Aug. 10, 1926. 1,595,418

F. B. RILEY

METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

Filed Dec. 21, 1922 7 Sheets-Sheet 1

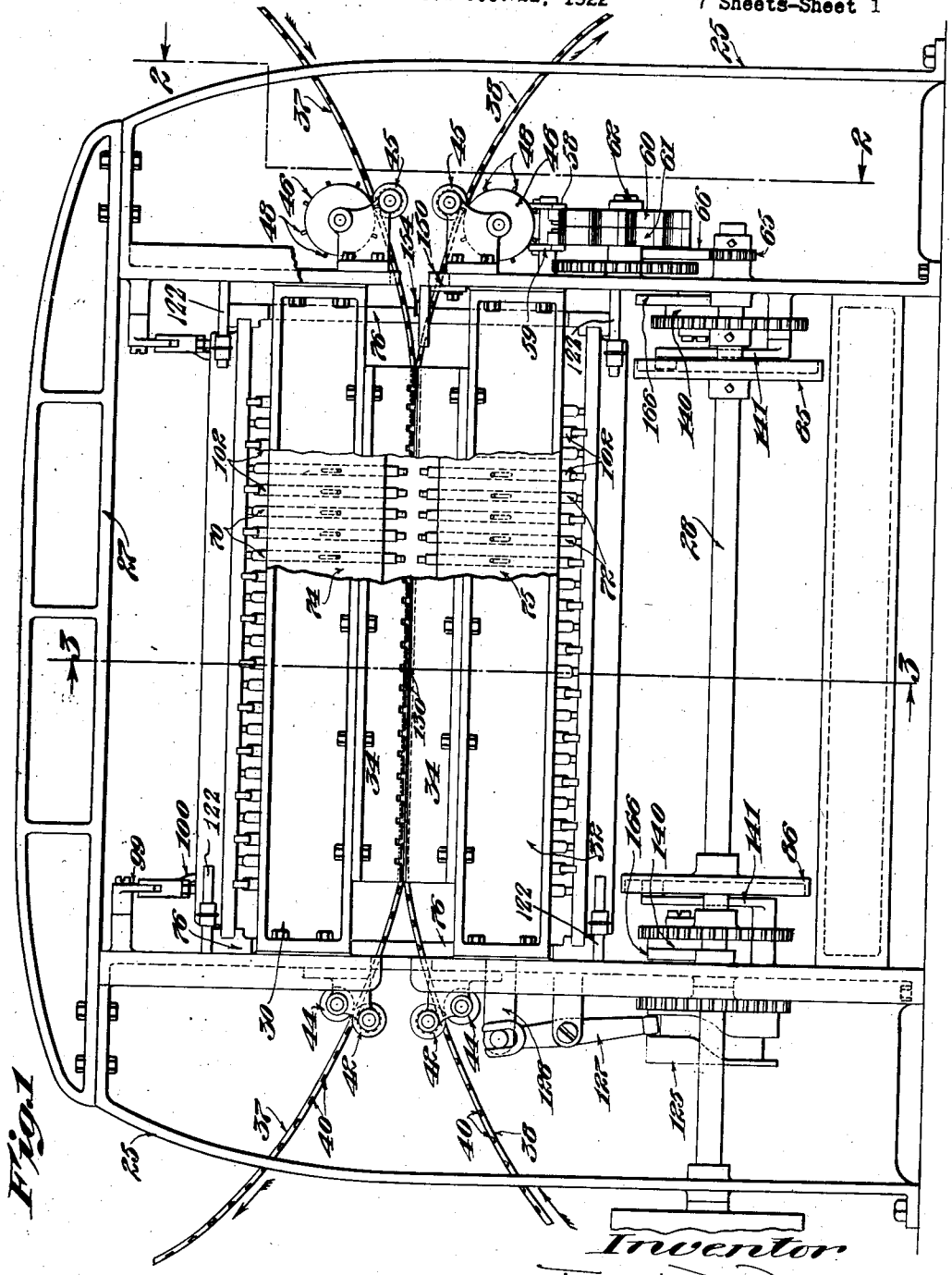


Fig. 1

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Fig. 2

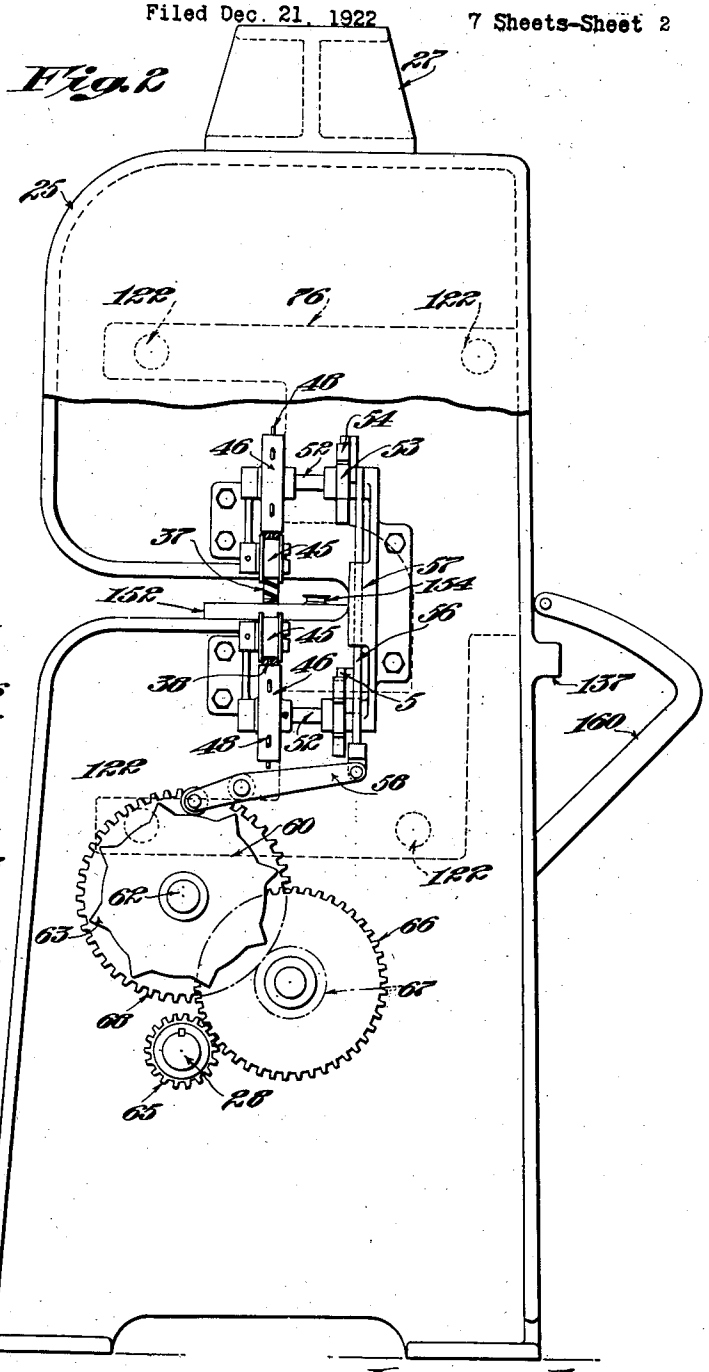
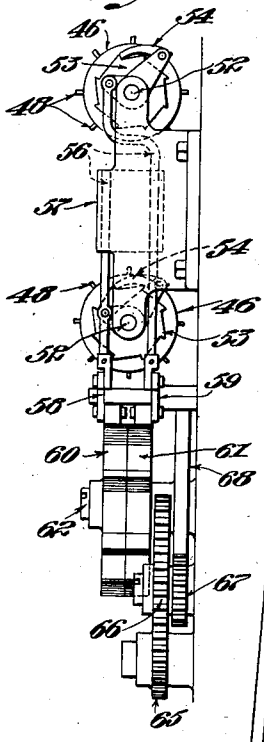


Fig. 2a



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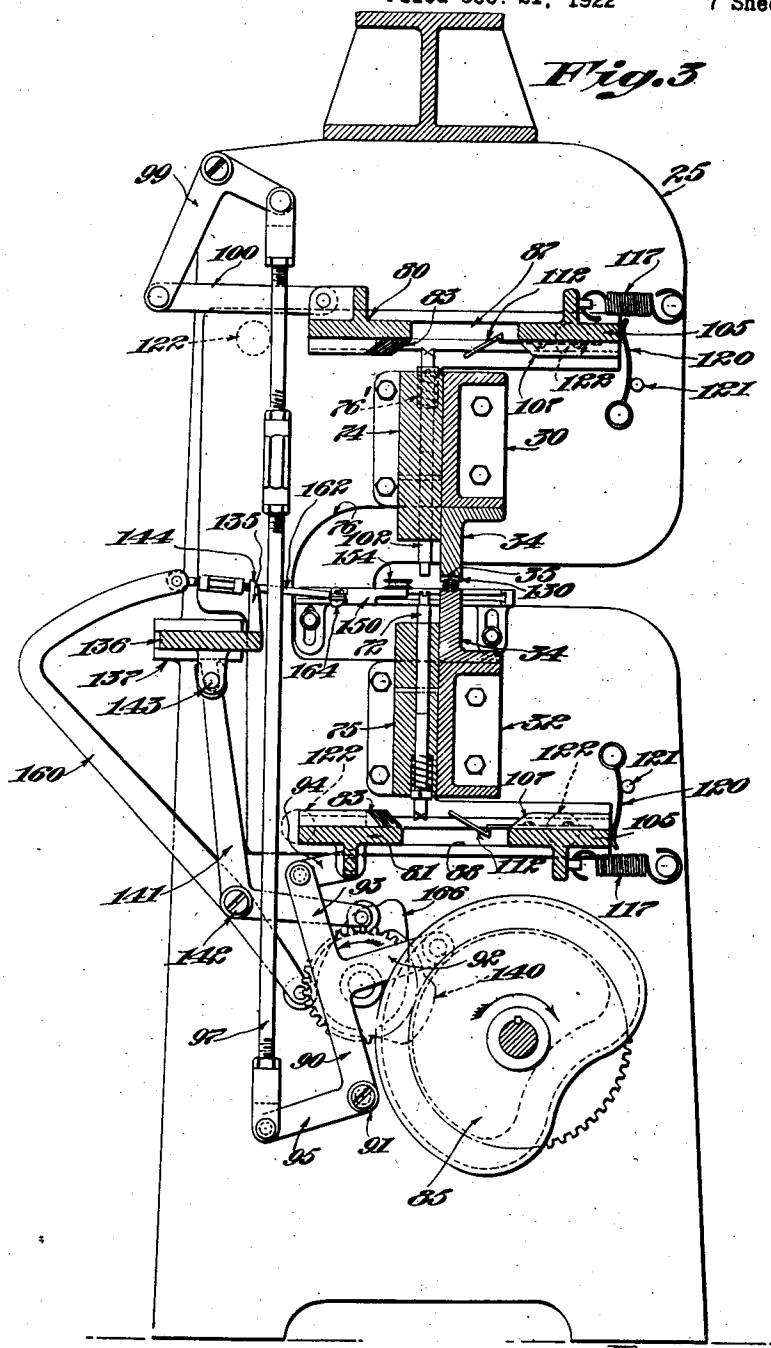
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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

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Fig. 3



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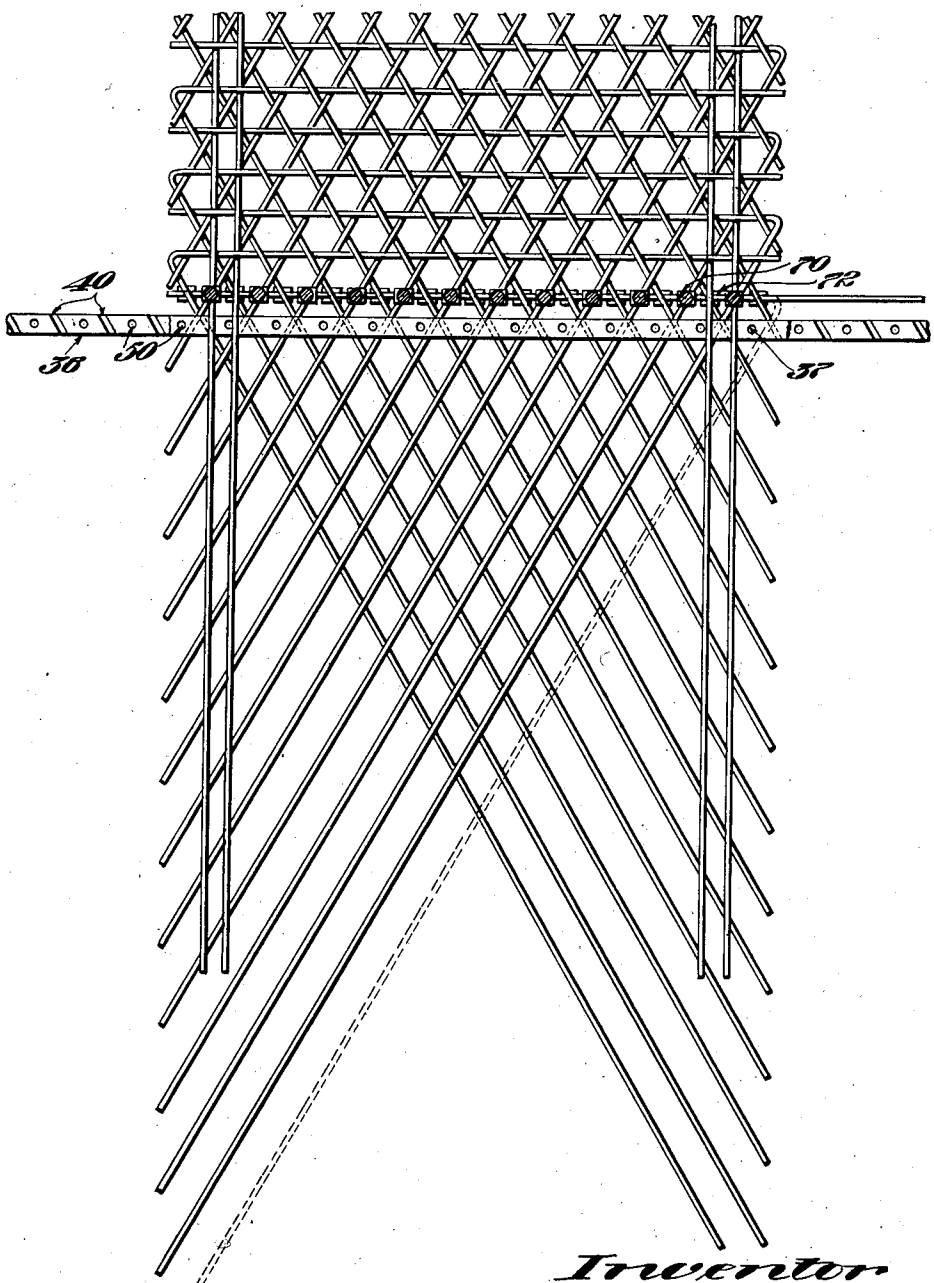
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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

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Fig. 4



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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

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Fig. 5

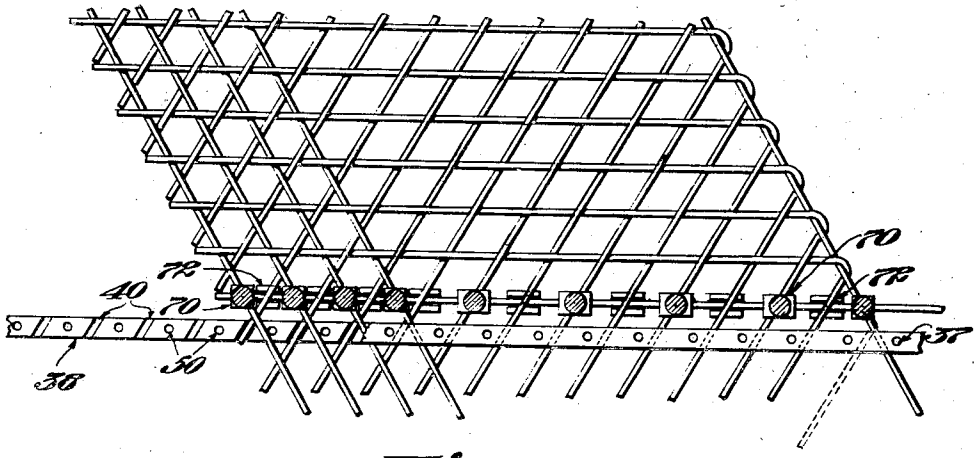
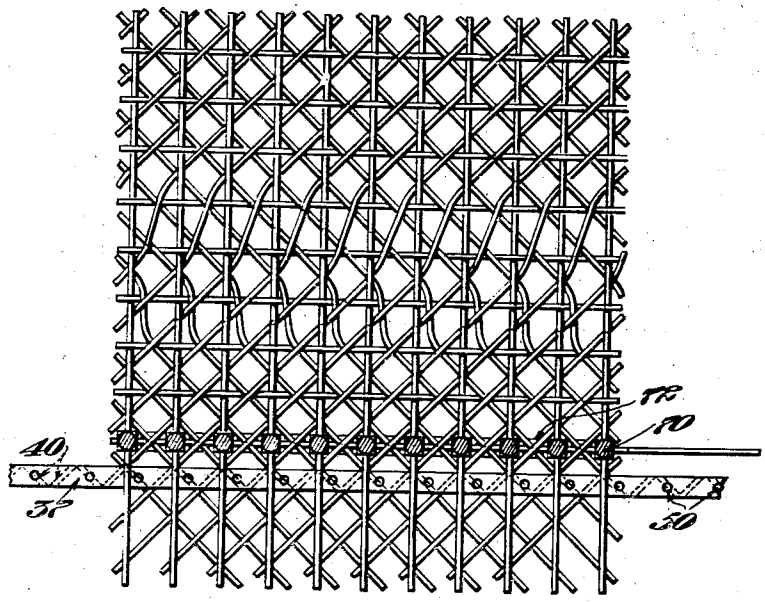


Fig. 6



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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

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Fig. 7

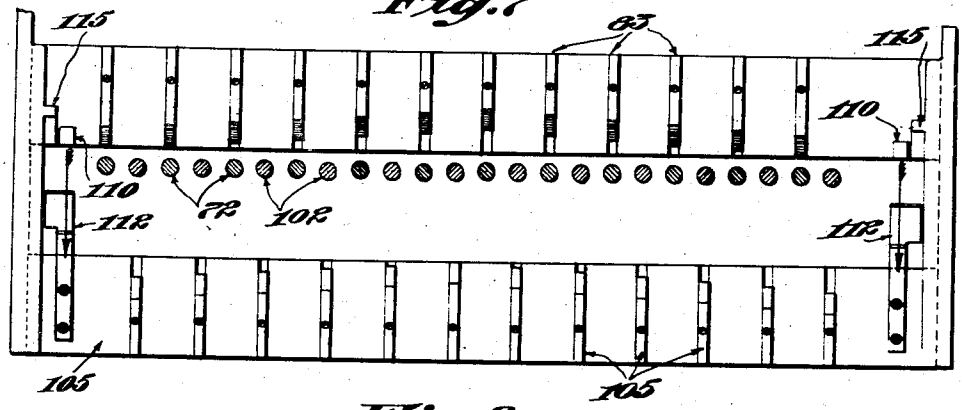


Fig. 8

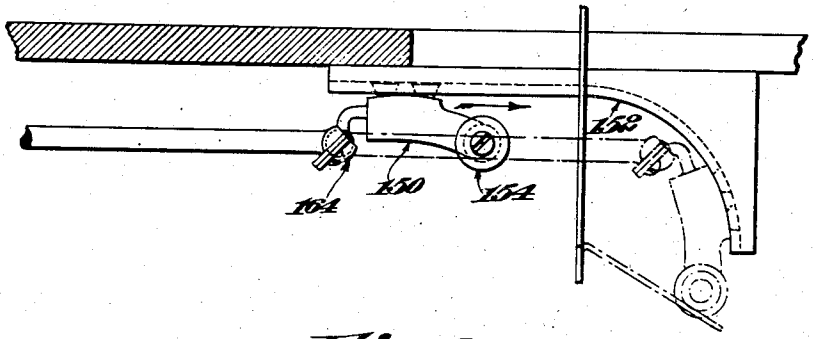
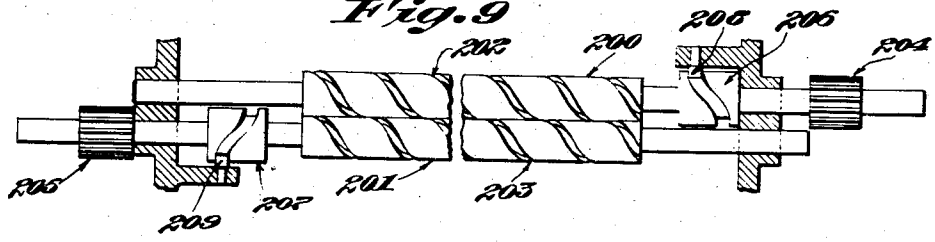


Fig. 9



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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS

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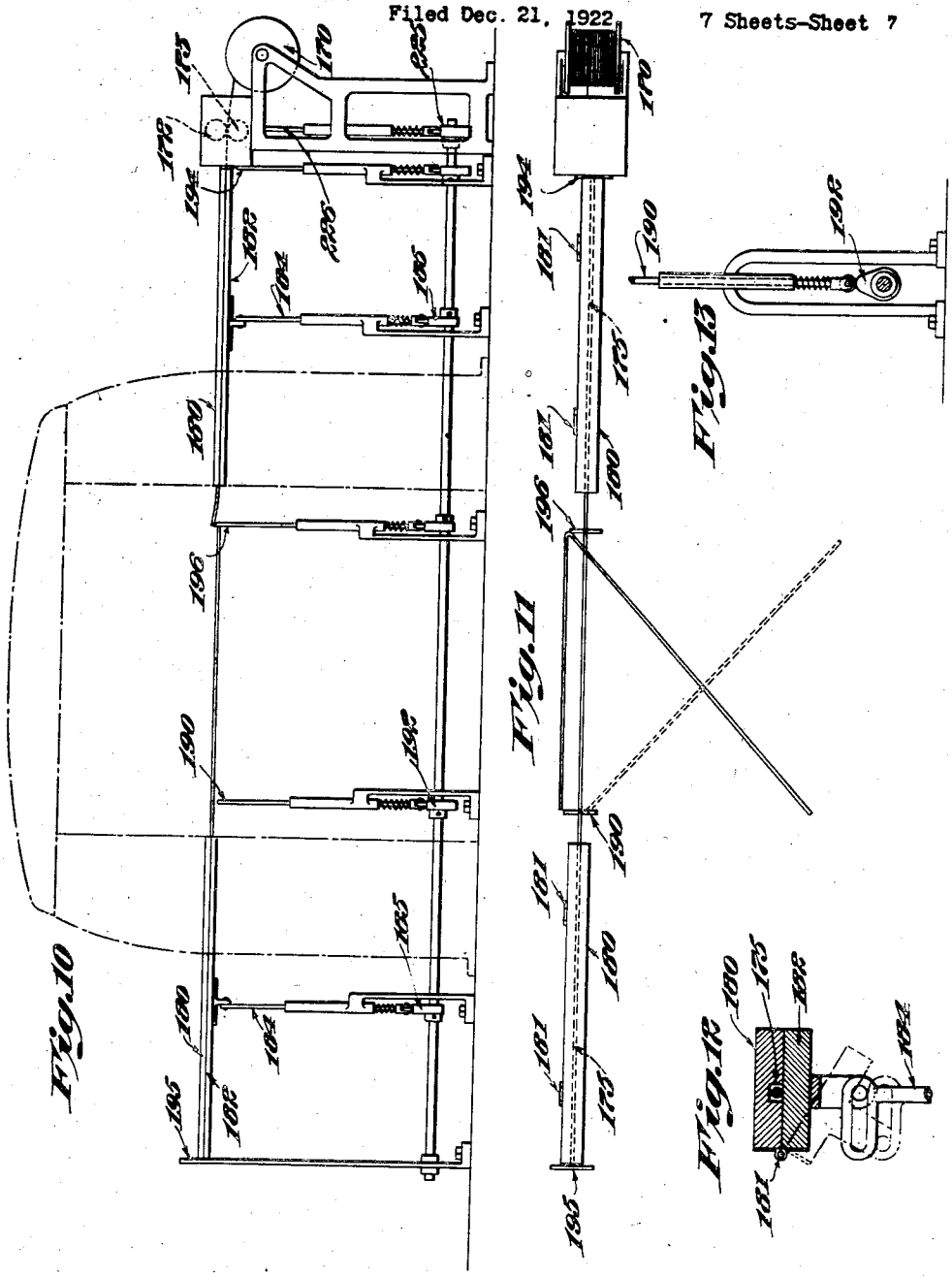


Fig. 10

Fig. 11

Fig. 13

Fig. 18

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1,595,418

UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR PRODUCING A PATTERN OF INTERLOCKING STRANDS.

Application filed December 21, 1922. Serial No. 608,326.

The present invention relates to a method and apparatus for producing a pattern of interlocking strands and is particularly adapted for utilizing strands of substantially non-flaccid material.

The art of weaving comprises generally the formation of a shed in a series of warp threads extending lengthwise of the fabric and passing through the shed opening thus formed one or more weft threads at right angles to the warp threads. There are numerous variations produced by such a method but essentially weaving denotes the employment of interlocked warp and weft strands at right angles to one another and all woven fabrics embody this general principle.

The object of the present invention is to produce a new and ornamental fabric of interlocked strands, which, owing to its characteristics, permits a wide latitude in design and forms a useful basis for various types of open fabrics of metal, reed, cane and similar materials.

With this object in view, one feature of the invention consists in disposing two sets of diagonally arranged strands in adjacent planes, deflecting the two sets of strands in opposite directions to produce a continuous shed passage and inserting a transverse locking strand in the shed passage thus formed to interlock the diagonal strands. This method is accomplished by a series of diagonal guide slots which are moved transversely in timed relation to the advancing movement of the diagonal strands in order to shift the guiding points for the strands in a manner to maintain a predetermined angular relation of the strands as the latter are worked into the pattern. The pressure exerted upon the strands by this transverse movement also serves to feed the strands together with the pattern in a lengthwise direction.

A further feature of the invention contemplates the provision of diagonal strand guiding and feeding members adapted to engage the diagonal strands in such a manner that the guiding points for the strands are progressed across the pattern as the strands are fed lengthwise and shed forming mechanism designed to engage the strands and deflect the strands in opposite directions sufficiently to form a continuous shed passage having substantially the cross section of the locking strand to permit the insertion of a locking strand.

A still further feature of the invention consists in the combination with diagonal strand guiding and feeding members of a series of independently operable shed forming members designed to engage and deflect diagonal or longitudinal strands in opposite directions to form a shed passage, the shed forming members being operated progressively across the fabric. The action of the shed forming members may be complemented by the employment of bending members, which engage the diagonal strands after their release by the shed forming members and impart a curved or wavy contour to the cross locking strand. The employment of these bending members is more particularly useful in case the fabric is produced from relatively heavy strands of metal or similar material where the tension of the diagonal members is insufficient to bend the locking members.

A further feature of the invention consists in disposing two or more sets of strands in adjacent planes, forming a shed passage by the deflection of the strands, inserting a cross locking strand with an end portion extending beyond the side of the fabric, and turning the extended portion of the cross strand into a diagonal position to form a diagonal. This method of forming both a locking strand and diagonal from the same strand member and in addition producing a selvage upon the fabric may be accomplished through the provision of a member engaging the cross strand after its insertion in the fabric and designed to bend the extended portion of the strand into a diagonal position, where it is received and engaged by the diagonal strand guiding and feeding mechanism.

Still further features of the present invention consist in certain novel features of construction, combinations and arrangements of parts hereinafter described and claimed, the advantages of which will be obvious to those skilled in the art from the following description.

In the accompanying drawings illustrating the preferred form of the invention Fig. 1 represents a front elevation with a certain portion broken away of a machine for producing the new fabric; Fig. 2 is an end elevation partly in section upon the line

2—2 of Fig. 1; Fig. 2ª is a detail illustrating an elevation of the mechanism for operating the feed rolls; Fig. 3 is a longitudinal section in elevation upon the line 3—3 of Fig. 1; Fig. 4 is a partially diagrammatic view illustrating the fabric produced by the apparatus of Fig. 1, together with the relation and plane of the diagonal strand guiding and feeding members and shed forming members; Fig. 5 is a diagrammatic view illustrating the fabric produced by using only one of the diagonal strand guiding members, thereby feeding the fabric diagonally; Fig. 6 is a plan view of a fabric produced by intermittently operating the diagonal strand guiding and feeding mechanism; Fig. 7 is a partially diagrammatic view illustrating the cams for progressively operating the shed forming and bending members; Fig. 8 is a detail illustrating a view of one of the members for engaging the cross strand and bending it into a diagonal position; Fig. 9 is a view of a modified form of mechanism for guiding and feeding the diagonal strands; Fig. 10 is a partially diagrammatic view illustrating the mechanism for automatically controlling the feed of the cross strands where it is desired to alternately return the cross strands at opposite sides of the fabric and form diagonals; Fig. 11 is a detail of the mechanism shown in Fig. 10; Fig. 12 is a sectional detail of the same mechanism illustrating the means for opening the guide boxes for permitting the cross strand to be bent into a diagonal position; and Fig. 13 is a detail illustrating one of the cam connections for operating the cutting and stopping members.

According to the present invention two series of diagonal strands extending in opposite directions are arranged in superimposed planes and guided in the proper relation to one another and to the length of the fabric. A shed passage is formed between these strands in close proximity to the guiding members and in such a manner that a cross locking strand may be thrust therethrough. After the insertion of the cross locking strand and the removal of the shed forming mechanism to an inoperative position, the fabric as a whole is fed into position for the insertion of the next locking strand. Coupled with this advancing movement of the fabric is a lateral or transverse movement of the guiding members for the diagonal strands such that the diagonal strands are at all times maintained in the desired angular relation to one another and to the length of the fabric. As the fabric is gradually advanced and the diagonal strand worked into the fabric, the guide point of the strand is traversed laterally of the fabric. With this construction, strands of non-flaccid material such as reed, cane, metal and similar materials may be fed and permanently maintained in the proper angular relation in such a manner that shed forming plungers or projections are enabled to accurately engage the strands during each formation of a shed passage and displace the strands in a manner to create the passage. Furthermore the thrusting of the cross strand through the shed passage thus formed permits the formation of the shed passage through the provision of a series of recesses or openings in the shed forming members, which when moved into alignment with one another provide a continuous passage approximating the cross section of the cross or locking strands. Such a construction for forming the shed has the very great advantage that it permits the locking strand to be inserted with a relatively slight deflection of the longitudinal or diagonal strands and in addition permits the formation of the shed passage in close proximity to the guiding point of the diagonal. In addition to the two sets of diagonals and cross locking strands, it may be desirable to provide additional strands running longitudinally of the fabric, these strands being guided in proximity to the guiding points of the diagonal strands and serving to further reinforce the fabric. It will be evident that if so desired the shed forming members may operate to deflect the longitudinal and diagonal strands in opposite directions to form a shed in this manner, rather than deflecting the diagonals in opposite directions, as in the formation of the three strand fabric.

The illustrated embodiment of the invention is shown in connection with a machine having end supports 25 surmounted by a cross member 27 and having a drive shaft 28 journaled in the lower portion of the end supports. Extending between the supports are two stationary cross heads indicated at 30 and 32 respectively, each of these cross heads having an angle bar 34 bolted thereto, which is provided with a track 35 for the reception of upper and lower guide bars 37 and 38. These guide bars have formed-therein diagonal guiding slots 40 which extend in opposite directions, as indicated in Fig. 4 for example, and are of substantially the cross section of the diagonal strands received therein. These guide slots not only are of sufficient length to preserve the angular relation of the strand but in addition maintain the several strands in parallel relation to one another. The guide bars receiving the diagonal strands are moved in opposite directions transversely of the fabric in timed relation to the advancing movement of the fabric in a manner which will be evident to those skilled in the art from an inspection of Figs. 1 and 2. Upon referring to these figures, more particularly

Fig. 1, it will be observed that the two guide bars which may consist of relatively thin steel bands having the desired degree of flexibility project from opposite ends of the guides 35. At one end of the machine these guide bars merely pass between cooperating guide rolls indicated at 42 and 44 respectively. At the opposite end, however, each of the bands extends between a guide roll 45 and a cooperating feed roll 46 having spaced teeth 48 for engagement with corresponding recesses or depressions 50 formed in the band. With this construction, the bands are advanced at a predetermined rate of speed which is properly timed with relation to the advancing movement of the fabric. Each of the feed rolls is connected to a shaft 52 which is intermittently advanced by a ratchet wheel 53 and cooperating pawl 54. Each pawl is connected with a separate sliding rod 56 movable in the guide bracket 57, these sliding rods 56 being connected at their lower ends with pivoted levers 58 and 59, as shown in Fig. 1. The levers 58 and 59 are rocked intermittently by cams 60 and 61 mounted in adjacent positions upon a shaft 62. Each time that one of the teeth 63 upon the cams engages with the end of the pivoted lever the latter is rocked to operate the connected slide rod and advance one of the feed rolls through the connected pawl and ratchet wheel. The provision of separate cams for operating the two feed rolls permits the bands to be traversed across the fabric at uniform amounts or to have varying degrees of travel imparted thereto. The cams are rotated at a uniform rate of speed from a driving pinion 65 connecting the end of the drive shaft and operating the cam shaft through a train of intermeshing gears indicated at 66, 67 and 68.

Operating in timed relation to the traversing movements of the guide bands are a series of shed forming members which engage and deflect the strands in close proximity to the guide bands. These shed forming members comprise a series of upper plungers 70 cooperating with a series of lower plungers 72, the upper plungers being slidingly received within a head 74 and the lower plungers in a similar head 75. Each of these heads is connected to a movable or false frame 76 which may be shifted transversely of the machine for a purpose to be presently described. The shed forming plungers are slidingly received within the heads and are normally retained in an inoperative position by springs 76′ surrounding each of the plungers and serving to maintain the plungers withdrawn, as indicated in Fig. 3. The plungers are moved toward one another at predetermined intervals by actuating heads 80 and 81 respectively, each of which is provided with a series of wedge shaped cam members adapted to engage with the projecting ends of the respective plungers and move them toward one another upon a sliding movement of the heads in the guide bars 87 and 88. The position of the cam members 83 with respect to the sliding heads may be varied to cause a progressive deflecting movement of the shed forming plungers or to cause all of the shed forming plungers to deflect the strands simultaneously. The sliding heads are actuated intermittently by cams 85 and 86, which are connected to opposite ends of the upper and lower heads 80 and 81. Each of the cams is connected to the lower head through a three-armed lever 90 pivoted at 91 and having one arm 92 connected with the cam, a second arm 93 connected with the head through a link 94 and a third arm 95 connected with a rod 97. The upper end of the rod 97 is connected to a bell crank lever 99 which is connected in turn with the upper head through a connecting link 100. With this construction the heads are traversed back and forth in a manner to cause a deflecting movement of the plungers at predetermined intervals and to hold the plungers in deflecting position during the insertion of the cross locking strand.

It may be desirable in weaving certain types of material, such as relatively heavy metal strands or wire, to provide means for bending the cross locking strand, after its insertion and the retraction of the shed forming plungers. To this end bending plungers indicated at 102 may be interposed between the shed forming plungers and operated upon the retraction of the latter through sliding heads 105, each carrying a series of cam plates 107 adapted to engage with and move the bending plungers into operative position. The operation of the sliding heads 105 is controlled by the sliding heads 80 and 81, these heads being provided with shouldered lugs 110 which are engaged in the advanced position of the heads by spring hooks 112 mounted upon the heads 105. Due to the engagement of the spring hooks with the lugs 110, the heads 105 are drawn into operative position with the rearward movements of the heads 80 and 81. This movement is sufficient to cause an engagement of the cam members with the bending plungers and move the latter into operative position. At the completion of the rearward movement of the heads 80 and 81, the extended ends of the spring hooks engage with lugs 115 formed upon the frame, permitting the heads 105 to be released and retracted under the action of springs 117. This rearward movement of the heads may be cushioned by leaf springs 120, which engage with the heads upon the rearward movement, as indicated clearly in Fig. 3,

these springs being held in position by pins 121. In producing certain patterns, it is essential that the shed forming mechanism be shifted laterally during each sucecssive cycle in order to engage with and deflect the proper diagonal strands. The necessity for this lateral shifting of the shed forming mechanism will be evident from an inspection of Fig. 4. As indicated in this figure, the shed forming plungers 70 and 72 engage with successive diagonal strands across the fabric to deflect these strands in opposite directions. After the formation of the shed and the insertion of a locking strand, the fabric is advanced for the formation of the next shed passage. During this advancing movement, the shed forming mechanism as a whole is shifted laterally to cause the engagement of the shed forming plungers with the proper strand. In order to accomplish a lateral shifting movement of the shed forming mechanism, the false frame 76 is slidingly supported upon trunnions 122 projecting from the end supports 25. As indicated in Fig. 1, a reciprocating movement is imparted to the false frame and shed forming mechanism carried thereby through a cam 125 connected with the false frame by a pivoted lever 127 at an extension 128. With this construction the shed forming and bending mechanism as a whole is shifted laterally during each advancing movement of the fabric. Although such a relative lateral shifting of the shed forming mechanism with respect to the fabric is essential when forming a fabric of the character shown in Fig. 4, a fabric such as shown in Fig. 6 for example is produced without any relative lateral movement of the shed forming mechanism, owing to the fact that in this type the shed forming plungers engage and deflect in opposite directions the longitudinal strands and two of diagonal strands at their intersecting points, the points of deflection being in longitudinal alignment with one another as the fabric is advanced through the machine. From an inspection of Figs. 4, 5 and 6, it will be observed that the diagonal strands are permanently received and guided in the slots 40 of the guide members and that the shed passage is formed in close proximity to the guiding points. The formation of the shed passage in this manner is highly desirable, as it permits the accurate location and retention of the strands in proper alignment with respect to the shed forming plungers and insures that the latter shall invariably engage with the proper strand in forming the shed passage. The location of the guiding means in close proximity to the shed forming mechanism is made possible in part by the fact that a shallow shed passage is formed with the last possible deflection of the diagonal strand. If it is desired to interlock a fourth or longitudinal strand with the diagonal and cross strands, this may be accomplished as indicated either in Fig. 4 or Fig. 6, these longitudinal strands being guided in a plane above the diagonals through the provision of a series of longitudinal guide slots 130 formed in the member 34 above the upper guiding band, as shown more particularly in Figs. 1 and 3. The location of the longitudinal strands with respect to the guide members for the diagonal strands is also indicated diagrammatically in Fig. 6.

In order to insure a uniform feeding movement of the fabric after its formation, a feeding member is conveniently located at the forward end of the machine and as indicated in Fig. 3, this feeding member comprises one or more upstanding feeding fingers 135, which extend from a reciprocating bar 136. These feeding fingers are preferably located at intervals along the bar to engage with the fabric at different points. The bar 136 slides in guides 137 formed upon the end supports and is reciprocated in timed relation to the production of the fabric from a cam 140. The cam is connected to the slide bar by a bell crank 141 pivoted to the frame at 142 having one end engaging with the periphery of the cam and the opposite end connected at 143 to the under portion of the slide. The feed fingers 135 are designed to engage in the interstices of the pattern and feed the latter during the movement to the left in Fig. 3. Upon movement of the feeding fingers in the opposite direction, the rounded ends 144 slide beneath the fabric without feeding, thus permitting the feeding fingers to be returned to initial position for engagement with the fabric at a new point.

For certain purposes and with certain types of material there is a distinct advantage in producing a selvage upon one or both edges of the pattern and in the present invention this is accomplished in a novel and useful manner by bending back the cross locking strands and incorporating the extended ends of these cross strands in the fabric as diagonal strands. This method of operation will be evident from an inspection of Fig. 4, in which successive cross strands are alternately bent back at opposite sides of the fabric to form certain of the diagonal strands. The bending of the cross strands in this manner is accomplished by an automatically operating bending mechanism shown more particularly in Figs. 1 and 8 of the drawings. This mechanism engages the extended end of the cross strand after the latter has been inserted in the shed passage and bends this extended end into a position in which it engages with a guiding slot in one of the bands 37 or 38. A movable bending member 150 is slidingly supported in a curve track 152, this mem-

ber being provided with a grooved roll 154, which is positioned opposite the extended end of a strand, as indicated in Fig. 8, when the latter is inserted in the shed passage. As the bending member carrying the roll is moved in the direction of the arrow, the strand is engaged by the groove and is gradually bent from the position shown in full lines in Fig. 8 into the position shown in dot and dash lines in Fig. 8 through the movement of the bending member in the curved track 152. In this position the strand is sprung into one of the diagonal slots formed in the guide member and is thereafter retained in the slot during the traversing movement of the guide member and the strand across the fabric. The bending member is operated by a curved lever 160 connected with the member through an adjustable link 162, as shown in Fig. 3, the inner end of the link being connected with the bending member through a ball socket joint 164 to permit swiveling movements of the member with respect to the link, as indicated clearly in Fig. 8. The lever 160 is pivoted at 142 and the lower end 164 engages with a cam 166, which actuates the lever in a manner to move the bending member at predetermined intervals. It will be obvious that by a proper design of the cam and connecting mechanism the bending member may be actuated to bend every successive cross strand or to bend alternate cross strands as desired.

Figs. 10 to 13 inclusive illustrate somewhat diagrammatically an arrangement for automatically accomplishing the insertion and bending of cross strands from an endless length of wire, cane or similar material. Although this mechanism is not shown as actually incorporated in the present machine, the manner in which it could be incorporated will be evident from the drawings and following description. As indicated, the cross strand is fed from a reel 170 between feeding and straightening rolls indicated at 172 and 173. From the feeding and bending rolls the strand passes through a closed passage 175 which is arranged in alignment with the shed forming members to cause the passage of the strand through the shed opening when the latter is formed. Upon the opposite side of the machine is located a similar closed passage 175 to receive the strand after it is passed through the shed opening. Each of these closed passages is formed in a member 180, the two members 180 being pivotally connected at 181 to cover plates 182. With this construction, the closed passages are provided for the insertion and retention of the cross strand at opposite ends of the shed passage, these closed passages 175 being opened, however, to permit the removal of the strand therefrom by the bending members. As indicated clearly in Fig. 12, the member 182 is normally supported in the position shown by a connected rod 184 engaging at its lower end with a cam 185. The rotation of this cam causes the member 182 to be dropped into the position shown in dot and dash lines at predetermined intervals in order to permit the removal of the strand from the passage 175. As indicated, the mechanism shown in Fig. 10 is adapted to engage and bend successive cross strands alternately at opposite ends. For this purpose, an automatically operating stop indicated at 190 is caused to project into the path of the strand by a cam 192. This stop finger is positioned at approximately the edge of the fabric and prevents the feeding of the strand beyond this point. Cooperating with the stop member is a cutter member 194 which severs the strand, leaving an extended end in the closed passage at the right of the machine. Thereafter the member 182 at the right of the machine is dropped to permit the cooperating bending member to engage this strand and bend it diagonally, as shown in Fig. 11, into position to be engaged by the guiding slots. During the insertion of the next successive locking strand the stop finger 190 and the cutter 194 are retained in an inoperative position and the strand is moved across the entire length of the closed passages 175 until engagement with a fixed stop 195. Thereafter this strand is severed at the right hand edge of the fabric through a cutting member 196 operated by a stop cam. In the meantime the member 182 at the left of the machine is depressed to permit this strand to be fed into a diagonal position, as shown in dotted lines in Fig. 11.

As an alternative to the endless guiding bands 37 and 38 the construction shown in Fig. 9 may be employed for certain types of material, for example metal strands. With this construction, the guiding of the diagonal strands is accomplished by cooperating rolls 200 and 201, which have spiral grooves 202 and 203 formed therein adapted to receive and maintain the strands in the proper position. It will be evident that if the diagonal strands are inserted in the grooves in the upper and lower rolls that these strands will not only be guided and maintained in the proper angular positions but will in addition be fed in a lengthwise direction as the rolls are rotated to traverse the strands along the length. It will be understood in this connection that the cross section of the spiral grooves approximates the cross section of the strands and the latter fit the grooves with relative accuracy. These rolls may be independently driven through separate drive gears indicated at 204 and 205 and shifted later-

ally through cams 206 and 207 engaging with stationary pins 208 and 209 projecting from the frame. It will be obvious that this lateral shift of the guiding and feeding rolls is for the same purpose as the lateral shift of the shed forming mechanism described in the preferred embodiment of the machine.

The patterns shown in Figs. 4, 5 and 6 of the drawings illustrate certain designs which may be produced embodying the principles of the invention. The fabric shown in Fig. 4 comprises generally two sets of diagonal strands maintained in adjacent planes by the guiding members and deflected in opposite directions to form a shed opening for the locking strand. In addition this pattern illustrates one method of interlocking additional sets of longitudinal strands, these strands being deflected at their points of intersection with the diagonal strands to form a shed passage. This pattern also illustrates the formation of a partial selvage by the bending back of successive cross strands at oppoiste sides of the fabric. Fig. 5 illustrates a pattern which may be produced by traversing one of the guide members for the diagonal strands and retaining the cooperating guide member stationary, this mode of operation causing the fabric to be fed in an inclined direction in the manner illustrated. In this construction also a shed passage is produced by an opposite deflection of successive diagonals extending in the same direction to produce the shed passage. Fig. 6 illustrates a conventional type of fabric which may be produced according to the principles of the invention, employing two sets of diagonal strands with cooperating longitudinal strands, the longitudinal strands and the diagonal strands at the points of intersection of the diagonals being deflected in opposite directions to form the shed passage so that the cross locking strand passes at one side of both diagonals and at the opposite side of the cooperating longitudinal strand. This pattern also illustrates a variation which may be introduced by intermittently varying the movement of one or both of the guide members.

It will be understood by those skilled in the art that the cross locking strand may be inserted manually in the continuous shed passage formed by the slots in the shed forming plungers when the latter are moved into alignment with one another. In addition Fig. 10 illustrates diagrammatically the feed rollers 172 and 173 which may be employed for the insertion of this strand. In the actual practice of the invention these feed rollers may be rotated intermittently through a cam 225 mounted upon the same shaft with the cams 185 and serving through connections indicated at 226 to control the intermittent driving of the feed rolls. In order to cause the insertion of the cross strands it is only necessary to positively rotate the feed rolls during the initial portion of the movement and thereafter the momentum of the feed rolls together with the strand engaged thereby causes the strand to be fed throughout the shed passage until its engagement with the stop. The cam 225 therefor is designed to intermittently rotate the feed rolls for a short period in timed relation to the formation of the shed passage. This can be readily accomplished by properly connecting the cam shaft with the machine as a whole.

It will be evident that the depth and character of the shed passage in the present machine is determined by the cross section of the slots formed in the working ends of the shed plungers, this passage being bounded upon three sides by the walls of the slot and upon the fourth side by the deflected strands between which the shed passage is produced. It will furthermore be evident that the formation of the shed passage by the deflection of the diagonal and longitudinal strands takes place progressively through the engagement of successive strands transversely of the pattern by individual shed forming members. In addition the illustrated embodiment of the invention shows a progressive bending action on the part of the bending members starting at the central portion of the pattern and progressing outwardly to opposite sides, this bending action being of particular importance as it tends to draw the cross strands inwardly from opposite sides as the overlying diagonal and longitudinal strands are brought back to initial position, this drawing action continuing until the bending operation has progressed to the outer edges of the pattern.

It may be pointed out that the production of a pattern of interlocking strands by feeding the pattern diagonally with relation to the machine in the manner shown in Fig. 5 not only permits the formation of the pattern with a single movable guide and feed member but in addition results in the production of more fabric for each cycle of operations. This will be evident from an inspection of Fig. 5 illustrating the insertion of the locking strands at an inclination to the direction of feed of the pattern. In addition to the pattern produced as shown in Fig. 5 by a single moving guide member, it will be evident that by the employment of two guide members with an unequal movement of the members in opposite directions the designed fabric shown in Fig. 6 may be produced and in addition a relative sidewise movement of the fabric in order to vary the alignment of the shed forming members with relation to the strands may be secured. In other words, it will be

evident that a considerable variation in the character of the work may be introduced by suitable variation of the guide members and their movements.

It will be understood by those skilled in the art that the actual feeding of the pattern is accomplished primarily by the lateral thrust exerted at the guiding points of the diagonal strands. The component of this thrust lengthwise of the pattern is sufficient to feed the pattern as the guiding points traverse across or transversely of the pattern. It will be furthermore understood that the terms "lengthwise strands" or "strands extending lengthwise of the pattern" are intended to embrace all strands in the pattern other than the cross locking strands, independently of whether these strands extend longitudinally of the pattern or diagonally at different angles.

I claim:—

1. An apparatus for producing a pattern of interlocking strands comprising a guide band, a series of inclined slots formed in the guide band and designed to receive and guide diagonal strands, cooperating shed forming members positioned ahead of and in relatively close proximity to the guide band, means for actuating the shed forming members to form successive shed passages, and means for feeding the guide band transversely.

2. An apparatus for producing a pattern of interlocking strands comprising cooperating guide bands, each having a series of guide slots formed therein to receive and guide strands extending in different directions, cooperating shed forming members positioned in close proximity to the guide bands, means for actuating the shed forming members to produce successive shed passages, and means for moving the guide bands transversely of the machine and in opposite directions.

3. An apparatus for producing a pattern of interlocking strands comprising two series of inclined slots extending in opposite directions, means for feeding each series of inclined slots in opposite directions transversely, a third series of stationary longitudinal slots, the three series of slots being positioned in different planes, and shed forming mechanism located in close proximity to the guide slots and adapted to produce a shed passage by deflection of the strands.

4. An apparatus for producing a pattern of interlocking strands comprising a relatively thin band having a series of inclined guide slots formed therein, means for intermittently feeding the band transversely of the machine, cooperating shed forming members, means for actuating the shed forming members to produce shed passages between the feeding movements of the band, and means for feeding the pattern simultaneously with the transverse movements of the band.

5. An apparatus for producing a pattern of interlocking strands comprising a guide member having a series of inclined guide slots formed therein, means for operating the member to cause an intermittent transverse movement of the guiding points of the strands, cooperating shed forming members, and means for actuating the shed forming members to form successive shed openings for the reception of a cross locking strand.

6. An apparatus for producing a pattern of interlocking strands comprising upper and lower stationary heads, a guide member having a series of diagonal slots slidingly received in each head for movement transversely of the machine, a series of shed forming members slidingly supported for vertical movement in proximity to the heads, means for actuating the shed forming members to deflect the strands, and means for bodily shifting the shed forming members in a lateral direction between the formation of the shed opening.

7. An apparatus for producing a pattern of interlocking strands comprising means for guiding a series of parallel strands, cooperating shed forming members operating to deflect the strands, cooperating bending members operating to return the strands toward initial position after the formation of the shed, means for actuating the shed forming members, and means for actuating the bending members controlled by the actuating mechanism for the shed forming members.

8. An apparatus for producing a pattern of interlocking strands comprising two series of cooperating shed forming plungers, a sliding head operating the plungers to form a shed, a series of cooperating bending plungers, a second sliding head for operating the bending plungers, and means adapted to connect the two heads to move the second head into an operative position upon the withdrawal of the first head from operative position.

9. An apparatus for producing a pattern of interlocking strands comprising cooperating shed forming members, cooperating bending members, means for operating the shed forming members to produce a shed opening, and means controlled thereby for thereafter operating the bending members to return the strands toward initial position after the formation of the shed opening.

10. An apparatus for producing a pattern of interlocking strands comprising two movable guide bands each having guide slots formed therein, means for guiding the movement of the bands transversely of the machine, and separate and independent

mechanism for intermittently moving each of the bands transversely of the machine at a predetermined rate of speed.

11. An apparatus for producing a pattern of interlocking strands comprising means for guiding a plurality of parallel strands, means for deflecting the strands to form a shed passage therebetween for the insertion of a cross locking strand, and means for engaging with the extended end of a cross locking strand at one side of the pattern and bending the strand into operative position with relation to the guiding means.

12. An apparatus for producing a pattern of interlocking strands comprising means for guiding a plurality of parallel strands, means for deflecting the strands to form a shed passage therebetween for the insertion of a cross locking strand, and a bending member movable in a curved path designed to cause engagement of the bending member with the extended end of a locking strand and movement of the extended portion of the strand into an inclined position in operative relation with the guiding means.

13. An apparatus for producing a pattern of interlocking strands comprising a guide member having a series of diagonal guide slots formed therein, means for actuating the member, shed forming mechanism designed to form a shed passage adjacent the guide member, and a bending member movable in a path to engage with the extended end of a locking strand and bend this end into operative relation with a diagonal guide slot at one side of the path.

14. An apparatus for producing a pattern of interlocking strands comprising a guide member having a series of diagonal guide slots formed therein, means for actuating the member, shed forming mechanism designed to form a shed passage adjacent the guide member, a bending head, a roll journaled upon the head for engagement with the extended portion of the locking strand, and means for actuating the head to bend the extended end of a strand into position above one of the guide slots and permit the reception of a strand thereby and its incorporation in the pattern.

15. An apparatus for producing a pattern of interlocking strands comprising guide bands each having a series of diagonal slots formed therein, means for intermittently moving the bands transversely of the machine, cooperating shed forming members positioned for vertical movement adjacent the guide bands and in advance thereof, means for operating the shed forming members between the transverse movements of the guide bands, feeding members adapted for engagement with the fabric in advance of the shed forming members, and means for intermittently actuating the feed members in timed relation to the movement of the guide bands and shed forming members.

16. An apparatus for producing a pattern of interlocking strands comprising a stationary head, a guide band having a series of guide slots slidingly supported by the head, means for intermittently moving the band, and a series of guide slots formed in the head and stationary with respect to the slots in the moving member.

17. An apparatus for producing a pattern of interlocking strands comprising cooperating guide members, cooperatng shed forming members positioned adjacent thereto, means for intermittently operating the guide members and shed forming members in timed relation, a bending member designed to engage the end of a cross locking strand and move it into operative relation to the guide members.

18. An apparatus for producing a pattern of interlocking strands comprising means for guiding diagonal strands, mechanism for intermittently feeding a cross locking strand, means for automatically measuring the length of strand thus inserted, and means for engaging with the extended end of the strand and bending it into an inclined position to engage with the guiding means.

19. An apparauts for producing a pattern of interlocking strands comprising means for feeding a cross strand, means for automatically limiting the insertion of the cross strand at one of two predetermined points, means for severing the cross strand thus inserted at different points, and means for successively bending the extended length of cross strand at opposite sides of the pattern.

20. An apparatus for producing a pattern of interlocking strands comprising cooperating feed wheels for inserting a cross locking strand, means for intermittently operating the feed wheels, means for limiting the insertion of the cross strand and the action of the feed wheels, means for severing a uniform length of cross strand thus inserted, and means for bending the extended end of the severed cross strand.

21. A method of producing a pattern of interlocked, non-flaccid strands which consists in arranging a series of diagonal strands in parallel relation, forming a shed passage by the deflection of the strands, inserting a cross locking strand with an end extending from the side of the pattern, and bending the extended end of the locking strand backward into parallelism with the diagonal strand to form a diagonal strand as the pattern is fed in the direction of its length.

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