

[54] **APPARATUS FOR MAKING A
PATTERN ON A FIBROUS WEB**

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[58] Field of Search28/4 R, 4 N, 72.2 R, 72.2 P,
28/72 P; 156/72, 148; 19/161 R, 161 P;
139/59, 317

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[57] **ABSTRACT**

A web is transported on a table crossed by a needle holder bar in which a row of needles is mounted for movement between retracted and advanced positions. Selected needles of the row are locked in the advanced position by control means of the Jacquard machine type. When the table with the web is moved toward the needles, the selected locked needles penetrate the web, forming depressed portions in the same, while the non-selected freely movable needles are pushed back by the web to retracted positions. After each step of the web, a row of depressed and non-depressed portions is formed so that the depressed portions form a depressed pattern on the web.

If the web has two layers of different colors, fibers of the depressed portions of one layer are pushed through the other layer and form a colored pattern on the face of the same.

13 Claims, 4 Drawing Figures

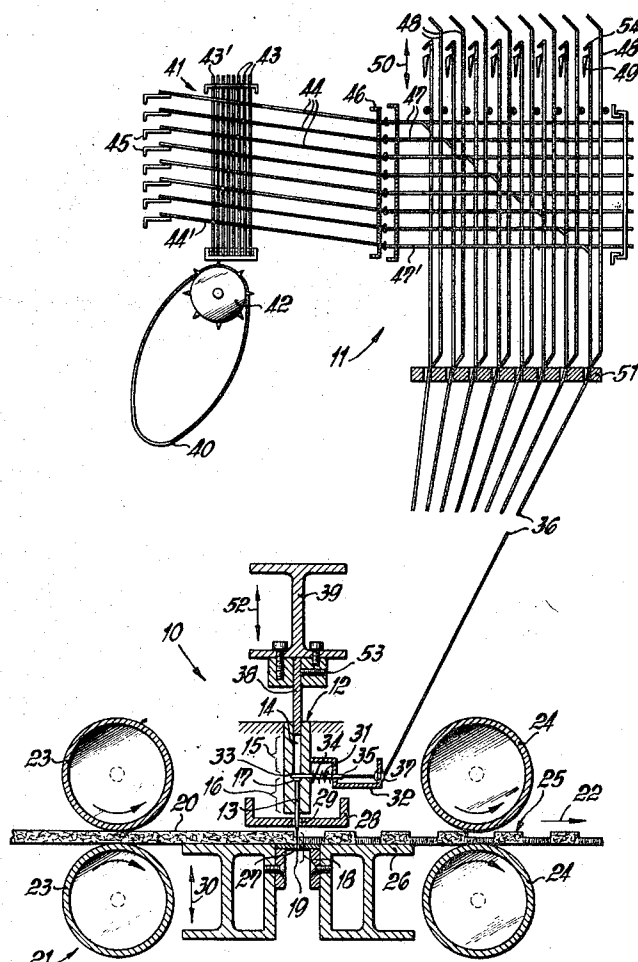


FIG. 2

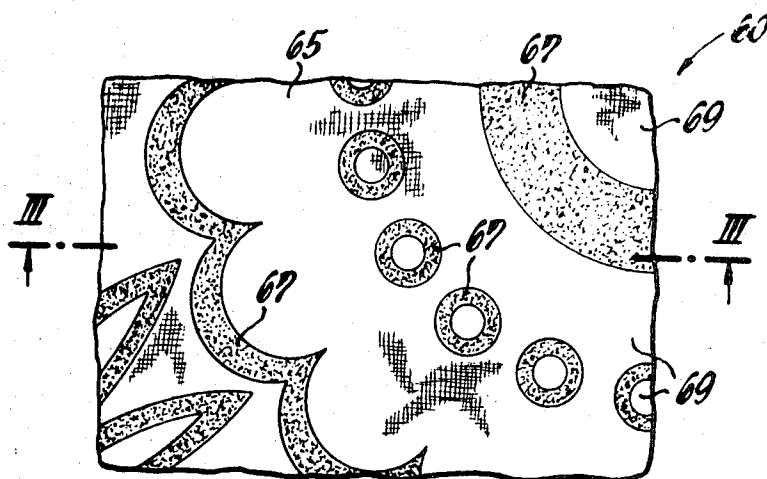


FIG. 3

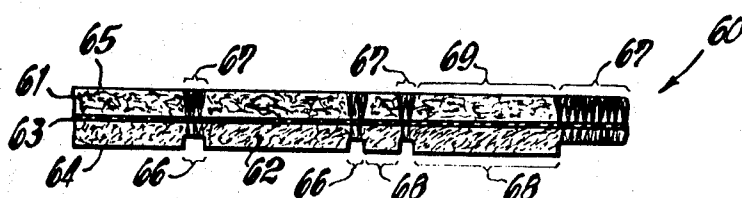
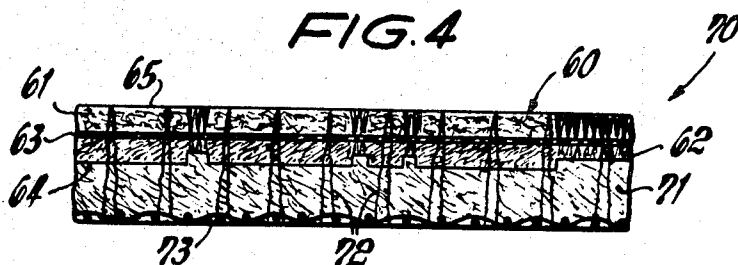


FIG. 4



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APPARATUS FOR MAKING A PATTERN ON A FIBROUS WEB

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for forming a relief pattern, or colored pattern, on a web, preferably a web consisting of a fibrous material.

It is known to stitch a fibrous web by needles in order to mechanically strengthen the web, and the fibers of the web may be additionally bonded by an adhesive. Webs treated in this manner have a felt-like appearance, and are used as floor coverings, decorative material, and furniture upholstery material. Depending on the intended use, the material, thickness and stiffness of the finished product are determined. In contrast to woven or knitted textile fabrics, it is very difficult to provide a design or pattern on a web reinforced by stitching. There is the possibility of using fibers of different color in the fleece before the same is stitched, and the stitched web has a marble design. It is not possible to produce design patterns by this method.

It has also been proposed to imprint fibrous fleeces in different colors before the stitching with needles. This has the disadvantage that the printing and drying is time consuming and expensive. Furthermore, it is not possible to penetrate the inner layers of the fleece by colors and dyes. This is particularly important for a good patterned design which can be made subject to great wear.

It is also known to produce strip-shaped patterns by needles of different length, or by arranging the needles at different distances from each other. Very simple patterns can be obtained in this manner. Another possibility is to move the needle transversely to the direction of movement of the web between successive needle operations so that repeated design patterns, for example a checkerboard design, can be obtained.

It is also known to arrange needles in accordance with a desired pattern, and penetrate the web by a single stroke of all needles so that a short pattern can be repeated on the web by transporting the web stepwise. The arrangements of the prior art for forming a pattern on a fibrous web permit only the making of very narrow design patterns which have to be repeated at short distances, since otherwise the number of needles becomes too high, and the control of the machine too complicated.

SUMMARY OF THE INVENTION

It is one object of the invention to provide an apparatus for forming a relief pattern, or a colored pattern on a fibrous web reinforced by stitching.

Another object of the invention is to place needles selectively, and under the control of program control means, in selected positions in which they penetrate into a fibrous web, while other needles are not selected, and do not penetrate into the web.

The objects of the invention are obtained in accordance with the invention by mounting needles in a needle holder for longitudinal movement, and to lock selected needles so that the same can penetrate the web, while non-selected needles are pushed back by the web to inoperative positions, and do not penetrate the web. An apparatus constructed in this manner is extremely simple, and in order to obtain a pattern on a web, it is only necessary to determine the desired pat-

tern, and to set program control means accordingly, so that the program control means select the locked needles in accordance with the pattern. A card with punched holes can be used for this purpose with a Jacquard machine. The presence or absence of punched holes determines whether a locking means is operated, or not operated for locking, or not locking, the respective correlated needles, and as explained above, only the locked needles are capable of penetrating the web, and to form a depressed pattern portion in the same. Mechanical or electrical sensing means may be used for sensing the holes in the card.

However, it is evident that other program control means, responding to magnetic or electric signals recorded on a magnetic tape, may be used.

The record carrier on which the program is recorded, is stepwise sensed, and the determined control impulses automatically carried out by the control means, so that the locking means either lock or release the respective needles. When a locking means is in the locking position, the respective needle is locked, and cannot be displaced by the web moving toward the needle, so that the needle penetrates into the web. When the web moves away from the needle holder with the needles, the web is stripped off the needles. Those needles which are not locked are pushed by other portions of the web to an inoperative position completely located in the needle holder means.

In accordance with the control signals from the program control means, the needles produce in successive operational cycles, stitches of different density in accordance with the pattern recorded as a program. If in one portion of the web, a number of needles produce dense stitches, the fibers or threads of the web are depressed to a substantial degree, and are compressed so that the respective surface portion of the web is depressed and lower than the other surface portions in which due to unlocking of the needles, the needles were unable to penetrate the fabric by densely arranged stitches. In this manner, a relief pattern is obtained, since the portions of the web with dense stitches are thinner than portions of the web where the stitching is less dense.

If the web consists of two layers of different colors which are superimposed and then together stitched in accordance with the invention, a colored pattern is obtained on the side of the web remote from the needles.

Due to the stitching by the needles, the rear face of one layer is compressed in certain pattern determined portions, and the fibers are pushed from this layer into and through the other layer and form a pattern on the front face of the other layer. Dependent on the density of the stitching by the needles, the original color of the front layer is changed by fibers of the rear layer. Where web portions in the original color of the front layers are desired, the web is not stitched in the respective region, or only stitched by a few needles which are locked in accordance with the invention.

Irrespective of whether a relief pattern, or a colored pattern is desired, the final pattern is influenced by the color, layer, thickness, density of the stitching, and by the material of the web. If in the initial material, a comparatively large layer is penetrated by the needles, a clear relief structure is obtained if stitching of different density is applied to different portions of the pattern.

On the other hand, if thin fibrous layers are used, and there is not much difference in the density of the stitching, the relief pattern is not pronounced, but the color pattern on the other side of the web is clearly discernable.

If the desired pattern requires comparatively large web portions which are not stitched, it is advisable to place a powder of a thermoplastic synthetic bonding agent between the layers of the web, and to heat the web after stitching so that the layers are not only connected by the stitching, but also by the bonding agent, and adhesively adhere to each other. For heating and drying the bonding agent, it is advantageous to blow hot air into the fibrous web, since in this manner, the bonding agent is quickly heated.

If only a colored design pattern is desired, and no relief pattern is wanted, while a web of great thickness is required, it is possible to mount the stitched web on a reinforcing other web and to loosely stitch the two webs to each other so that the colored design of the patterned web forms the front face of the finished composite fabric, while the relief structure is covered.

The apparatus of the invention not only permits the stitching of the web to be of different density, in accordance with the pattern, but it is also possible to permit the needles to penetrate to different depths of the web. In one arrangement, several rows of needles are mounted in the needle holders, which are of different length, or perform strokes of different length relative to the web. By controlling the locking means for the needles of different length, it is possible that stitches are either made by a long deeply penetrating needle, or by a short, less deep penetrating needle.

Another possibility is to associate each needle with several locking means which in the operative locking positions thereof partly or totally prevent the displacement of the needles. For example, if a first locking means is placed in the locking position, the needle is supported during the working stroke, and will not penetrate the web. However, if the first locking means unlocks the needle, but another locking means for the same needle is moved to the locking position, during the following stroke of the machine, the needle can be pushed into the holder for a short distance, until abutting the second locking means so that the needle penetrates into the fabric for a shorter distance than when locked by the first locking means. In this manner, although the stroke for moving the web and the needles toward each other remains the same, nevertheless, the first and second locking means can be actuated by the program control means in accordance with the program to produce deeper or less deep penetration of needles into the fabric, depending on the actuation of the first or second locking means.

In a modified arrangement of the construction in which needles of different length are used, different needles have different hooks which are of different size, or provided on the needle in a different number. The hooks displace fibers or thread portions of the web when penetrating into the same. Different hooks displace different amounts of fibers.

It will be seen that the apparatus of the invention permits the making of a very wide range of different patterns, which may be combined. The termination, or the variation, of the program can be quickly and easily car-

ried out by using a different card with differently punched holes in the pattern control means.

An embodiment of the invention comprises supporting means, preferably including a table for a fibrous web; transporting means, preferably secured to the supporting means for transporting the web stepwise in one direction; a needle holder for guiding a plurality of needles between an inoperative position located in the needle holder, and an operative position projecting from the same toward the web; a plurality of locking means, preferably including locking latches, cooperating with the needles, respectively, and having an inoperative position and a locking position for locking the respective needle in the operative position; and control means for actuating selected locking means to move to the locking position so that the respective needles are locked after a step of the web.

During relative movement between the supporting means and table and the needle holder toward each other, the locked needles penetrate in the operative position into the web for depressing the penetrated portions of the web, while non-selected locking means permit other portions of the web to push the respective needles to the inoperative position so that other portions of the web are not depressed. The pressed and other portions of the web form a pattern.

The needle holder has a row of guideways in the form of stepped bores, in which the needles are guided. Each bore has a rearward portion and a forward portion of smaller diameter. Each needle has a main portion slidably fitting into the forward portion, and a head portion at the rear end slidably fitting into the rearward portion of the stepped bore. The head portion of the needle abuts a shoulder formed between the rearward larger and forward smaller portions of the guideway. The rearward portion of the guideway is at least as long as the distance which the front portion of the needle projects from the needle holder when locked by the locking means.

Each locking means includes a locking latch urged by a spring into the respective guideway, and moving behind the head portion of the needle in the locking position, preventing a pushing in of the needle by the penetrated web. An actuating element is connected to each locking latch, for example a harness cord of a Jacquard mechanism, which senses a card having a pattern programmed in the form of punched holes. When the locking latch is withdrawn to an inoperative position, against the action of its spring, there is no resistance of the needle to movement into the needle holder, and the needle is pushed in by the engaged portion of the web.

If a needle which was not locked by its locking means, has been pushed back into its inoperative position located in the needle holder, it is necessary to move the needle back to the operative position before the next operational cycle so that needles can be locked or unlocked for the next operation in accordance with the program. Since the movement of the needles by gravity is not reliable, the preferred embodiment of the invention provides pins which reciprocate with the supporting means of the web, but are arranged at the rear ends of the guideways in which the needles are mounted, so that, when the web moves away from the needles, the pins enter the guideways and push the

needles from the retracted inoperative position to the advanced operative position, in which they can be locked, or not locked, in accordance with the pattern.

Preferably, the supporting means for the table, the transporting means for the web, the support of the pins and a stripper means between the needles and the web, form a unit which is together reciprocated toward and away from the needle holder by a cam and cam follower linkage.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims.

The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiment when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 has a lower portion which is a cross-sectional view illustrating an apparatus of the invention, and an upper portion which is a schematic side view illustrating a program controlled means for operating the locking means, and being shown on an enlarged scale;

FIG. 2 is a plan view illustrating a portion of a web provided with a colored pattern in accordance with the invention;

FIG. 3 is a sectional view taken on line III—III in FIG. 2, and illustrating a web having two layers with a relief pattern, and colored pattern, respectively; and

FIG. 4 illustrates a fabric composed of the web of FIGS. 2 and 3 mounted by thread stitches on a supporting fabric.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The lower portion of FIG. 1 illustrates a stitching apparatus 10 in accordance with the invention, and the upper portion illustrates a program control apparatus by which the stitching apparatus 10 is controlled.

The stitching apparatus 10 has a single needle holder bar 12 provided with a single row of needles 13, of which only one needle in front of the row is shown. The needles are uniformly spaced along the row, and it is possible to provide several parallel rows of needles in the needle holder, or to provide several needle holders, each of which has one row of needles, but the simple arrangement of FIG. 1 will now be described as characteristic of the invention.

Needle holder 12 is fixedly secured on the frame of the machine, not shown, and has a stepped guideway or bore 14 for each needle 13. The lower forward portion of each guideway has a smaller diameter than the higher rearward portion of the guideway 14. The needle has a front portion slidably fitting into the forward portion of guideway 14, and a head portion 17 at its rear end slidably fitting into the rearward portion of the guideway. In the illustrated operative position of a needle 13, the head portion 17 abuts the annular shoulder between the forward and rearward portions of guideway 14. The length 15 of the rearward portion of guideway 14 is at least as great as the distance 18 which the front portion of needle 13 projects from the needle holder 12. Each needle 13 has a retracted inoperative

position completely located within the needle holder bar 12, and in the retracted position, as well as in the illustrated operative position, each needle is guided by the respective forward portion of guideway 14 along the length 16.

The front end 19 of each needle 13 has lateral notches which form hooks or barbs for engaging the fibers of a fibrous web 20 which is located on a table 26 and transported by transporting rollers 23, 24.

Supporting means, not shown, support not only table 26, but also the shafts of transporting rollers 23, 24, and are reciprocable by cam means, not shown, to move in the direction of the double arrow 30 toward the row of needles and away from the same. After such a reciprocating movement, transporting rollers 23, 24 are operated to move the web one step in the direction of the arrow 22 whereupon the web stops to be penetrated by, and removed from the row of locked needles 13 during the following reciprocating strokes of table 26. Table 26 has a transverse slot 27 permitting passage of the front ends 19 of needles 13 when the same are locked in the position shown in FIG. 1. Above the web 20, a stripper plate 28 is provided which also has a slot 29 for the passage of needles 13 registering with the same and with slot 27. Stripper plate 28 is also secured to the supporting means of table 26 and of the transporting rollers 23, 24, and reciprocates with the same. When table 26 with the web 20 moves away from the needles after a penetration, the stripper plate 28 pulls the web off the needles so that the web remains on the top surface of table 26. The needle holder bar 12 has a row of transverse bores and corresponding recesses 33 in the region of the shoulder between the wider and narrower portions of the guideways 14, and in each bore, a locking latch 31 is located which is also mounted on a supporting bracket 32 for movement into and out of the respective guideway 14. A spring 34 abuts bracket 32 and the needle holder bar 12, and urges the locking latch 31 by means of a transverse plate on the same, into guideway 14 and recesses 33. The other end 35 of locking latch 31 is connected to a cord or other actuating element 36 of the program control means shown in the upper portion of FIG. 1. If a cord 36 is pulled upward, as will be described hereinafter, the respective locking latch 31 is pulled back to an inoperative position out of the locking position shown in FIG. 1, and in the inoperative position of any locking latch 31, the rearward guideway portion is free, and the respective needle 13 can be pushed to a position completely retracted into the needle holder bar 14.

In the locking position of the locking means 31, the respective needle 13 is supported, so that when the table 26 with the web 20 is moved toward the needle holder bar 12, the front end 19 of the needle penetrates the web 20 compressing and depressing the same by the barbs and hooks at the front end 27. Due to the fact that the locking latch is located behind the head 17 of the needle, the needle cannot yield during the upward stroke of the table 26 with web 20. During the following downward stroke of table 26 with web 20, the web is pulled off the front end portion 19 of needle 13, particularly due to the action of the stripper plate 28, and a locked needle 13 cannot follow this downward movement since its head portion 17 abuts the shoulder

between the wider and narrower portions of guideway 14. As noted above, when penetration of the web by a needle 13 is not desired, the respective locking latch 31 is withdrawn from the respective guideway 14 so that the respective needle 13 is freely movable to a retracted position when its front end is pushed back by the upwardly moving web and table 26. Which of the needles are selected to be locked in the operative position, and which are not selected and are not locked, is determined by the program control means shown in the upper part of FIG. 1 which is constructed in the manner of a Jacquard machine. The entire program for controlling the needles 13 in successive positions of the transported web 20, is recorded on a card 40 which carries information concerning the entire pattern of the web. The recording takes place by means of punched holes in the card 40, which represent information for locking the needles, while unpunched portions of the card 40, or absence of punched holes or similar marks, indicates the unlocking of the respective needle 13 of the row.

The holes for each operational cycle are combined in groups and contain the entire information for all needles of the apparatus. The groups of holes are sensed by the sensing mechanism 41, and after each group of holes has been sensed, the card 40 is transported by a transporting sprocket 42 until the next group of punched holes is placed under the sensing means 41. The control means in the upper portion of FIG. 1 are shown at an enlarged scale as compared with the lower portion of FIG. 1 illustrating the apparatus 10. The sensing mechanism 41 has a plurality of thin sensing needles 43 which are held by suitable holding means in a vertical position above the read out portion of the cylindrical card 42. Only the front row of the feeler needles 43 is shown in the drawing because eight adjacent needles 43 perform the task of reading out the information contained on corresponding sensed portions of card 40. Rearwardly of the illustrated feeler needles 43, many rows of correspondingly constructed feeler needles are provided, which cooperate with other parts which are shown for the front row of needles 43. The number of rows of eight needles 43 corresponds to the number of needles 13 in the needle holder. Each of the feeler needles 43 is pivotally connected with a plate 44 whose end rests on a comb structure 45, and whose other end is guided in an opening of a perforated support plate 46. Plates 44 respectively cooperate with needles 47 which have hooks cooperating with plates 48 having hook-shaped upper portions 54 cooperating with knives 49. Plates 48 are respectively connected with the cords 36 which leads to the ends 37 of the locking latches 31.

The operation of the control means 11 will now be explained with reference to the operation of the locking means 31 of the illustrated needle 13. It is assumed that a needle 13 is associated with the feeler needle 43' of the sensing means 41. In order to sense the information of the cylindrical card 40, the comb structure 45 is moved downward to the left as viewed in FIG. 1 so that the plates 44, and particularly the plate 44' cooperating with the feeler needle 43' are lowered until the feeler needles 43 rest on the card 40. If the specific feeler needle 43' finds a hole in the card 40, it passes through the card, and the associated plate 44'

assumes a position in which the comb structure 45 cannot engage plate 44' when moving in the direction of plates 44. While the other needles 47 are pushed back by plates 44, needle 47' cannot be pushed back by the stopped plate 44' so that the plate 48' remains in the illustrated untensioned position in which the hook-shaped end 54° overlaps with a knife 49' of an upwardly and downwardly reciprocating grid of knives. Consequently, knife 49' engages the hook 54' of plate 48' and moves the same upward in the direction of the double arrow 50. The cord 36 secured to plate 48 is pulled through the respective perforation of a plate 51 in upward direction, so that the rear end 35 of the locking latch 31 to which the cord 36 is secured, is withdrawn. Cord 36 is guided in a guide means 37 on bracket 32. The actuated cord pulls the respective locking means to the inoperative position so that the head portion 17 of needle 13 is released, and can freely move in the rearward higher portion of guideway 14.

During the following upward stroke of the table 26 and transporting means 23,24, the front end 19 of needle 13 is pushed by the web 20 into the guideway 15 to a completely retracted inoperative position, and due to the fact that the needle 13 is not locked, it cannot penetrate the web, or otherwise depress the same. In the above-described arrangement, a hole in card 40 means that the needle 13 will not penetrate into the web 20, whereas a sensed unperforated portion of the card causes the locking of the needle by the latch 31 under the action of spring 34, and consequent penetration of the needle 13 into the web.

After the table 26 with the web has reached the highest point of the reciprocating stroke, it moves downward in a stroke away from the needles, and it is desired that the needle 13 moves at the same time without any delay in the guideway 14 back to the operative position projecting out of the needle bar 12, as illustrated. Since the small weight of the needles is not sufficient to assure a return of the displaced needles from the retracted position to the operative projecting position, return pins 38 are mounted on a support 39 which moves together with the table 26, being mounted on common supporting means, not shown, which are operated by cam means. Pins 38 register with the guideways 14 and project into the rear end of the same. When the supporting means, not shown, move together with the pins 38 downward, the needles which were placed in the retracted position by the pressure of the unpenetrated web 20, are pushed by the pins 38 to the projecting operative position, in which the spring 34 causes the locking latches 31 to move into the guideway 14 behind the head portion 17 of the respective needle to lock the same. If in accordance with the program, no penetration of the web by a specific needle is required, card 40 causes a mechanical impulse for operating the respective cord 36 to unlock the respective needle.

The transporting means 23, 24 are now operated to move the web one step so that the row of needles 13 is located above a next following strip-shaped portion of web 20, which is stitched during the following cycle of operations in accordance with the program on card 40 so that selected needles are locked and penetrate into the web 20, while other needles are not selected and are pushed back without penetrating the web.

It may now be assumed that during the next following cycle the needle 13 has to penetrate the web in accordance with the program. This requires movement of card 40 for one step, while the comb structure 45 moves upward along a slanted path, and lifts all plates 44 so that also feeler needle 43', which was located in the hole of card 40, is pulled out of the hole, so that card 42 can be shifted one step to the next sensing position.

It is now assumed that in the region of the card opposite the feeler needle 43', no hole is provided. Consequently, feeler needle 43' remains in the raised position, and a corresponding plate 44' also remains in this position. By the above-described movement of the comb structure 45, the bent portions of the same engage the plate 44', and other plates, and plate 44' pushes with its head against the control needle 47' which pushes the plate 48 with the hook 54' away from knife 49'. When the grid of knives is moved upward in the direction of the arrow 50, the plate 48' is not engaged by the respective knife and remains in the illustrated position so that no pull is exerted by cord 36 on the locking latch 31 which is held by spring 34 in the illustrated locking position behind the head 17 of the respective needle 13.

The cords 36 connected with the other plates 48 are respectively connected to other locking latches which cooperate with the row of needles 13, and each needle 13 is selectively locked, or remains free for movement in guideway 14, in accordance with the pattern recorded on card 40.

If the design pattern formed by the depressed portions and non-depressed portions 25 of web 20 is narrow, and extends over only a part of the needles 13 of the row, it is possible to connect the locking latches 31 of needles which have to assume the same position to the end of cords 36 which together are connected to a single plate 48, so that several locking latches are simultaneously operated in the same manner by the single plate 48 selected by card 40.

FIGS. 2 and 3 illustrate a finished stitched web 60, made in accordance with the invention. The web consists of two superimposed fibrous fleeces 61, 62 having different distinguishable colors, for example the fleece layer 62 may be yellow, and the fleece layer 61 blue. Before the fleece layers are superimposed, a powder 63 consisting of a thermoplastic material which bonds the superimposed layers 61, 62 when heated is applied two the inner surface of the layers 61, 62.

The two layers, bonded together, are supplied by the transporting device 21 to the working position under the needle holder 12 where the needles of the row are selectively locked and unlocked in accordance with the program, so that selected needles penetrate the web 20, and other needles are pushed back to the inoperative position because they are not locked. Since the colored pattern 67 is to appear on the front face of the front layer 61, the web 60 is placed in the apparatus on table 26 with the rear face 64 of the rear layer 62 on top. As schematically shown in FIG. 3, the penetrating needles push by the barbs or hooks thereof, fibers of layer 62 into the lower front layer 61, so that on the rear face 64 depressed portions 66 are made, while on the front face 65 of the front layer 61, fibers of layer 62 appear along the depressed portions 66. If the needles make the

stitches closely enough on the web, only the yellow fibers of the layer 62 are visible along the pattern region 67 of the front face 65, as shown in FIG. 2. Assuming that other portions 68 are less densely stitched, the layers 61, 62 remain on portions 68 at the original thickness, and are not depressed. On the front face 65 of the finished product 60, the corresponding regions 69 remain at the original blue color of the front fleece 61 because no fibers of the rear layer 62 are pushed through the front layer 61. Consequently, FIG. 2 shows yellow pattern portions 67, and blue background portions 69. No such different colors appear on the rear face 64 of the rear layer 62, but the same has depressed portions 66 corresponding to the pattern on portions of normal height 68.

Depending whether in a particular situation, a relief structure is preferred for representing a pattern, or whether a colored pattern is preferred, the size and number of needles is selected but it is also possible to select the thickness of the layers of the initial web differently. If a relief structure with a depressed pattern is preferred, the side of the web confronting the needles becomes the front face with the relief pattern, while in the event that a front face with a colored pattern is preferred, the side of the web remote from the needles becomes the front face. FIG. 4 illustrates a web with a pattern as shown in FIGS. 2 and 3, applied to a backing web 71 of greater thickness. The backing web and the patterned composite web 60 are connected to each other by stitching which can be widely spaced. The relief structure face 24 faces the backing web 71, and is invisible. The backing web 71 is advantageously provided with a woven bottom layer 72. The uniform, widely spaced stitching 72 does not substantially influence the colored pattern on the front face 65. The composite fabric 70 shown in FIG. 4 is advantageously used as a floor covering, such as a wall-to-wall carpet.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus for making a pattern on a fibrous web differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus on which a pattern is stitched by locked needles in accordance with a program, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. Apparatus for making a pattern on a fibrous web, comprising, in combination, supporting means for a fibrous web; transporting means for transporting said web on said supporting means; needle holder means for

guiding a plurality of needles for individual movement between an inoperative position located in said needle holder means and an operative position projecting from said needle holder means toward said web; a plurality of locking means correlated with said needles, respectively, each locking means being individually movable between an inoperative position, and a locking position for locking the respective needle in said operative position to said needle holder means; control means for actuating in accordance with a desired pattern, at least one locking means of said plurality of locking means to move to said locking position so that the respective selected needle is locked in said operative position against movement relative to said needle holder means to said inoperative position; and means for moving said supporting means and needle holder means relative to each other in the longitudinal direction of said needles so that movement of said supporting means and needle holder means toward each other causes engagement of said web by all needles in said operative position, but penetration into said web only by selected needles locked in said operative position so that the penetrated web portions are deformed, while non-selected locking means in said inoperative position permit other web portions to move the respective unlocked needles to said inoperative position so that said other web portions are not deformed whereby the deformed web portions and said other web portions form a pattern.

2. Apparatus as claimed in claim 1 comprising means for returning said needles from said inoperative position to said operative position.

3. Apparatus as claimed in claim 1 wherein said needle holder means has a plurality of guideways in which said needles are mounted for movement between said inoperative position and said operative position; wherein each guideway has forward guide portion holding the respective needle in both said inoperative and operative positions, and a rearward guide portion for the rear portion of the needle in said inoperative position when the front portion of the needle is located in said forward guide portion; and wherein each needle in said operative position projects from said needle holder means a distance not greater than the length of said rearward guide portion.

4. Apparatus for making a pattern on a fibrous web comprising, in combination supporting means for a fibrous web; transporting means for transporting said web stepwise on said supporting means; a needle holder means for guiding a plurality of needles between an inoperative position located in said needle holder means, and an operative position projecting from the same toward said web, said needle holder means including a bar transverse to the transporting direction of said web, and having a row of guide ways perpendicular to said web for guiding said needle between said inoperative and operative positions, said bar further having a row of bores transverse to said guide ways opening into the same, respectively; a plurality of locking means correlated with said needles, respectively, and having an inoperative position and a locking position for locking the respective needles in said operative position, said plurality of locking means including a row of latches mounted in said bores for movement between said inoperative position and said locking position, and projecting into said guide ways in said locking position for

engaging the rear portions of needles in said operative position and locking the same; and control means for actuating selected locking means to move to said locking position so that the respective needles are locked in said operative position after a step of said web so that relative movement of said supporting means and said needle holder means toward each other causes penetration of locked needles in said operative position into said web for depressing the penetrated portions of said web while non-selected locking means permit other portions of said web to push the respective correlated needles to said inoperative position so that said other portions are not depressed whereby said depressed portions and said other portions of said web form a pattern.

5. Apparatus as claimed in claim 4 wherein each locking means includes a spring biasing the respective latch toward the respective guideway so that the latches project into said guideways for locking needles in said operative position against movement to said inoperative position; and wherein said control means include a plurality of actuating elements respectively connected with said latches for moving the latches of non-selected locking means to said inoperative position and for holding same in said inoperative positions during relative movement between said needle holder means and said web.

6. Apparatus as claimed in claim 5 wherein said actuating elements are harness cords of a jacquard machine.

7. Apparatus for making a pattern on a fibrous web, comprising, in combination, supporting means for fibrous web, including a table for said web formed with openings for the front ends of needles in said operative position; a needle holder means for guiding a plurality of needles between an inoperative position located in said needle holder means, and an operative position projecting from said needle holder means toward said web; transporting means for transporting said web and mounted on said supporting means for stepwise moving said web on said table, said supporting means with said transporting means and said web being movable in a reciprocating motion toward and away from said needle holder means while said web is not transported; a plurality of locking means correlated with said needles, respectively, and having an inoperative position and a locking position for locking the respective needles in said operative position; and control means for actuating selected locking means to move to said locking position so that the respective needles are locked in said operative position after a step of said web so that relative movement of said supporting means and said needle holder means toward each other causes penetration of locked needles in said operative position into said web for depressing the penetrated portions of said web while non-selected locking means permit other portions of said web to push the respective correlated needles to said inoperative position so that said other portions are not depressed whereby said depressed portions and said other portions of said web form a pattern.

8. Apparatus as claimed in claim 7 wherein said needle holder means include a needle holder bar extending across said table and said web and having a row of guideways perpendicular to said table and web for

guiding said needles; and wherein said supporting means include stripper means located between said needle holder bar and said table with said web thereon so that during movement of said supporting means with said table and web away from said needle holder means, said stripper means moving with said table strip the penetrated web portions off needles in said operative position.

9. Apparatus as claimed in claim 7 wherein said needle holder means includes a row of guideways perpendicular to said table for guiding said needles between said inoperative and operative positions, said guideways penetrating said needle holder means and having open rear ends remote from said table and web; wherein said supporting means include a support and a row of pins mounted on said support registering with said guideways, respectively; and wherein said support reciprocate with said table so that said pins moving in said guideways push needles in said inoperative position to said operative position during movement of said table and web away from said needle holder means.

10. Apparatus as claimed in claim 1 wherein said needle holder means include a needle holder bar transverse to the direction in which said web is transported, and having a row of stepped bores for guiding said needles between said inoperative and operative positions; wherein each bore has a rearward portion and a forward portion having a smaller diameter than said rearward portion; wherein each needle has a main portion slidably fitting into said forward portion and being guided by the same, and a head portion at the rear end thereof slidably fitting into said rearward portion of said stepped bore and being guided by the same during movement of the respective needle to and from said inoperative position; and wherein said head portion abuts

a shoulder formed between said rearward and forward portions of said guideway when the respective needle is in said operative position.

11. Apparatus as claimed in claim 10 wherein each locking means includes a locking latch, and a spring biasing said locking latch to move into the rearward portion of the respective stepped bore to a locking position located behind said head portion; and wherein said control means are program-controlled and comprise actuating elements connected with said locking latches, respectively for moving non-selected locking latches against the action of said springs to inoperative positions located outside of said stepped bore.

12. Apparatus as claimed in claim 1 wherein said supporting means support said web in a position in which the front face of said web confronts said needles so that a relief pattern is formed on said front face by deformed and depressed and non-depressed portions.

13. Apparatus as claimed in claim 1 wherein said web includes a front layer and a rear layer superimposed on each other and having different distinguishable colors; wherein said supporting means supports said web in a position in which the front face of said front layer faces away from said needles, and the rear face of said rear layer confronts said needles; and wherein said needles have means for displacing fibers of the penetrated and deformed portions of said rear layer through said front layer to said front face of said front layer during consecutive penetration of said rear and front layers of said web while said supporting means and said needle holder means move toward each other so that the displaced fibers form a pattern on said front face of said front layer having the color of said rear layer.

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