

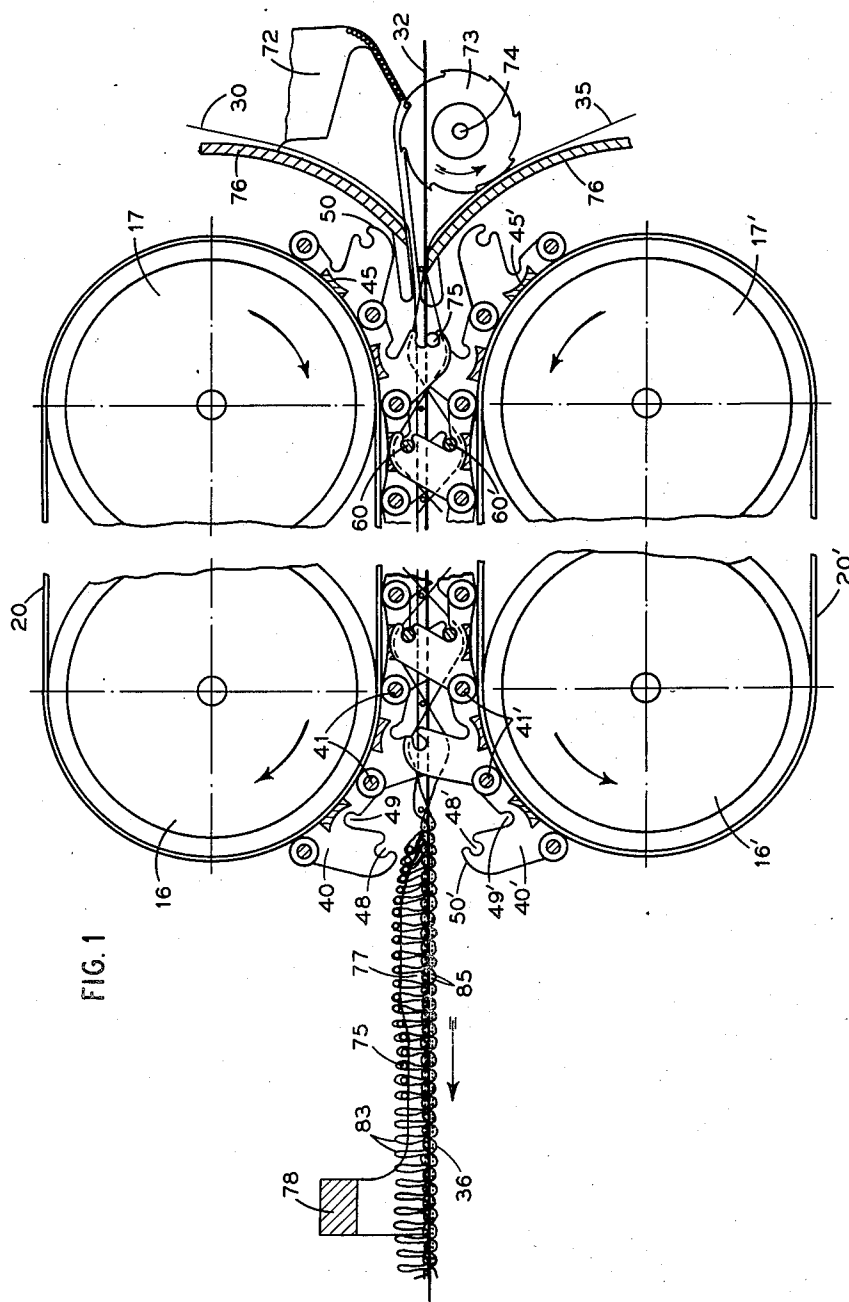
Aug. 9, 1960

W. BEJEUHR
WEAVING APPARATUS

2,948,302

Filed April 24, 1956

4 Sheets-Sheet 1



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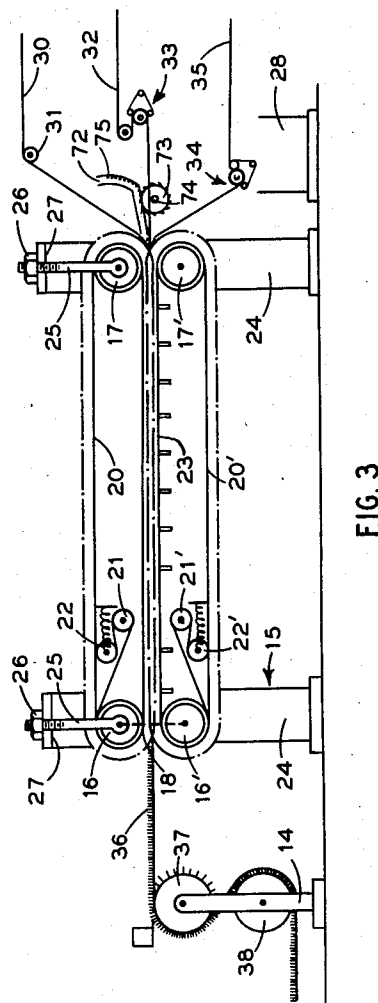
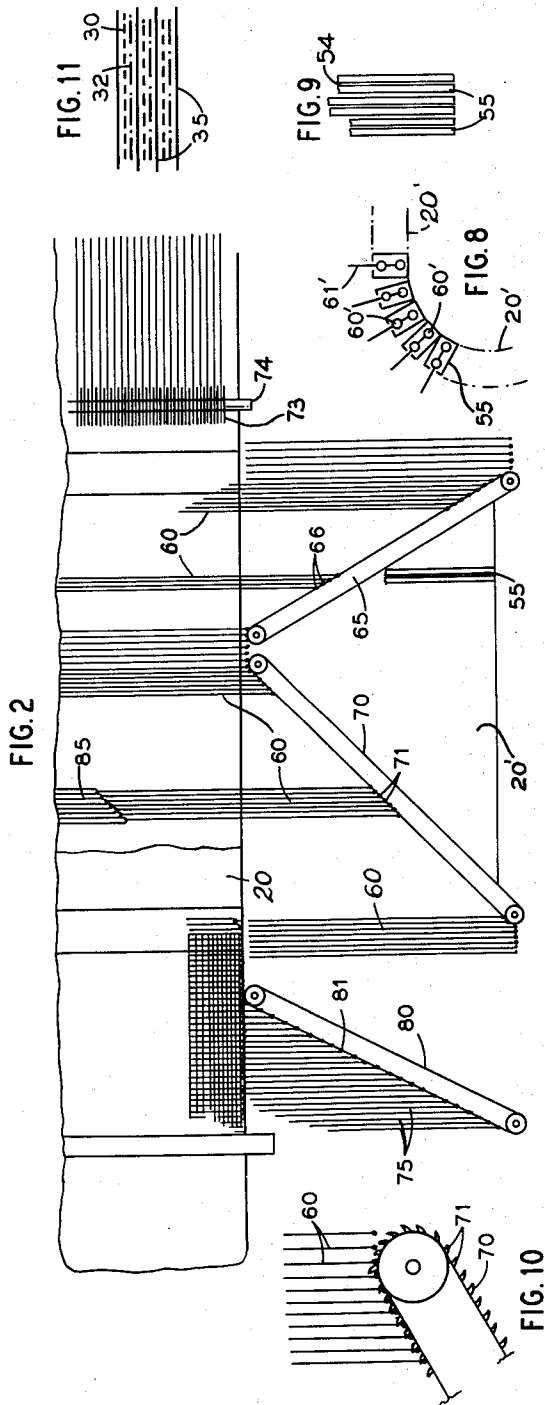
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FIG. 4

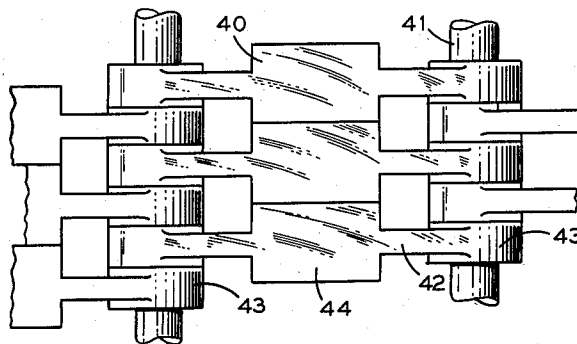


FIG. 6

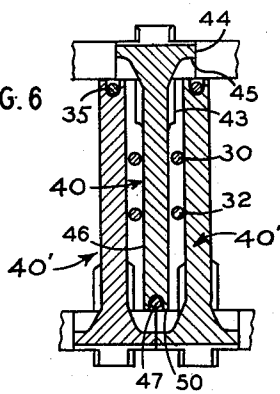


FIG. 5

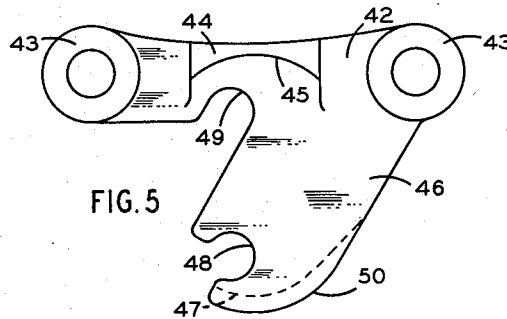
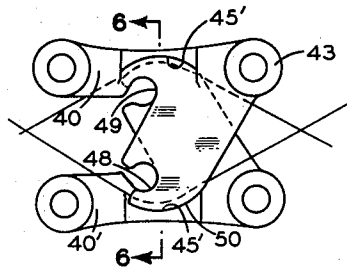


FIG. 7



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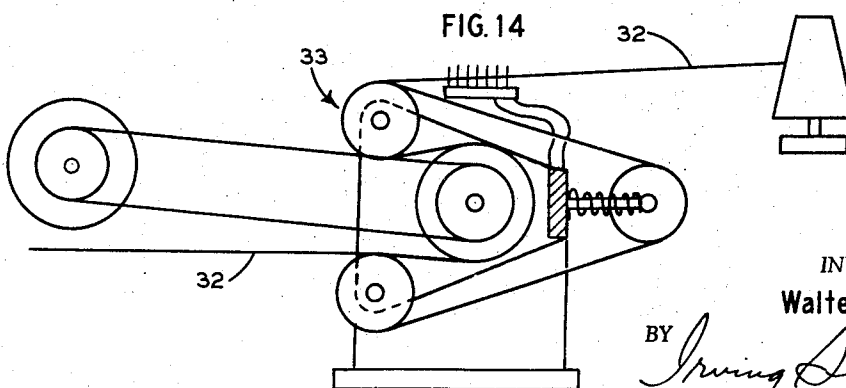
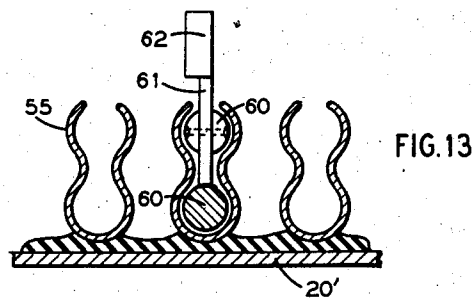
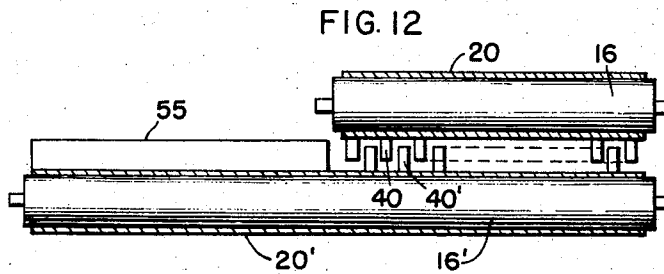
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4 Sheets-Sheet 4



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WEAVING APPARATUS

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5 Claims. (Cl. 139—11)

This invention relates to weaving apparatus and, more particularly, to an improved high speed weaving apparatus particularly adapted to the weaving of pile fabrics.

The limiting factor in the rate of producing woven fabric is the speed of operation of the weaving apparatus, which is still a loom basically the same as when first invented and operating in the same manner. In a loom, each row of weave is formed individually by opening a shed to permit movement of a shuttle or needle across the fabric to insert a filler yarn or weft thread to anchor in place the successive loops in the warp or longitudinal threads. All this is effected by reciprocating components with their attendant inertia and inadaptability to high speed operation.

Operations auxiliary to the actual weaving have been greatly accelerated and are capable of substantial further acceleration. For example, the yarns are beamed in advance to avoid the need for separate creels for each loom, and the woven fabric from each loom is rapidly rolled into bales. However, due to the slow speed of even the most improved looms, the actual fabric production is only a few inches per minute. Thus, with relatively high speed auxiliary operations and a relatively low speed weaving apparatus, a coordinated continuous operation is substantially impossible. While the weaving operation may be continuous, the auxiliary operations, due to their much higher relative speeds, are "batch" operations. As a result, there is a waste of available man power due to the uncoordinated speeds of the weaving and the auxiliary operations.

Despite the numerous improvements in loom construction, the speed of operation, both actual and potential, is severely restricted by virtue of the aforementioned fact that the actual weaving elements are reciprocated components with resultant high inertias. It is apparent that the overall speed of production of woven fabric can be increased only by utilizing a completely new type of weaving apparatus.

In accordance with the present invention, such an apparatus is provided, and in which the weaving elements are all operated in continuous and cyclic progression, there being no reciprocating parts with high inertias. Consequently, it is possible, with the present invention, to produce woven fabrics at speeds of up to 10 feet per minute with ordinary weaving yarns and, if the yarns have higher strength, the fabric can be produced at even greater speeds.

More specifically, the invention comprises a pair of superposed endless conveyors carrying loop forming and retaining links on the outer surface, the links on one conveyor interfitting and coacting with the links on the other conveyor to form alternating loops in the warp yarns and "hold" these loops in an "expanded" weave for a predetermined interval of travel of the conveyors. The number of loops in any transverse row is determined by the width of the fabric to be woven.

Next to one side of these two loop forming conveyors

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is a second pair of needle carrying conveyors operating in synchronism with the loop forming conveyors, and these needle conveyors carry transversely extending channel guides in each of which is slidably mounted a pair of needles. As the conveyors move in synchronism from the receiving end of the apparatus to the discharge end thereof, cam means engaged with the pairs of needles progressively advance the needles through the successive yarn loops on the loop forming links to catch filler thread loops at the opposite side of the loop forming conveyors. As the needles are further advanced toward the discharge end of the apparatus, the cam means progressively retracts the pairs of needles to draw the filler yarn through the loops held on the loop forming links, and suitable means knit the filler yarn into the edge of the fabric.

To form pile fabric, a pile wire magazine is provided at the feeding end of the apparatus and feeds a pile wire between successive rows of the loop forming links, a pile yarn being fed over the pile wires. At the discharge end of the machine, the pile wires are "raised" to form pile loops in the pile yarn, then lowered to "free" the pile loops, and finally withdrawn progressively by sloping cam means. The pile wires are then returned to the magazine. To provide a cut pile fabric, knives may be provided on the pile wires to sever the pile loops as the pile wires are withdrawn from such loops.

The apparatus thus comprises loop or shed forming means moving continuously in the same direction, and filler yarn shuttles or needles which are gradually inserted through the chain yarn loops, and gradually withdrawn, while travelling in the same direction and in synchronism with the shed forming means. Finally, the pile wires are not reciprocated but are fed sidewise into pile loop forming position. Thus there are no reciprocating parts, and the weaving operation is correspondingly accelerated, resulting in a greatly increased rate of output of the fabric.

For an understanding of the invention principles, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing. In the drawing:

Fig. 1 is a vertical sectional view through the superposed loop forming conveyors, illustrating the pile wire feeding and guiding mechanisms;

Fig. 2 is a partial plan view of the apparatus, with the upper run of the upper belt conveyor partly broken away and certain parts omitted for clarity;

Fig. 3 is a view, similar to Fig. 1, illustrating the yarn feeding means and fabric take-up means;

Fig. 4 is an enlarged partial plan view of the lower run of the upper loop forming conveyor;

Fig. 5 is a side elevation view of a loop forming link on the upper conveyor;

Fig. 6 is a sectional view on the line 6—6 of Fig. 7;

Fig. 7 is a side elevation view of interfitting and co-acting links on the upper and lower loop forming conveyors;

Fig. 8 is a partial end elevation view of a needle guide conveyor;

Fig. 9 is a partial plan view of a needle conveyor;

Fig. 10 is an enlarged partial plan view of the needle advancing and needle and pile wire retracting means;

Fig. 11 is a diagrammatic plan view illustrating the relative feeding positions of the several yarns;

Fig. 12 is a transverse sectional view through the superposed conveyors;

Fig. 13 is an enlarged partial end view of the needle guide conveyor, corresponding to Fig. 8; and

Fig. 14 is an enlarged side elevation view of a typical yarn metering device.

Referring to Figs. 1, 2 and 3, the apparatus is mounted

on a suitable frame 15 and includes a pair of driven rolls 16, 16' having an axial length of at least twice the maximum width of the fabric to be woven, and rolls 16, 16' are spaced longitudinally from a corresponding pair of idler rolls 17, 17'. Rolls 16, 16' are interconnected for positive synchronization by suitable means, indicated schematically at 18, such as chains and sprockets or gearing.

Trained over each set of driven and idler rolls are endless flexible belts 20, 20' of canvas, cotton, rubber, or other suitable heavy, flexible and rugged material, the lower belt 20' being at least twice the maximum width of fabric to be woven and the upper belt 20 having a width of the order of that of such fabric. The right hand edges of the two belts, looking in the direction of movement of the belts in Fig. 2, are substantially aligned vertically. Tension on the belts is maintained by tension rolls 21, 21' and 22, 22' over which the belts are trained. The upper run of lower belt 20' is supported on a rigid flat plate 23 mounted on frame 15, so that this "working" run of the belt is maintained horizontal without sagging. Rolls 16', 17' are fixedly positioned, as to elevation, in columns 24 of frame 15, whereas the height of rolls 16, 17 is adjustable by means of threaded hangers 25 carrying nuts 26 engaged with cross members 27 on columns 24.

The pile, stuffer and chain yarns are fed into the right end of the apparatus by yarn feeding means mounted on frame elements 28. Pile yarns 30 are fed over a roller 31, whereas stuffer yarns 32 are delivered through synchronized metering feed devices 33 and chain yarns 35 are delivered through synchronized metering feed devices 34. The several yarns are withdrawn from creels (not shown) mounted at the right end of the apparatus. The woven fabric 36 is withdrawn from the left end of the apparatus by a synchronously driven pin roll 37 rotatably mounted in frame elements 14. Roll 37 delivers the fabric to a reversing take-up roller 38 also rotatably mounted in frame elements 14 and providing a greater wrap around of fabric 36 on roll 37.

Referring more particularly to Figs. 1, 4, 5, 6 and 7, belt 20 and the right hand half of belt 20', looking in the direction of movement in Fig. 2, carry roller link chains formed of interconnected identical links 40, 40', each transverse row of links extending through slightly less than half the width of belt 20' and being equal in length of the maximum width of fabric to be woven. The links 40, 40' are aligned in rows by rods or pins 41, 41' which also pivotally interconnect successive links and rows of links as best seen in Fig. 4.

As links 40 are identical with links 40', only links 40 will be described in detail. Each link 40 is a one-piece construction, which may be cast, for example, including a relatively narrow base 42 having an arcuate undersurface with the radius of curvature equal to that of belts 20, 20' in passing around their driven and idler rolls. Thereby, the bases of the links remain in firm surface contact with the belts as the belts pass around the main rollers.

At each end of base or body 42 are bosses or bearings 43 for rods 41 and, midway between these bosses, the bottom or base of the body has a pair of lateral wings 44 having arcuate upper surfaces 45. Body 42 has an upward extension 46 with a curved outer end 50 having a radius of curvature equal to that of arcuate surfaces 45. A slot 47 extends along surface 50. Adjacent surface 50, extension 46 has a circular recess 48 substantially midway between the ends of link 40, and a second circular recess 49 is formed in extension 46 adjacent wings 44 and somewhat outwardly therefrom.

In the operation of the apparatus, each link 40 interfits laterally between laterally adjacent links 40', with arcuate surface 50 bearing against arcuate surfaces 45' of links 40'. Similarly, arcuate surfaces 50' of links 40' bear against arcuate surfaces 45 of adjacent links 40. This is clearly illustrated in Figs. 1, 6 and 7. Such interfit-

ting of the upper and lower links is effective, of course, only in the parallel runs of belts 20, 20'. At the same time, the recesses 48, 48' and 49, 49' of the upper and lower links are aligned transversely of the conveyor and substantially closed for a purpose to be described.

Adjacent the chain link conveyors, belt 20' carries a series of partly closed channel guides each aligned laterally with the circular recesses of adjacent upper and lower links. Each channel guide 55 receives a pair of hook end needles 60 joined in parallel spaced relation by pins 61, the rear pin 61 of each pair projecting from a slot 54 in the outer surface of each guide 55. The lateral spacing of needles 60 is equal to the center-to-center spacing of recesses 48, 49 in the links 40, and the length of the needles is somewhat greater than the width of the chain link conveyors.

As needles 60 reach the adjacent runs of belts 20, 20', they are projected through recesses 48, 48' and 49, 49' of interfitted links 40, 40' by an endless step conveyor 65 having hook shape steps 66 engageable with the projecting rear end pins 61 of the paired needles. Conveyor 65 extends at an angle of preferably 60° to the line of travel of belts 20, 20' and, as the needles are moved along this line of travel, advances the needles through the recesses in the links 40, 40'. As best seen in Fig. 2, when the needles 60 have been fully projected, they remain in this position for a short period of travel while the needle hooks engage a filler yarn loop held in readiness by suitable means at the far side of the machine, and then are progressively retracted by a second endless step conveyor 70 having hook steps 71 engageable with pins 61, pulling the filler yarn into the recesses 48 and 49. Conveyor 70 extends at an angle of preferably approximately 30° to the line of travel of belts 20, 20' and withdraws the needles through the link recesses at a rate somewhat less than the rate of advance of the needles by conveyor 65. Conveyors 65 and 70 are driven in synchronized timed relation with belts 20, 20'.

The apparatus also includes means for forming woven pile fabric, when desired, such as towelling, carpets, rugs, and other pile fabric. This means includes a pile wire magazine 72 at the right end of the apparatus and containing a supply of pile wires 75. A plurality of thin, notched disks 73 are keyed to a shaft 74 driven in synchronized relation with belts 20, 20'. Each disk 73 is longitudinally aligned with the links of the roller chains. Disks 73 feed a pile wire 75 behind each row of links 40, 40' through aprons 76, 76' acting as yarn guides.

At the output side of the apparatus, wires 75, which are advanced by the following row of links 40, 40' are accelerated in their travel as the outer ends of the links travel at a greater speed in moving around drive rollers 16, 16', so that the wires "bunch up" on the pile raiser fins 77 mounted on a cross bar 78. These are narrow fins longitudinally aligned with the links 40, 40' so as to lie transversely between the pile loops, as will be explained. Guide fins 77 raise wires 75 so as to extend the pile loops, and then lower the wires 75 to free them from frictional engagement with the loops. At this point on the path of travel of wires 75, an endless step conveyor 80 is provided, with hook shape steps 81 engaging bent up ends of the pile wires. Conveyor 80 extends at such an angle to the line of travel of belts 20, 20' that the pile wires are withdrawn from the pile loops in advance of cross bar 78. Suitable conveying means (not shown) returns the wires 75 to magazine 72.

The apparatus operates in the following manner. By operation of screws 25 and 26, the upper conveyor is raised an amount sufficient to permit an operator to lay pile yarns 30, stuffer yarns 32, and chain yarns 35 between the conveyors. Metered feed means 33 and 34 are loosened to permit ready drawing of the yarns through the machine, and the yarn ends are attached to a bar and wrapped on pin roll 37. The chain yarns are laid in slots 47 in curved surfaces 50 of links 40, 40', and the

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pile and stuffer yarns are laid between transversely adjacent links. The pile yarn 30 should be suitably lubricated as it is pulled through the apparatus at a rate faster than the speed of travel of links 40, 40', and thus is subjected to friction against the sides of the links. A wire 75 is placed in advance of each row of links 40, 40'.

The upper conveyor is then lowered to interengage the links 40 with links 40'. This forms the chain yarns into alternating loops extending under one link 40 and over the next link 40', forming an open weave. The needle pairs 60 are then advanced the proper amounts through recesses 48, 49 and set onto conveyors 65 and 70. All the needles 60 except those engaged with conveyor 65 are hooked onto filler yarn 85 to draw loops of filler yarn through the open chain yarn weave formed by links 40, 40'.

The apparatus is now started, after re-setting metering means 33, 34. As the formed loops of chain yarn 35 are advanced to the left, needles 60 are pushed through recesses 48, 49 by conveyor 65, hook onto filler yarn 85, and pull filler yarn loops through the expanded weave formed by the chain yarn loops as the needles 60 are withdrawn by conveyor 70. As the needles 60 are fully retracted, they are disengaged from the filler yarn loops and suitable knitting mechanism (not shown) knits these loops together to form a smooth selvage at the side of the fabric.

Meanwhile, pile wires 75 are moved to the left, by links 40, 40' between pile yarns 30 and stuffer yarns 32, the relative lateral positions of the pile, stuffer and chain yarns being shown in Fig. 11. The acceleration of wires 75 at the outlet side of the apparatus "packs" the pile loops closely together and, as wires 75 are lifted by fins 77, the pile loops are extended. This results in linear movement of the pile yarns 30 at a rate in excess of the conveyor speed. Wires 75 are then lowered by fins 77 to free the pile loops 83, and wires 75 are extracted by conveyor 80 and returned to magazine 72. If a cut pile is desired, wires 75 may carry knives on their trailing ends. The finished fabric 36 is then wound over rolls 37 and 38.

As a typical, but not limiting example, the following figures apply to a fabric output speed of 4.875 ft. per min. with a pile height of approximately 1/2 inch. The delivery speed can be much higher or lower as desired. In the typical example, the conveyor speed is 32.5 ft. per min., the pile yarns speed is 30 ft. per min. (f.p.m.), the chain yarn speed is 9.5 f.p.m., and the stuffer yarn speed is the same as the fabric output speed, 4.875 f.p.m. The frictional speed of the pile yarns against the links 40, 40' is 32.5 f.p.m. less 9.5 f.p.m., or 23 f.p.m.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood

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that the invention may be embodied otherwise without departing from such principles.

What is claimed:

1. For use in weaving apparatus, a pair of superposed endless conveyors having adjacent runs in relatively closely spaced relation; means for driving said conveyors in synchronism in the same direction in said adjacent runs; of said conveyors carrying, on its outer surface, a plurality of identical links pivotally interconnected in end to end relation to form a chain and arranged in transverse rows, the links in adjacent rows being staggered transversely of the associated conveyor; the rows of links on the two conveyors being transversely aligned with each other with the links of each conveyor overlapping and fitting transversely between the links of the other conveyor in said adjacent runs, whereby the links of the two conveyors are aligned in alternation longitudinally of the conveyors; each of said links having means forming a convexly curved yarn guiding surface facing outwardly from the associated conveyor and extending longitudinally thereof; whereby, when yarns are laid along the aligned guiding surfaces of the longitudinally alternated links of the two conveyors, an "expanded weave" is formed by the links in said adjacent runs; said links being formed with transverse aperture means, and said aperture means being in transverse alignment to form openings throughout the rows of links when the links of the two conveyors are overlapped and interfitted in said adjacent runs to receive elongated needle means slidably mounted in alignment with the aperture means in the associated row of links.

2. Apparatus as claimed in claim 1 in which said guiding surfaces are longitudinally grooved.

3. Apparatus as claimed in claim 1 in which said guiding surfaces are outwardly convex and longitudinally grooved.

4. Apparatus as claimed in claim 3 in which each link has outwardly concave surfaces conformingly engaged by the convex surfaces of laterally adjacent links on the other conveyor in said adjacent runs to form closed yarn guiding channels.

5. Apparatus as claimed in claim 1 in which said conveyors are relatively movable to increase the space between adjacent runs to provide for laying of yarn in said guiding surfaces.

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