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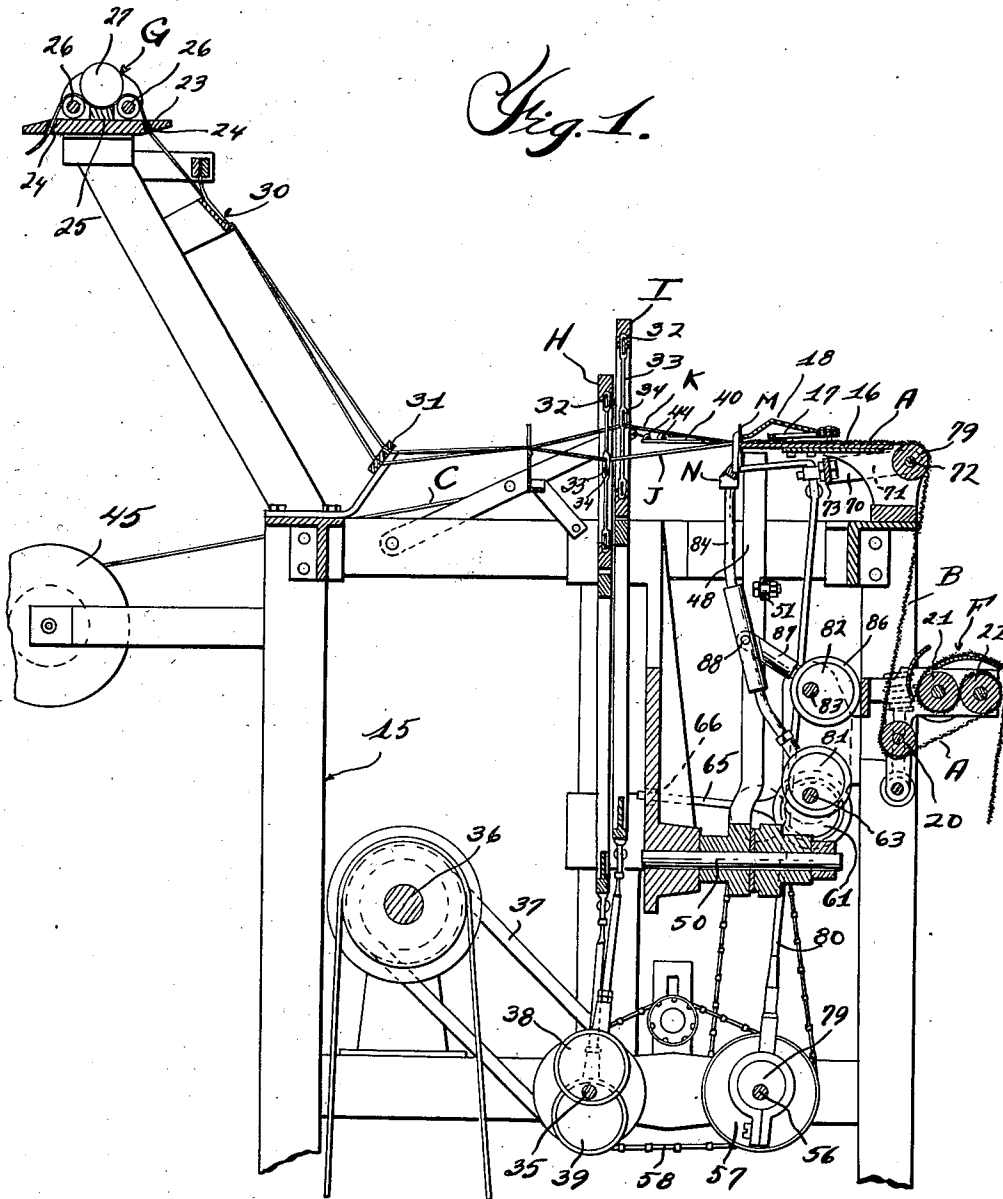
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2,013,230

METHOD AND APPARATUS FOR MAKING A TEXTILE PRODUCT

Filed Jan. 16, 1933

4 Sheets-Sheet 1



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Sept. 3, 1935.

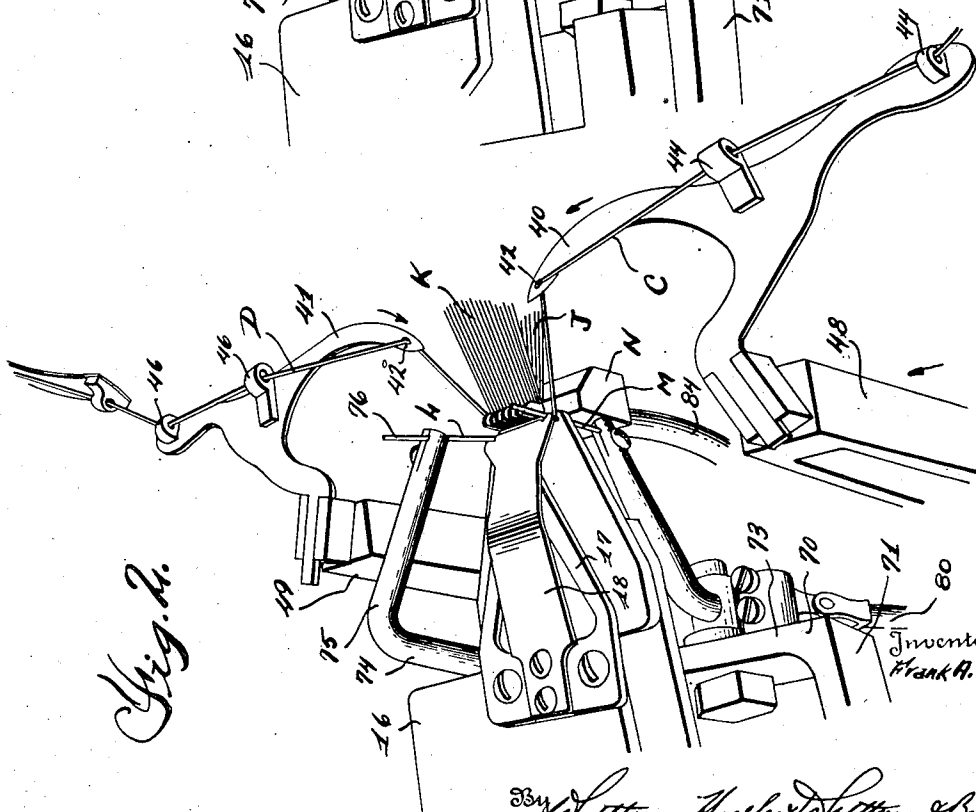
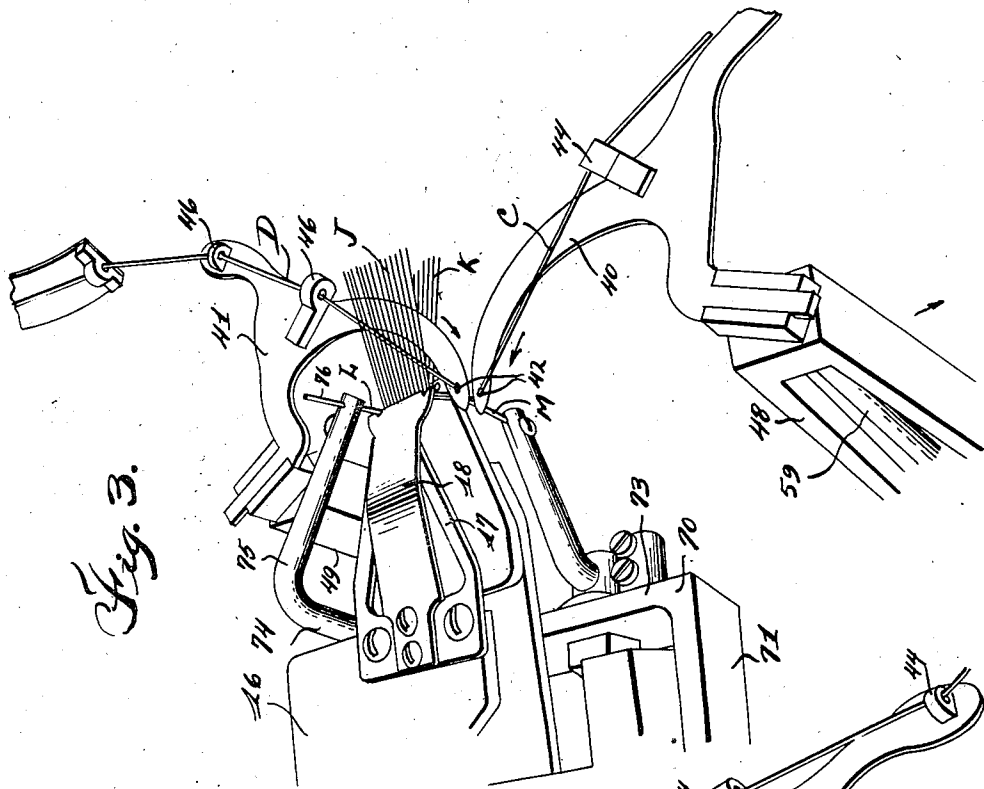
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2,013,230

METHOD AND APPARATUS FOR MAKING A TEXTILE PRODUCT

Filed Jan. 16, 1933

4 Sheets-Sheet 2



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2,013,230

METHOD AND APPARATUS FOR MAKING A TEXTILE PRODUCT.

Filed Jan. 16, 1933

4 Sheets-Sheet 3

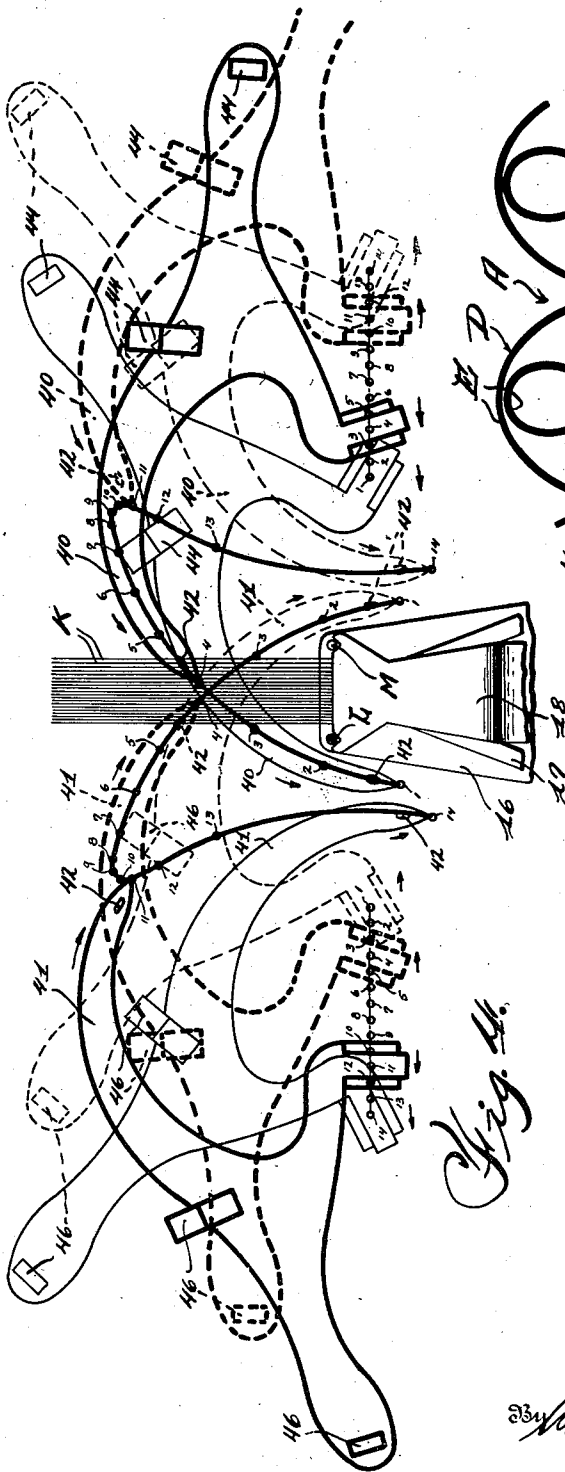


Fig. 4.

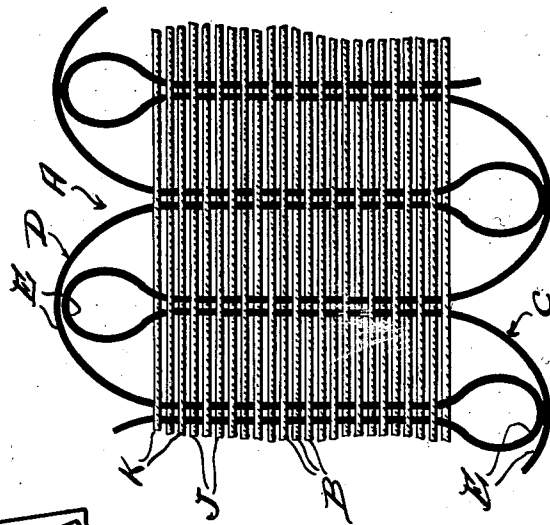


Fig. 5.

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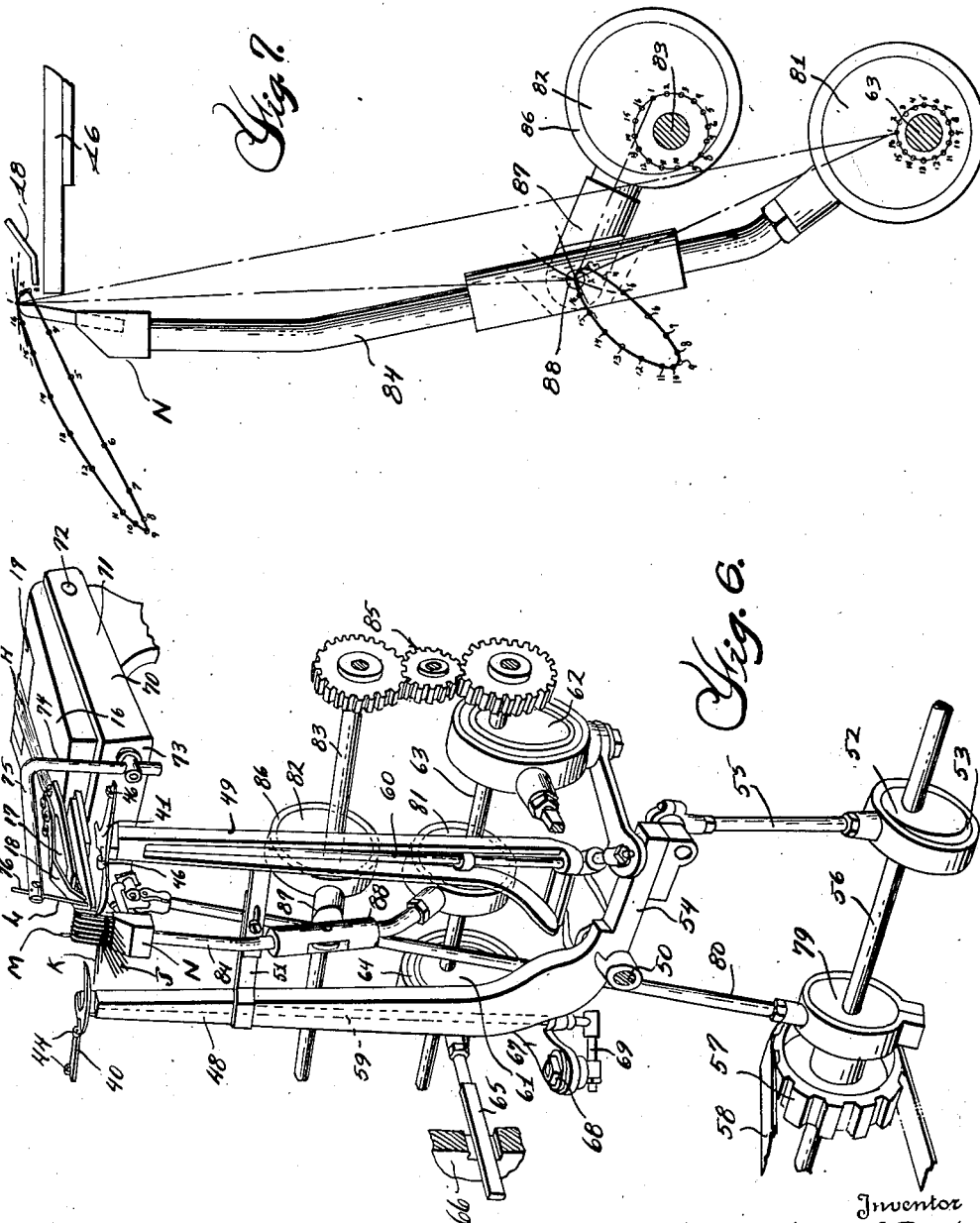
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2,013,230

METHOD AND APPARATUS FOR MAKING A TEXTILE PRODUCT

Filed Jan. 16, 1933

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,013,230

METHOD AND APPARATUS FOR MAKING
TEXTILE PRODUCT

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Application January 16, 1933, Serial No. 652,083

10 Claims. (Cl. 139—124)

This invention relates generally to a method and apparatus for forming fabricated products composed of interwoven strands of threads of suitable material. The invention concerns itself more particularly with a method and loom for weaving wire cloth wherein the warp is formed of a textile thread and the weft comprises a metal thread.

One of the principal objects of the present invention is to simplify, expedite, render more efficient and otherwise improve the manufacture of fabricated products of the foregoing character.

In accordance with this invention, the warp is divided into two groups of threads, and these groups are relatively moved in opposite directions alternately to successively form sheds. In timed relation to the relative movement of the warp threads to form one shed, a weft thread is passed through the shed transversely of the warp threads from one side of the shed. The side aforesaid will be referred to hereinafter as the right side for the purpose of convenience, and as the weft thread is extended beyond the left side of the shed, the same is passed around a suitable looper whereupon the adjoining portion thereof is returned to the right side of the shed. Upon returning the adjoining portion of the weft thread to the right side of the shed, the same is passed around a second looper located on the latter side and moved rearwardly to a position in readiness for the next operation.

As the adjoining portion aforesaid of the weft thread is returned to the right side of the shed, the latter is closed and the relative positions of the two groups of warp threads forming the same are reversed to form a second shed. In forming the second shed in the manner specified above, the two groups of weft threads are crossed over the previously formed loop tying the latter in place. During the formation of the second shed, a suitable comb is moved forwardly in the direction of length of the warp threads for engaging the rear transverse side of the loop in the previous shed to tuck the latter, or in other words, move the same into close proximity to the adjacent side thereof. As the aforesaid steps of the method are successively effected, the warp is continuously advanced forwardly so that upon completion of the tucking operation, the previously formed loop is moved out of the line of action of the weft forming mechanism and a second weft thread is passed transversely through the second named shed upon the left side thereof to the right side of the same. As this weft thread

is extended beyond the right side of the shed, the same is passed around the right-hand looper in rear of the first named weft thread, and the adjoining portion of the same is returned to the left side of the machine whereupon it is passed around the left-hand looper. During the return of the portion aforesaid of the weft to the left side of the shed, the latter is closed and the two groups of warp threads are again relatively moved to the first mentioned positions thereof to form another shed. The loop formed in the previous shed by the second weft thread is then tucked in the same manner pointed out above, and the foregoing functions are repeated in their proper sequences throughout the operation of the apparatus.

It will be apparent from the novel method previously set forth that a fabricated product will result wherein the weft loops in alternate warp sheds are continuous and wherein these loops extend through the warp from opposite sides thereof.

In addition to the above, the present invention contemplates the provision of a loom for carrying the above method into effect composed of a relatively few number of simple parts and having actuating mechanism operable to perform the steps of the method in the desired sequence at a speed heretofore considered impractical.

One feature of this invention which contributes materially to expediting the speed of the weaving operation resides in the provision of two needles or weft carrying members for alternately forming the loops in successive sheds and also to the novel paths of travel through which the needles move during operation of the same. As will be presently described, the two needles, in addition to being mounted for swinging movement in a plane common to the normal plane of travel of the warp, are also capable of simultaneous rectilinear movement toward and away from the warp. This arrangement obviously expedites manipulation of the weft, and, as a consequence, increases the production of the apparatus.

A further feature of the present invention which provides for obtaining high speed operation of the loom is attributed to the absence of grooved cams or lifts and to the use of simple eccentrics or other purely rotatable elements.

With the foregoing as well as other objects in view, the invention resides in the peculiar construction of the apparatus and the novel method employed for forming the desired fabric which will be made more apparent as this description

proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a sectional side elevational view of the apparatus;

5 Figure 2 is a fragmentary perspective view of a portion of the apparatus shown in Figure 1;

Figure 3 is a view similar to Figure 2 showing the parts in a different position;

Figure 4 is a semi-diagrammatic plan view illustrating the paths of travel of the weft needles;

Figure 5 is a fragmentary plan view of the product of the apparatus shown in Figure 1;

Figure 6 is a perspective view of a portion of the apparatus featuring the actuating means for the weft needles and tucking mechanism for the weft threads;

Figure 7 is a sectional side elevational view of the comb and actuating means therefor illustrating the path of travel of the comb.

The method and apparatus forming the subject matter of this invention is shown herein for the purpose of illustration as forming a strip of wire cloth designated generally in Figure 5 by the reference character A. In the present instance, the warp of the product is formed of a series of textile threads B, while the weft of the product is formed by a plurality of metallic threads C interwoven with the warp threads so as to form a one-piece strip of the required strength and flexibility. In the specific embodiment of the invention, two weft threads are provided, and these threads are continuous throughout the length of the strip. As shown in Figure 5, the weft thread C is interwoven with the warp threads from the right-hand side of the warp, while the cooperating weft thread D is interwoven with the warp threads from the left-hand side of the warp. In order to permit forming both the weft threads continuous and at the same time provide for extending portions of the weft threads transversely through the warp, both of the weft threads are formed with transversely extending looped or return-bent portions E spaced from each other longitudinally of the strip. As previously stated, the weft threads are assembled with the warp from opposite sides of the latter, and, in the present instance, the return-bent portions E of the weft thread C extend between adjacent return-bent portions E of the weft thread D. The warp threads are weaved around the return-bent portions E of the weft in such a manner as to prevent shifting of the weft threads longitudinally of the strip, and any suitable means may be employed for anchoring the weft threads to prevent lateral shifting movement thereof relative to the warp.

Referring now generally to the method and apparatus for manufacturing the above strip and with special reference to Figure 1, it will be noted that the warp is continuously fed through the apparatus by a drawing operation effected by suitable mechanism F positioned to engage the finished end of the strip. The warp threads are normally held under tension during the travel of the same through the apparatus by means of a device G, and at a predetermined point along the path of travel of the warp, the latter is divided into two groups of threads by a pair of heddles H and I. The two groups of warp threads formed by the heddles H and I are designated in Figure 1 by the reference characters J and K, respectively. The two aforesaid heddles are mounted for reciprocation in parallel verti-

cal planes and are operatively connected to actuating mechanism designed to periodically move both heddles simultaneously in opposite directions. Inasmuch as the group of warp threads K pass through the heddle I and in view of the fact that the group of warp threads J pass through the heddle H, it will be apparent that alternate reciprocations of the heddles will successively form two sheds. In other words, simultaneous movement of the heddle I upwardly and the heddle H downwardly forms a shed in front of the heddles with the group of warp threads K at the top thereof, while reverse action of the heddles effects a crossing of the warp threads and forms a shed with the group of warp threads J forming the top portion of the shed.

In timed relation to the reciprocation of the heddles to the position thereof shown in Figure 1 to form a shed in advance of the same, a weft thread C preferably formed of metal is passed transversely through the shed from the right-hand side of the warp and is engaged with a suitable looper L on the left-hand side of the warp whereupon the adjoining portion of the weft thread is returned to the right-hand side of the warp. Upon return of the weft to the right-hand side of the warp, the looper M is moved upwardly to a position in rear of the weft thread and the adjoining portion of the latter is moved rearwardly. During the aforesaid return movement of the weft thread through the shed, the relative positions of the heddles are reversed so as to cross the group of warp threads K with the group J and form a second shed with the group J at the top thereof. By crossing the two groups of warp threads in forming the second shed, the weft threads are tied in the previous shed, and during the formation of the second shed, the latter weft threads are tucked by a suitable comb N so as to bring both sides of the loop in close relationship. Upon completion of the tucking operation, the other weft thread D is passed transversely through the second shed from the left-hand side of the warp and is extended forwardly beyond the retracted right-hand looper M whereupon the latter is again moved upwardly to form an abutment for both the wefts C and D. The adjoining portions of the weft thread D are then returned to the left-hand side of the machine and moved forwardly beyond the previously retracted looper L whereupon the latter is again actuated to form an abutment for the weft thread D so as to permit the adjoining portions of the thread to be moved rearwardly preparatory to the next operation. The second shed is closed during the return movement of the weft thread D and is actuated by the heddles to form another shed similar to the one shown in Figure 1 whereupon another loop is formed in the warp by the weft thread C in the same manner hereinbefore set forth. It is to be understood that during the above operations, the warp thread is being continuously moved along its path of travel so that the sheds are formed by different portions of this thread and the weft threads are spaced from each other longitudinally of the warp.

Referring now more in detail to the particular construction of the loom illustrated herein, it will be noted from Figure 1 that the same comprises a frame 15 of any suitable design having a horizontally disposed plate 16 at the forward end thereof forming a flat surface over which the finished product is conveyed subsequent to the weaving operation. The product is maintained

in engagement with the plate 16 by means of a guide plate 17 spaced above the former a sufficient distance to receive therebetween the product aforesaid and having a spring member 18 secured thereto at the forward end thereof fashioned to yieldably contact with the product throughout the width of the same at a point opposite the rear edge of the plate 16. From the latter plate, the finished product is received around a pair of idler rolls 19 and 20 to the feeding mechanism supported upon the front side of the frame 15 below the plate 16. The roll 19 is journaled upon the frame at the front edge of the plate 16 with its axis extending transverse to the path of travel of the product while the roll 20 is similarly journaled upon the frame below the roll 19 so as to guide the product to the feeding mechanism F. In the present instance, the latter mechanism comprises a pair of power driven rolls 21 and 22 journaled upon the frame with their axes parallel to the axes of the guide rolls. The product is reeved over the roll 22 and under the roll 21 so that rotation of the latter rolls in opposite directions will effect the desired feeding of the product through the apparatus. Both the driven rolls are driven from any suitable source of power at a speed determined in accordance with the rate at which the weaving of the product is effected.

As previously stated, the warp of the product is kept under tension during travel of the same through the apparatus and this is accomplished by the device G supported upon the frame 15 at the rear side thereof. In detail, the device G comprises a plate 23 disposed in a substantially horizontal plane and having a series of openings 24 extending vertically through the front edge thereof as well as through the rear edge of the same for receiving the warp threads. Fixed to the top surface of the plate 23 intermediate the two series of openings 24 is a bar 25, and journaled upon opposite sides of the bar are rollers 26. With the construction as thus far described, it will be seen that the warp threads extend from a suitable source of supply upwardly through the rear openings 24 to a position above the plate 23 whereupon they are extended over the rolls 26 and passed downwardly through the front series of openings 24. The rolls 26 are of greater diameter than the height of the block so that the portions of the warp therebetween are spaced above the bar permitting the warp to be tensioned by exerting a pressure upon the portions aforesaid of the same. In the present instance, the pressure is exerted by a roll 27 mounted for vertical swinging movement relative to the rolls 26 and engageable with the top surface of the portions of the warp between the latter rolls for normally urging the same downwardly toward the bar.

The warp threads extending downwardly through the front series of openings 24 in the plate 23 are passed through guides 30 and 31 fixed to the frame 15 in spaced relation to each other along the path of travel of the warp thread. The path of travel of the warp thread is changed upon leaving the guide 31 from a downward direction to a forward direction, and alternate warp threads are separated from the remaining warp threads by the respective heddles H and I prior to being introduced to the weft forming mechanism. The latter mechanism is interposed between the heddles and the rear edge of the plate 16 so that as the weft is formed in the warp, the finished product is passed over the plate 16

to the feeding mechanism F hereinbefore described.

Both of the aforesaid heddles are identical in construction comprising yokes 32 disposed in a vertical plane extending transversely of the path of travel of the warp and each frame is provided with a set of vertically extending heddles 33 therein corresponding in number to the number of warp threads in each of the two groups J and K. The heddles 33 are formed with eyes 34 intermediate the upper and lower ends thereof through which the warp threads of the aforesaid groups are passed to the weft forming mechanism. In detail, the group of warp threads J are extended through the eyes formed in the rear set of heddles, while the group K of warp threads are extended through the eyes formed in the front set of heddles. As previously stated, both the heddles are mounted for reciprocation in opposite directions to successively form sheds, and in order to permit crossing of the two groups of warp threads, the heddles of one set equally divide the space between the heddles of the other set, or in other words, both sets of heddles are alternately positioned transversely of the path of travel of the warp thread.

The heddle assemblies H and I are so arranged with respect to each other that when the same are in registration or directly opposite, the two groups of warp threads are disposed in a common plane, with the result that when these assemblies are alternately moved in opposite directions, two sheds are successively formed opposite the weft forming mechanism. In the present instance, the heddle assemblies are reciprocated by a common shaft 35 operatively connected to a drive shaft 36 through the medium of a belt 37 and having eccentrics 38 and 39 secured thereto in spaced relation axially of the shaft. The eccentric 38 is operatively connected to the heddle assembly I for reciprocating the same in a vertical plane and the throw of this eccentric is 180° out of phase with the throw of the eccentric 39 which is similarly connected to the heddle assembly H. With the above construction, sheds will be formed opposite the weft forming mechanism in rapid succession since one complete revolution of the shaft 35 will produce four sheds in registration with the aforesaid mechanism. In addition, it will be apparent that in forming each successive shed, the two groups of warp threads are crossed so as to effectively tie the weft thread in the previous shed.

In the illustrative embodiment of the invention, the weft forming mechanism comprises two needles 40 and 41 located upon opposite sides of the path of travel of the warp between the heddles and rear edge of the plate 16. For the purpose of simplicity, the needle 40 will be referred to hereinafter as the right-hand needle, and the needle 41 will be designated as the left-hand needle. As shown in Figure 2, both needles are identical in shape and are each formed with an eye 42 in the inner ends thereof in order to provide means for securing the weft threads thereto. The weft thread C hereinbefore referred to is secured to the needle 40 and is supplied thereto, through suitable guides 44 fixed to the needle, from a spool 45 journaled upon the rear end of the machine. The cooperating weft thread D is fixed to the eye 42 in the needle 41 and is supplied to the latter, through suitable guides 46 on the needle, from a second spool (not shown) also preferably mounted on the frame. The needles 40 and 41 are pivotally mounted upon the upper

ends of suitable vertically extending stanchions 48 and 49, respectively, for swinging movement in substantially a horizontal plane bisecting the open warp sheds. The lower ends of the stanchions are journaled upon a stub shaft 50 for swinging movement in a direction transverse to the path of travel of the warp and are connected intermediate the ends for unitary operation by means of an adjustable strap 51. The stanchions are rocked as a unit about the shaft 50 by means of an eccentric 52 having a transversely curved face 53 operatively connected to the free end of an extension 54 on the stanchion 48 through the medium of a connecting rod 55. The eccentric 52 is fixed upon a shaft 56 having a sprocket 57 secured thereto and operatively connected to a similar sprocket secured to the shaft 35 through the medium of a belt 58. Inasmuch as the stanchions are arranged upon opposite sides of the path of travel of the warp, it will be apparent that rotation of the shaft 56 will effect a movement of one of the stanchions together with the needle carried thereby toward the warp and cause a simultaneous movement of the other of the stanchions with its associated needle in a direction away from the warp.

As previously pointed out, the needles are pivotally mounted upon the upper ends of the stanchions for swinging movement in substantially a horizontal plane, and in the present instance, the needles are actually oscillated in timed relation to the aforesaid movement of the stanchions. Actuation of the needles in the present instance is accomplished by a pair of vertically extending rockshafts 59 and 60 respectively journaled in the stanchions 48 and 49. The upper ends of the rockshafts 59 and 60 are respectively secured to the needles 40 and 41, while the lower ends thereof are operatively connected to suitable power means. As shown in Figure 6, the rockshafts are actuated to effect the desired movements of the needles by a pair of eccentrics 61 and 62 fixed to a shaft 63 which in turn is operatively connected to the shaft 56 for actuation thereby. The eccentric 61 is provided with a race 64 concentrically arranged with respect thereto and prevented from rotation by means of a pitman 65 reciprocally engaging a fixed bearing 66. The race 64 has a link 67 universally connected at one end thereto and having the opposite end pivotally connected as at 68 to a crank 69 fixed to the lower end of the rockshaft 59. The lower end of the rockshaft 60 is operatively connected to the eccentric 62 in an identical manner, with the result that rotation of the shaft 63 will effect an oscillation of both rockshafts together with the needles carried thereby relative to the stanchions. The actuating means for both the stanchions and rockshafts are timed so that as one of the needles is swung through the shed formed by the warp threads, the corresponding stanchion is moved inwardly toward the shed. Inasmuch as both the eccentrics 61 and 62 are operated simultaneously, the needle on the opposite side of the shed is also swung inwardly toward the latter, but owing to the fact that the associated stanchion is moved outwardly away from the shed during movement of the opposite stanchion toward the latter, the only function of this needle is to maintain the weft thread carried thereby in advance of the weft thread extended through the shed by the aforesaid needle.

The combined movements of the needles by the rockshafts and stanchions are also effected in

timed relation to the operation of the heddle units to successively form the sheds. In this connection, it is to be noted that when the heddle units are in their relative positions shown in Figure 1 to form the shed also illustrated in this figure, the right-hand needle 40 is moved bodily toward the shed and simultaneously swung about its pivotal connection in a direction to extend the portion of the weft thread C previously passed around the right-hand looper M transversely through the shed forwardly beyond the line of action of the retracted looper L. At the same time the needle 40 is moved throughout the aforesaid path of travel thereof, the left-hand needle 41 is bodily moved away from the shed and simultaneously swung inwardly in advance of the needle 40 so as to maintain the weft thread D in proper relationship to the weft thread C. The foregoing will, perhaps, be made more readily apparent upon considering Figure 4 wherein the aforesaid movements of the needles are illustrated by the solid heavy and light line positions of the needles. The left-hand looper L is then moved to its operative position rearwardly of the weft threads, and the right-hand looper M is moved out of registration with the weft threads. As soon as the left-hand looper is in its operative position, the needle 40 is returned to the right-hand side of the shed by a combined outward movement of the stanchion 48 and a rearward swinging movement of the needle 40 about its pivotal connection with the stanchion. During the outward or the return movement of the needle 40 through the shed, the needle 41 is bodily moved a limited distance inwardly by its associated stanchion, but since the inner end thereof is simultaneously swung rearwardly about its pivotal connection with the aforesaid stanchion, the same does not interfere with the adjacent shed. As the needle 40 is being withdrawn from the shed, the heddles operate to close the shed and upon complete withdrawal of the needle 40, the heddles form the next successive shed by crossing the warp threads over the previously formed loop in the weft thread C. Immediately upon crossing the weft threads in the manner specified above, the comb N is instantaneously operated to tuck the aforesaid loop in the warp.

Upon completion of the combing operation, the stanchion 49 is moved the remaining distance inwardly to effect a corresponding movement of the needle 41, and the inner end of the latter is simultaneously swung toward the right side of the warp through the shed beyond the line of action of the looper M. As a consequence of the inward movement of the stanchion 49, the stanchion 48 is moved the remaining distance outwardly, and the inner end of the needle 40 carried thereby is swung forwardly in advance of the needle 41 to maintain the proper relationship of the weft threads relative to the looper M. The latter is then moved to a position in rear of the weft threads, while the looper L is retracted from the previously formed loop and the needle 41 is returned to the left side of the machine by the combined action of the stanchion 49 and rockshaft 60. During the interval the needle 41 is being retracted from the shed, the heddles are again operated to close the shed and form the next successive shed by crossing the warp threads over the loop of the weft thread D in the previously formed shed. The aforesaid movements of the needles are clearly shown in Figure 4 by the heavy broken and light broken line positions of the needles. The function of the right-hand needle

40 to form another loop in the warp thread by the weft thread C is repeated, and this sequence is maintained throughout the operation of the loom.

5 The rapidity with which the loom is capable of weaving the desired product will be readily appreciated by the foregoing description and is attributed not only to the provision of weft needles on opposite sides of the warp for alternately forming loops of the weft thread in successive warp sheds, but also to the novel operation of the needles by the combined action of the aforesaid stanchions and rock-shafts which materially increases the rate of effective travel of the needles.

10 Aside from the above, it is to be noted that I have provided relatively simple means for operating all of the mechanisms in their proper sequences.

In the foregoing description of the operation of the weft forming mechanism reference was made to the function of the loopers L and M in timed relation to each other. In the present instance, both of the aforesaid loopers are actuated by a yoke 70 having arms 71 pivotally connected as at 72 to the forward end of the frame and having a transverse portion 73 connecting the rear ends of the arms 71. Mounted upon the connecting portion 72 and extending upwardly therefrom is a bracket 74 having a rearwardly extending portion 75 at the upper end thereof spaced above the path of travel of the warp and provided with a depending rod 76 hereinbefore referred to as the looper L. The rod 76 assumes a position with the lower end thereof spaced above the plate 16 of the apparatus in the uppermost position of the yoke and moves into a suitable opening through the plate 16 upon swinging the free end of the yoke downwardly from the aforesaid position thereof. The right-hand looper M is also mounted upon the portion 73 of the yoke 71, but differs from the looper L in that it is disposed below the plate 16 and is insertable into an opening through the right side of the latter upon upward movement of the yoke to space the looper L above the plate. The above construction is such that movement of the rear end of the yoke upwardly causes the looper M to move into operative relationship with respect to the plate 16 and effects a withdrawal of the looper L from the latter plate while movement of the yoke downwardly provides a reversal of the above operations. Oscillation of the yoke is automatically effected in timed relation to the movements of the needles, and for accomplishing this result, a suitable eccentric 79 is fixed to the shaft 56 and is operatively connected to the portion 73 of the yoke through the medium of a suitable connecting rod 80. The eccentric 79 is designed to effect the desired operations of the loopers at the intervals previously set forth during the function of the needles 40 and 41 to form the loops in the weft.

Owing to the relatively high speed of operation of the needles hereinbefore described, it is essential to effect substantially instantaneous action of the comb N. The above is accomplished in the present instance by moving the comb through an elliptical orbit and by accurately timing the operation of the comb so that as soon as the warp threads are crossed in forming successive sheds, the comb is moved into the warp to tuck the weft threads. The desired results are secured by a pair of eccentrics 81 and 82 respectively fixed to the shaft 63 and shaft 83. The eccentric 81 controls the vertical dimension of the orbit throughout which the comb moves and is operatively

connected directly to the comb by means of the connecting rod 84. The eccentric 82, on the other hand, is driven by the shaft 83 from the shaft 63 through a suitable gear train 85 and controls the length of the aforesaid orbit. In this connection, it is to be noted that the eccentric 82 is provided with a ring 86 surrounding the same and having a connecting rod 87 pivotally secured to the connecting rod 84 as at 88. By reason of the above construction, it will be apparent that the comb is continuously moved throughout its orbit, and, as a consequence, is practically instantaneous in its operation of tucking the weft threads in the successive sheds of the warp.

From the foregoing description of the invention, it will be apparent that I have provided a relatively simple method and apparatus for forming fabricated products capable of being inexpensively installed. It will also be observed from the previously described method and apparatus that the same lends itself with facility to the manufacture of wire or reinforced cloth of the type having textile warp threads and metallic weft threads. In addition to the above, the apparatus featured is capable of performing the several steps of the method in their proper sequence at an exceptionally high rate of speed rendering it possible to appreciably increase the production of products of the foregoing character.

What I claim as my invention is:

1. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle mounted upon one side of the warp for swinging movement in a plane bisecting the open sheds, a second weft needle similarly mounted upon the opposite side of the warp, means for actuating one of the needles upon the formation of one shed to extend a weft thread transversely through the shed, and means for simultaneously actuating the other of said needles to maintain the proper relationship between the weft threads carried by said needles and to subsequently move the latter needle through the next adjacent shed upon the formation of the same.

2. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle mounted upon one side of the warp for swinging movement in a plane bisecting the open sheds, a second weft needle similarly mounted upon the opposite side of the warp, means for simultaneously swinging and bodily moving one of the needles toward the warp upon the formation of one of the sheds to extend a weft thread transversely therethrough, means operable upon movement of the aforesaid weft needle toward the warp to effect a movement of the opposite weft needle away from the warp, and means for simultaneously swinging the latter needle in a direction to maintain the weft carried thereby in advance of the weft carried by the needle aforesaid.

3. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle mounted upon one side of the warp for swinging movement in a plane bisecting the open sheds, a second weft needle similarly mounted upon the opposite side

of the warp, means operable in timed relation to the formation of the one shed for simultaneously swinging and bodily moving one needle toward the warp to extend the weft thread carried thereby transversely through the open shed and for subsequently similarly moving said needle in a direction away from the shed to withdraw the adjoining portion of the weft thread from the shed, means connecting the mountings of the two weft needles whereby movement of the first needle toward the warp effects a movement of the second needle in a direction away from the warp and movement of the first needle away from the warp effects a corresponding movement of the second needle toward the warp, and means operable upon movement of the second needle away from the warp to swing the needle to maintain the weft thread carried thereby in advance of the weft thread carried by the first needle and operable upon movement of the second needle toward the warp to extend the weft carried thereby through the next successive shed.

4. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, means located on opposite sides of the warp and alternately operable in timed relation to the means aforesaid for extending weft threads through successive sheds, said means including needles mounted for swinging movement in a common horizontal plane bisecting the open sheds, means for simultaneously swinging said needles bodily relative to the sheds, means operatively connecting said needles, and means for moving said needles toward and away from said warp during the swinging movement of said needles.

5. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle located upon each side of the warp, means for swinging and simultaneously moving the needles alternately toward and away from the warp to extend weft threads through successive sheds, and means interconnecting the needles whereby movement of one needle in one direction relative to the warp effects a movement of the other needle in the opposite direction.

6. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle located upon each side of the warp, means for alternately moving the needles toward and away from the warp in timed relation to the shed forming means to extend weft threads through successive sheds,

and means for simultaneously swinging the needles in timed relation to each other to maintain a predetermined relationship between the weft threads carried thereby.

7. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle upon each side of the warp, means interconnecting said needles whereby movement of one of the needles in one direction relative to the warp effects a movement of the other needle in the opposite direction, means for alternately moving the needles in timed relation to the shed forming means to extend weft threads through successive sheds, and means for simultaneously swinging the needles in timed relation to effect a predetermined relationship between the weft threads carried thereby.

8. A loom comprising means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a needle located upon each side of the warp, and means for simultaneously swinging and alternately moving said needles in predetermined timed relation to each other relative to the warp to extend weft threads through successive sheds.

9. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, means positioned upon opposite sides of the warp and alternately operable in timed relation to the means aforesaid for extending weft threads through successive sheds, said means including needles mounted for swinging movement in a common horizontal plane bisecting the open sheds, and means for simultaneously swinging and moving said needles bodily relative to the sheds.

10. A loom comprising, means for dividing a warp into two groups of threads, means for relatively moving the two groups of threads alternately in opposite directions to form in each extreme position a shed, a weft needle located upon each side of the warp, means for alternately moving the needles toward and away from the warp in timed relation to the shed forming means to extend weft threads through successive sheds, means for simultaneously swinging the needles in timed relation to each other to maintain a predetermined relationship between the weft threads carried thereby, and means operable in timed relation to the actuation of the needles for tucking the weft threads in the warp.