

Sept. 18, 1973

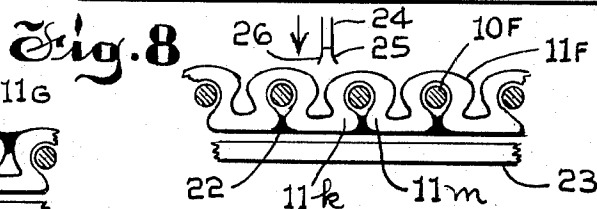
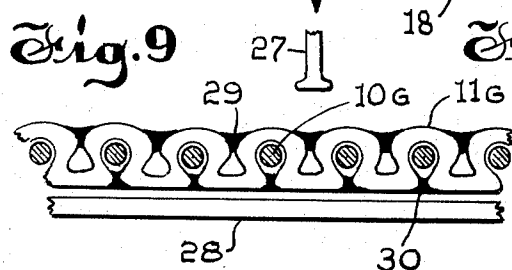
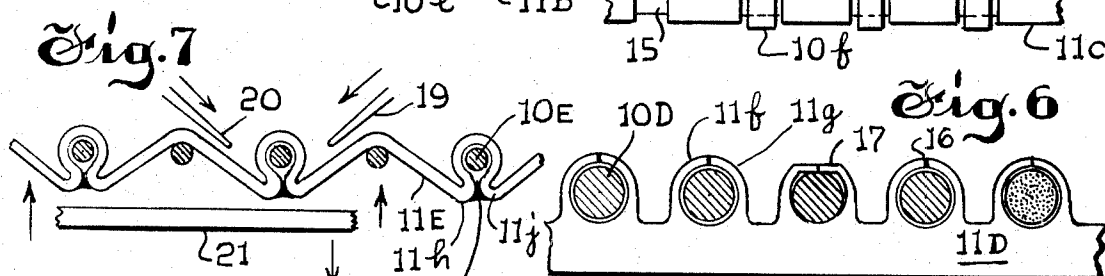
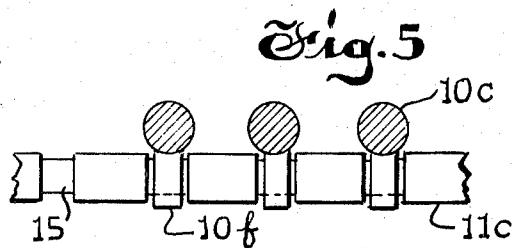
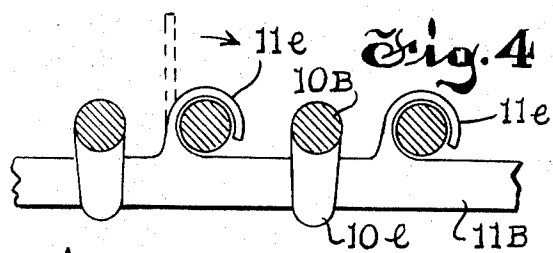
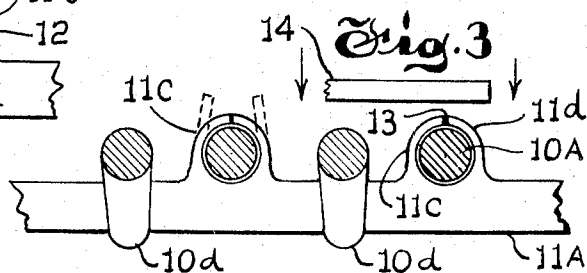
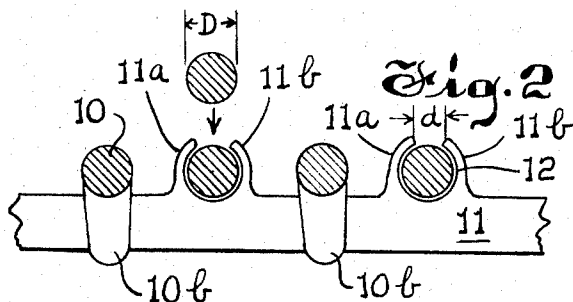
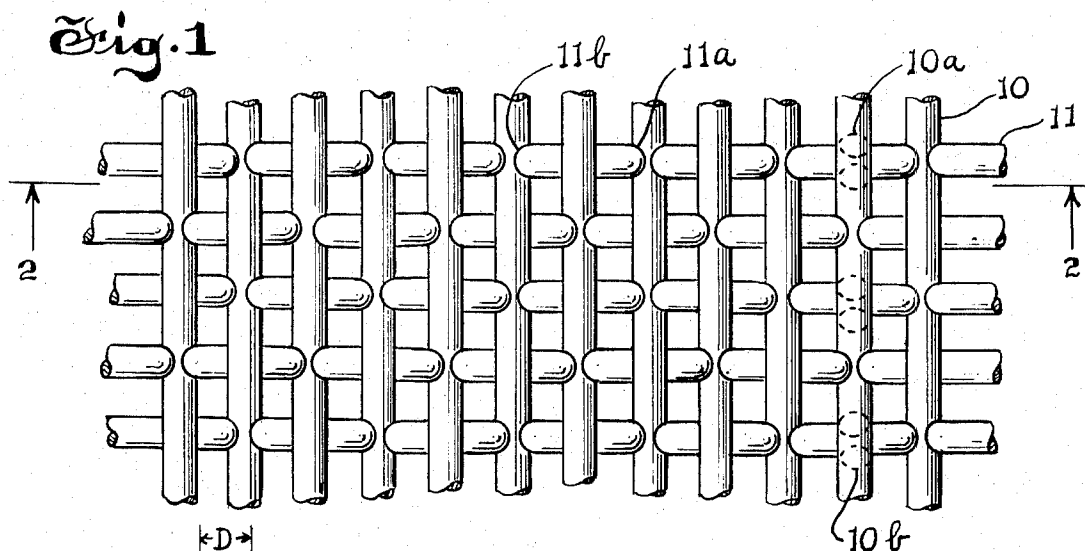
K. T. BLEUER

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CROSSLAID FABRIC

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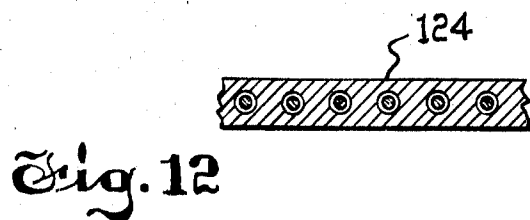
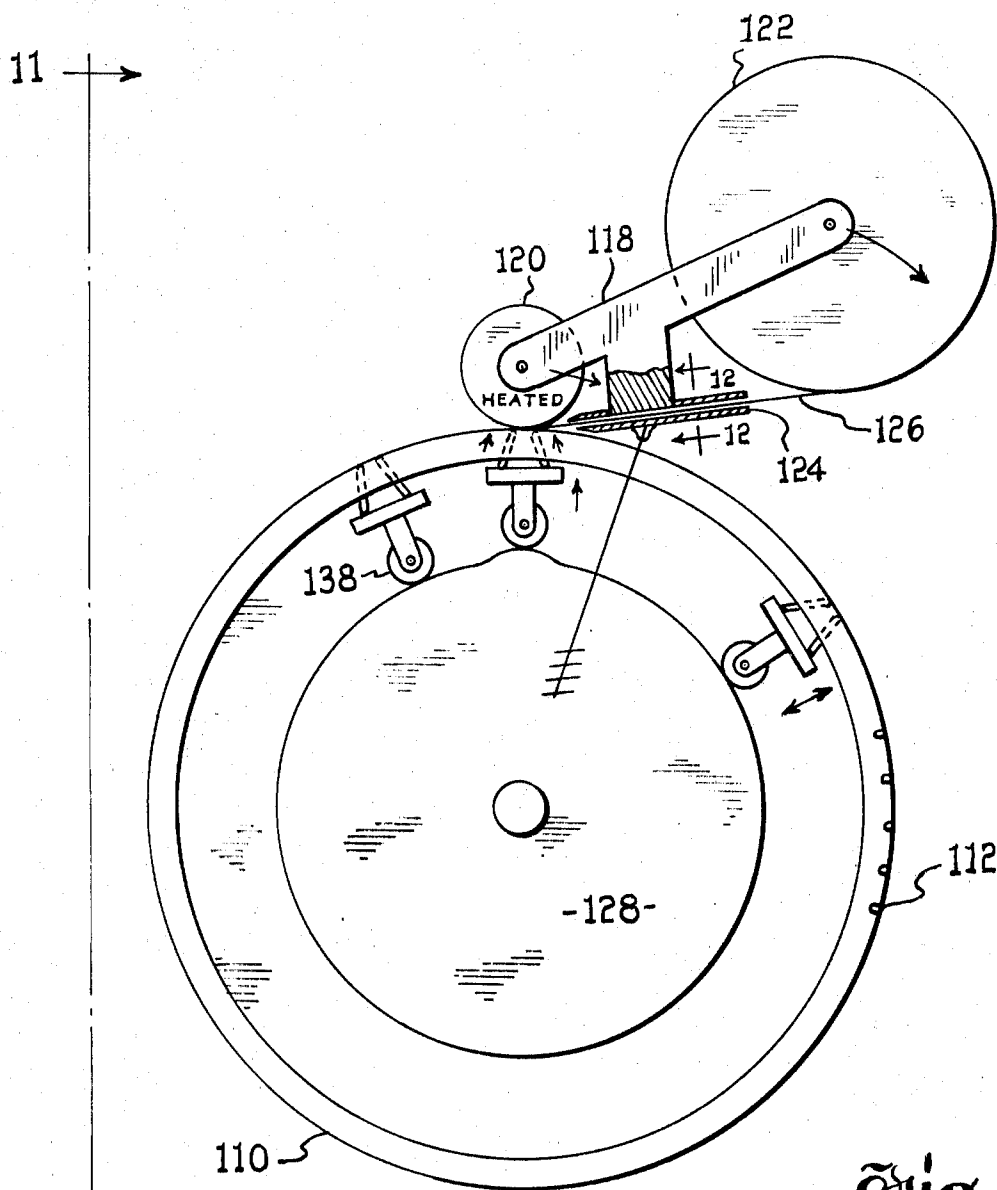
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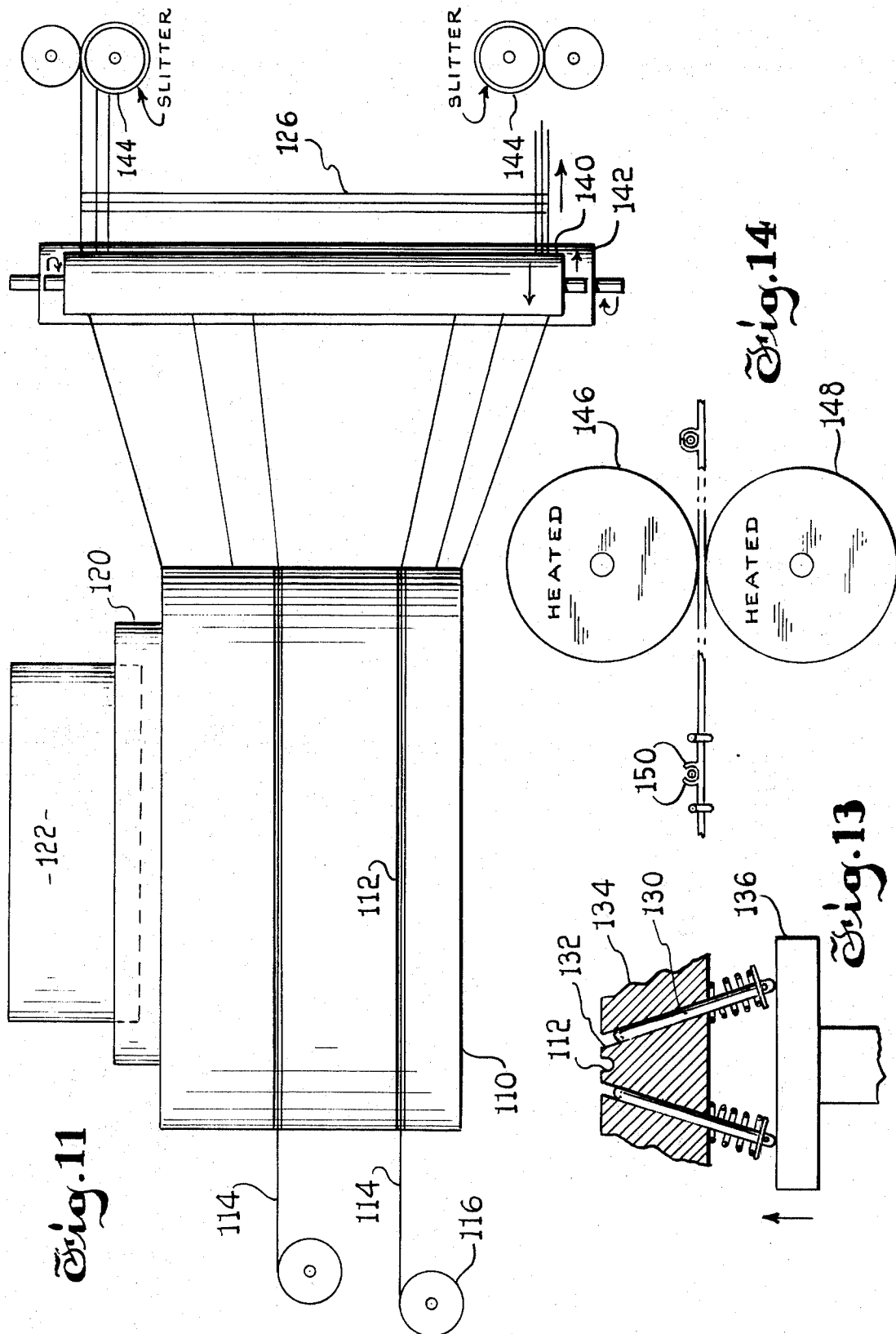
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CROSSLAID FABRIC

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12 Claims

ABSTRACT OF THE DISCLOSURE

A crosslaid fabric made up of warp and shute filaments in which the warp filaments have portions integrally formed therewith at least partially embracing the shute filaments and in which the shute filaments also have portions integrally formed therewith at least partially embracing the warp filaments or in which only the warp filaments or only the shute filaments have such integral portions.

The invention relates to crosslaid fabrics.

Crosslaid fabrics have been previously proposed in which the warp and the shute filaments are bonded to each other by means of a cement or adhesive, and such a crosslaid fabric is shown in a patent to E. H. Condon et al. No. 3,307,992 issued Mar. 7, 1967. The warp and shute filaments are thus bonded together rigidly by means of the cement or adhesive, and the crosslaid web product therefore has considerable rigidity and is not suitable for the usual purposes for which ordinary woven fabrics are used.

It is an object of the present invention to provide an improved crosslaid fabric in which the interconnections between the warp and shute filaments are obtained by means allowing substantially more relative movement between the warp and shute filaments so that a less rigid, more flexible fabric is obtained that is more suitable for the uses for which ordinary woven fabrics are used. The crosslaid fabric is considerably more economical to manufacture than conventional woven fabrics, since the warp and shute filaments are simply laid over each other rather than being interwoven, whereby many shute filaments may be laid simultaneously over a series of warp filaments or vice-versa rather than being of such a construction in which only a single shute filament may be laid down with respect to a series of warp filaments as is necessary with the usual weaving process.

Briefly, the invention contemplates that the warp or shute filaments or both may have integral lug portions which at least partially embrace the filaments lying crosswise so as to form a mechanical interconnection between the filaments, and preferably the overlying portions provide a clearance with respect to the filaments that they embrace so that the interconnections are loose ones. The filaments may, in order to provide these integral embracing portions, be of non-round configuration; however, round filaments may also be used, and either monofilaments or multifilaments may be used.

It is also an object of the invention to provide improved machines and methods for making the crosslaid fabric and such a machine may include a drum over which such filaments are drawn longitudinally and mechanism for at the same time winding other filaments over the first filaments and interengaging the other filaments with the first filaments.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects, and such other objects, as will be apparent from the following description of preferred forms of the invention, illustrated with reference to the accompanying drawings, wherein:

FIG. 1 is a plan view of a crosslaid fabric embodying the principles of the invention;

FIG. 2 is a sectional view on an enlarged scale taken on line 2—2 of FIG. 1;

FIGS. 3 and 4 are sectional views similar to FIG. 2 of modified forms of the fabric;

FIG. 5 is a sectional view similar to FIG. 2 but of still another modification in which only the warp filaments are provided with portions that embrace the filaments lying crosswise with respect thereto;

FIG. 6 is a sectional view similar to FIG. 2 of a modification in which the warp filaments are multifilaments while the shute filaments are monofilaments;

FIG. 7 is a sectional view similar to FIG. 2 of a modification in which both the warp and shute filaments are round in cross section;

FIGS. 8 and 9 are views similar to FIG. 2 of other modifications in which both warp and shute filaments are round in cross section;

FIG. 10 is an end elevational view of a machine for making some of the fabrics illustrated in the previous figures;

FIG. 11 is a side elevational view of the machine taken on line 11—11 of FIG. 10;

FIG. 12 is a cross sectional view on an enlarged scale taken on line 12—12 of FIG. 10;

FIG. 13 is a partial sectional view of the outer shell of the drum of the machine illustrated in FIGS. 10—12 along with a pair of filament carrying rods which move through the shell; and

FIG. 14 is a side elevational view of another machine for making others of the fabrics.

Like characters of reference designate like parts in the several views.

Referring now to the drawings, the fabric illustrated in FIGS. 1 and 2 may be seen to comprise warp filaments 10 and shute filaments 11 that lie at 90 degrees with respect to each other. It will be understood that although the filaments 10 are labeled as warp filaments and the filaments 11 as shute filaments, the nomenclature could just as well be reversed, with the filaments 11 being labeled warp filaments and the filaments 10 as shute filaments, the terms warp and shute being used only with respect to this embodiment as well as the other embodiments of the invention, for the purpose of differentiating between the filaments lying in one direction and those lying at angles thereto. Each of the warp filaments 10 overlie all of the shute filaments 11 as is apparent from the figures.

The shute filaments 11 are provided with integral lug portions 11a and 11b, and each pair of these lug portions 11a and 11b partially embrace a warp filament 10. The warp filaments 10 are provided with similar integral lug portions 10a and 10b, and each pair of the portions 10a and 10b embrace one of the shute filaments 11, as shown. It will be noted that the filaments 10 and 11, except for the lug portions 11a, 11b, 10a and 10b are shown to be of round configuration; and it will be observed that, at each crossing of a warp filament and a shute filament, there is an interconnection between the warp filament and the shute filament. In the form of fabric illustrated, the lug portions 11a and 11b extend upwardly as seen in FIG. 2, while the lug portions 10a and 10b extend downwardly as seen in this figure, due to the fact that the warp filaments 10 overlie the shute filaments 11 as the fabric is illustrated.

It is contemplated that the warp and shute filaments 10 and 11 shall be monofilaments and that the lug portions 11a, 11b, 10a, and 10b are simply formed integrally with these filaments. It is contemplated also that preferably the filaments 10 and 11 shall be of a plastic

3

such as nylon (and other suggested materials for the filaments are listed hereinafter), and preferably the material of which the filaments 10 and 11 is made is somewhat resilient. The filaments 10 and 11 are preferably formed with a spacing "d" between the ends of the pairs of lug portions 11a and 11b and the pairs of lug portions 10a and 10b, while the diameter of the filaments is somewhat larger than the dimension, so therefore in order to cause the lug portions 11a and 11b to embrace a warp filament, it is only necessary that the warp filament be moved downwardly between the open ends of a pair of lug portions 11a and 11b, and each of the mechanical connections at each of the cross over points of the warp and shute filaments may be made in the same manner. The lug portions 11a and 11b and the other lug portions 10a and 10b simply spring apart sufficiently so that the filament with which the lug portions will embrace enters between the lug portions, and the lug portions then spring back so as to partially embrace the filament that is so thrust between the lug portions. Preferably, there is a clearance 12 between the inner surfaces of the lug portions 11a and 11b and the warp filaments 10 which these lug portions embrace, and the same is true at each of the other interconnections between the warp and shute filaments. The clearances 12 allow a limited movement between the warp and shute filaments, even though the warp and shute filaments are mechanically fastened together by means of the lug portions 10a, 10b, 11a and 11b, so that the fabric has substantial flexibility. It thus is apparent that the fabric illustrated in FIG. 1 may be made simply by moving all of the warp filaments 10 down in the proper positions on the shute filaments 11 so that the lug portions 11a and 11b embrace the warp filaments 10 and the lug portions 10a and 10b embrace the shute filaments 11 at each of the interconnections of the warp and shute filaments.

The form of fabric shown in FIG. 3 is made up of the warp filaments 10A and the shute filaments 11A, and the lug portions 11c and 11d instead of only partially embracing warp filaments 10A, fully embrace the warp filaments 10A; and the lug portions 11c and 11d are welded together at their ends at 13. The warp filaments 10A are first moved between the lug portions 11c and 11d with the lug portions upstanding, and then the lug portions 11c and 11d are bent over and welded at 13. The warp filaments 10A have lug portions corresponding to the lug portions 11c and 11d, including the lug portions 10d which are illustrated, which are welded together in the same manner as the lug portions 11c and 11d. It is contemplated that preferably the warp filaments 10A and the shute filaments 11A are made of thermoplastic material, and the bending over and welding together of the lug portions 11c and 11d and the corresponding lug portions on the warp filaments 10A may be done simply by moving a heated plate 14 toward and in contact with the fabric thereby bending the lug portions together and welding them at 13. The lug portions 10d and mating lug portions and also the lug portions 11c and 11d, have the same clearance 12 with the filaments they embrace.

The form of fabric illustrated in FIG. 4 is similar to the fabric forms shown in the first three figures except that, in lieu of pairs of integral lug portions, the shute filaments 11B are formed with single lug portions 11e, and the warp filaments 10B are formed with individual corresponding lug portions 10e. Assuming that the filaments 10B and 11B are of thermoplastic material, the lug portions 10e and 11e may be bent over by the application of heat, similarly as suggested in connection with the FIG. 3 form of fabric.

In the FIG. 5 form of fabric, the shute filaments 11C do not have any lug portions that embrace the warp filaments 10C and the shute filaments 11C are instead provided with grooves 15. Preferably the filaments 10C and 11C are both monofilaments of thermoplastic material. The warp filaments 10C are provided with lug portions

4

10f which are similar to the lug portions 11e, and one of the lug portions 10f is provided for each of the crossings of a warp filament 10C with a shute filament 11C. The lug portions 10f are bent around the shute filaments 11C and rest in the grooves 15 for attaching the warp filaments 10C and shute filaments 11C together, and a clearance similar to the clearance 12 is preferably provided between the inner surface of each of the lug portions 10f and bottom of the respective groove 15.

The form of fabric shown in FIG. 6 includes the lug portions 11f and 11g for each of the warp filaments 10D, the lug portions 11f and 11g being carried by each of the shute filaments 11D. The shute filaments 11D thus provide all of the attachments with the warp filaments 10D at the crossings of the warp and shute filaments. The shute filaments 11D are preferably monofilaments of thermoplastic material, and the welds 16 of the lug portions 11f and 11g are formed in the same manner as the welds 13. The filaments 10D may be monofilaments but they are preferably multifilaments as shown, and the filaments 10D may be of thermoplastic material or may be of natural fibers, such as cotton for example. Stability of the fabric is obtained by reducing the internal diameter of the openings provided by some of the lug portions 11f and 11g, such as by applying pressure and reducing in height some of the lug portions 11f and 11g as at 17, so that these particular lug portions grip the filament 10D that passes beneath them.

The fabric shown in FIG. 7 is made up of warp and shute filaments 10E and 11E that are round in cross section. Alternate crossings of the filaments 10E and 11E are mechanically connected together by the portions 11h and 11j of the shute filaments 11E which are brought beneath warp filaments 10E and are then bonded together at 18. The filaments 10E and 11E may be either monofilaments or multifilaments, and in either case the welds 18 may be made by the application of heat to the portions 11j and 11h such as by means of a heated plate 21 if the filaments are of thermoplastic material. The portions 11h and 11j may be brought around the filaments 10E by means of rods or pins 19 and 20. The portions of the filaments 11E that encircle the filaments 10E preferably have the same clearance with respect to the filaments 10E as the clearance 12 in the first embodiment so that there may be relative movement between the filaments 11E and the filaments 10E. At alternate crossings, the filaments 10E are bent and formed around the filaments 11E in the same manner as the filaments 11E are formed with the returned bent portion 11h and 11j so that the filaments 11E embrace the filaments 10E at half of the crossings of the warp and shute filaments and the warp filaments 10E embrace the shute filaments 11E at the other crossings. In case the filaments 10E and 11E are multifilaments of thermoplastic materials 10E and 11E are multifilaments of thermoplastic material, it will be understood that the heated plate 21 will cause a melting and bonding together of the small component filaments at the welds 18.

In the form of fabric shown in FIG. 8, all of the crossings of the warp filaments 10F and shute filaments 11F are provided by the return bent portions 11k and 11m with which the filaments 11F are provided. The return bent portions 11k and 11m are welded together at 22 so as to embrace the filaments 10F, preferably with a clearance corresponding to the clearance 12, and the welds 22 may be provided by a heated plate 23 and a member 24 that passes between adjacent filaments 10F and has leaf springs 25 and 26 thereon which spread outwardly as resistance to movement of the member 24 is encountered due to the plate 23. The springs 25 and 26 spring outwardly to move the portions 11k and 11m together, with the heat then forming the welds 22. The filaments 10F and 11F may be monofilaments of thermoplastic material or they may be multifilaments of thermoplastic material; and, since the filaments 10F simply extend lengthwise of the fabric without return bent portions corre-

sponding to the portions 11k and 11m, the filaments 10F if desired may be of natural material, such as cotton for example.

The form of fabric shown in FIG. 9 is substantially the same as that shown in FIG. 8 except that the welds 29 are provided, and these welds may be provided by any suitable heated instrument. The member 27 which is of increasing width on its end may be utilized in connection with a heated plate 28 for the purpose of forming the welds 30, the member 27 being moved between adjacent warp filaments 10G so as to be effective on the shute filaments 11G for this purpose.

Although I have mentioned nylon as being a suitable monofilament material, and nylon may also be used for the multifilament warps 10 and 11, with heat may be used in order to weld this material, other synthetic materials may also be used as well for the warp and shute filaments 10 and 11. Such other materials, for example, may include rayon, fortisan, acetate, polyesters, acrylics, modacrylics, saran, nitril and vinyon. Some of these materials do not weld as well under heat as do some of the others, and in those cases where the welds 18, 13, 22, 30 and 29 are desired, the better welding synthetic filaments would be preferred. In those cases for the above described fabrics in which welding is not desired, then of course the other synthetic materials that do not weld as well are satisfactory. Also for the latter filaments, the natural materials, such as cotton and wool and also glass may be used, and in those cases in which multifilaments are satisfactory as mentioned above, multifilaments made of wool, cotton or glass may be used. It will be understood that for greater flexibility and drape, the multifilaments generally would be preferred. The compositions of the synthetic materials mentioned above are of course well known; however, for more definite information the volume "Introduction to Textiles" by Mary L. Cowan and published by Appleton-Century-Crofts, New York, N.Y., copyrighted 1962, Library of Congress Card Number "62-8832," may be referred to.

It will be apparent to those skilled in the art that changes may be made in the fabrics without departing from the principles of the invention. In particular, although I have described each of the crossings of various of the warp filaments and shute filaments as having mechanical interconnections, it will be apparent that, if desired, a portion of these interconnections may be dispensed with while still obtaining a satisfactory fabric. For example, half of the pairs of lug portions 11a and 11b and the lug portions 10a and 10b in the first form of fabric may be dispensed with, and the remaining lug portions will be sufficient to hold the warp and shute filaments 10 and 11 together. Although I have above referred to various portions (including portions 11a, 11b, 10a, 10b, 11c, 11d, 11e, 10e, 10f, 11f, 11g, 11h, 11i, 11k and 11m) as "lug portions" or the like, it will be apparent that these portions may also be termed "hooking portions." Although I have described the welds 13, 18 and 16 etc. as being formed by the melting of thermoplastic material, it will be understood that these welds could also constitute simply a cementing of the adjoining portions together without the melting of any material. With respect to the FIG. 6 form of fabric, it will be observed that substantially all of the surface on one side of the fabric is multifilament and this may be of natural fibers, so that in effect one side of the fabric is practically all of natural fibers while the other side is entirely of synthetic material; and such a fabric may be very desirable for some clothing uses.

The machine illustrated in FIGS. 10-13 may be utilized for making the various forms of fabric of the invention and may be seen to comprise a drum 110 having longitudinally extending slots or channels 112 on its periphery. Although just a few of the channels 112 are illustrated, these channels 112 are disposed about the complete periphery of the drum 110 and may be spaced very closely

together if it is desired that the fabric have closely spaced filaments. A filament 114 extends through each of the channels 112 and is drawn off a supply roll 116 of filament. The drum 110 is stationary, and a carriage 118 is disposed to rotate about the drum 110. A heated roll 120 and a plurality of filament supply rolls 122 are carried by the carriage 118; and the carriage 118 is formed with a filament guide 124 through which the filaments 126 from the supply rolls 122 pass. The roll 120 is in contact with the drum 110, and the filaments 126 pass from the guide 124 into the nip of the roll 120 and the drum 110 as shown.

The carriage 118 is fixed with respect to a rotatable cam 128 which is disposed inside the drum 110. Pins 130, which are notched on their outer ends to receive a filament, are slidably disposed in slanted channels 132 extending through the shell 134 of the drum 110, and a platen 136 is disposed to act on pairs of the pins 130 as shown in FIG. 13. A roller 138 is rotatably disposed with respect to each of the platens 136 and is adapted to co-act with respect to the single node of the cam 128. It will be appreciated that the rollers 138, the platens 136 and the pins 130 are held with respect to the drum 110 so that they do not rotate about the axis of the drum 110 while the cam 128, the carriage 118, the rolls 122 and roll 120 rotate about the axis of the drum 110.

A pair of pull rolls 140 and 142 are disposed at one end of the drum 110 for pulling the filaments 114 and the completed fabric off the drum 110, and pairs of slitters 144 are disposed beyond the rolls 140 and 142 for slitting the fabric into two layers or sheets.

In operation, assuming that a fabric as shown in FIG. 7 is to be made, the filaments 114 are drawn off their supply rolls 116 by means of the pull rolls 140 and 142. At the same time, the carriage 118 and rolls 120 and 122 planetate about the drum 110 and lay down the filaments 126 onto the filaments 114. As the filaments 126 pass into the nip of the drum 110 and roll 120, the pins 130 move outwardly due to the action of the single node of the cam 128 on the roller 138 and platen 136 for the pair of pins 130 located beneath the roll 120, and each pair of pins 130 receives a filament 126 in the slotted ends of the pins 130 and move the filament 126 to embrace a filament 114 disposed in the slot 112 located between the pins 130. The filaments 126 are thus moved into contact with the heated roll 120 which performs the weld of the filament 126, so that the construction of the fabric looks like the form shown in FIG. 7. As the filaments 114 continue to travel through the channels 112, the rolls 120 and 122 continue to planetate about the drum 110, and successive series of filaments 126 are laid down on the filaments 114 and form a completed fabric. The pins 130 and roll 120 perform the welding at the welds 18 shown in FIG. 7. The completed fabric travels between the pull rolls 140 and 142, and the slitters 144 are effective to cut the completed fabric, while is in the form of a loop, into two sheets or layers. It will be noted that many filaments 126 may be laid down at a time, such as 50, 100 or even more. The operations just described will cause the filaments 11E to be interengaged with the filaments 10E, using the return bent portions 11h and 11j, as shown in FIG. 7; and, if it is desired to form corresponding return bent portions on the filaments 10E, the fabric sheets formed by the slitters 144 may be run over the drum 110 again, this time with the plurality of filament supply rolls 122 being replaced with a single fabric supply roll and with the individual filament openings in the guide 124 being replaced with a single fabric carrying slot.

The forms of fabric shown in FIGS. 8 and 9 may be made in the same manner as just described, but in these cases the instruments 24 or 27 are used in lieu of the pins 130 or instruments 19 and 20.

The machine shown in FIGS. 10 to 13 may also be used for making the other forms of fabric illustrated. In making the fabric shown in FIG. 6, the multifilament fila-

7

ments 10D of cotton or other material are carried by the rolls 122, and the filaments 114 are preliminarily formed with the lug portions 11f and 11g; and the heated roll 120 welds these lug portions together. The filaments 11D are held upright with the lug portions 11f and 11g upstanding to receive the filaments 10D by suitably shaping the channels 112 in cross section.

The form of fabric shown in FIG. 3 may be partially completed using the machine of FIGS. 10 to 13. The heated roll 120 welds the lug portions 11c and 11d together, and the parts 138, 136 and 130 are dispensed with. A subsequent heated roll is used to weld the lug portions 10d to their mating lug portions. Such a subsequent heated roll is the roll 146 shown in FIG. 14; and the companion roll 148 in this case may be unheated. Alternately, the rolls 146 and 148 of FIG. 14 when both are heated may be used for completing the manufacture of the fabric in FIG. 3. The filaments 10A and 11A are preliminarily put together using the machine of FIGS. 10 to 13 in the manner above mentioned, and then the fabric, with the lug portions 150 being shown to correspond to the lug portions 11c, 11d and 10d in FIG. 3, being welded over by the opposite heated rolls 146 and 148. The structure of FIG. 14 may likewise be used for making the fabric shown in FIG. 4; the rolls 146 and 148 in this case cause the lug portions 10e and 11e to overlies their respective crossing filaments. The machine of FIGS. 10 to 13 may in the same manner be used for mating the fabric of FIG. 2, but the roll 120 in this case need not be heated. The filament channels in guide 124 are so shaped in cross section, as are the channels 112, to cause the lug portions 11a and 11b to extend in one direction and the lug portions 10a and 10b to extend in the opposite direction so that interlocking of the filaments 10 and 11 takes place.

I claim:

1. A fabric comprising a first series of filaments and a second series of filaments extending across the first series filament on front sides thereof, each of said first series filaments having a plurality of hooking portions integral therewith each of which extends around one edge of and overlies the back side of a cooperating second series filament with a clearance around the complete internal periphery of the first series filament with respect to the second series filament to loosely hook around and to at least partially surround the second series filament, for providing loose mechanical connections of the filaments together at crossings of the filaments.

2. A fabric as set forth in claim 1, said integral hooking portions each extending more than half-way around the said cooperating second series filaments.

3. A fabric as set forth in claim 1, said first series filaments being of thermoplastic material and said second series filaments being of natural fibers.

4. A fabric as set forth in claim 11, each of said first series filaments also having another such hooking portion integral therewith for each first mentioned hooking portion and forming a pair therewith and which is positioned

8

opposite to the first mentioned hooking portion and extends around the same cooperating second series filament from the other edge thereof toward the first mentioned hooking portion.

5. A fabric as set forth in claim 4, said two hooking portions being of the same length and meeting at their ends.

6. A fabric as set forth in claim 4, each of said first series filaments being uniform in thickness lengthwise and each of said hooking portions being formed of parts of a said first series filament which extends from the front side of the fabric to the back side thereof and around the cooperating second series filament and which then extends back to the front side of the fabric.

7. A fabric as set forth in claim 4, said two hooking portions being fixed together at their ends by welds.

8. A fabric as set forth in claim 4, said cooperating second series filaments having a groove for receiving each pair of said hooking portions.

9. A fabric as set forth in claim 4, each of said second series filaments having a plurality of pairs of hooking portions of the same type as mentioned for the first series filaments and extending around cooperating ones of the first series filaments.

10. A fabric as set forth in claim 4, said hooking portions of each pair being spaced at their ends and the first series filaments being formed of resilient material so that the cooperating second series filament for each said pair may be pushed between the two hooking portions by spreading the hooking portions apart and so that the hooking portions subsequently return together to hold the cooperating second series filament between them.

11. A fabric as set forth in claim 10, each of said second series filaments having a plurality of pairs of hooking portions of the same type as mentioned for the first series filaments and extending around cooperating ones of the first series filament.

12. A fabric as set forth in claim 10, said first series filaments being of thermoplastic material.

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U.S. Cl. X.R.

161—70, 111, DIG. 6