May 20, 1941. C. LUCKHAUPT 2,242,864

APPARATUS FOR MAKING PILE FABRICS

Filed June 17, 1939 3 Sheets-Sheet 1

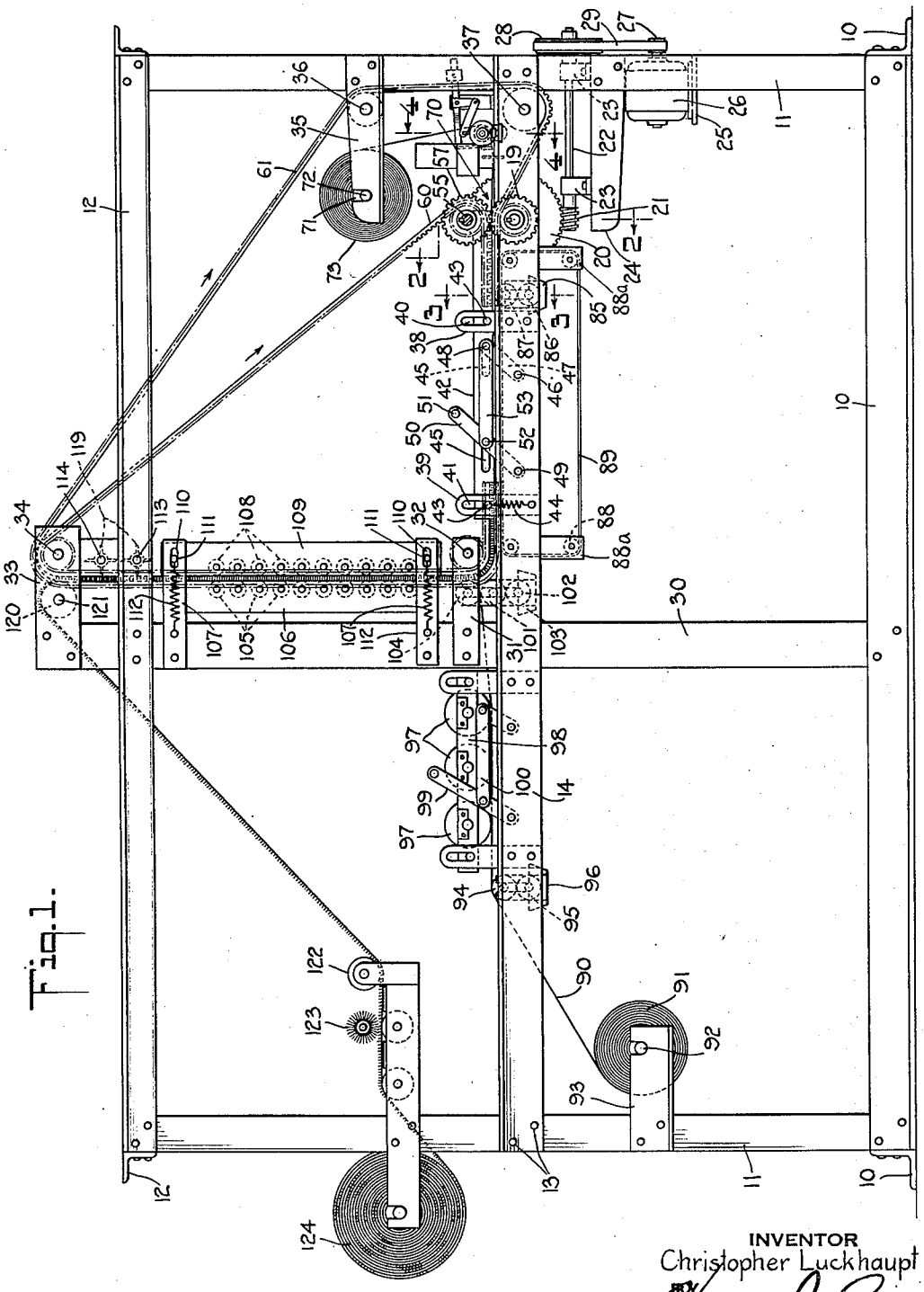


Fig. 1.

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Filed June 17, 1939 3 Sheets-Sheet 2

Fig. 2.

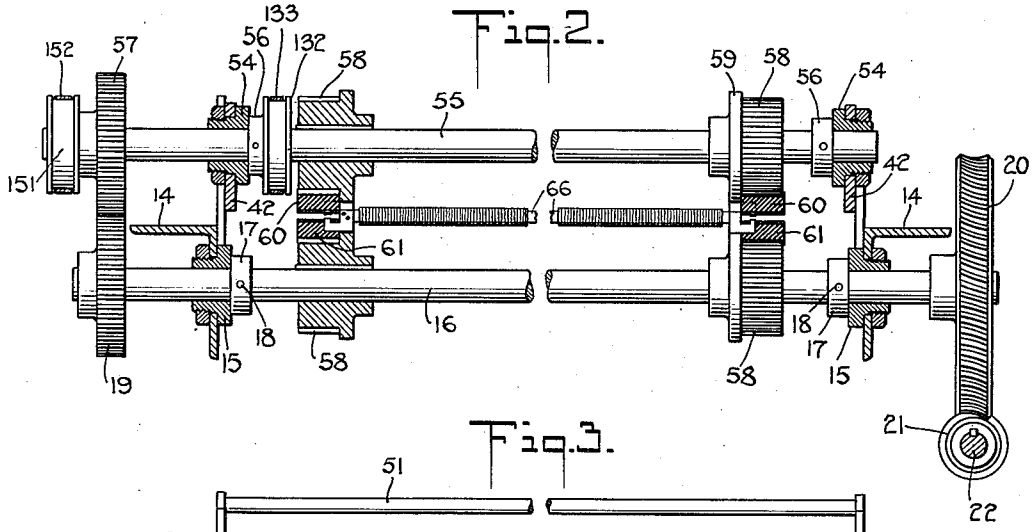


Fig. 3.

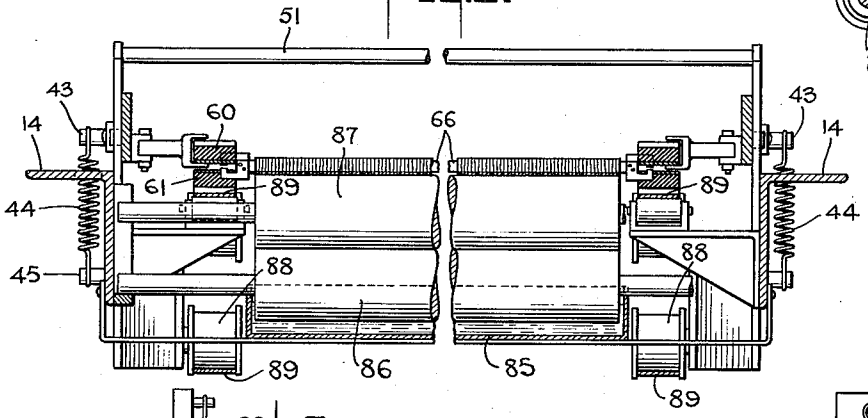


Fig. 4.

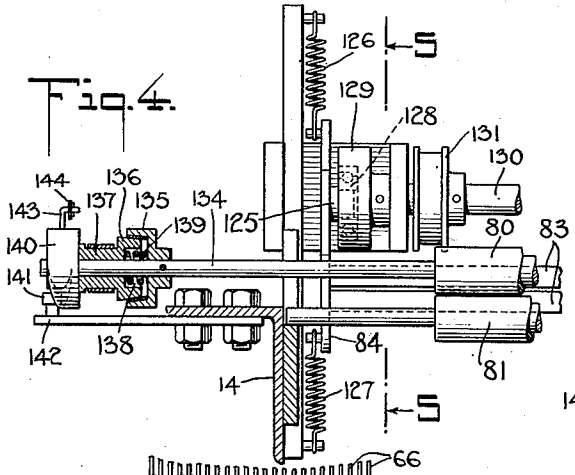


Fig. 5.

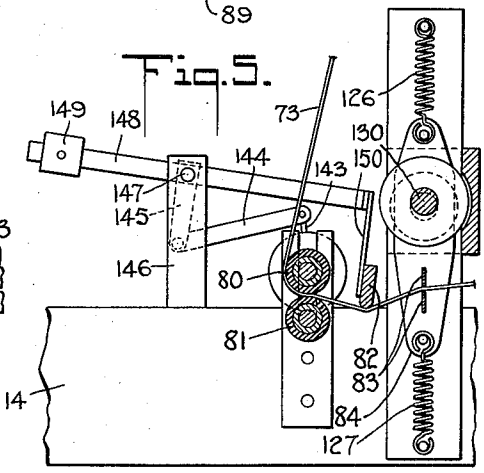


Fig. 6.

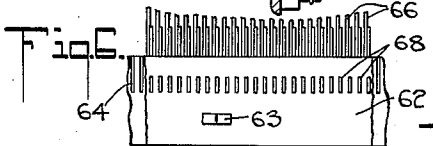


Fig. 7.

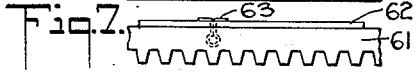


Fig. 9.

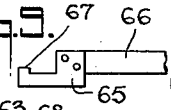
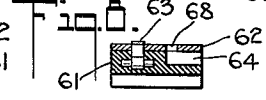


Fig. 8.



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Filed June 17, 1939 3 Sheets-Sheet 3

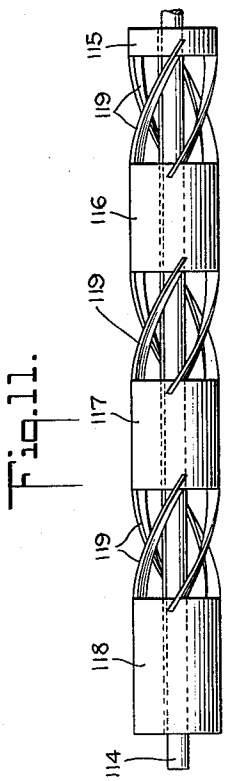


Fig. 11.

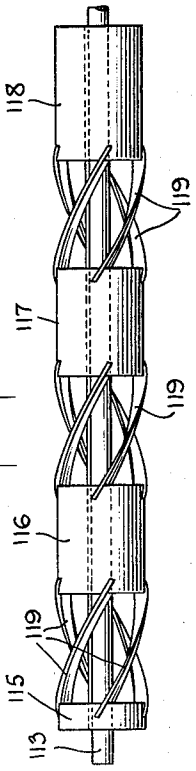


Fig. 12.

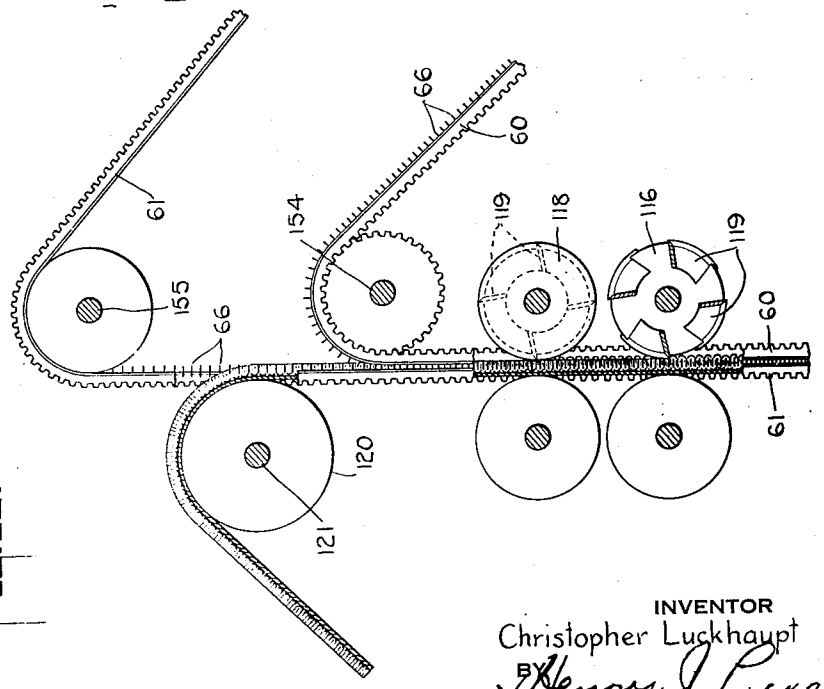


Fig. 10.

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UNITED STATES PATENT OFFICE

2,242,864

APPARATUS FOR MAKING PILE FABRICS

Christopher Luckhaupt, Jamaica, N. Y.

Application June 17, 1939, Serial No. 279,696

5 Claims. (Cl. 154—1)

My present invention relates to pile fabrics, and more particularly to an improved apparatus for making pile fabrics.

In carrying out my invention I utilize a warp of any desired width and of indeterminate length and fold the individual members of the warp into folds of any desired length, such as would be suitable for use on a pile fabric, as a rug or carpet, and while retaining the individual members of the warp in folded condition apply an adhesive in liquid or semi-liquid form to one end of the folds and bring such end into juxtaposition with one face of a base fabric and which base fabric preferably has, on its contacting face, adhesive in liquid form. The adhesive is preferably rubber or any similar yielding, adhesive and resilient material which will in its cured state retain its resiliency to such a degree as not to seriously affect the pliability of the resulting pile fabric. After the folded warp threads have been caused to adhere to the surface of the base fabric, and the adhesive sufficiently set or cured to be in permanent form, the then other ends of the folds are cut or severed to produce on the base fabric a pile whose height is determined by the length of the loops or folds in the warp threads.

I may in practicing my invention utilize as the material from which to make the pile of the resulting fabric, a bat of fibers which may be fed to the point of use directly from a carding machine. Such bat necessarily will be of a width equal to the width of the desired pile fabric, whether such pile fabric is to be ordinary stair carpet width or the usual rug width, and the folds are made in the bat in the same manner as the folds are made in the individual threads in the warp above referred to.

A feature of my invention is an improved machine for applying fibers to a base material to produce a pile fabric.

A feature of my invention is an improved apparatus for making pile fabrics.

The present application is a continuation in part of my co-pending application Serial No. 118,201, filed December 30, 1936.

In the accompanying drawings illustrating a machine embodying my present invention:

Figure 1 is a schematic view of my machine and illustrating the various operations forming a pile fabric according to my present invention;

Figure 2 is a sectional elevation taken on the line 2—2 of Fig. 1;

Figure 3 is a sectional elevation taken on the line 3—3 of Fig. 1;

Figure 4 is a sectional elevation taken on the line 4—4 of Fig. 1;

Figure 5 is a sectional end elevation taken on the line 5—5 of Fig. 4;

Figure 6 is a fragmentary plan view of a small portion of one of the endless conveyor belts showing the steel tape for spacing the bars in position thereon;

Figure 7 is an end elevation of the structure shown in Fig. 6 and showing the mechanism for attaching the steel tape to the endless belt;

Figure 8 is a sectional end elevation through the endless belt, the steel tape, and the means for securing said two elements together;

Figure 9 is a detail of one end of a cross bar and the means for attaching such end in association with the endless belt and steel tape;

Fig. 10 is a view on a relatively enlarged scale of an apparatus similar to but slightly modified from that shown in Fig. 1;

Fig. 11 is a side elevation of one cutting roller for shearing the loops of the pile fabric, and

Fig. 12 is a side elevation of the other of the loop cutting rollers.

Referring to the drawings and particularly to Figure 1, there is shown a schematic layout of a machine embodying my invention. In such machine, there is a rectangular framework composed generally of commercial structural angles and consisting of base members 10, end uprights 11, top members 12, and the necessary gussets and struts (not shown) for erecting such members into a rigid hollow framework. Secured to the end uprights 11 by rivets 13, and extending along each side of the framework, are the angle members 14 and which constitutes a platform or table on which is mounted the apparatus constituting my improved machine.

Referring specifically to Figure 2 in conjunction with Figure 1, it will be noted that the spaced side frame members 14 are drilled to receive bearings 15 which are in alignment with each other, and in such bearings is rotatably mounted a shaft 16. The shaft 16 is positioned relative to the side frame members and is prevented from end play by the collars 17 secured to the shaft 16 by means of pins 18. On one end of the shaft 16 is keyed a gear 19 of any desired diameter and pitch for a purpose to be hereinafter described. To the other end of the shaft 16 is secured, by keying or in any other desired manner, the worm wheel 20. The worm wheel 20 meshes with and is driven by a worm 21 secured to a shaft 22 rotatably mounted in aligned bearings 23 secured to a bracket 24. Such bracket 24 is in

turn secured to the uprights 11 of the framework. Also secured to the uprights 11 forming part of the framework is a bracket 25 on which is mounted a prime mover, such as an electric motor 26, and which derives energizing current from any suitable source. On the drive shaft of the motor 26 is secured a pulley 27 which is in alignment with a pulley 28 secured to the shaft 22 above referred to. Over the pulleys 27 and 28 runs a belt 29 and by means of which power is transmitted from the motor 26 to the shaft 16 through the worm 21 and worm wheel 20.

Intermediate the end uprights 11 are uprights 30, such uprights being secured to the lower and upper members 10 and 12 respectively, preferably by rivets. Secured to each of the uprights 30 and extending parallel to and above the angles 14 are frame members 31. In these frame members are aligned bearings, in which is rotatably mounted a shaft 32 which lies parallel to the shaft 16. At the upper end of the uprights 30 are secured frame members 33, and such frame members lie parallel to but above the members 12. In the frame members 33 are aligned bearings, in which is rotatably mounted the shaft 34 which lies directly above and parallel to the shaft 32, and, therefore, the shaft 16.

Secured to the end uprights 11 to which is secured the bracket 24 are bracket members 35 and in these bracket members are aligned bearings in which is rotatably mounted the shaft 36, such shaft being parallel to the shafts 16, 32, and 34. Directly beneath the shaft 36 and rotatably mounted in aligned bearings in the frame members 14 is a shaft 37 also parallel to the shafts above mentioned.

Secured to the frame members 14 are members 38 and 39 arranged in pairs and spaced apart from each other, as clearly shown in Figure 1. The upper ends of the pairs 38 and 39 are provided with vertical slots 40 and 41 respectively. Associated with one of each of the pairs of members 38, 39 on each of the frame members 14 are members 42 of a framework. Each of the members 42 is provided with laterally extending pins 43 which extend through the slots 40 and 41 of the uprights 38 and 39 of the pairs of uprights, and the ends of the pins 43 associated with the pair of uprights 39 have secured thereto one end of a spring 44, the other end of this spring being secured to a pin 45, which in turn is secured to the side frame members 14. The springs 44 tend to keep the pins 43 in the lower end of the slots 40 and 41, and, therefore, tend to keep the frame members 42 in their lowermost position, as viewed in Figure 1.

Each of the frame members 42 is provided with longitudinal slots 45, the slots being arranged in pairs. Pivotally mounted on shaft 46 are links 47, to the upper end of which is secured the ends of a shaft 48 which extends through the rearward pair of slots 45. Pivotally mounted on shaft 49 in the frame members 14 are the lower ends of levers 50. The levers 50 extend upwardly to a point above the frame members 42, and to the upper ends thereof is secured a shaft 51. Extending through the slots 45 adjacent the uprights 39 is a shaft 52 and to which is pivoted the levers 50 and also the rearward end of connecting rods 53. The forward ends of the connecting rods are also pivotally mounted on the shaft 48.

By means of the levers 50, the shafts 48 and 52 may be utilized to raise or lower the framework comprised of the members 42. The end of the framework 42 terminates at a point approximately above the shaft 16, and in the framework 42 are the bearings 54. These bearings are in alignment with each other, and rotatably mounted therein is a shaft 55, such shaft lying above and parallel to the shaft 16. Also, the shaft 55 is prevented from axial movement in the bearings 54 by means of the collars 56 secured thereto, as shown in Figure 2. To one end of the shaft 55 is secured a gear 57 equal in pitch and diameter to and meshing with the gear 19. Therefore, it will be apparent that the shaft 55 rotates at the same speed but in a direction opposite to the direction of rotation of the shaft 16.

On each of the shafts 16, 32, 34, 36, 37, and 55 are keyed gears 58. These gears are spaced apart from each other, as shown in Figure 2, and each of such gears is provided with a flange 59 for a purpose to be hereinafter described.

Over the gears 58 run endless gear chains or belts 60 and 61 in a manner to be described. For example, over the gears 58 on the shafts 55, 32, and 34 runs the endless gear chain or belt 60. Over the gears 58 on the shafts 16, 32, 34, 36, and 37 run the chains or belts 61.

The endless chains or belts 60 and 61 are preferably made of flexible resilient material, such as rubber. Over each of the chains or belts is secured a steel band 62. The steel band 62 is secured to the chain or belt, as the chain or belt 61, by a plurality of clips 63, as shown in Figures 6, 7, and 8. The top and inner surfaces of the endless chains or belts 60 and 61 are provided with transversely extending, equally spaced slots 64. These slots are of a dimension to receive a clip 65 secured, by riveting, welding, brazing, or in any other suitable practical manner, to the ends of flat bars 66. The ends of the clips 65 are provided with, at their extreme outer ends, an upwardly extending hook member 67. The steel bands 62 are each provided with parallelly arranged, equally spaced slots 68, and which slots, when the steel bands are clamped onto the chains or belts 60 and 61 by the clips 63, are in alignment each with its respective slot 64 and, therefore, a clip 65 positioned in a slot 64 will have the hooked member 67 extending upwardly through the slot 68 in the band or tape 62.

The shafts 55 and 32 are parallel to each other and their axes lie in the same horizontal plane. When the framework 42 is in its lowermost position, thus bringing the shaft 55 into operative association with the shaft 16, the chains or belts 60 and 61, together with the bars 66, form a throat at the point 70 into which may be fed material to be operated upon.

As the belts 60 and 61 move to the left, as viewed in Figure 1, the reaches thereof extending from the shafts 55 and 16 to the shaft 32 lie in the same horizontal plane and the bars 66 associated with each of said gear belts interlock or inter-engage with each other so as to have the bars 66 form a platform of a plurality of parallelly arranged bars. As material is fed into the throat 70 in the form of parallelly arranged warp threads or as a bat of parallelly arranged fibers, the bars 66 in moving into the throat and into parallel relationship to each other on the horizontal reach referred to, will cause the warp threads or parallelly arranged fibers to assume a serpentine form, thus filling the spaces between adjacent bars 66 and looping over the tops and bottoms thereof.

Any suitable source of supply of warp threads or parallelly arranged fibers can be provided for,

and I have shown on the bracket 35 notches 71 in which is rotatably mounted a shaft 72 carrying a roll 73 of either warp threads or fibers of indeterminate length. The warp threads or fibers, it should be understood, extend across a width equal to the length of the bars 66 or across a width equal to the width of the material it is desired to produce.

The fibrous material 73 is led downwardly from the roll and between the rolls 80 and 81, see Figs. 4 and 5, under the tension bar 82 through the slot formed by the spaced bars 83 carried by the vibratory members 84 and thence into the throat 70 into association with the series of interlocking bars 66.

The details of the tension mechanism including the members 80 to 84 inclusive will be hereinafter described in detail at the proper time.

As the fibrous material 73 is put into position between adjacent bars of the gear belts 60 and 61, the bottom loops thereof are exposed on the underneath face of the platform formed by the cooperating bars 66 and are conditioned by having a suitable adhesive applied thereto.

In order to insure a proper positioning of the warp threads or parallel fibers of a bat of material with respect to the interlocking bars of the two series of bars 66, the operator, by means of the cross bar 51, swings the levers 50 on their pivot shaft 49 to the left, as shown in Fig. 1, thereby causing the shafts 48 and 52 to move along the slots 45 and lift the frame members 42 upwardly carrying the shaft 55 therewith and making an elongated throat or passage throat or passage through which the operator will draw the warp threads or parallel fibers. When the warp threads or parallel fibers have been properly positioned, the operator by swinging the levers 50 to the right about their pivots brings the same into the position shown in Fig. 1.

As will be apparent, the warp threads or parallel fibers will be formed into a plurality of parallelly arranged portions with loops at the top and bottom thereof and it is necessary and desirable to condition the lower loops of the fibers that are to be attached to the base fabric. Accordingly, I have arranged an adhesive applying device comprising a tank 85 containing a suitable and preferably liquid adhesive and associated with said tank are the feeding and adhesive applying rolls 86 and 87, respectively. The adhesive, therefore, is applied to the lower loops of the warp threads as the same are fed on the reach extending from the shaft 52 to the shaft 32.

It will be noted that the reaches of the endless chains or belts 60 and 61 from the gears 58 to the pulleys on shaft 32 are unsupported and in order to support the same in operative relation to each other I have provided a supporting member. Such supporting member comprises a framework 88a which in conjunction with the frame members 14 support idler rollers 88 arranged in sets of four, one set for each of the endless chain or belt members 60 and 61, and over each set runs an idler belt 89, the upper reach of which supports the reaches of the chains or belts 60 and 61 together with the bars 66.

The interlocking bars 66 on the pairs of chains or belts 60 and 61 pass under the rollers carried by the shaft 32 and then move upwardly until such time as they pass over the rollers mounted on the shaft 34. As the interlocked bars 66 pass from the horizontal path into a substantially vertical path, they have associated therewith a base fabric which is also to be properly conditioned.

The base fabric 90 comes in the form of a roll 91 of indeterminate length and such roll is mounted on shaft 92 carried by the bracket arms 93, secured to the uprights 11. The base fabric passes over an adhesive applying roll 94 which is associated with an adhesive feeding roll 95 dipping into a liquid adhesive carried in a tank 96 which is mounted on the frame members 14.

To properly condition the adhesive which has been applied to the base fabric, I provide a plurality of conditioning rolls 97 which may be heated in any suitable manner and which rolls are mounted in a frame 98 vertically movable between specified limits by means of a lever 99 and the proper linkage 100.

As a further precaution, I apply a second application of adhesive by means of an applying roll 101 which has adhesive fed thereto by a roll 102 mounted in a tank 103 carrying a suitable adhesive. The base fabric passes between the adhesive applying roll and a weighted roll 104 which brings the adhesively coated face of the base fabric into close association with the adhesively conditioned loops of the warp threads or parallel fibers carried by the two series of interlocking bars 66.

The base fabric, 90, which is now attached to the loops of the warp threads or parallel fibers, is passed through a conditioning device comprised of a plurality of heat rollers. The device consists actually of two sets of heated rollers. One set has the heated rollers 105 arranged in parallel relation being carried by a frame member 106 fixedly secured to bracket members 107, secured to the upright frame members 30. The second set of heat rollers 108 is arranged in parallel relation on frame members 109 movable toward and from the set of rollers 105 under spring tension in the following manner. The outer ends of the bracket members 107 are slotted as at 110 and through the slots extend pins 111 which are secured to the frame members 109. Springs 112 having one end secured to the pins 111, and the other end to any convenient portion of the bracket members 107 continually exert yielding force on the conditioning rollers 108 which urges the rolls toward the rollers 105.

After the base fabric 90 and attached warp threads or parallel fibers pass upward beyond the conditioning rolls 105 and 108 and before they pass over the rolls carried by the shaft 34 the operation is performed by the cutting means illustrated in detail in Figs. 11 and 12, and as indicated in Fig. 1. There are two sets of rolls, one mounted on the shaft 113, and the other on the shaft 114. The shafts are rotatably mounted in suitable members mounted on the topmost side frame members 12 and are arranged parallel to each other. The cutting devices mounted on the shafts 113 and 114 comprise spaced cylindrical pressure rolls 115, 116, 117, and 118, as mounted on the shaft 113 and similar members similarly indicated as mounted on the shaft 114. Between adjacent cylindrical rolls 115 and 116, 116 and 117, 117 and 118 are arranged the plurality of cutting blades 119 which define cylinders of a diameter equal substantially to the diameter of the cylindrical rolls referred to.

The rolls above described are arranged in the machine in the approximate position shown in Figs. 11 and 12 where it will be noted that the cutting blades 119 on the shaft 113 will cut or shear uppermost loops of the warp threads or those loops remote from the loops adhesively

applied to the base fabric 90 in a plurality of parallel bands. The parallel bands correspond not only to the blades 119, but to the aligned cylindrical members 118, 117 and 115 on the shaft 114. As the material passes upward past the shaft 114 that portion of the loops of the warp threads or parallelly arranged fibers which were not removed by the first set of cutters 119 are now removed by the sets of cutters on the shaft 114.

The cutting of the loops above referred to makes it possible to withdraw the parallelly arranged bars 66 from the warp threads or parallelly arranged fibers, and in order to support the now completed pile fabric consisting of the base fabric 90 with the loops of warp threads adhesively connected thereto the same is led over a roller 120 mounted on a shaft 121 and thence downwardly under a roller 122 through a cleaning device 123 and is thence formed into a roll 124. The series of parallelly arranged pairs of belts 60 and 61 carrying the spaced bars 66 are passed downwardly over the appropriate rolls to be again brought into position to repeat the sequence of operations above referred to.

Referring again to Fig. 1, and to Figs. 4 and 5 there is shown the tensioning device hereinbefore referred to. As before stated the warp threads or parallelly arranged fibers 73 pass between the tension rolls 80 and 81 under the tension bar 82 and through the slot formed by the spaced bars 83 before passing into the throat 70. The spaced bars 83 are carried by the end plates 84.

The end plates are spring suspended by the top and bottom springs 126 and 127, respectively. At one face of each of the plates 84 is secured a laterally extending stub shaft 125. The stub shafts, each of them, engage in an eccentrically positioned perforation in a bearing member 128 rotatably mounted in a hub 129 secured to and rotatable with a shaft 130, mounted in suitable members on the frame members 14. Secured to the shaft 130 is a pulley 131 in alignment with a pulley 132, secured to the shaft 55, and over these aligned pulleys runs a belt 133.

As the shaft 55 rotates a rotary movement will be imparted to the shaft 130 by the belt 133 and the rotation thereof will cause a reciprocatory motion to be imparted to the end plates 84, thus causing a reciprocatory motion to be imparted to the bars 83 and which has the effect of producing a wave motion in that part of the warp threads or parallelly arranged fibers 73 in the space between the bars 83 in the throat 70.

On the shaft 134 of the roller 80 is arranged a clutch member 135. This clutch member is fixedly secured to the shaft 134 and has cooperating therewith a complementary clutch member 136. Forming part of the complementary clutch member 136 is a pulley 137. The complementary clutch member 136 is recessed at 138 to form a housing for a compression spring 139 and, as the complementary clutch member 136 is loose on the shaft 134, such spring 139 tends to move such clutch member to the left, as shown in Fig. 4 and bring the clutch members 135 and 136 out of engagement with each other.

Loosely mounted on the shaft 134 is a cam member 140 which has its cam face in operative engagement with a cam rider 141, secured to a plate 142, attached to the frame member 14. The cam member 140 is fixed to the pulley 137 which latter is a fixed part of the complementary clutch member 136. Extending outwardly from the cam member 140 is an arm 143, the outer end of which is pivotally attached to a connecting rod 144. The other end of the connecting rod 144 is connected to a crank arm 145 pivotally mounted in a bearing member 146 on a shaft 147. Secured to the shaft 147 and, therefore, to the crank arm 145 is a balance lever 148 on one end of which is adjustably mounted a balance weight 149 and to the other end of which is secured a depending member 150. At the lower end of the depending member is the bar 82 above referred to. It should be understood, of course, that the bar 82 extends across the entire width of the machine so as to have the same engage with all of the warp threads or parallelly arranged fibers 73.

As the warp threads 73 are being fed to the machine they are given a vibratory or wave motion by the bar 82 and such motion is prevented from being transmitted backward by the bar 82 which also places the necessary tension on the fibers. If the machine is taking the fibers faster than the same are being fed thereto, the bar 82 is moved upwardly thereby causing a rotary movement of the cam 140 which moves the complementary clutch member 136 into association with the clutch member 135. It should be noted that the pulley 137 forming an integral portion of the clutch member 136 is in alignment with a pulley 151 on the shaft 55 and that a belt 152 runs over the pulleys 151 and 137 thereby imparting a rotary movement to the complementary clutch member 136. Therefore, when the clutch members 136 and 135 are moved into engagement with each other a rotary movement bearing a definite relation to the speed of rotation of the shaft 55 is imparted to the rolls 80, 81, and, therefore, the fibers 73 are fed into the machine as rapidly as the machine will take the same. On the contrary, if the machine is not able to properly operate upon the fibers 73 as fast as the fibers are fed thereto, the bar 82 will move downwardly thereby through the instrumentalities above noted imparting a rotary movement to the cam 140 in a direction opposite to that above noted, whereupon the clutch members 135 and 136 will move out of engagement with each other and rotary movement of the roll 80 will cease until the slack in the material thus far fed has been taken up.

As a modification of my improved machine, I may adopt the arrangement illustrated in Fig. 10 wherein the completed pile fabric is removed from engagement with the cross bars 66 by a different arrangement than that shown in Fig. 1. Referring to such Fig. 10, there is substituted in place of the shaft 34 of Fig. 1, a gear pulley mounted on the shaft 154, over which runs the endless chain or belt 60. Located above such shaft 154 is a second shaft 155 carrying a pulley over which runs the endless chain or belt 61. Intermediate the shafts 155 and 154 and on the other side of the completed pile fabric is arranged the shaft 121 carrying the pulley 120 and over which the pile fabric moves as in the case of the structure shown in Fig. 4.

In the arrangement shown in Fig. 10, the pile fabric has just been completed, and while still in engagement with the cross bars 66 of both the endless chains or belts 60 and 61, moves to the point at which is located the shaft 154 and its associated rollers. At this point, which is above the cutting members shown in Figs. 11 and 12, the endless chains or belts 60 and associated bars 66 are removed from the pile fabric

and also from the bars 66 associated with the endless chains or belts 61. At a point above the shaft 154 the completed pile fabric is led over the pulley 120 and thus separated from the bars 66 carried by the endless chains or belts 61, which chains or belts pass over the pulley associated with the shaft 155 to be moved again into operative association with the bars 66 on the endless chains or belts 60. By this arrangement any possible strain on the bars 66 or on the completed pile fabric is reduced to a minimum.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention.

I claim:

1. In an improved apparatus for manufacturing pile fabric, the combination of a source of supply of warp threads, two pairs of endless chain belts, two series of bars, each series including a plurality of parallelly arranged bars secured at their ends to a pair of the endless chain belts, driving means for moving the series of bars in unison and for maintaining the bars in parallel relation and for driving the same at any desired speed as a unit in a direction transverse to the length of the bars, said driving means being so arranged as to constrain the two series of bars to inter-engage with each other throughout any desired length of the series and in any desired rectilinear path, said driving means causing the two series of bars to form, as they inter-engage with each other in a desired rectilinear path, a throat into which the warp threads from the source of supply are fed into engagement with the bars and to form said warp threads into a sinuous path, and whereby the loops of the sinuously formed warp threads are arranged alternately on opposite faces of the inter-engaging parallel bars, means for applying a web of backing material to the loops of the warp threads on one of such faces, and means for severing the loops of the warped threads on the face of the parallelly arranged bars furthest from the backing material and separating the warped threads attached to the backing material from the inter-engaging bars.

2. In an improved apparatus for manufacturing pile fabric, the combination of a source of supply of warp threads, two pairs of endless chain belts, two series of bars, each series including a plurality of parallelly arranged bars secured at their ends to a pair of the endless chain belts, driving means for moving the series of bars in unison and for maintaining the bars in parallel relation and for driving the same at any desired speed as a unit in a direction transverse to the length of the bars, said driving means being so arranged as to constrain the two series of bars to inter-engage with each other throughout any desired length of the series and in any desired rectilinear path, said driving means causing the two series of bars to form, as they inter-engage with each other in a desired rectilinear path, a throat into which the warp threads from the source of supply are fed into engagement with the bars and to form said warp threads into a sinuous path, and whereby the loops of the sinuously formed warp threads are arranged alternately on opposite faces of the inter-engaging parallel bars, means for applying adhesive to the loops of the warp threads on one face of the inter-engaging bars and treating the adhesive to bring such adhesive into condition to have a backing material applied thereto, a source of supply of backing material, and means for attaching said backing material to the conditioned loops while maintaining the bars in inter-engaging relation, and means for severing the loops of the warped threads on the face of the parallelly arranged bars furthest from the backing material and separating the warped threads attached to the backing material from the inter-engaging bars.

3. In an improved apparatus for manufacturing pile fabric, the combination of a source of supply of warp threads, two pairs of endless chain belts, two series of bars, each series including a plurality of parallelly arranged bars secured at their ends to a pair of the endless chain belts, driving means for moving the series of bars in unison and for maintaining the bars in parallel relation and for driving the same at any desired speed as a unit in a direction transverse to the length of the bars, said driving means being so arranged as to constrain the two series of bars to inter-engage with each other throughout any desired length of the series and in any desired rectilinear path, said driving means causing the two series of bars to intermesh as they inter-engage with each other in a desired rectilinear path, means including a set of mutually parallel rotary elements for leading said endless chains into paths converging toward one another to form a throat into which the warp threads from the source of supply are fed into engagement with the bars and to form said warp threads into a sinuous path, and whereby the loops of the sinuously formed warp threads are arranged alternately on opposite faces of the inter-engaging parallel bars, means for applying adhesive to the loops of the warp threads on one face of the inter-engaging bars and treating the adhesive to bring such adhesive into condition to have a backing material applied thereto, a source of supply of backing material, and means for attaching said backing material to the conditioned loops while maintaining the bars in inter-engaging relation, means for treating the sinuously formed warp threads and backing material to permanently attach the backing material to the warp threads, and means for severing the loops of the warped threads on the face of the parallelly arranged bars furthest from the backing material and separating the warped threads attached to the backing material from the inter-engaging bars.

4. In an improved apparatus for manufacturing pile fabric, the combination of a source of supply of warp threads, two pairs of endless chain belts, two series of bars, each series including a plurality of parallelly arranged bars secured at their ends to a pair of the endless chain belts, driving means for moving the series of bars in unison and for maintaining the bars in parallel relation and for driving the same at any desired speed as a unit in a direction transverse to the length of the bars, said driving means being so arranged as to constrain the two series of bars to inter-engage with each other throughout any desired length of the series and in any desired rectilinear path, said driving means causing the two series of bars to intermesh as they inter-engage with each other in a desired rectilinear path, means including a set of mutually parallel rotary elements for leading said endless chains into paths converging toward one another to form a throat into which the warp threads from the source of supply are fed

into engagement with the bars and to form said warp threads into a sinuous path, and whereby the loops of the sinuously formed warp threads are arranged alternately on opposite faces of the inter-engaging parallel bars, means for applying adhesive to the loops of the warp threads on one face of the inter-engaging bars and treating the adhesive to bring such adhesive into condition to have a backing material applied thereto, a source of supply of backing material, and means for attaching said backing material to the conditioned loops while maintaining the bars in inter-engaging relation, means for treating the sinuously formed warp threads and backing material to permanently attach the backing material to the warp threads, means for displacing the bars of one pair of said endless chain belts relative to the bars of the other pair of endless chain belts for control of the positioning of the warp threads thereon in advance of the stage of attachment of the warp threads to the backing material, means for severing the loops of the warp threads on the opposite face of the parallelly arranged bars and separating the warp threads attached to the backing material from the inter-engaging bars.

5. In an improved apparatus for manufacturing pile fabric, the combination of a source of supply of warp threads, two series of bars, pairs of endless carrier chains arranged parallel to and separated from each other, each series of parallelly arranged bars secured at their ends to a pair of the endless carrier chains, driving members for driving the endless carrier chains and for moving the same in unison in a direction transverse to the length of the bars and at any desired speed, said driving means being so arranged as to constrain the two pairs of bars to inter-engage with each other throughout any desired length of the series in any desired rectilinear path or paths and to form, as the two series of bars inter-engage with each other, a throat into which the warp threads from the source of supply are fed into engagement with the bars and to thereby be formed into a sinuous form having loops arranged alternately on opposite faces of the inter-engaging parallel bars, and means for adhesively applying a web of backing material to the loops on one face of the inter-engaged bars traveling in a rectilinear path, and means for severing the loops of the warped threads on the face of the parallelly arranged bars furthest from the backing material and separating the warped threads attached to the backing material from the inter-engaging bars.

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