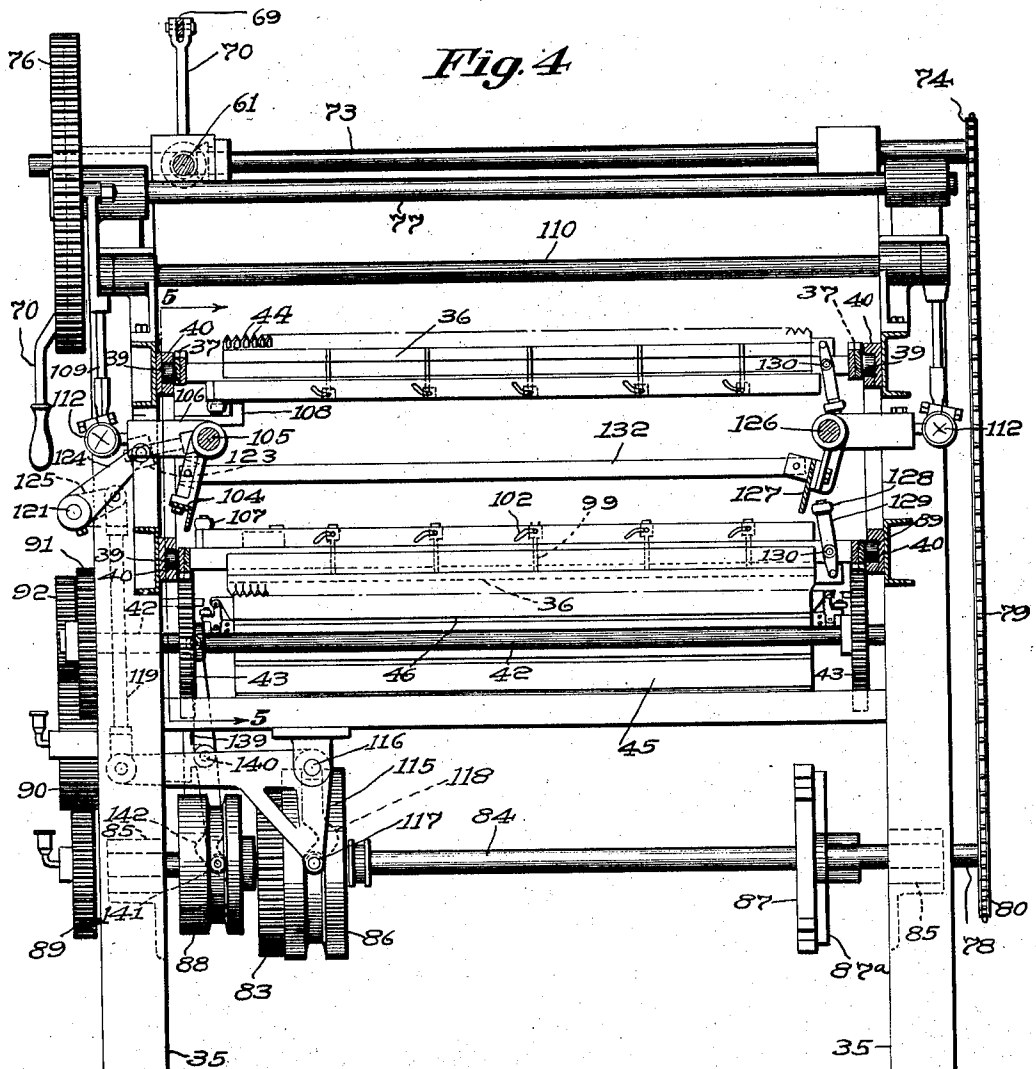
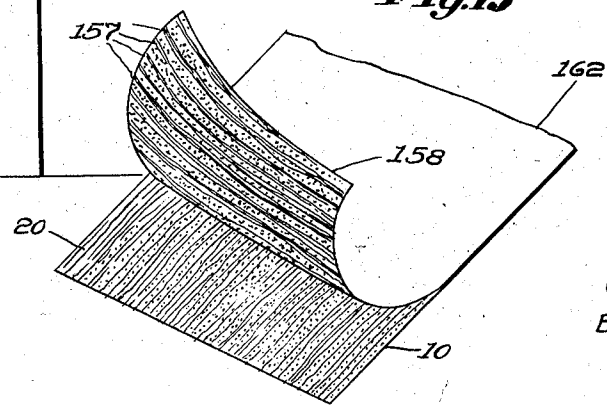


Fig. 15



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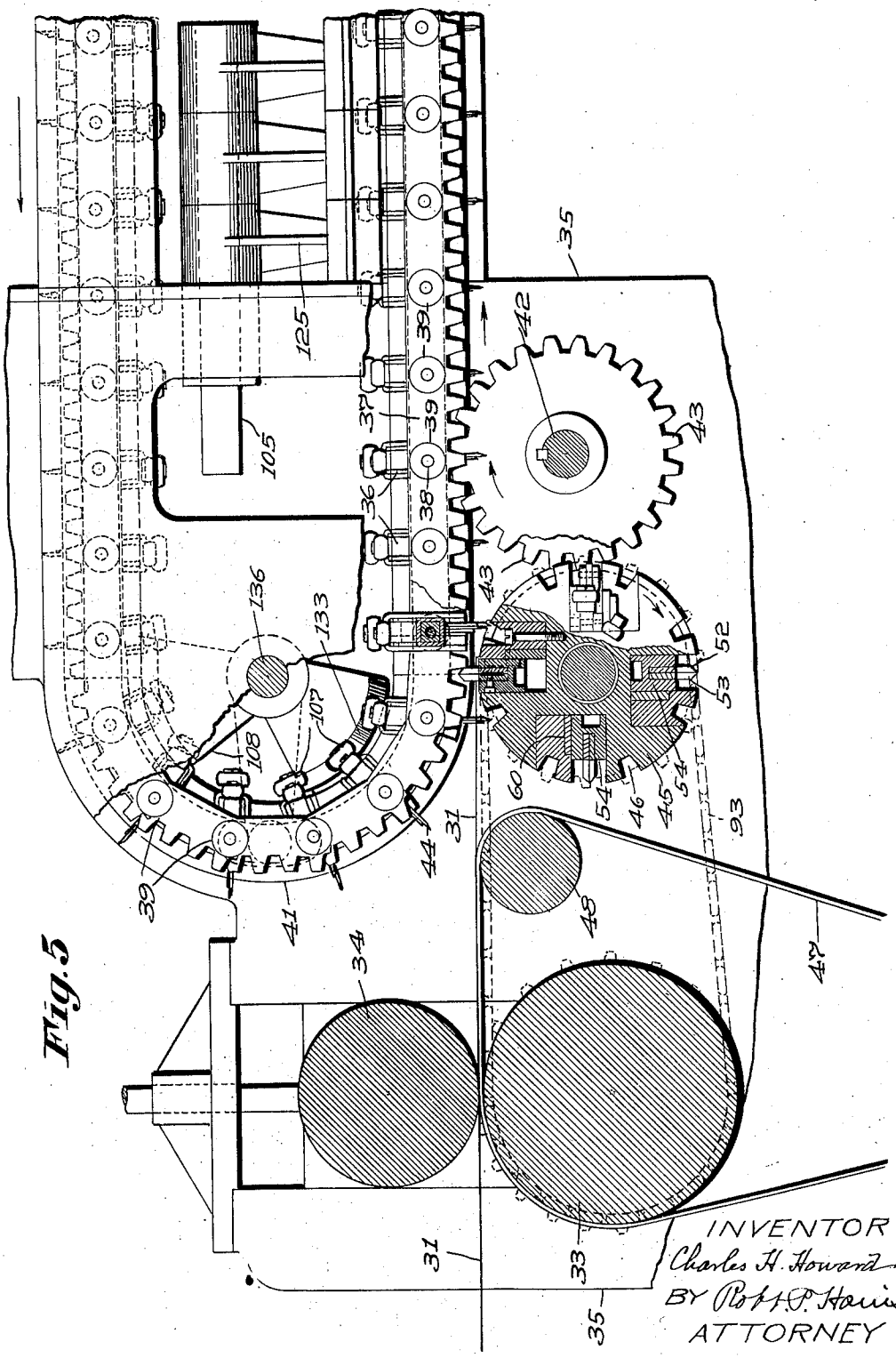

Fig. 5

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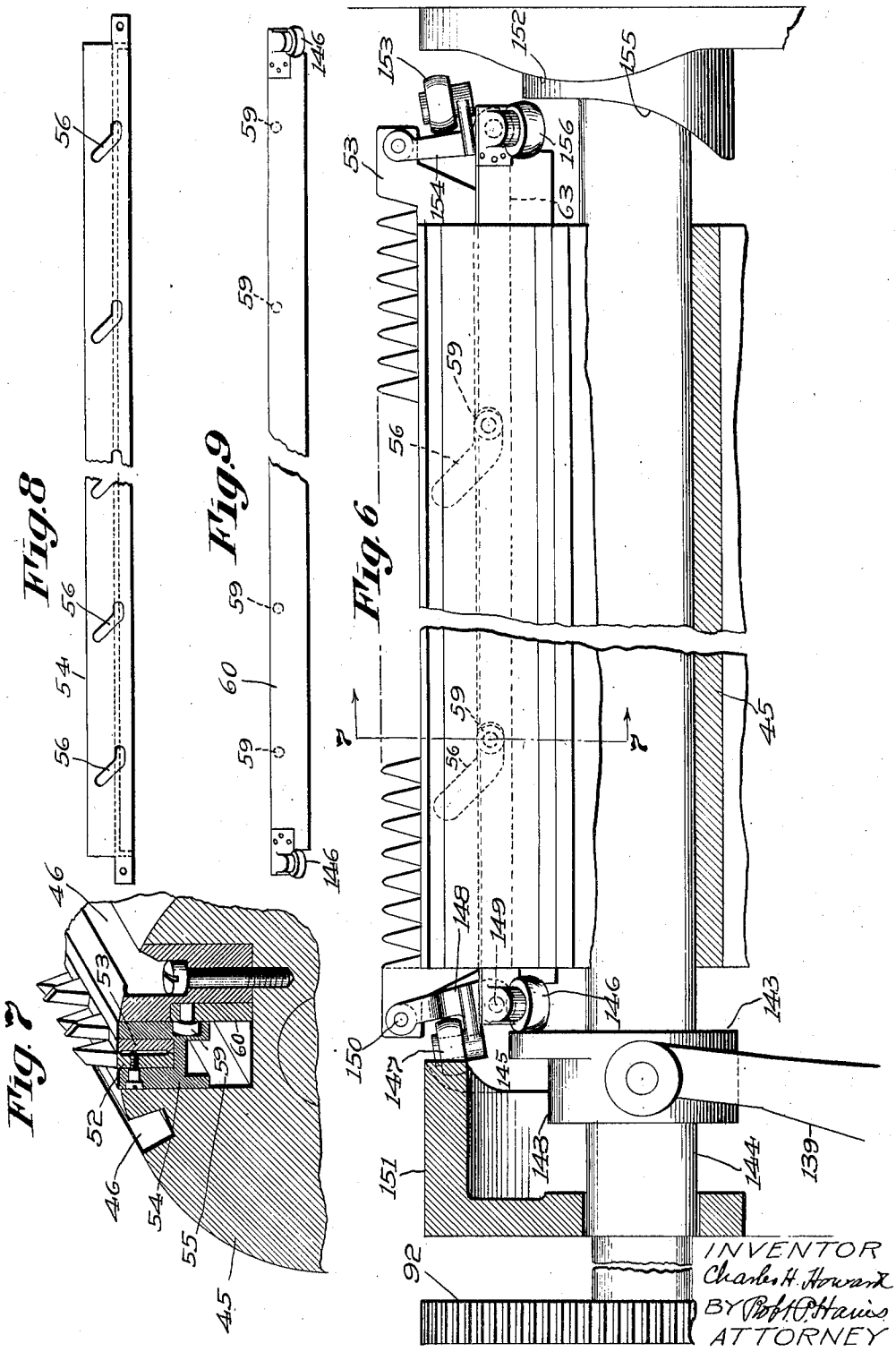

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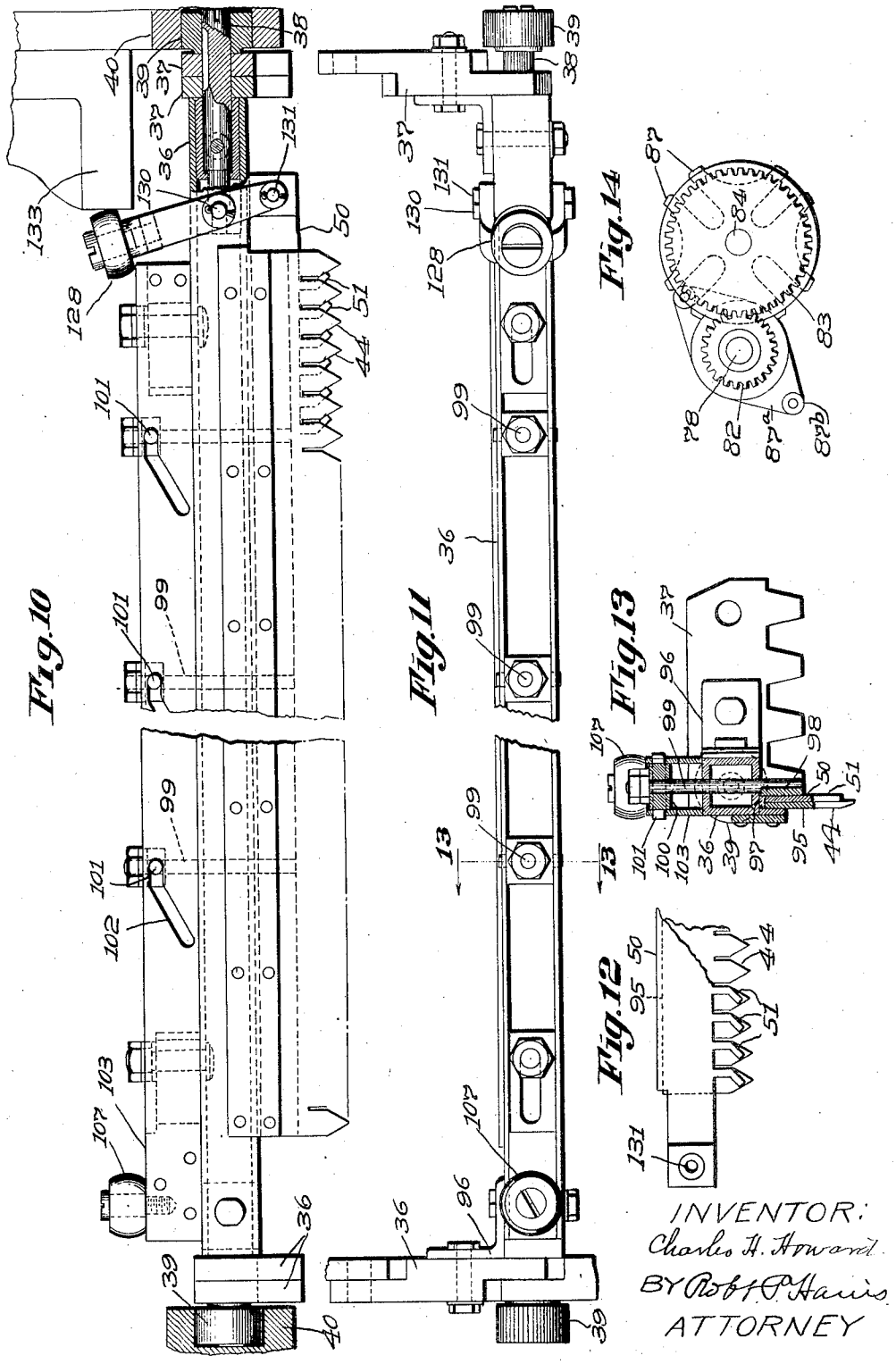

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Patented June 22, 1926. 1,590,167

UNITED STATES PATENT OFFICE.

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MACHINE FOR REENFORCING PAPER.

Application filed June 7, 1924. Serial No. 718,579.

This invention relates to machines for reenforcing fabric with filaments, and more particularly to machines for applying reenforcing filaments transversely of fabric such as paper.

Various different kinds of filaments may be used by the present machine as the transversely applied reenforcing elements, but inasmuch as unspun fibres, such for instance as hemp, sisal, flax, ramie and the like, possess certain advantages over the 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 fabric, it being understood, however, that the invention is not necessarily restricted thereto, and that the invention may be used to apply other forms of reenforcing filaments transversely of a fabric.

The present invention is particularly well adapted to apply relatively long unspun fibres transversely of a sheet of paper in a thin sheet having the fibres disposed in a straightened and approximately parallel condition and adhesively secured to the paper to increase the strength of the paper without materially increasing its weight, thickness or cost, and, although various adhesives may be employed, one which is waterproof, such as black asphaltum, is preferred.

The mechanism of the present invention is shown in position to apply the reenforcing fibres transversely of a sheet of paper that has been just previously reenforced by longitudinally extending fibres, and a second sheet of paper is preferably placed over the reenforcing fibres to form a two-ply sheet of paper that is strongly reenforced both longitudinally and transversely, and which, due to its strength and durability, forms an excellent wrapper, and is well adapted for many other purposes.

The reenforcing fibres applied longitudinally of the paper or fabric are shown as drawn from containers in the form of rovings, and these rovings are combed and drawn out into a thin sheet with the fibres disposed in substantially parallel relation and are then adhesively secured to a sheet of paper, as more fully set forth in the co-pending application, Serial No. 391,433, renewed August 14, 1923.

The fibres which are applied transversely of a sheet of paper or fabric by the present machine may likewise be supplied in the form of rovings and may be combed and attenuated by means similar to that disclosed in the application just mentioned. The present invention, however, does not concern itself with the means for forming the fibres into a sheet, and various means may be employed to this end.

The machine of the present invention is constructed to feed a sheet of reenforcing fibres transversely of a traveling sheet of fabric, and to cut the sheet of fibres transversely to form sections and then apply these sections successively to the traveling fabric. In employing unspun fibres as the reenforcing elements much difficulty is experienced in maintaining the fibres in a straightened and parallel condition after they are cut into sections and while they are being applied to the paper or fabric.

One important feature of the present invention, therefore, resides in traveling combs for applying the reenforcing fibres to the fabric transversely thereof, and having means for closing the entrances between the comb teeth to positively hold the fibres in the combs.

Another feature of the invention resides in mechanism for cutting the fibre sheet transversely between two of the combs and, while the sheet is held by a comb at each side of the cutter, to keep the fibres in place.

Another feature of the invention resides in novel means for operating the doffers for transferring the fibres from the combs to the fabric to be reenforced.

Still another feature of the invention resides in the construction by which the machine may be readily changed to reenforce paper or fabric of different widths.

Other features of the invention and novel combination of parts in addition to the above will be hereinafter described in connection with the accompanying drawings which illustrate one good, practical form thereof.

In the drawings—

Fig. 1 is a vertical, sectional view through mechanism for applying reenforcing filaments longitudinally of the fabric, the mechanism for applying the fibres transversely of the fabric being shown in end view.

Fig. 2 is a side view of a machine constructed in accordance with the present invention for applying fibres transversely of the fabric.

Fig. 3 is a perspective view of mechanism to be described for operating the doffing bars.

Fig. 4, on an enlarged scale, is a vertical sectional view taken on the line 4—4 of Fig. 2.

Fig. 5 is an enlarged sectional view, taken on the line 5—5 of Fig. 4.

Fig. 6 is a side view with parts in section, of the cutter operating drum and associated parts.

Fig. 7 is a sectional detail view, taken on the line 7—7 of Fig. 6.

Fig. 8 is a side view of an H-shaped bar that supports the cutters.

Fig. 9 is a side view of a cutter actuating bar.

Fig. 10 is a side view of one of the combs with the supporting means shown in section.

Fig. 11 is a top plan view of Fig. 10.

Fig. 12 is a side view of several of the comb teeth and of the means for positively holding the fibres between the teeth.

Fig. 13 is a sectional view taken on the line 13—13 of Fig. 11.

Fig. 14 is a side view of a Geneva gear construction employed to operate certain parts; and

Fig. 15 is a perspective view of a two-ply fabric, showing one sheet pulled back to disclose both the longitudinal and transverse reenforcing fibres.

In Fig. 1, which shows mechanism for applying fibres both longitudinally and transversely of a fabric or sheet of paper, the fabric 10 is shown as drawn from a supply roll 11 and as the fabric 10 is unwound from its supply roll, it passes about guide rolls 12 and 13 and between the adhesive applying rolls 14 and 15. The roll 15 may rotate in a receptacle 16 containing adhesive, so that, as the roll 15 rotates, it applies a coating of adhesive to the under face of the fabric 10 and this adhesive is preferably waterproof such as black asphaltum so that the same will not release the reenforcing fibres should the fabric or paper become wet. After the adhesive has been applied to the fabric 10 it passes under a guide roll 17 and then between a pair of feed rolls 18 and 19, and the upper roll 19 is shown as made hollow, in order that it may be heated by passing steam through the same.

The sheet of reenforcing fibres which are applied longitudinally of the fabric 10 is indicated by 20, and this sheet may be formed of rovings 21 drawn from containers 22. The arrangement is such that a number of rovings are positioned side by side and are drawn between the pair of rolls 23 by the grooved feed rolls 24 and 25, and these rolls are shown as driven by a chain 26. The sheet of fibres 20 is relatively thick as it leaves the feed rolls 24 and 25 and an endless carrier 27 is provided having a number of combs 28 which serve to straighten and attenuate the fibres of the sheet and then deliver this sheet between the feed rolls 18 and 19 where it is applied to the adhesive covered face of the fabric 10. The mechanism just described for applying the fibres longitudinally of the fabric 10 is more fully disclosed in the application above mentioned. The fabric 10, with the fibres applied longitudinally thereof, passes from the feed rolls 18 and 19 below mechanism for applying the transverse reenforcing fibres, to the pair of rolls 29 and 30.

The mechanism so far described does not form a part of the present invention, and the present invention is directed to the mechanism, which will now be described, for applying reenforcing fibres transversely of the fabric 10 and it will be understood that, although the mechanism now to be described is shown in position to apply fibres to a fabric which has been previously reenforced by longitudinally extending fibres, the longitudinal reenforcing fibres may be omitted if desired. The sheet 31 of fibres which are applied transversely of the fabric is shown as directed downwardly by spaced guides 32 from an elevated source of supply, not shown. The fibres forming the sheet 31 pass from the guides 32 to means not shown for combing and attenuating the same into a thin sheet having the fibres disposed in a straightened and substantially parallel condition. The combing and attenuating means may be similar to that shown in Fig. 1 for treating the fibres which are applied longitudinally of the fabric 10, and the sheet of fibres 31 after it has been sufficiently combed and attenuated, is delivered to the feed rolls 33 and 34 (see Figs. 2 and 4) rotatably supported by the machine frame 35. It may be desirable to vary the pressure of the upper roll 34 upon the lower roll 33 and this may be accomplished by adjusting screws operated by hand wheels 34^a.

In reenforcing fabric transversely by the machine of the present invention the sheet of fibres 31 upon leaving the feed rolls 33 and 34 is carried transversely of the fabric and is cut into sections, which sections are applied successively across the traveling fabric 10. As stated, it is very difficult to keep the fibres in a straightened condition after they have been cut to form a section and while the section is being applied to the fabric. In the embodiment of the invention illustrated, a series of traveling combs 36 are provided to engage the sheet of fibres delivered by the rolls 33 and 34 and carry this sheet to a position over the traveling fabric 10, whereupon the sheet of fibres

after being cut is forced out of engagement with the comb teeth by doffing bars and is deposited upon the traveling sheet 10. In the construction shown, the opposite ends of the combs 36 are secured to endless racks composed of the rack sections 37 connected by pivot pins 38 and upon the pivot pins 38 are mounted rollers 39 which travel in fixed grooved runways 40 (see Fig. 4). The runways 40 are disposed at the opposite sides of the machine frame 35 and consist of an upper runway and a lower runway connected at each end by the semi-circular portions 41, the arrangement being such that each section 37 of the endless racks is continuously supported and guided by the rollers 39 traveling in the runways 40, 41. The endless racks are driven by the shaft 42 provided with the gears 43 that mesh with the teeth of each rack.

It is important that the sheet 31 of fibres be well supported at the point where the comb teeth 44 are engaged with the fibres and to this end, in the present case, a rotating drum 45 is provided just below the lower run of the combs, as best shown in Fig. 5, and this drum is operated at the same peripheral speed as the combs, and is provided with a number of longitudinally extending recesses 46 adapted to receive the ends of the comb teeth which project through the sheet of fibres. The arrangement is such that fibres pass over the roll 45 and are supported by this roll as the comb teeth are moved into engagement with the fibres. In the construction shown, the sheet of fibres is further supported upon leaving the feed rolls 33 and 34 by an endless apron 47 which passes about the lower feed roll 33 to a spaced roll 48 and then downwardly about the lower roll 49. This apron serves to support stray ends of the fibres until they have practically reached the comb teeth 44.

In the present construction, in which the fibres are carried to a position over the fabric to be reinforced by the lower run of the combs, there is a tendency of a sheet of fibres to move downwardly under the force of gravity out of engagement with the comb teeth. To prevent this the present invention contemplates means for positively retaining the fibres in engagement with the comb teeth and in the construction shown each comb is provided with a sliding bar 50 (see Figs. 10 and 12) having the downwardly extending bent fingers 51. In the present case the teeth 44 of the comb are made relatively wide and the fingers 51 are so constructed that each finger 51 may normally lie back of a tooth 44 out of the active position as shown in Fig. 12, but, when it is desired to positively hold the fibres between the teeth, the bar 50 may be moved in the direction of its length to position the fingers 51, as shown in Fig. 10, in which it will be noted that a curved portion of each finger extends across the opening between a pair of teeth.

As stated, the sheet of fibres 31 is cut into sections and these sections are successively applied to the traveling fabric 10. The present invention contemplates means for cutting the fibres after they have been engaged by the traveling combs 36 and after the fingers 51 have been moved into position to positively retain the fibres in engagement with the combs. This is desirable because it enables the fibres to be firmly held at each side of the point where the sheet of fibres is cut and causes one of the combs to remain in engagement with the main sheet 31 after a section has been cut from the sheet. The cutting devices of the present invention are carried by the rotating drum 45 and each consists of a fixed bar 52 and a sliding bar 53 and each of these bars is provided with a series of pointed cutting teeth, as best shown in Figs. 6 and 7. The cutting bars 52 and 53 normally are held retracted so that they lie entirely within the periphery of the roll 45 and means is provided for moving the cutters radially outwardly to sever the sheet of fibres between a pair of combs. To this end the cutter bars 52 and 53 are mounted in an H-shaped rail 54 which is slidably mounted in the radially extending slot 55 of the drum 45. The arrangement is such that the rail 54 may be moved radially outwardly from the position occupied by three of the cutters shown in Fig. 5 to the position occupied by the fourth and upper cutter of this figure. In order to impart this radial movement to the H-shaped bars, these bars are held from moving in the direction of their length in the slots 55 and in one face of each of the bars 54 are provided a number of upwardly inclined slots 56, as best shown in Fig. 8, which slots are adapted to receive the heads 59 of pins carried by the sliding bar 60, best shown in Fig. 9; the arrangement is such that when the bar 60 is moved axially in one direction the pins 59 travel in the slots 56 to move the rail 54 outwardly, and when the bar 60 is moved in the opposite direction it pulls the H-shaped rail inwardly and holds it in its retracted position.

The mechanism for driving the various parts of the machine forming the subject matter of the present invention will now be described. As best shown in Fig. 2, a horizontally extending shaft 61, supported above the main mechanism of the machine is driven by a sprocket chain 62 from any suitable source of supply supported overhead. The chain 62 passes about a sprocket wheel 63 mounted on a short shaft 64 which rotates loosely upon the shaft 61, and a hand-operated clutch 65 is slidably but nonrotatably secured to the shaft 61 and may be moved

into and out of engagement with the corresponding clutch elements 66 to start and stop the machine. A hand wheel 67 may be secured at one end of the shaft 61 so that the machine may be operated by hand in making adjustments. The sliding element 65 of the clutch is moved to and from its operative position by a yoke 68, pivoted at its lower end to a fixed support, and connected at its upper end by a rod 69 to a hand lever 70 which is pivotally supported at 71. The shaft 61 through the co-operating bevel gears 72 drives the shaft 73, as best shown in Fig. 4, and the shaft 73 is provided at one end with a sprocket wheel 74 and at its opposite end with a small gear 75 which meshes with a large gear 76 rotatably supported by the transversely extending shaft 77. Power is imparted from the transversely extending shaft 73 to a lower transversely extending shaft 78 by the sprocket chain 79 which engages the upper sprocket wheel 74 and a lower sprocket wheel 80 rigidly secured to the shaft 78. The shaft 78 extends entirely across the machine, as shown in Fig. 4, and at its opposite end is provided with a change gear 81 (see Fig. 2) and upon an intermediate portion of the shaft 78 is rigidly secured the pinion 82 (see Fig. 14) which meshes with and drives the gear 83 which is rotatably mounted upon a second shaft 84 extending alongside the shaft 78 and having its ends journaled in the brackets 85. The gear 83 is rigidly secured to and rotates a cam drum 86 which is loosely mounted upon the shaft 84, the arrangement being such that the cam drum is supported by the shaft 84 and is driven by the shaft 78. It is desirable to drive the shaft 84 at a variable speed, for a purpose to be described, and to this end a Geneva gear is employed to drive the shaft 84 from the shaft 78, and, as best shown in Fig. 14, the slotted element 87 of the Geneva gear is rigidly secured to the shaft 84, while the co-operating element having the oppositely extending arms 87^a carrying the slot-engaging rollers 87^b is rigidly secured to the shaft 78. A second cam drum 88 is rigidly secured to and is rotated by the shaft 84. The driving connections between the main upper shaft 73 and drum 86 is such that the drum is given one complete rotation for four complete rotations of the main shaft 73, and the connections described for operating the cam drum 88 likewise impart one complete rotation to this drum for four complete rotations of the shaft 73.

The change gear 81 secured to the lower main shaft 78 meshes with an adjustable gear 89, shown in Fig. 2, and this adjustable gear meshes with and drives an idle gear 90. The idler gear 90 is relatively wide, as shown in Fig. 4, and meshes with and drives the gear 91 which is rigidly secured to and operates the shaft 42, above described as provided with the gears 43 for driving the combs. The wide idle gear 90 serves also to drive the cutter drum 45 and, since the cutter drum and shaft 42 both rotate in the same direction, and are relatively close together, the gear 92 which drives the cutter drum meshes with the idle gear 90 and is supported out of the plane of rotation of the gear 91 so that the gears 91 and 92 will rotate freely without interfering with each other. The feed roll 33 may be driven by a sprocket chain 93, preferably positioned at the opposite side of the machine, as shown in Fig. 5, and this sprocket chain may be driven by a sprocket wheel rigidly secured to the shaft of the cutter drum 45.

From the driving mechanism just described it will be seen that the carrier racks, the cutter drum and the feed rolls 33 and 34 are all driven from the change gear 81 and that by changing the size of this gear the speed of the elements just mentioned may be increased or decreased without changing the speed at which the cam drums 86 and 88 rotate. The adjustable gear 89 is supported by an adjustable bracket 94 of well known construction, whereby the gear 89 may be shifted to different positions to accommodate different change gears 81.

From the foregoing it will be seen that the speed at which the sheet of fibres 31 is carried to a position over the fabric to be reenforced may be readily varied. This is desirable because it may be wished to employ the present machine to reenforce paper or fabric of different widths and the machine is so constructed that the fabric to be reenforced may be fed at a uniform speed, irrespective of the width of the same, and if the fabric is relatively narrow the speed at which the reenforcing fibres are advanced will be slowed down; whereas, if a wider sheet is to be reenforced the speed at which the reenforcing fibres are advanced will be increased. The combs 36 are not only provided with the sliding bar 50, having the fibre retaining fingers 51, but are also provided with doffing bars. The combs 36 are preferably given the construction shown in Figs. 10 to 13 inclusive, and may consist of a hollow bar square in cross section, as shown in Fig. 13, to which the comb teeth 41 are rigidly secured, the teeth being conveniently formed by cutting the strip of sheet metal 95 to form the same. The opposite ends of the combs are shown as secured to the rack sections 37 by the L-shaped brackets 96 and the sliding bar 50 is preferably provided with a lip 97 at its inner edge which retains the bar in place. The doffing bars 98 are preferably secured to and operated by sliding pins 99 which extend through apertures formed in

the opposite walls of the combs 36. The doffing bars are normally supported in their inactive position as shown in Fig. 13, but may be moved outwardly to doff the fibres by sliding the pins 99 in the direction of their length. This may be accomplished by providing each pin 99 with a head 100 having oppositely extending lugs 101 which extend into the inclined slots 102 formed in the spaced bars 103 which are mounted upon the combs to slide in the direction of their length; the arrangement is such that when the bars 103 are moved in a right-hand direction, viewing Fig. 10, the pins 99 will be moved downwardly to the doffing position, and when these bars are moved in a left-hand direction the pins 99 will be raised to retract the doffing bars.

Since as stated the sheet 31 of fibres is cut into sections and the sections are applied successively to the traveling fabric, it is necessary to provide means for operating the doffing bars of a number of combs simultaneously so that all the fibres of an entire section may be transferred simultaneously from the combs to the fabric. The means disclosed for operating simultaneously a predetermined number of doffing bars consists of a number of actuators 104 which are mounted upon a shaft 105 extending lengthwise of the machine and supported near one side of the machine by the spaced brackets 106. The actuators 104 are rigidly secured to the shaft 105 and are moved to and from their operative position when the bar 105 is rocked. The lower ends of the actuators engage rollers 107 mounted upon one end of the sliding bars 103, the arrangement being such that when the actuators are rocked they engage the rollers 107 and slide the bars 103 in a right-hand direction, viewing Fig. 10, to move the doffing bars to the doffing position. The doffing bars will remain in this position until they are retracted by movement of the bars 103 in the opposite direction, and this is accomplished by providing a fixed cam 108 located within the path of travel of the combs and adapted to engage the rollers 107 and move the bars 103 in a left-hand direction.

It will be understood that the series of combs travel at a relatively fast speed and that when the actuators are operated they move across the path of travel of the rollers 107. It will also be understood that since the combs 36 are spaced only a short distance apart the movement of the actuator 104 must be extremely rapid to move to and from its doffing position without interfering with the leading roll 107 which is not doffed. In order to give the doffing actuators 104 more time to complete their operation, the present invention contemplates means for momentarily advancing the entire set of doffing actuators in the direction of travel of the combs. This is accomplished in the present case by supporting the shaft 105 for sliding movement in the direction of its length and the shaft 105 is periodically shifted in the direction of its length by a rocking lever 109 rigidly secured to the rocking shaft 110 extending transversely of the machine. The upper end of the lever 109 is provided with a roller which engages an eccentric slot 111 formed in a face of the large gear 76. The gear 76 is driven by its pinion 75 at a ratio of 1 to 4, to correspond with the speed at which the cam drums 86 and 88 are rotated. The lower end of the lever 109 is connected to an auxiliary bar 112 (see Fig. 3) extending lengthwise of the actuator supporting bar 105 and the other end of the auxiliary bar is operatively secured to the bar 105 by an arm 113 which loosely embraces the shaft 105 and is held in place thereupon by spaced collars 114. The result of the construction is such that the rocking lever 109 may move the shaft 105 back and forth without interfering with the rocking movement that is imparted to the shaft to operate he actuators 104.

In the contruction shown, the slotted drum 86 is provided to operate the actuators 104 and to this end a rocking bracket 115 is pivotally mounted upon a fixed support at 116 and one arm of this bracket is provided with a roller 117 which engages the cam slot in the face of the drum 86 and is actuated by an offset portion 118 of this cam slot. A second arm of the bracket 115 is connected by means of a rod 119 to a crank arm 120 which is secured to a shaft 121 (see Fig. 3) and serves to rock this shaft. Rocking movement is imparted from the shaft 121 to the shaft 105 by an arm 122 rigidly secured to the shaft 105 and the outer end of which extends into an elongated slot formed in a block 123 supported by arms 124 operated by the rocking shaft 121. The construction just described imparts the desired rocking movement to the shaft 105 without interfering with the longitudinal movement of this shaft.

When relatively wide paper is to be reenforced, it will be understood that it is necessary to doff simultaneously a greater number of combs than should be doffed when narrow paper is being reenforced. To vary the number of combs that are doffed simultaneously a number of independently adjustable actuators are secured to the bar 105 at the left-hand end of the same, viewing Fig. 2, as at 125, the arrangement being such that these actuators may be swung to or from a position in which they will operate the doffing bars and may be clamped by set screws in either an active or inactive position.

Since as described each comb is provided with means for positively maintaining the fibres in engagement with the comb teeth,

it is necessary to provide means to move the fibre-retaining fingers 51 out of their active position, before the fibres are doffed. To this end a shaft 126 similar to the rocking shaft 105 is supported at the opposite side of the machine and is provided with actuators 127 adapted to engage rollers 128 at the upper end of the rocking bars 129 pivotally mounted at 130 and the lower ends of which are secured by pins 131 to the sliding bars 50. Rocking movement is imparted to the actuators 127 by a bar 132 extending across the machine from the actuators 104 and the mechanism above described for moving the shaft 105 momentarily in the direction of its length serves also to impart a similar movement to the shaft 126 through the shaft 110 that extends transversely of the machine. The arrangement of the parts just described is such that the fingers 51 are not moved to the fibre-releasing position until the doffing bars begin to move to the doffing position.

The mechanism just described serves to move the fingers 51 out of the fibre-holding position and they remain in their inactive position until after the teeth of a comb have been engaged with the sheet of fibres, whereupon the fingers 51 are quickly moved to the fibre-holding position. This is accomplished by providing a cam 133 (see Fig. 5). Since the position of the cam 133 should be accurately adjusted, this cam is shown as rigidly secured to an adjustable shaft 136 and this shaft may be moved slightly in one direction or another by means of an arm 137 (see Fig. 2) which may be clamped in the desired position of adjustment by a nut 138.

As above stated the cutters of the present invention serve to cut a sheet of fibres between a pair of combs and while the fibres are held upon each side of the cutter. The means for moving the cutters outwardly to the cutting position and for then actuating the cutters will now be described. A rocking lever 139 is pivotally mounted upon a fixed support at 140 and the lower end of this lever is provided with a roller 141 which engages the cam slot formed in the face of the cam drum 88, the arrangement being such that this lever is rocked by an offset portion 142 of the cam slot. The upper end of the rocking lever 139 is forked and is secured to a collar 143 slidably mounted upon the central shaft 144 of the cutter drum. The collar 143 has a relatively wide lug 145 which engages a roller 146 secured to one end of the sliding bar 60, which bar as above pointed serves to move the cutters to and from their active position. The teeth of the cutter bars 52 and 53, are pointed as shown and preferably are spaced the same distance apart as the teeth of the comb so that the cutter teeth will aline with the comb teeth and may be readily inserted between the fibres retained in place between the pair of comb teeth. After the H-shaped rail 54 has been moved outwardly by the sliding movement of the bar 60, it is necessary to move the cutter bar 53 in the direction of its length to cut the fibres. This is accomplished by means of a roller 147 carried by a link 148 secured at 149 to a projection upon the rail 54 and secured at 150 to the sliding cutter. Promptly after the cutters have been moved radially outward to the cutting position, the roller 147 engages the cam face of a fixed cam 151 and as the cutter drum rotates the roller travels along the cam face of the fixed cam and rocks the link 148 to slide the cutter blade 53 in the direction of its length. A fixed cam 152 at the opposite side of the machine is positioned to engage a roller 153 mounted upon a link 154 and to rock this link to move the cutter back to its original position. A second fixed cam 155 positioned near the cam 152 is adapted to engage a roller 156 upon an end of the lever 60 and serves to slide this lever in a left-hand direction, viewing Fig. 6, to retract the cutters.

When the machine of the present invention is operated at high speed it is necessary that the cutters be moved to and from the cutting position very quickly, and to this and the Geneva gear above described is employed to momentarily increase the speed at which the shaft 84 is rotated, thereby to increase the speed at which the parts are operated to shift the bar 60. It will be understood that means other than the Geneva gear may be employed for momentarily increasing the speed at which the shaft 84 is rotated.

It will be noted that the comb teeth 44 are relatively wide and the distance between two teeth 44 is preferably greater than the distance between the individual fibres of the sheet 31. As a result several fibres will enter between each pair of teeth and when the fibres of the sheet are applied to the fabric or paper 10 they will be positioned in rows or spaced groups, as at 157 (see Fig. 15). This is desirable because by grouping several fibres together they will resist a much greater force than would a single fibre.

As above stated the present machine may be changed to reenforce either wide or narrow fabric by simply changing the gear 81 and in addition to this one or more of the actuators 125 may require adjustment to or from its active position to increase or decrease the number of combs simultaneously doffed.

In order that the present machine may run at its maximum capacity, irrespective of the width of the paper being reenforced, the width of the sheet of fibres 31 should at all times be as wide as the machine will accommodate and when paper is being reen-

forced having a width less than the maximum capacity of the machine, the speed at which the reenforcing fibres 31 are advanced should be reduced without reducing the speed at which the fabric is advanced. When the machine is thus operated a section of fibres will be applied to the fabric 10 every time a portion of the fabric 10 corresponding in length to the width of the sheet 31 is passed under the combs. This means that the doffing operations will occur at the same intervals of time, irrespective of whether a wide or narrow fabric is being reenforced, but, when a narrow sheet is being reenforced, obviously less fibres are required, and this condition is met by slowing down the speed at which the fibres 31 are advanced.

Changing the gear 81 it will be understood does not change the speed at which the cam drums 86 and 88 are operated. This means that while the cutter drum 45 may have its speed of rotation increased or decreased, the intervals at which the cutters themselves are operated remain constant. As a result the same cutter may not always be in the uppermost position when a cutting operation is called for and the cutting drum shown is therefore provided with four different cutters, any one of which may be operated when in the uppermost position.

After the fibres have been applied to the fabric 10 both longitudinally and transversely, or, if desired, transversely alone, it is preferable to apply a second sheet of fabric over the fibres to protect them, and thus form a two-ply sheet with the fibres between the two sheets. To this end a second supply of paper or fabric may be drawn from the supply roll at 158 (see Fig. 1) and, after passing around suitable guides and between the adhesive applying rolls 159 and 160, it is led between the rolls 29 and 30, at which point it is applied to the reenforced fabric 10 and the two-ply fabric thus formed may pass part way around the roll 30 and then part way around the upper roll 161, from which it issues as a finished, two-ply, reenforced fabric 162. The rolls 30 and 161 serve to force the two sheets of paper or fabric firmly together and the pressure exerted by each roll may be varied by means of the hand wheels 163 and 164. The various feed rolls for the fabric and for the fibres which reinforce the fabric longitudinally should be driven at a constant speed with respect to the main driving shaft of the machine that applies the fibres transversely of the fabric so that all parts will be operated in their proper timed relation.

What is claimed is:—

1. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet having the fibres arranged in approximately parallel relation, traveling combs for engaging the fibres and applying them to the fabric transversely thereof, and means for positively holding the fibres between the teeth of the combs.

2. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely thereof, and means movable into and out of position to close the entrances between the teeth of the combs to hold the fibres between said teeth.

3. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely thereof, and bent fingers movable across the entrances between the comb teeth to hold the fibres between said teeth.

4. A machine of the character described comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric in the form of a thin sheet having the fibres arranged in approximately parallel relation, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely thereof, and means carried by the combs and movable across the entrances between the comb teeth to hold the fibres between said teeth.

5. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely thereof, a sliding bar mounted upon each comb, and fingers that are moved by the bar to and from a position in which they extend across the space between the teeth of the comb to retain the fibres in place.

6. A machine of the character described comprising, in combination, means for feeding a fabric to be reenforced by unspun fibres, means for feeding the unspun fibres transversely to the path of feed of the fabric and in the form of a thin sheet having the fibres arranged in approximately parallel relation and slightly spaced, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely

thereof, and the combs being provided with teeth that are spaced apart further than the average distance between the individual fibres of the sheet, whereby the fibres are divided by the teeth into groups and are applied to the fabric in spaced groups.

7. A machine of the character described comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet having the fibres arranged in approximately parallel relation and slightly spaced, traveling combs for engaging the fibres of said sheet, and the combs being provided with relatively wide teeth that divide the fibres into groups so that they are applied to the fabric in spaced reenforcing groups.

8. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and carrying them to a position across the fabric, doffing bars for transferring the sheet of fibres from the combs to the fabric, and sliding bars extending lengthwise of the combs and movable in the direction of their length to actuate the doffing bars.

9. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and carrying them to a position across the fabric, doffing bars for transferring the sheet of fibres from the combs to the fabric, sliding bars extending lengthwise of the combs and movable in the direction of their length to actuate the doffing bars, and means for simultaneously actuating a number of sliding bars.

10. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric and in the form of a thin sheet, traveling combs for engaging the fibres of the sheet and carrying them to a position across the fabric, doffing bars for transferring the sheet of fibres from the combs to the fabric, sliding bars extending lengthwise of the combs and movable to actuate the doffing bars, and means at one side of the path of travel of the combs and operable to shift simultaneously a predetermined number of sliding bars.

11. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres transversely to the path of feed of the fabric and for cutting the sheet into sections, traveling combs for moving the sections to a position across the fabric, doffing bars upon the combs, elements shiftable axially of the combs to operate the doffing bars, and means at one side of the path of travel of the combs to actuate said elements and adjustable to vary the number of combs that are doffed simultaneously.

12. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres transversely to the path of feed of the fabric, an endless carrier provided with combs adapted to engage the sheet of fibres and carry it across the fabric for application to the fabric, a rotating drum for supporting the sheet of fibres at the point where the teeth of the combs are engaged with the fibres, and the drum having notches formed longitudinally in its face to receive the portions of the combs that extend through the sheet of fibres.

13. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres transversely to the path of feed of the fabric, an endless carrier provided with combs engaging the fibres and applying them to the fabric transversely thereof, and a cutter for cutting the sheet of fibres into sections and constructed and arranged to cut the sections so that a comb always remains in engagement with the main portion of the sheet from which the section is cut.

14. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, and a cutter for cutting the sheet of fibres into sections for progressive application to the fabric and constructed and arranged to cut the sections so that a comb always remains in engagement with the main portion of the source of fibre supply.

15. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversly of the fabric, and a cutter for cutting the sheet of fibres into sections for application to the fabric and positioned to cut the sheet of fibres between a pair of combs each of which engages the fibre sheet.

16. A machine of the character described, comprising, in combination, means for feed-

ing a fabric to be reenforced, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, and means for severing the sheet of fibres while it is held upon each side of the severing means by the traveling combs.

17. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, a rotating drum for supporting the sheet of fibres at the point where the combs are engaged with the fibres and having notches formed longitudinally in its face to receive the portions of the combs that extend through the sheet of fibres, and a cutter upon said drum and operable to cut the fibres while they are held by the combs on each side of the cutter.

18. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, a rotating drum for supporting the sheet of fibres at the point where the teeth of the combs penetrate the sheet, and a cutter upon said drum and operable to cut the fibres while they are held by the combs at each side of the cutter.

19. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, a rotating drum for supporting the sheet of fibres, and a cutter normally retained within the drum and adapted to be projected beyond the periphery of the drum to cut the sheet of fibres.

20. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, a cutter mounted upon a rotating drum, and means for moving the cutter radially outwardly to introduce it between a pair of combs and then actuate it to cut the sheet of fibres.

21. A machine for reenforcing fabric, comprising in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres and applying them transversely of the fabric, a cutter consisting of two sets of relatively movable teeth which teeth are pointed to project through the sheet of fibres, and means for moving one set of teeth relative to the other set to cut the fibres.

22. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs having relatively wide teeth for engaging the fibres and applying them transversely of the fabric, a cutter consisting of two sets of relatively movable teeth which teeth are constructed to aline with the teeth of the combs and are adapted to be inserted between the fibres held by the comb teeth, and means for moving one set of the cutter teeth relative to the other set to cut the fibres.

23. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, traveling combs for engaging the fibres of the sheet and applying them to the fabric transversely thereof, a drum rotated in timed relation with the travel of the combs, a plurality of cutters mounted upon the drum in spaced relation about its axis to cut the sheet of fibres into sections, and means including changeable driving mechanism for actuating any one of the angularly spaced cutters to cut the fibre sheet into sections of the desired length.

24. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, an endless carrier provided with combs for engaging the fibres and applying them transversely of the fabric, a drum adjacent the carrier and rotated at the same surface speed, independently operable cutters carried by the drum to cut the sheet of fibres into sections, and means including changeable driving mechanism for operating different cutters to cut the fibre sheet into sections of the desired length.

25. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, an endless carrier with combs for engaging the fibres and applying them transversely of the fabric, a drum adjacent the carrier and having independently operable cutters, means for rotating the drum in timed relation with the carrier to introduce the cutters

between the combs, and means for operating the cutters in different order to cut the fibre sheet into sections of the desired length.

26. A machine for reenforcing fabric, comprising in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, an endless carrier with combs for engaging the fibres and applying them transversely of the fabric, a drum rotatably mounted adjacent the carrier in position to force the fibres into engagement with the comb teeth and having recesses in its face to clear said teeth, means for rotating the drum at the same surface speed as the carrier, a cutter upon the drum that is introduced between a pair of combs, and means for actuating the cutter to sever the fibres between a pair of combs.

27. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, an endless carrier with combs for engaging the fibres and applying them transversely of the fabric, means for positively holding the fibres between the teeth of the combs, and a cutter for severing the sheet between a pair of combs and while it is positively held in each comb.

28. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres in a path transverse to the direction of feed of the fabric, an endless carrier with combs for engaging the fibres and applying them transversely of the fabric, means movable into and out of position to close the entrances between the teeth of the combs to hold the fibres between the teeth, and a cutter for severing the sheet between a pair of combs and while the entrances between the teeth are closed.

29. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric in the form of a thin sheet, an endless carrier having traveling combs for engaging the fibres of the sheet and carrying them across the fabric, doffers upon the combs for transferring the fibres to the fabric, an actuator supported at one side of the path of travel of the combs for operating simultaneously a number of the doffers, and mechanism for momentarily advancing the actuator in the direction in which the combs travel while it operates the doffers.

30. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric in the form of a thin sheet, an endless carrier having traveling combs for engaging the fibres of the sheet and carrying them across the fabric, doffers upon the combs for transferring the fibres to the fabric, an actuator supported at one side of the path of travel of the combs and movable transversely of said path to operate the doffers, and mechanism for advancing the actuator in the direction in which the combs travel while it operates the doffers to prevent other advancing doffers from striking the actuator.

31. A machine for reenforcing fabric comprising in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric for application thereto, a carrier consisting of a pair of spaced endless racks formed of connected rack sections constructed to travel in an endless path, combs extending from one rack to the other and connected to the rack sections and adapted to engage the fibres of the sheet and advance them toward the fabric, supporting rollers mounted upon the rack sections, a pair of endless runways one for the rollers of each rack and constructed to support the racks, and means for applying the fibres to the fabric.

32. A machine for reenforcing fabric comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for feeding the fibres transversely to the path of feed of the fabric, traveling combs for engaging the fibres of the sheet and carrying them across the fabric for application thereto, doffing bars mounted upon the combs, means for positively holding the fibres between the teeth of the combs, and mechanism for actuating the doffing bars and said holding means in timed relation.

33. A machine of the character described, comprising in combination, means for feeding a fabric to be reenforced by fibres, means for feeding a sheet of fibres transversely to the path of feed of the fabric, traveling combs for engaging the fibres of the sheet and carrying them to a position across the fabric, doffing bars for transferring the sheet of fibres from the combs to the fabric, actuators for the doffiing bars, means for rocking the actuators, and means for imparting the rocking movement of the actuators, to the doffing bars to operate them.

34. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, a traveling comb for engaging the fibres of the sheet and carrying them over the fabric for application thereto, and means movable into and out of position to close the entrances between the teeth of the comb to hold the fibres between said teeth.

35. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, a traveling comb for engaging the fibres of the sheet and carrying them over the fabric for application thereto, and fingers movable across the entrances between the teeth of the comb to hold the fibres between said teeth.

36. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric, doffing bars for transferring the sheet of fibres from the combs to the fabric, and bars extending lengthwise of the combs and movable in the direction of their length to actuate the doffing bars.

37. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric for application thereto, a rotating drum for supporting the sheet of fibres at each side of the point where the teeth of a comb are engaged with the fibres, and the drum having recesses adapted to receive the portion of the combs that extends thru the fibre sheet.

38. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric for application thereto, and a cutter for cutting the sheet of fibres into sections and constructed and arranged to cut the sheet between two combs so that a comb remains in engagement with the main portion of the fibre sheet from which a section is cut.

39. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric for application thereto, a rotating drum for supporting the sheet of fibres, and a cutter normally retained within the drum out of engagement with the fibre sheet and adapted to be projected beyond the periphery of the drum to cut the sheet of fibres.

40. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric for application thereto, a rotating drum provided with independently operable cutters spaced about the axis of the drum, and means including changeable driving mechanism for operating different cutters to cut the fibre sheet into sections of the desired length.

41. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, a rotating drum provided with cooperating cutters comprising two sets of relatively movable teeth pointed at their ends and adapted to be projected thru the sheet of fibres, means for moving one set of teeth relatively to the other to sever the fibre sheet, and means for applying the fibres to the fabric.

42. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, a rotating drum provided with cooperating cutters comprising two sets of relatively movable teeth pointed at their ends and adapted to be projected thru the sheet of fibres, means for moving the teeth radially outwardly from the axis of the drum to insert them thru said sheet, means for moving one set of teeth relatively to the other to sever the sheet, and means for applying the fibres to the fabric.

43. A machine of the character described, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric for application thereto, doffing bars associated with the combs, means for positively holding the fibres between the teeth of the combs, and mechanism for actuating said holding means to release the fibres and for actuating the doffing bars to eject the fibres.

44. A machine for reenforcing fabric, comprising, in combination, means for feeding a fabric to be reenforced by fibres, means for advancing a sheet of fibres toward the fabric, traveling combs for engaging the fibres of the sheet and carrying them over the fabric, doffers upon the combs for transferring the fibres to the fabric, an actuator supported adjacent the path of travel of the combs for operating simultaneously a number of the doffers, and mechanism for momentarily advancing the actuator in the direction in which the combs travel while it operates the doffers.

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

CHARLES H. HOWARD.