Dec. 31, 1940. L. C. MILLER ET AL 2,226,632

DEVICE FOR MAKING PILE FABRICS

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FIG. 1.

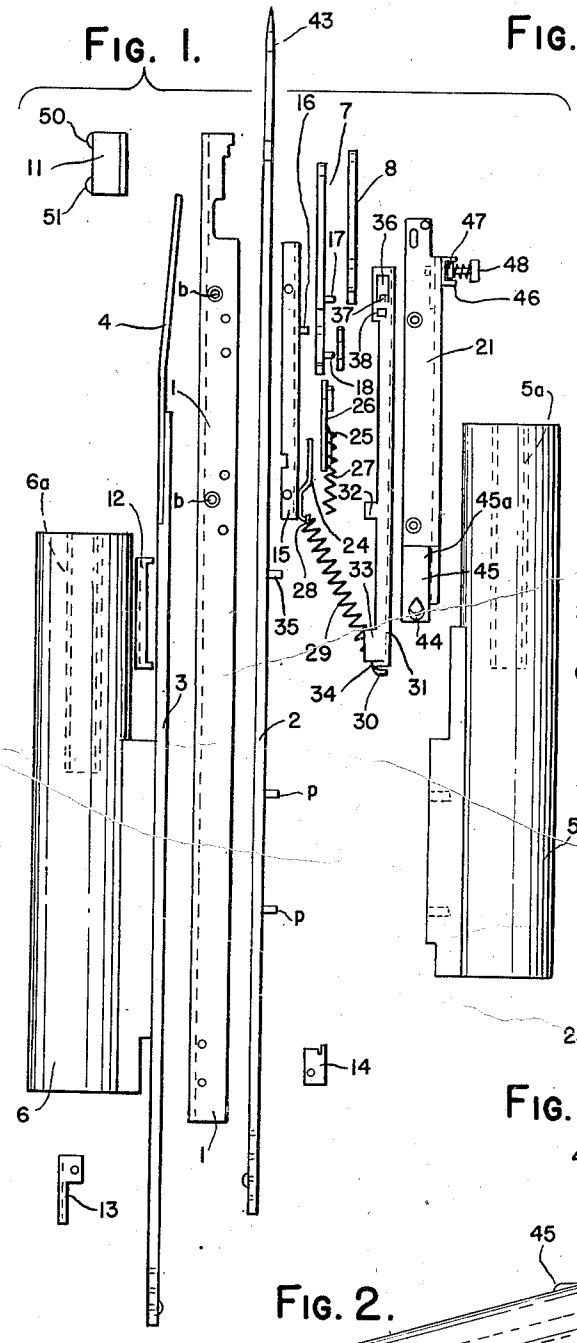

FIG. 3.

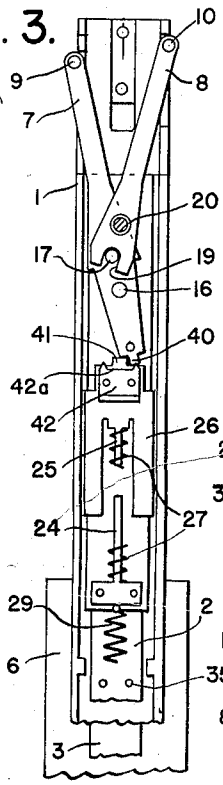

FIG. 4.

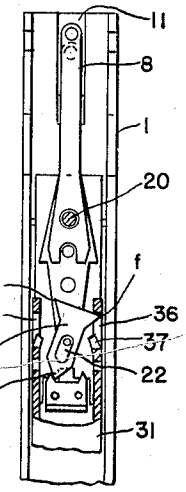

FIG. 6.

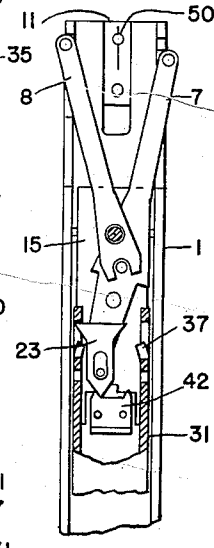

FIG. 5.

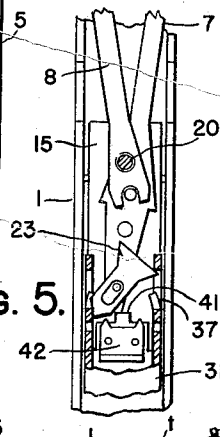

FIG. 2.

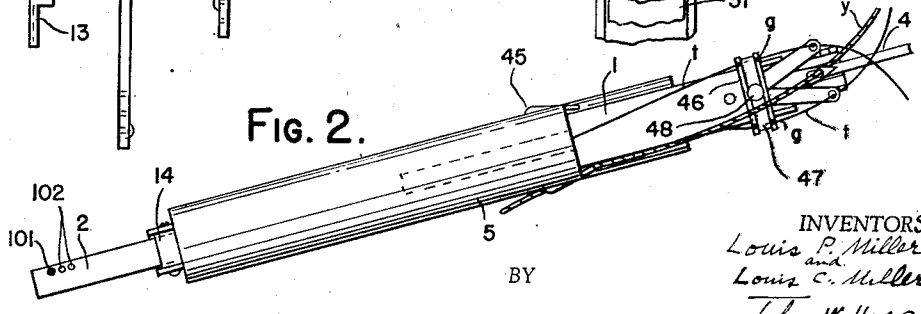

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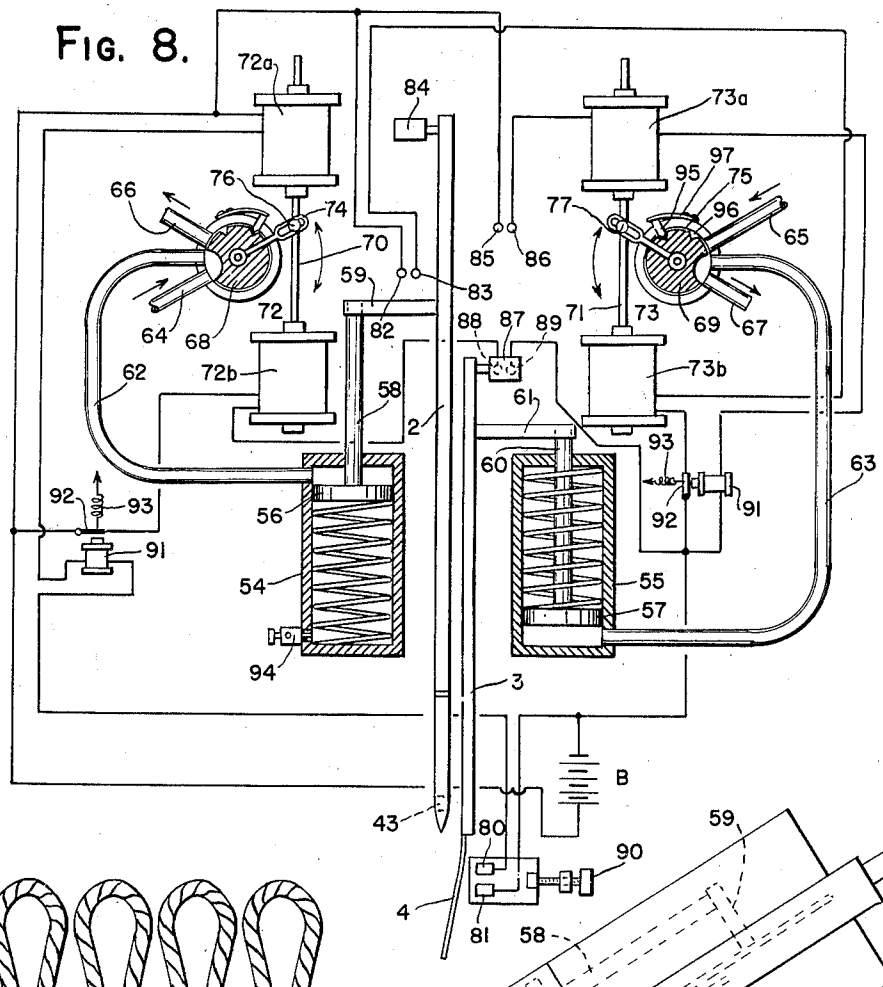
FIG. 8.



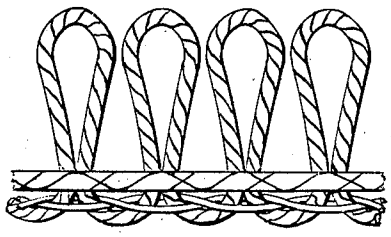


FIG. 10.

FIG. 7.

FIG. 9.

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DEVICE FOR MAKING PILE FABRICS

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Application July 14, 1937, Serial No. 153,633

8 Claims. (Cl. 112—80)

This invention relates to a device for making pile fabrics.

Pile fabrics made by devices which have heretofore been used for inserting pile yarn through a base fabric have not been satisfactory in as much as the inserted pile loops tend to pull out unless an additional operation of coating the base of the pile fabric with an adhesive is performed, and this operation impairs the quality of the product.

By our invention we provide a device which in addition to a needle for inserting pile yarn through a base material, and a follower by which yarn inserted through the base material by the needle may be held in position while the needle is retracted for the next stroke, comprises means for laying binding filaments to engage the legs of the pile loops. The binding filament employed may be of any suitable kind. If desired, it may be a soluble thread such as cellulose acetate, and by applying a solvent to the binding thread it may be caused to adhere to, and fuse with, the base fabric, thereby firmly binding the loops within the base fabric in the manner set forth in the co-pending application Serial No. 131,284 filed by Louis P. Miller on March 13, 1937.

For the purpose of a full description of the invention we have disclosed herein two embodiments of the invention, one of which may be manually operated and the other power operated. Like numerals are used to represent like parts throughout. It will be understood that the number and arrangement of the parts may be widely varied without departing from the scope of the claims appended hereto.

In the drawings:

Figure 1 is an exploded view of a manually operable embodiment of my invention;

Figure 2 is a top view of the device of Figure 1, showing the needle bar withdrawn and the loop follower in extended position;

Figure 3 is a plan view of a horizontal section of a portion of the device, showing the arms which carry the binding thread in their position at the end of the down stroke of the needle bar;

Figure 4 is a detail view, partly in section, showing the binding thread arms crossing during the up stroke of the needle bar;

Figure 5 is a detail view similar to Figure 4 but showing the relation of the parts at the top of the up stroke of the needle bar;

Figure 6 is a detail view showing the relation of the parts at the bottom of the down stroke of the needle bar, similar to Figure 3 but showing the arms oppositely crossed after the next succeeding reciprocation of the needle bar;

Figure 7 is a plan view of a power operated embodiment of the invention employing a telescopic frame;

Figure 8 is a schematic view of a system using air under pressure as a power means, and of an electric control circuit therefore; and

Figure 9 is a detail of a portion of the needle bar showing a number of pin receiving apertures whereby the position of certain pins may be adjusted to conform to adjustments in the length of the frame to form pile loops of various predetermined lengths.

Figure 10 shows diagrammatically the construction of a tufted rug or other pile fabric with loops of pile yarn inserted through the base fabric and fusible binding threads or filaments extending around the legs of the loops on the side of the fabric opposite to the loops and between the base fabric and the portions of the pile yarn overlying the base fabric on the side opposite to the loops.

The numeral 1 indicates a channel shaped frame in which the needle bar 2 is slidably mounted. Mounted on the side of the channel frame 1 opposite the needle bar 2 is the loop follower bar 3 having at its front end the flexible tip 4 which is inclined so that its forward end approaches very close to the needle bar 2. Secured to needle bar 2 and follower bar 3 respectively by pins *p*, *p* on the said bars, are cylindrical members 5 and 6 which constitute convenient handles for manually reciprocating the bars 2 and 3. As illustrated in Figure 1 the members 5 and 6 have hollow, annular inwardly extending flanges, 5*a* and 6*a* respectively, on which spools of binding thread may be supported, and through which the threads may be led from the cylinders 5 and 6 to the pivoted arms 7 and 8 and threaded through the respective eyes 9 and 10 thereof.

The follower 3 is retained in position by means of channel guides 11, 12 and 13. The needle bar 2 is retained within the channel frame 1 by means of channel shaped guide member 14, which is detachably secured to frame 1 near its rear end and bridges over the needle bar, and by channel shaped member 15 which bridges over the needle bar in front of cylinder 5 and, besides being a guide for the needle bar 2 serves as a base on which is mounted the mechanism for crossing the binding-thread bearing arms 7 and 8.

The member 15 is secured within the channel

shaped frame 1 by means of screws extending laterally through registering apertures *b*, *b* in the side flanges of frame 1 and member 15. Adjacent the forward end of base member 15 the arm 7 is pivotally mounted on pin 16. Pins 17 and 18 are provided on arm 7 on opposite sides of pivot 16. Pin 17 is in front of pivot 16 and engages a notch 19 in the rear end of the arm 8 which is pivoted on pin 20 projecting downwardly from cover element 21. Movement of arm 7 thus causes arm 8 to rotate on its pivot in the opposite direction. The pin 18 is located adjacent the rear end of the arm 7 and engages a slot 22 in the cam follower 23.

Adjacent the rear end of member 15 is secured the forwardly extending finger 24, alined with finger 25 extending rearwardly from the bifurcated rear end of slide member 26 which overlies the base member 15. Extending between, and supported on the fingers 24 and 25 is the coil spring 27 which tends to return slide 26 when it is moved relatively to the base 15.

At the base of finger 24 is a lug 28 which engages one end of spring 29 the other end of which is connected to a hook 30 on the rear end of slide member 31. This member is channel shaped, having side flanges which extend down on either side of member 15, and having extended portions 32 and 33 which serve as spacing members. At the rear end of member 31 is a downwardly projecting flange 34*a* which, when the needle bar is retracted, is engaged by pins 35 on the needle bar, thereby moving the slide 31 rearwardly against the action of spring 29. In the side flanges of the member 31, adjacent its front end, rectangular slots 36 are provided and behind the slots are fingers 37 which are inclined inwardly from the side flanges. When the device is assembled the member 31 is positioned so that the slots 36 are adjacent the pivoted cam follower 23. As the needle bar is reciprocated the side flanges *f*, *f* of cam follower 23 are alternately engaged, by the fingers 37 on the down stroke of the needle bar 2, and by the shoulders 36*a* at the front of the slots 36 on the up stroke of bar 2, thus actuating cam follower 23 to cause angular movement of the arms 7 and 8.

Rectangular slots 38 may also be provided at the rear of fingers 37 to receive the point 39 of cam follower 23 at the respective ends of its travel.

At its rear end the arm 7 has a projection 40, indicated in Figure 3, which when the slide 26 is at rest abuts against one side or the other of the projection 41 on the front end of slide member 26, depending on the position assumed by arm 7 at the end of the last up stroke of the needle bar. Secured on slide 26 adjacent its front end is the member 42, the front edge of which constitutes a cam surface 42*a* against which the rear point 39 of cam follower 23 travels. It will be noted that the two extremities of the cam surface 42*a* are somewhat elevated. During each complete reciprocation of the needle bar the point 39 of cam follower 23 moves entirely across the cam surface and comes to rest beyond the elevated portions of the cam surface. The elevated portions serve to prevent accidental movement of member 23, but when the needle bar is positively actuated the pin of the member 23 readily slips over the elevated portions of the cam surface.

Adjacent the pointed end of the needle bar 2 an eye 43 is provided to receive a pile forming yarn *y*. The yarn may be guided to the needle eye 43, from a spool or other source (not shown), through guide 44 in spring arm 45, the free end 45*a* of which may serve as a pile yarn tensioning device.

The acetate or other binding threads, *t*—*t*, are lead from cylinders 5 and 6, to the respective sides of the binding thread tensioning means. As illustrated herein this means constitutes a cross bar 46 mounted near the front of the frame and having grooves *g*, *g* to receive the binding threads, and a cover 47 secured over the cross bar by an adjustable screw 48 whereby the tension on the threads may be varied.

In operation the needle is preferably held pointed downwardly. The operator first slides the needle bar 2 down thereby inserting the point of the needle bar and a portion of the pile yarn threaded through the eye 43 of the needle, through the base fabric. He then slides the follower bar 3 forwardly until the flexible tip 4 is also inserted through the base cloth and engages the pile yarn close to the eye 43 of the needle bar, thus retaining the last loop of yarn inserted through the base material by the needle bar while the needle bar is retracted for the next stroke. The follower remains down until the needle bar has inserted another loop through the base material. The follower is then reciprocated and engages the new loop.

As the needle bar moves on its up stroke pins 35 thereon engage the rear end 34 of slide member 31 and move it rearwardly. As the slide 31 moves rearwardly one of the slots 36 engages one of the lateral flanges *f*, *f* of cam follower 23 causing it to raise slide 26 against the action of spring 27, thereby disengaging the projections 40 and 41 and causing the point 39 of member 23 to travel across the cam surface 42*a* at the same time exerting a pull on its pivot pin 21 and thereby rotating arm 7 on its axis. The movement of arm 7 in turn causes movement of arm 8 in the opposite direction. Member 23 is thus rotated on its pivot 18 and the other of the lateral flanges *f*, *f* is protruded into the slot 36 opposite to the one engaged by the cam follower on the preceding stroke, in the position illustrated in Figure 5. As soon as the point of cam follower 23 ceases to exert pressure on it slide 26 resumes its normal position thus bringing into abutting relation the faces of projections 40 and 41 opposite to those engaged on the preceding stroke of the needle bar. At the end of the up stroke of the needle bar 2 the point 39 of member 23 is beyond the cam surface 42*a* at one end or the other, depending on the position of arm 7, and its opposite lateral flange *f* is engaged in the opposite slot 36.

Upon the forward movement of needle bar 2 member 23 is urged forwardly by one of the inwardly projecting fingers 37 on member 31, causing cam follower 23 to move forward relatively to pivot 18 and to be rotated on its pivot to the position shown in Figure 6 in preparation for the next return stroke when the arms 7 and 8 will be crossed in the opposite direction.

The second small set of rectangular slots in the side flanges of members 31 below the fingers 37 serve merely to receive the lower point of member 23 at the extremes of its angular motion thereby increasing its range of movement within the channel of frame member 1.

As the follower remains engaged through the base material when the needle is withdrawn it will be seen that, in the hand operable embodiment of the invention described above, the engaged tip of the follower will act as a pivot on

which the device tends to rotate with the shock of each retraction of the needle bar. By controlling the distance of the tip of the follower 3 from the path of the needle bar the extent to which the device will be rotated in this way upon each stroke of the needle bar, may be controlled. Adjustable stop members 50 and 51 are provided in follower guide 11, the ends of which press against the flexible follower tip 4 when it is in extended position. By adjusting members 50 and 51 the distance between member 4 and the path of the needle bar may be regulated and in this way the distance between successive loops can be controlled.

In Figures 6, 7 and 8 a power driven embodiment of my invention is shown wherein compressed air is used to move the needle bar 2 on its down stroke, and the follower bar 3 on its up stroke, and springs are employed to move the bars in the opposite directions. The air supply is controlled by electrically operated valve means.

The numeral 52 indicates generally the frame which may be substantially H-shaped to provide slideways for the needle bar 2 and follower bar 3 and has an enlarged central portion 53 constituting the housing for the valve mechanism. This mechanism includes two cylinders 54 and 55 in which are contained the piston heads 56 and 57 respectively. The piston head 56 is connected by piston rod 58 and bridge member 59 to the needle bar 2. Movement of the piston head 56 is therefore transmitted to needle bar 2. Similarly piston head 57 is connected by piston rod 60 and bridge member 61 to follower bar 3.

In front of the piston head in each of the cylinders 54 and 55 a spring S is provided whereby the pistons may be returned to normal position whenever the air is exhausted from the cylinders.

Air for operating the pistons may be admitted to the cylinders 54 and 55 through the tubes 62 and 63 respectively. These tubes may be alternately connected to the inlet passages 64 and 65 or to the exhaust passages 66 and 67 respectively by the rotary valves 68 and 69. The valves 68 and 69 are actuated by the movement of the cores 70 and 71 respectively of solenoids 72 and 73 comprising the coils 72*a*, 72*b*, and 73*a*, 73*b* respectively. The valves 68 and 69 are respectively joined to the cores of the solenoids by arms 74 and 75 the ends of which are slotted to make a sliding connection with pins 76 and 77 on the respective cores.

As illustrated in Figure 8 when core 70 moves in the direction of coil 72*a* valve 68 will be rotated thereby connecting tube 62 with inlet passage 64 and air will be forced into cylinder 54 above piston head 56 thus moving the needle bar 2 on its down stroke. Similarly when core 70 is moved in the direction of coil 72*b* the valve will be rotated to connect tube 62 with exhaust passage 66 permitting the air to escape from cylinder 54 whereupon spring S will return the depressed piston 58 thus moving the needle bar 2 on its up stroke. In the same way when core 71 moves in the direction of coil 73*a* valve 69 will be rotated thereby connecting tube 63 with the exhaust passage 67 permitting the air to escape from cylinder 55 whereupon spring S will return the depressed piston 60 thus moving the follower bar on its down stroke. Similarly when core 71 is moved in the direction of coil 73*b* valve 69 will be rotated to connect tube 63 with inlet passage 65 and air will be forced into cylinder 55 above piston head 57 thus moving the follower bar on its up stroke.

The electric circuit for operating the valves 68 and 69 controlling solenoids 72 and 73 includes the pairs of contacts 80 and 81 located at the front end of the frame adjacent the follower bar and adapted to be bridged by the tip 4 of the follower bar 3 to actuate solenoid coil 72*a* causing air to be admitted to cylinder 54 for the down stroke of the needle bar; contacts 82 and 83 which are adapted to be bridged by contact member 84, carried at the rear end of needle bar 2, to actuate solenoid coil 73*b* causing air to be admitted to cylinder 55 to retract the follower bar; contacts 85 and 86 which are adapted to be bridged by contact member 87 carried at the rear end of the follower bar to actuate solenoid coil 73*a* causing air to be exhausted from cylinder 55 thereby allowing the spring S in cylinder 55 to return the follower bar to its down position, and contacts 88 and 89 which are adapted to be bridged by contact 87 on the rear end of the follower bar when the follower bar reaches the end of its down stroke thereby actuating solenoid 72*b*, causing cylinder 54 to be connected to exhaust, and allowing spring S in cylinder 54 to return the needle bar to its up position.

The contact members 80 and 81 are preferably adjustable, as by screw 90, toward or away from the follower bar to control the extent to which the frame may move forward relatively to the follower bar. When the device is moved forward for each new stroke of the needle bar the follower bar is extended through the base material and the extent to which the device can move forward is determined by the distance the frame can move before being stopped by contact of the tip 4 of the follower bar with the stops 80 and 81. As disclosed herein forward movement of the device is ended simultaneously with actuation of the needle bar to commence its next stroke due to the tip of the follower bar bridging stops 80 and 81, which serve also as electrical contacts.

In the operation of this embodiment of the invention the follower is initially inserted through the base material and the device is moved forward sufficiently to cause the tip 4 of the follower bar 3 to abut against and to bridge the adjustable contacts 80 and 81, after which the needle and follower bars are reciprocated automatically. It will be noted that the electrical control circuit is so devised that the follower bar moves upwardly and downwardly again while the needle is inserted through the base material, and remains inserted through the base material while the needle bar is retracted on one stroke and moves downwardly on its next stroke.

To prevent coils 72*b* and 73*b* from being actuated at the same time that coils 72*a* and 73*a* are actuated circuit breakers 91 are provided in the connections leading to coils 73*b* and 72*b* respectively. The switches 92 provided in connection with each circuit breaker are normally retained in closed position by means of springs 93.

In order to obtain smoother action of the pistons within the cylinders 54 and 55 we provide each cylinder at its air intake end with a needle valve 94 of any suitable conventional structure. We prefer also to provide each of the valves 68 and 69 with a spring detent 95 the point of which seats in one of two concavities 46 provided therefore in the periphery of each valve to prevent accidental movement of the valves. The detents 95 are readily freed from their seats 96 upon movement of the valve due to the resiliency of the spring arms 97 by which the detents are fixed to the valve casing.

In Figure 7 a telescopic frame is illustrated, the two parts of the frame being joined together by screws 98 which may be positioned in different apertures 99 to adjust the distance between the front ends of the needle and follower bars and the shoe 100 at the front end of the frame 52. The length of the pile loops formed depends of course on the distance the eye of the needle moves below the base material. By adjusting the length of the frame relatively to the needle bar the length of the pile loops formed may be varied over a wide range. In making this adjustment the position of pins 35 on needle bar 2 which engage the flange 34 at the rear of slide 31 should also be adjusted and in Figure 9 a detail of needle bar 2 is shown having a number of apertures 35*a* adapted to receive pins 35. The position of pins 35 may thus be raised according to the adjustment of the telescopic frame.

In the hand operated embodiment of the invention the length of the stroke of the needle bar 2 and the follower bar 3 may be adjusted by positioning stops 101 in the various apertures 102 provided therefor in the rear ends of the bars. The down stroke of the bars is limited by contact of the stops 101 with the rear channel guides for the needle and the follower bars respectively.

In the method of carrying out our invention either by hand or by power operated means, as illustrated in Figure 10, the needle bar 2, the eye of which is threaded with pile yarn *y*, is inserted through the base fabric 110 forming a loop 111. The follower bar 3 is next actuated and its tip portion 4 inserted through the same interstice of the fabric through which the legs of the loop of yarn *y* extends, so that the tip engages the loop and prevents its withdrawal with the needle bar. The needle bar 2 is then withdrawn from the fabric and the arms 7 and 8 carrying the fusible binding threads move in opposite directions across the line of the loops. The device is then inclined forwardly and the needle bar 2 again inserted through the base fabric thus carrying the yarn *y* forward and over the previously crossed fusible threads or filaments *t*, and the aforesaid steps are repeated. The loops 111 are thus connected by portions 112 of yarn overlying the surface of the base fabric on the side of the base fabric opposite to the loops, and between the base fabric and the portions of the pile yarn overlying the base fabric, threads or filaments, *t*, of cellulose acetate or other fusible material are present. As illustrated in Figure 10 the fusible threads or filaments *t* are passed between and on alternate sides of successive loops thus encircling the legs of each loop of pile yarn *y*. It will be noted that the cellulosic or other fusible material is present only along the lines of loops, and not substantially between the lines of loops or on the under or exposed surface of the portions of the pile yarn *y* overlying the base fabric on the side opposite to the loops.

After the pile and the fusible threads or filaments are in position the latter are partly dissolved or fused in any suitable manner as by wetting the cellulose acetate filaments with acetone, either alone or in combination with a suitable plasticiser, or subjecting the fusible filaments to heat treatment, or a suitable vapor, or other means for fusing the filaments until it becomes plastic and penetrates the portions of the pile yarn and base fabric between which it is interposed. The fused material is then indurated. The product thus formed has the advantages that the pile yarn and base fabric are firmly secured together, and the desirable qualities of softness and flexibility are retained because the fused material is not present over the entire back of the completed fabric, but only along the line of the loops, and substantially within the completed fabric.

What we claim is:

1. A device for making pile fabrics comprising a frame, a needle bar and a follower bar slideably mounted therein, and adapted to be manually operated separately, a pair of thread throwing arms pivotally mounted in the frame each having an eye in its free end to receive a thread, spool supports fixed to the needle bar and carrier bar respectively and thread tensioning means intermediate said spool supports and the eyes of said thread throwing arms, means for rotating one of said arms so that its thread carrying end moves across the line of stitch once for each reciprocation of the needle bar, and means interengaging the two thread throwing arms whereby the threaded end of the second arm will be moved across the line of stitch in the opposite direction to the first arm when the first arm is actuated.

2. A device for making pile fabrics comprising a channel frame, a needle bar and a follower bar slideably mounted therein, a base member fixedly secured in the channel frame, a thread throwing arm pivotally mounted on said base, a second thread throwing arm separately pivoted in the said frame and having means engageable with the first arm in such a manner that upon movement of the first arm both arms will be rotated in opposite directions across the line of stitch, a cam follower attached to said first arm to the rear of its pivot, a slideable member having a cam surface cooperating with said cam follower, a second slide member moveable with the needle bar and having means adapted to contact the cam follower and to cooperate with the cam surface so as to cause said thread throwing arms to move in opposite directions across said line of stitch once for each reciprocation of the needle.

3. A device for making pile fabrics comprising a frame, a needle bar, and a follower slideably mounted in the frame, and each having a handle to facilitate manual reciprocation thereof, a pair of pivoted arms having thread receiving eyes at their free ends pivotally mounted on the frame in front of the needle bar and arranged so that rotary movement of the free end of one arm across the path of the needle bar in one direction causes similar movement of the other arm in the other direction, a slideable cam member, means whereby the said slideable cam is reciprocated in timed relation to movements of the needle bar, a cam follower, and means interengaging one of said arms and said cam follower such that the said arms will be caused to move across the path of the needle bar once for each reciprocation of the needle bar.

4. A device for making pile fabrics comprising a frame, a needle bar, and a follower slideably mounted in the frame and each adapted to be manually reciprocated, a pair of pivotally mounted crossed arms mounted on the frame, having thread receiving openings in their free ends, a member slideably mounted in the frame having a cam face, a cam follower interposed between the cam surface and said crossed arms and a second slide member in said frame actuated by movement of the needle bar and adapted to actuate the said cam face carrying member and the cam

follower whereby the pivoted thread throwing arms are moved in opposite directions transversely across the path of the needle once for each reciprocation of the needle bar.

5. Apparatus for making pile fabrics comprising a needle bar and a follower bar, a motor to project and withdraw said needle bar and said follower bar respectively, controlling means for each of said motors, and means influenced by said needle bar and follower bar to set each of the controlling means to transmit a power medium to said motors and exhaust same therefrom to cause said motors to move said needle bar and follower bar in alternation.

6. Apparatus for making pile fabrics comprising a needle bar and a follower bar, a frame, and means for mounting said bars in the frame so that each is capable of reciprocable motion, means to reciprocate each of said bars, means to control said reciprocating means including a number of interconnected electrical circuits, and means carried by the said bars to close the said circuits in sequence such that the bars will be alternately reciprocated.

7. Apparatus for making pile fabrics comprising a needle bar and a follower bar, a frame, and means for mounting said bars in the frame so that each is capable of reciprocable motion, means for reciprocating each bar including a cylinder, a piston, a fluid power medium supply, means to transmit said power medium to said cylinder and exhaust it therefrom, and control means for said fluid power medium including a valve, a solenoid for operating the valve, and a number of related electrical circuits for energizing the solenoids adapted to be closed in sequence in accordance with the position of the said bars.

8. A device for making pile fabrics comprising in combination a support, a needle bar and a follower bar mounted in said support so as to be capable of reciprocating movement, a piston carried by each of said bars, a cylinder enclosing each piston member, a connection between a source of fluid pressure and each chamber on one side of said member, a spring in each chamber on the other side of said piston member, a valve in said fluid pressure connection, an electrical circuit for controlling the valve including a solenoid, and means interconnecting the core of said solenoid and said valve whereby the latter may be opened or closed to admit fluid pressure to said cylinder, said circuit including a number of contacts adapted to be closed in sequence by the bars at predetermined points in their travel.

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