Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 1

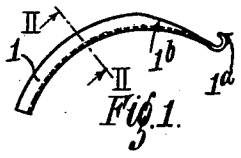


Fig. 1.

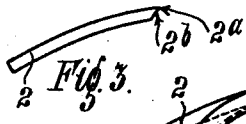


Fig. 3.

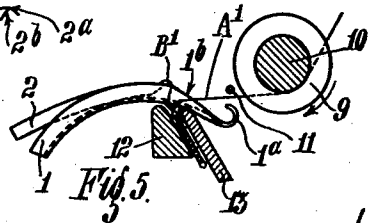


Fig. 5.

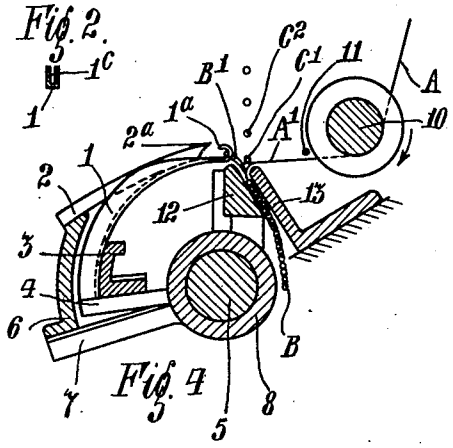


Fig. 4.

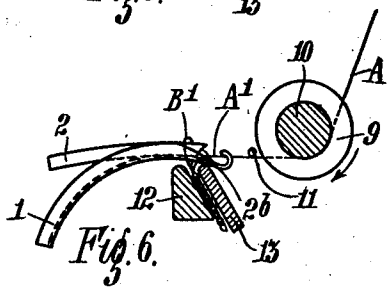


Fig. 6.

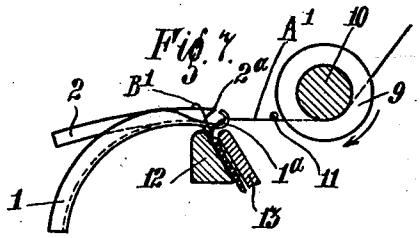


Fig. 7.

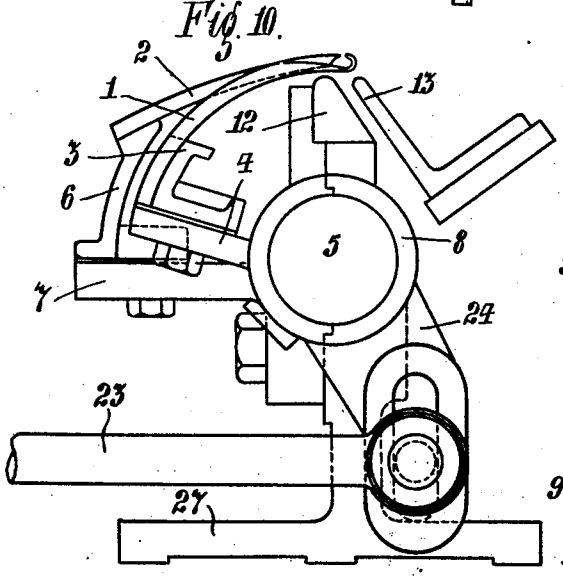


Fig. 10.

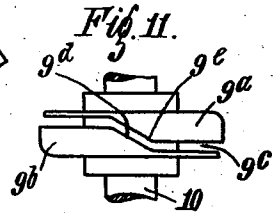


Fig. 11.

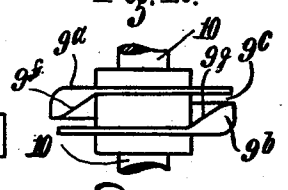


Fig. 12.

Inventor:
James Morton
By. [illegible]
Attorney

Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 2

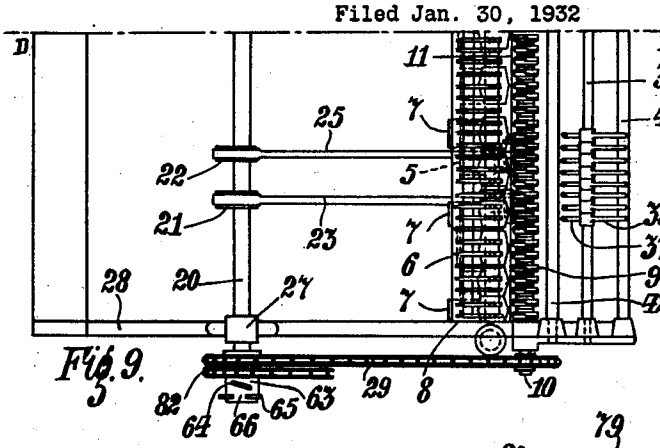


Fig. 9.

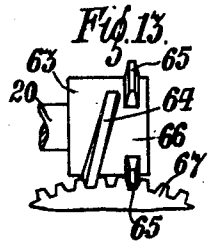


Fig. 13.

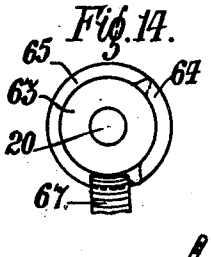


Fig. 14.

Fig. 8.

Inventor
James Morton
By [illegible]
Attorney

Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 3

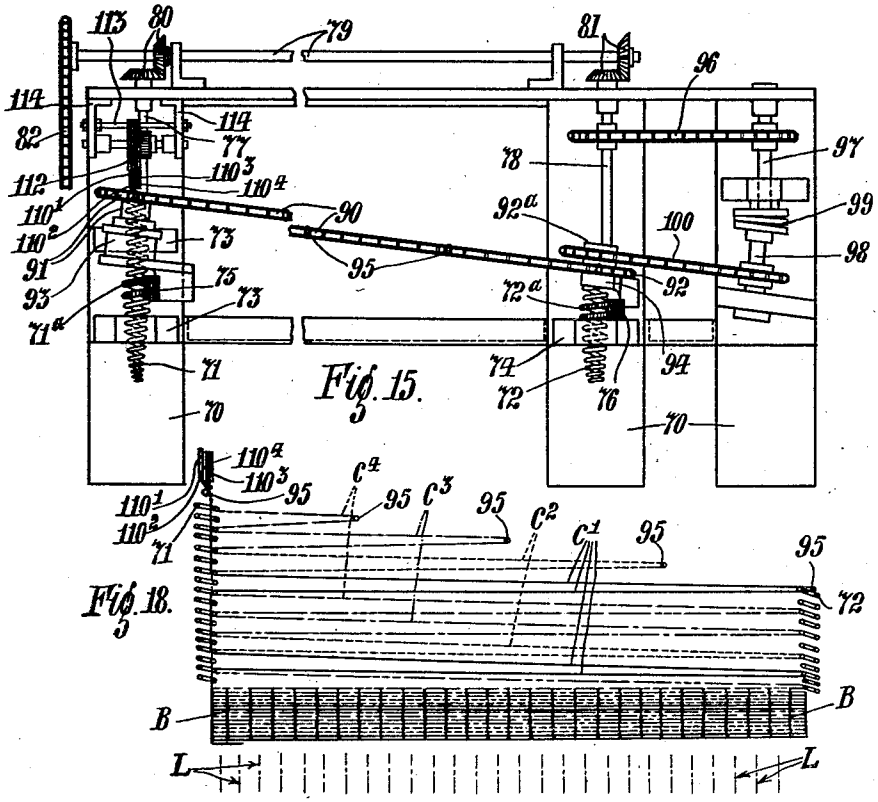


Fig. 15.

Fig. 18.

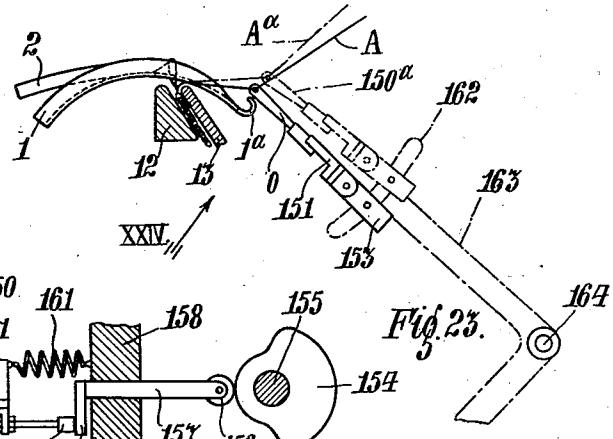


Fig. 23.

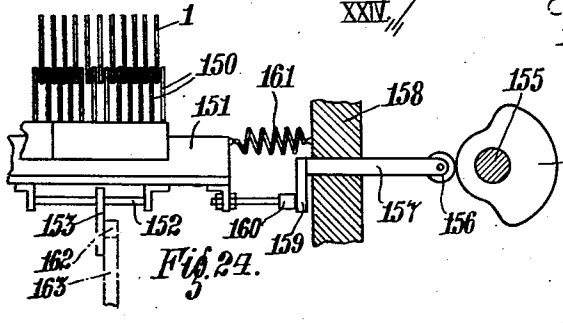


Fig. 24.

Inventor:
James Morton
By [illegible]
Attorney

Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 4

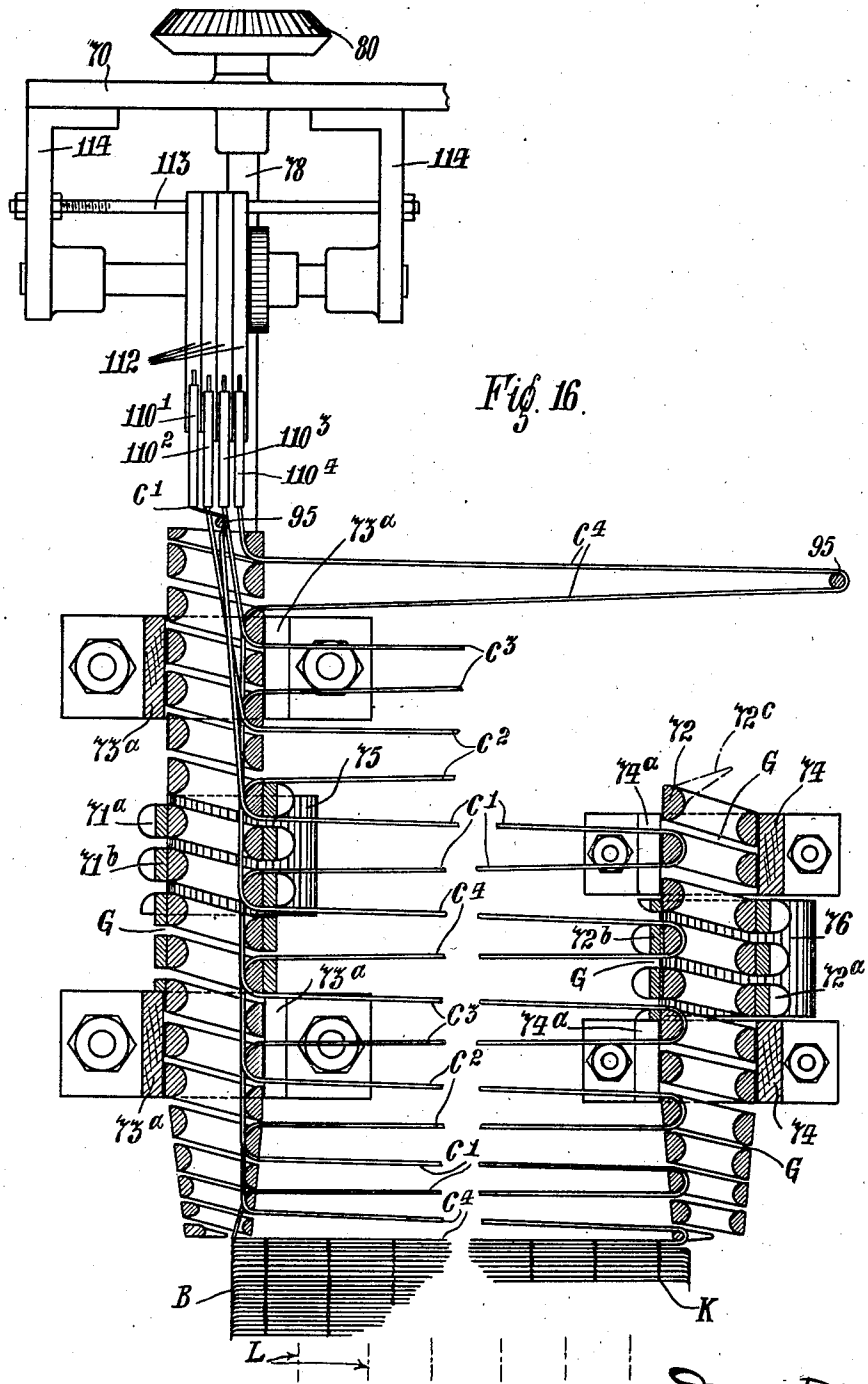


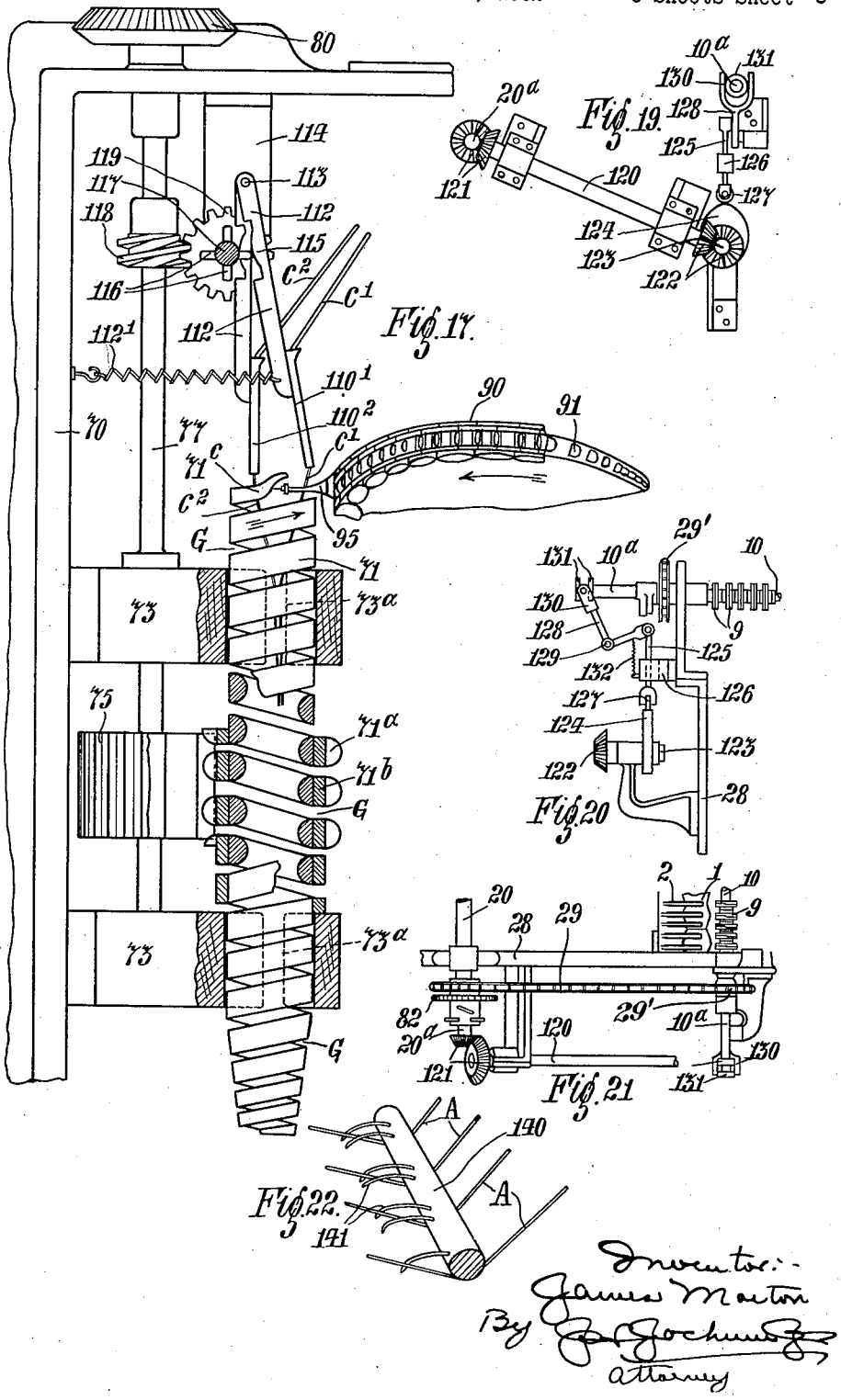
Fig. 16.

Inventor:
James Morton
By. [illegible]
Attorney

Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 5



Inventor:-
James Morton
By
Attorney

Feb. 6, 1934. J. MORTON 1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

Filed Jan. 30, 1932 6 Sheets-Sheet 6

Fig. 25.

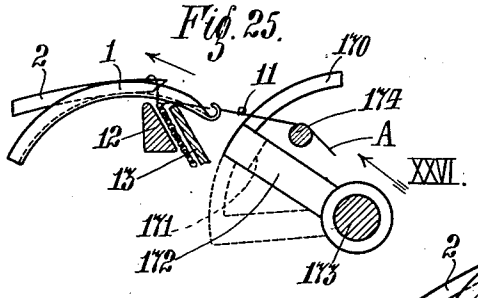


Fig. 28.

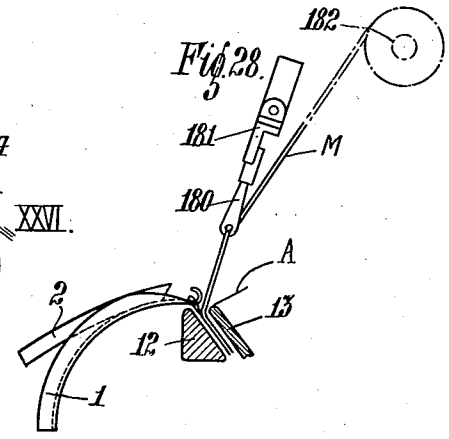


Fig. 26.

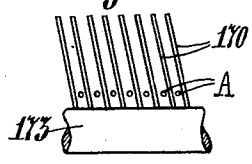


Fig. 27.

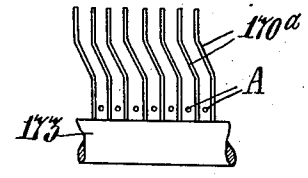


Fig. 29.

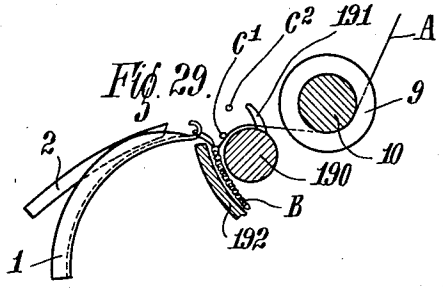


Fig. 31.

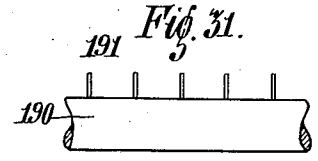
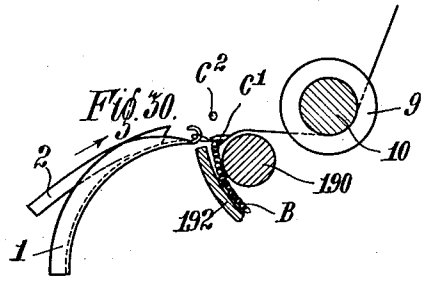


Fig. 30.



Inventor:
James Morton
By
Attorney

Patented Feb. 6, 1934 1,946,030

UNITED STATES PATENT OFFICE

1,946,030

MANUFACTURE OF FABRICS OF VARIOUS KINDS BY NEEDLE ACTION

James Morton, West Lothian, Scotland

Application January 30, 1932, Serial No. 589,827, and in Great Britain February 27, 1931

21 Claims. (Cl. 66—85)

This invention relates to the manufacture of fabrics of various kinds by needle action.

The object of the invention is to enable fabrics to be manufactured at a greater speed than with ordinary weaving, knitted or other processes.

In accordance with this invention threads are formed into chains of thread loops by the co-operative action of oscillating hooks or hook needles (hereinafter referred to as "hook needles") and separate oscillating members (referred to hereinafter as "tongues") mechanically operated in timed relationship with the needles, these parts performing the thread looping and casting-off operations in the formation of the chains; while deflectors act on the threads as they are supplied and deflect them sideways in order that they may be caught by the hooks and pulled into loop formation. The wefts, when necessary for incorporation in the fabrics, can be supplied automatically by suitable mechanism. Preferably, a continuous through weft is supplied which also serves to bind the edges of the fabric.

The oscillatory hook-needles and tongues preferably move in an arcuate path about a common central axis. The deflectors may be rotary. The working parts are all driven in timed relationship.

A preferred construction of the mechanism comprises three principal motions:—

(1) A timed differential movement of the oscillating hook-needles and the co-operating tongues about a common axis, whereby chains of thread loops are formed;

(2) A motion effected by the deflectors for deflecting the threads sideways when being acted on by the hook-needles; and

(3) A helical or screw feed motion for supplying weft threads for incorporation with the chains of thread loops in the formation of the fabrics.

The machine may be provided with a take-up motion characterized by a segmental worm which moves a toothed driving wheel intermittently to take-up the fabric and which also locks said wheel during the intervals between the intermittent movements.

In carrying out the invention, in accordance with a preferred embodiment thereof, a bar with needles is used and each needle, preferably of arcuate form and removably or otherwise secured, is grooved along its shank and terminates simply in a hooked end without a barb or latch. A bar with tongues is also used, each tongue being fitted so as to slide in the groove of each needle and terminating in a point which, in its forward position, projects slightly above the hook of the needles. The needle and tongue bars are mounted on co-axial rock shafts which are actuated by eccentrics and eccentric rods or by cranks and connecting rods or equivalent mechanism, from a main shaft, the parts being so arranged that the tongues are caused to move differentially from the needles. Each needle is formed behind the hook with an elevated curved surface which serves to guide already formed loops upon the tongue with which it co-operates as it advances to engage a new loop. Each tongue is so shaped that, when in its forward position, it gives a top surface to the hook, with which it co-operates, for the purpose of casting off the loops, so that the loops are allowed freely to slide past the hook and off the needle.

The mechanism for deflecting the threads may comprise a series of disc like members, hereinafter referred to as "deflectors", mounted on a rotary shaft and spaced apart in conformity with the spacing of the needles; or the deflectors may take other suitable forms, as hereinafter described.

The deflectors can be shogged or traversed laterally for the purpose of presenting the threads to other neighbouring needles when it is desired to manufacture a fabric in which the individual chains are joined together. In such a fabric the insertion of wefts can be omitted if desired.

In the manufacture of fabrics in which through wefts are incorporated, these may be supplied in the manner set forth in either of the prior U. S. A. specifications 1,680,614 of 14th August 1928, and 1,804,106 of 5th May 1931 but, preferably, by means of special feed mechanism comprising two helical members working in conjunction and operated by suitable gearing in timed relationship with the machine. The threads to form the lengths of weft are supplied to helical passageways in the said members from bobbins, cops or spools, or otherwise.

If desired, a bar or bars of thread guides may be used for the purpose of inserting stuffer warps and the said bar or bars may have means for imparting thereto traverse movements in order to lay warp threads in short traverses as and where desired in the fabric.

The machine is suitable for the manufacture of either cellular or other open fabrics or for solid fabrics of either a light or heavy nature; also for making fancy chain threads or composite chain threads; and it is particularly suitable for the manufacture of chenille preparatory cloth

adapted to be cut into strips of chenille for use in the manufacture of carpets, rugs, etc.

The invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 is an elevation of a needle and Fig. 2 is a cross section thereof taken on the line II—II of Fig. 1.

Fig. 3 is an elevation of a tongue.

Fig. 4 is an elevation of an assembled needle and tongue and the parts immediately associated therewith.

Figs. 5, 6 and 7 are diagrams illustrating different cycles in the operation of producing a loop by the inter-action of a needle and tongue.

Fig. 8 is an elevation of a machine incorporating needles and tongues, parts of the machine being broken away or omitted in this view for clearness.

Fig. 9 is a half plan of the machine illustrated in Fig. 8.

Fig. 10 is a fragmentary elevation (corresponding to Fig. 4) of parts already shown in Fig. 8, Fig. 10 being drawn to a larger scale.

Figs. 11 and 12 are a plan and an inverted plan respectively of a rotary deflector.

Figs. 13 and 14 are fragmentary elevations at right angles to each other of a device for transmitting an intermittent take-up motion.

Fig. 15 is a view in the direction of the arrow XV in Fig. 8 of weft-inserting mechanism.

Figs. 16 and 17 are sectional elevations of the weft-inserting mechanism to a larger scale.

Fig. 18 is a diagram serving to illustrate the principle on which the weft-inserting mechanism works.

Figs. 19 and 20 are elevations at right angles to each other of mechanism which may be used for imparting a shogging or traverse motion to the deflectors and Fig. 21 is a corresponding plan.

Fig. 22 is a perspective view of a modified form of deflecting means.

Fig. 23 is an elevation of yet another form of deflecting means, and Fig. 24 is a sectional view of known means for imparting a traverse movement to the deflectors shown in Fig. 23.

Fig. 25 is a diagram of yet another form of deflector, this form constituting a reed as shown in Fig. 26 and which is a view in the direction of the arrow XXV in Fig. 25. Fig. 27 shows an alternative form which the dents of the feed may take.

Fig. 28 is a diagram showing a form of thread guide which can be used for inserting stuffer or traverse warps.

Figs. 29, 30 and 31 are diagrams showing a device for pressing inserted wefts firmly into the fabric being manufactured.

The principle upon which this invention is based will be described with reference to Figs. 1 to 7, the construction and action of only a single needle 1 of a gang of needles arranged side-by-side and of a single co-operating tongue 2 of a corresponding gang of tongues being taken into consideration for the sake of simplicity and clearness.

The needle 1 is, as shown, arcuate in form and terminates simply in a hook 1^a and is formed on its upper surface immediately behind the hook with a curved, gently rising surface 1^b. The needle is made of channel section (see Fig. 2) so as to provide a recess within which a slightly arcuate tongue 2 fits. The tongue 2 (see Fig. 3) terminates in a point 2^a which overhangs a concave cut-away surface 2^b. As shown in Fig. 4, the needle 1 is secured to a bar 3 which is supported by arms, of which one is shown at 4, these arms being secured to and moved by a rock-shaft 5. The tongue 2 is also secured to a bar 6 supported by arms, of which one is shown at 7, these arms projecting from and moved by a rock-shaft 8, which constitutes a sleeve on the rock-shaft 5, with the result that both bars move about a common axis.

The thread A to be acted upon by the needle and tongue passes to these parts by way of a rotary deflector 9 (hereinafter described) secured to a rotary shaft 10, the thread passing from the deflector to the needle and tongue below a horizontal wire 11. Two stationary bars 12 and 13 are spaced apart to provide a passage for the chain of loops B into which the thread A is formed by the inter-action of the needle and tongue. The chain B passes under tension to a take-up beam hereinafter described.

The needle and the tongue are oscillating by their rock-shafts 5 and 8, the movements being independent and timed so that the needle and tongue move differentially with respect to one another, as hereinafter explained.

One cycle of operations in the formation of a single loop will now be described.

Assuming that both the oscillating needle 1 and the oscillating tongue 2 are positioned as shown at Fig. 4, i. e. in their fully withdrawn or rearward position, with the topmost loop B^1 of the chain B (which is shown already partly formed) looped around the hook 1^a and the thread A extended, as shown at A^1, from the chain B to the lower side of the wire 11, and thence through the deflector 9 to the source of supply: then, when the needle, at its next oscillation, advances to its foremost position (with the tongue 2 also advanced slightly) as at Fig. 5, it passes on the far side of the short length of thread A^1, its upwardly curved part 1^b passing through the loop B^1, with the result that the latter is raised by the part 1^b above the level of the point 2^a of the tongue (see Fig. 5 where the point of the tongue is shown in dotted lines). The tongue now, in its turn, advances further while the needle moves backwards, with the result that, on the one hand, the point of the tongue passes freely through the loop B^1 and holds it and on the other hand, the hook 1^a of the needle engages the thread A^1, which, meantime, has been moved to the far side of the hook so as to lap the same by the deflecting action of the deflector 9 (see Fig. 6) and commences to pull the lapped thread A^1 into another new loop and also through the loop B^1, which latter rests on top of the tongue (see Fig. 7). At this stage in the cycle of operations, the point 2^a of the tongue is touching, or almost touching, the hook, and is substantially flush therewith, so that when the needle and tongue together move backwards they pass freely through the loop B^1, which, as a result, is cast-off over the newly formed loop which remains caught by the hook 1^a, the cast-off loop, in its turn, becoming the topmost loop of the chain B and the newly formed loop taking the place in Fig. 4 of its predessor B^1. Thereafter, the thread A^1 is moved by the deflector 9 to the near side of the needle in readiness for the next similar cycle of loop-forming operations. It will be seen that during each cycle of operations, the thread is hooked and pulled as a loop through the previously formed loop which is then cast-off to form part of the chain B. It is necessary for the thread A^1 to be deflected from side to side of the

needle in order that it may be caught by its hook.

The function of the wire 11 is to rest on and depress the thread A^1 thereby ensuring that the thread will be engaged by the hook 1^a when the needle is withdrawn.

It will be manifest that the needle and tongue form a simple chain stitch such as is ordinarily formed by a warp knitting machine with latch needles or bearded needles. The needle and tongue differ from these known needles notably in that an entirely unobstructed passage is presented to the loop when it is being cast-off. Accordingly, a machine having needles and tongues as herein described can work at very high speed, the thread being at the same time relieved of the serious stresses encountered in the use of latch-needles or bearded-needles.

It will be clear that, if a number of needles 1 and co-operating tongues 2 are mounted side-by-side along the bars 3 and 6 and are supplied with threads A so that they act upon these threads in the manner above described, a number of chains B will be simultaneously produced and will pass side-by-side down the space between the parts 13 and 12. One way of binding the chains so as to form a fabric is to insert wefts, which pass through all the chains and are bound by the stitches thereof.

Fig. 4 illustrates diagrammatically these wefts being inserted, a number of wefts being therein shown and the two lowermost being denoted by C^1 and C^2. As shown, the weft C^1 has been inserted into the open shed formed between the length of thread A^1 and the topmost loop B^1 of the chain. As the needle 1 advances it passes through the space between the wefts C^1 and C^2. Accordingly, in the formation of the stitch, the needle 1 passes to-and-fro over the top of the weft C^1, and the loop B^1 and length A^1, in forming the stitch in the manner hereinbefore described, lock the weft in position. Thereafter, prior to the formation of the next stitch, the weft C^2 is fed into the next open shed and is locked in position in the same manner. By repeating the above procedure, a number of side-by-side chains B are formed and these are all interconnected by weft threads bound by the stitches which constitute the chains.

There are various known ways whereby the wefts can be fed in succession and in parallel formation to the chains of stitches, but a special and preferred way will be described hereinafter.

A machine incorporating the needles and tongues and associated parts as above described is illustrated in Figs. 8, 9 and 10 and will now be described particularly with reference to these figures. This machine is intended to produce a simple chenille preparatory cloth consisting of spaced chains, formed by the needles 1 and tongues 2, and wefts bound together by these chains, the wefts constituting what will ultimately be pile tufts.

The differential oscillatory movements of the needles 1 and tongues 2 are derived from a main driving shaft 20 having at each side of the central plane D—D (see Fig. 9) of the machine two eccentrics 21 and 22, the first of which is connected through an eccentric rod 23 to an arm 24 on one of a number of sleeves constituting the previously mentioned sleeve shaft 8, the connection between the rod 23 and 24 being adjustable by a pin-and-slot arrangement, which permits the amplitude of oscillation of the shaft 8 to be adjusted. As shown in Fig. 10, the shaft 8 is provided with a number of arms 7 which carry the tongue bar 6. The eccentric 22 is connected in the same adjustable manner by an eccentric rod 25 to an arm (not shown) secured to the inner shaft 5. At each rotation of the shaft 20, the eccentric rods 23 and 25 transmit to the respective shafts 5 and 8 oscillatory movements which are, in turn, transmitted to the tongues 1 and the needles 2 so that these parts receive the motions hereinbefore described.

The shaft 20 is supported at each end in a bearing 27 secured to a stationary frame 28.

The rotary shaft 10 carrying the deflectors 9 derives its rotary movement from the shaft 20 through a chain drive 29. The construction of these deflectors can be readily gathered from Figs. 11 and 12. As therein shown, each deflector comprises two annular members 9^a and 9^b between which there is an open sinuous passage 9^c through which a thread A passes on its way to the respective needle 1. The passage 9^c is bounded by edges on the members 9^a and 9^b, the said edges including inclined portions 9^d, 9^e, 9^f and 9^g, the function of which is to impart sidewise movements to the thread A in the rotation of the shaft 10. The arrangement is such that, during one revolution of said shaft, the thread receives a complete to-and-fro sidewise movement, which carries it from one side to the other of the needle.

As shown in Fig. 8, the threads A are supplied to the needles from a beam 30 (near the bottom of the machine) whose spindle 31 is mounted, at each end, in a bearing 32 secured to the frame 28, the threads being automatically drawn by the needles at the required rate by the needles themselves against a light frictional drag against which the beam 30 turns. This drag may be imposed in any suitable known manner. The thread passes from the beam to a tensioning device comprising a roller 33 supported at each end by a pivotally mounted arm 34 which is pulled continuously downwards by a spring 35 anchored to a fixed bracket 36. The thread A passes to the needles by way of another tensioning device in the vicinity thereof, this tensioning device comprising a number of fingers 37 having eyes through which the threads A pass. These fingers 37 form parts of a number of bell-crank-levers which are all strung on a stationary shaft 38 and which each include an arm 39 continuously pulled downwards by a spring 40 anchored to a fixed bar 41. The threads A pass from the tensioning fingers 37 to the needles 1 by way of a stationary shaft 42, over which they are led to the lower side of the deflector shaft 10.

The fabric B composed of the chains produced by the needles 1 and tongues 2 passes to a take-up beam 50 whose spindle 51 rests at each end on an inclined bracket 52 secured to the frame 28. The take-up beam 50 is rotated by virtue of the fact that the periphery B^2 of the wound fabric rests frictionally against a roller 53 operatively connected by a chain drive 54 with an intermittently rotated shaft 55, the roller 53 being mounted on a shaft 53^a journalled in stationary bearings in the frame 28. The shaft 55 is journalled at each end in a bearing 56 secured to the frame 28 and is provided with a drum 57 around which the fabric B passes to a guide roller 58 whose spindle 58^a is journalled in bearings in the frame 28. The arrangement is such that the fabric B passes first from between the spaced bars 12 and 13 to a roller 59, and from this roller it passes around the underside of the drum 57, whence it

passes over the roller 58, and finally passes to the top side of and around the beam 50.

The shaft 55 derives its intermittent rotational movements from the main driving shaft 20 through the intermediary of a counter-shaft 60 which is operatively connected to the shaft 55 through intermeshing bevel pinions 61 and which is operatively connected to the shaft 20 through an intermittent worm wheel drive. This worm wheel drive includes what may be termed a segmental worm 63 secured to the shaft 20 and formed with two interrupted teeth 64 and 65 (see also enlarged view, Figs. 13 and 14). The tooth 64 is arranged helically, whereas the tooth 65 is arranged in a transverse plane at right angles to the shaft 20. The tooth 64 is also arranged in axial alignment with a space 66 between the ends of the tooth 65, and the ends of the tooth 64 both slightly overlap the space 66. Both the tooth 64 and 65 intermesh with the teeth of a worm wheel 67 on the shaft 60. The arrangement is such that, during a portion of one revolution of the shaft 20, the tooth 64 imparts to the worm wheel 67 a slight rotational movement, and throughout the remainder of the revolution the tooth 65 positively locks the worm wheel 67 against rotational movement.

The timing is such that the drum 57 is rotated at about the same speed as the fabric B is produced, and the beam 50 rotates at a speed which is automatically adjusted to suit the rate at which the fabric B is supplied to it.

The mechanism for feeding the wefts forward in succession and in parallel formation to the needles for incorporation in the fabric B will now be described with particular reference to Fig. 8 and Figs. 15 to 18.

The working parts of this mechanism are mounted on a frame 70, secured upon the frame 28 of the mechanism hereinbefore described.

The feeding devices comprise two rotary helical members 71 and 72, which are preferably vertically arranged as shown and have an appearance somewhat like helical springs with closely spaced coils, a free helical passage G being left from end to end of each member. The member 71 and 72 respectively are journalled in bearings 73 and 74, which may be made of wood, such as lignum-vitae, these bearings being secured to opposite ends of the frame 70 and formed with longitudinal slots 73^a and 74^a (see Fig. 16) for a purpose hereinafter described. The helical members 71 and 72 are respectively provided with portions 71^b and 72^b of greater external diameter than the convolutions themselves, the said portions being cut with gear teeth 71^a and 72^a which mesh with gear wheels 75 and 76 secured to vertical shafts 77 and 78, journalled at opposite ends of the frame 70 and driven at the same uniform speed and in the same direction by a horizontal driving shaft 79 through the intermediary of intermeshing bevel gear wheels 80 and 81. The portions 71^b and 72^b rest upon the lower bearings 73 and 74 which accordingly support the members 71 and 72.

The shaft 79 is rotated from the main driving shaft 20 through the intermediary of a chain drive 82.

It will be seen, particularly at Fig. 17, that the member 71 is hook-shaped at its upper end 71^c and is longer than the member 72 and that the bottom ends of both members are disposed in the same horizontal plane. The member 72 also has a hook-shaped upper end 72^c (see Fig. 16). It will also be seen that the members taper to a smaller diameter in the vicinity of their lower ends and also that the convolutions themselves become reduced in thickness.

With the two helical members there is associated an endless chain conveyor disposed immediately in front of the helical members and extending at an inclination between their upper ends. The chain passes around two chain wheels 91 and 92 journalled at a corresponding inclination in bearings 93, 94 secured to opposite ends of the frame 70. The chain is provided with ten equi-spaced projections 95 which move along a path passing across the tops of both helical members. The chain 90 is driven from the vertical shaft 78 through the intermediary of the following means, namely:—a chain drive 96 extending between the shaft 78 and a vertical shaft 97; an inclined shaft 98 driven by the shaft 97 through a flexible coupling 99; and a chain drive 100 extending between the inclined shaft 98 and the nave 92^a of the chain-wheel 92. The time relationship between the movement of the chain and the rotation of the helical members is such that a projection 95 crosses the top of each member once during each two revolutions thereof.

Immediately above the member 71, four tubules 110^{1-4} are provided through which are guided four yarns C^{1-4}, these yarns being of different colours or other characteristics and being supplied from cones, one of which is denoted by H in Fig. 15, the yarns passing by way of any suitable guide arrangement J in the vicinity of the cones and guides 111 secured to the frame 70. The tubules are carried by little slats 112 which are pivotally attached at their top ends to a rod 113 supported by brackets 114 which depend from the frame 70. Each slat 112 has a rounded portion 115 which cooperates with one of four tappets 116 projecting radially from a shaft 117 journalled in the brackets 114, the slats 112 being pulled towards the shaft 117 by springs, one of which is shown at 112'. These tappets are equispaced angularly around the shaft 117 and they are also spaced apart axially along the shaft to such an extent that each tappet can move into register with one portion 115. Thus, in a complete revolution of the shaft 117, the four tubules are displaced in single succession towards the chain 90. This will be clear from Fig. 17, in which the tubule 110^1 is shown displaced in the manner described. The shaft 117 derives its rotation from the vertical shaft 77 through the intermediary of a worm reduction gear consisting of a worm 118 on the shaft 77 and a worm-wheel 119 on the shaft 117, the reduction ratio of the gear being 8 to 1. The time relationship between the rotation of the shaft 117 and the rotation of the member 71 is therefore such that one tubule is displaced as shown at Fig. 17, once during each two revolutions of each member.

The chain drive 82 and other gearing is so designed that the helical members each perform one revolution for each cycle of operations of the needles 1 and tongues 2.

The modus operandi of the weft-feeding mechanism will now be described, reference being particularly directed to Fig. 18. As therein shown, the yarn C^1 is represented by a continuous full line, while the other three yarns C^2—C^4 are represented in dotted lines, and it is to be understood that each of these yarns adopts precisely the same form as the yarn C^1.

As one of the projections 95 on the endless chain 90 moves towards the top of the helical member 71, the tubule 110^1 is displaced and

leads the yarn C^1 into the path of the said projection 95 (see Fig. 17). Accordingly, as the chain continues its movement, the projection engages the yarn C^1 and pulls it at a downward inclination towards the right of Figs. 15, 16 and 18 in an open loop. The formation of this loop can be at once seen by referring to the yarns C^2, C^3 and C^4 each of which is shown pulled into such a loop in Fig. 18. As the said projection 95 continues its movement with the yarn C^1 downwards to the right, the hook 71^c during the rotation of the member 71 moves around and above the yarn C^1, and conveys the open or left hand end of the loop downwards along the helical passageway G. The movement and inclination of the chain conveyor is such that the downward component of said movement has a speed substantially equal to the feeding speed of the helical members, the arrangement being therefore such that the closed end of the loop engaged by the projection 95 moves downwards at the same rate as the open end of the loop engaged by the member 71. Thus, the approximate parallelism of the loops is maintained. Eventually, the projection 95 pulls out the loop of yarn C^1 to such an extent that the loop moves into the path of the topmost end 72^c of the member 72, and during this period the member 71 has been feeding the open end of the loop downwards and maintaining the loop horizontal, as shown in full lines at Fig. 18. At this instant, the topmost convolution of the rotary member 72 enters into engagement with the loop and removes it from the projection 95. Thereafter, the loop of yarn C^1 is fed horizontally downwards by both members until it finally reaches the ends thereof simultaneously and is delivered in two successive parallel lengths.

During the conveyance of the loops from the top to the bottom of the helices, they pass freely along the helical passage G, and in their movement they pass the bearings 73 and 74 by way of the slots 73^a and 74^a provided for this purpose.

Precisely the same procedure as above described with respect to the tubule 110^1 and yarn C^1 is followed with respect to the tubules 110^{2-4} and the yarns C^{2-4}. As shown in Figs. 16 and 18, all the yarns are fed down the helical passageways G in substantially parallel formation, and as they approach the bottom of the members, they gradually become more closely spaced, on account of the gradually decreasing pitch and thickness of the convolutions. The yarns are all disposed in the vertical plane containing the axes of the two members 71 and 72, and the slots 73^a and 74^a are disposed in this plane also, so that the bearings 73 and 74 offer no obstruction to the downwardly moving yarns. In the passage of the yarns down the helical passageways G in the members 71 and 72, the yarns prevent the appearance of a downwardly moving web composed of a continuous sequence of groups of yarns, each group containing two lengths of the yarn C^1, followed by two lengths of the yarn C^2, then two lengths of the yarn C^3 and finally two lengths of the yarn C^4.

As the helical members are hollow throughout, the yarns can be fed right down from the tubules 110. These tubules are displaced, in the manner described, in any desired order to introduce one or other of the yarns to the projections on the conveyor chain for the purpose of being pulled into loops.

The mechanism shown is simple and is adapted to work with only four yarns C^1 to C^4, but if so desired more tubules and yarns could be employed.

The yarns are fed, as indicated at Fig. 4, in quick succession and in parallel formation as wefts, by the members 71 and 72 to the open shed formed by the thread A^1 and the topmost loop B^1 of the chain of loops, and are incorporated one after the other in the fabric by the rapidly acting needles 1.

The mechanism I have described with reference to Figs. 1 to 18 is intended, as aforesaid, for the manufacture of the simple form of chenille preparatory cloth shown diagrammatically in Figs. 16 and 18. For the production of such a fabric, the needles would be spaced comparatively far apart in order to provide the required length of pile tufts for the strips of chenille into which the fabric has ultimately to be cut. Rows of stitches B in the fabric produced are shown in Figs. 16 and 18 as spaced comparatively widely apart, the fabric being suitable for subsequent cutting along the lines indicated by L into strips of chenille, whose tufts would consist of the cut portions of the originally supplied yarns C^{1-4}.

It will be clear however that the machine may have needles located closely together, in which event the chains formed by the needles will likewise extend in the fabric closely together. Moreover, the machine, as so far described, produces independent chains of stitches, which depend entirely upon the wefts to hold them together as a fabric. As an alternative to, or in addition to, the insertion of wefts, the chains of stitches may be themselves interconnected by causing the threads A to be moved sidewise from one needle to one or more neighbouring needles. An arrangement whereby the chains can be interconnected in this manner will now be described with reference to Figs. 19 to 21.

In these figures, the deflector-carrying shaft 10 has an extension 10^a while the main driving shaft 20 has an extension 20^a, which drives a countershaft 120 through the intermediary of intermeshing bevel pinions 121. The shaft 120, in its turn, rotates, through the intermediary of intermeshing bevel pinions 122, a short cam shaft 123, whose cam 124 actuates a vertical tappet 125 guided by a fixed bearing 126. The tappet 125 has a roller 127 which rides upon the surface of the cam 124. The tappet 125, at its top end, has a pin-and-slot connection with one arm of a bell-crank-lever 128 having a stationary fulcrum 129. The other arm of the bell-crank-lever 128 has a fork 130 connected with an annular groove between two collars 131 at the end of the shaft extension 10^a. A spring 132 acting on the bell-crank-lever serves to maintain the roller 127 in contact with the cam 124. The gears 121 and 122 are so designed that the shaft 123 rotates once during each two revolutions of the driving shaft 20. The arrangement is therefore such that once during each two cycles of operations of the needles 1 and tongues 2, the cam 124 rocks the bell-crank-lever 128 and accordingly displaces the entire shaft 10 to-and-fro endwise through its bearings on the frame 28. The shaft 10 would have a feather-and-groove connection (not shown) with its driving sprocket 29', so that the shaft would be free to slide relatively to the chain drive 29 during the shaft's endwise displacement. Accordingly, the deflectors 9 carry the threads A to-and-fro sidewise through a distance of, say, three needle pitches, although the gear may be designed to give movements of any desired num-

ber of needle pitches. In consequence of this movement, the threads A are carried from one needle to another, with the result that the chains into which the threads are formed are interconnected, so that they can form a fabric either with or without wefts.

In the arrangements so far described, the sidewise movement of the threads A is derived from the rotary deflectors 9. It is to be understood that other forms of thread-deflecting means may be provided, and another form is illustrated in Fig. 22. In this form, a shaft 140 (which would be positioned similarly to the shaft 10) is provided with pairs of projecting guide prongs 141. Each of the threads A is led, as shown, around the underside of the shaft 140 and between a pair of prongs 141. Endwise to-and-fro movements would be imparted to the rod 140, for example, by mechanism such as described in Figs. 19 to 21, and the said movements may be such as to carry the threads A either from one side to another of single needles or to carry them through a distance of several needle pitches.

Another form of means, not novel in itself, for imparting a to-and-fro sidewise movement to the threads A is illustrated in Figs. 23 and 24. As therein shown, each thread A passes through the eye of a finger 150, which forms one of a gang mounted on a bar 151, this bar having a sliding support at each end. The said sliding support consists of a rod 152 secured to the bar 151 and a member 153 through which the rod 152 passes. The bar 151 can be moved endwise under the control of a cam 154, secured to a rotatable shaft 155. With the cam there co-operates a roller 156, at one end of a rod 157 passing slidably through a frame member 158 and having, at its other end, a plate 159 against which presses an adjustable stop 160 at the adjacent end of the bar 151. A spring 161 extending between the frame member 158 and the bar 151 keeps the stop 160 permanently in contact with the plate 159 and at the same time keeps the roller 156 in contact with the cam. The shaft 155 is rotated in timed relationship to the cycle of operations performed by the needles 1 and tongues 2, and the arrangement is such that the fingers 150 are given a sidewise movement at timed intervals in the cycle of operations, in one direction by the cam 154 and in the other direction by the spring 161, with the result that the threads A are deflected sidewise at the said timed intervals. The extent and sequence of the sidewise movements is determined by the design of the cam 154. The cam shown is designed to impart, once in each cycle of operations, sidewise movement of three needle pitches to the needles 150; but it will be obvious that the cam can be designed to impart sidewise movements of any desired magnitude and/or any desired sequence.

If desired, a small oscillatory movement (for the purpose of lapping the threads around the needle hooks) can be imparted to the fingers 150 when used with hook-needles 1 operating according to the present invention, and in that event the member 153 would be attached to a member 162 on an oscillatory lever such as 163 fulcrumed on a stationary pin 164.

Provision for oscillating the thread-guiding fingers is generally necessary where more than one gang of thread-guiding fingers is provided in order to lead more than one thread from different sources to each needle 1. Where one or more additional gangs of thread-guiding fingers are provided these would be made and mounted on the member 162 in precisely the same way as already described with reference to the fingers 150, and they would receive their endwise movement from a cam such as the cam 154 through the intermediary of corresponding parts. In Fig. 23, one of a second gang of needles is indicated in dotted lines at 150^a, and a second thread is indicated by A^a. This second thread would be led from a separate source of supply.

Yet another form of means for imparting a sidewise movement to the threads A is illustrated in Figs. 25 and 26. As therein shown, the said means comprises a reed composed of dents 170 all secured to a horizontal bar 171 which is supported at each end by an arm 172 secured to, so as to move with, a rock-shaft 173. As shown in Fig. 26, the dents 170 are set at an inclination. The threads A are led between the dents to the needles 1, the threads being guided by a horizontal rod 174 extending in front of the reed and by the previously mentioned wire 11 which extends along the rear of the reed. The arrangement is such that, when the reed occupies its upper position, in which it is shown in full lines in Fig. 25, each thread A is located at the far side of its needle 1. When the reed is rocked downwards into the position in which it is shown in dotted lines, it moves each thread A sidewise to the near side of its needle, because of the inclined setting of the dents 170.

In Fig. 26, the dents 170 although inclined are straight. If desired, the same result may be obtained by making the dents of bent form, as indicated by 170^a in Fig. 27.

The thread-deflecting means described with reference to Figs. 25 to 27, is particularly useful where the threads A are finely pitched (i. e. are arranged closely together), and also where a simple construction of thread-deflecting means is desired.

As illustrated in Fig. 28, stuffer or other warps M may be introduced to the fabric while being produced by the co-operating needles 1 and tongues 2. The stuffer warps M may, as shown, be guided to the fabric-receiving space between the bars 12 and 13 (Fig. 4) by a gang of fingers, one of which is denoted by 180, the gang of fingers being carried by a bar 181. The stuffer warps M may be supplied to the fingers 180 from an overhead beam indicated in dotted lines at 182. The bar 181 may have the same kind of mounting as the bar 151 previously described with reference to Figs. 23 and 24. That is to say, the bar may be mounted so as to be capable of performing an endwise or shogging movement and, if desired, an oscillatory movement also.

In machines where provision is made for interconnecting or interlooping the chains of loops B, if desired, without the use of wefts, the bar 181 may be stationary and the fingers so arranged that the warps M would pass into the fabric and would be bound into the chains of loops. Alternatively, the bar may be given an endwise or shogging movement, in which event the warps M would be carried in a zig-zag fashion between the chains of loops and would be bound therein. There would thus be inserted in the fabric what may be termed short traverse warps. The shogging movement may also be varied to vary the traverse of the warps.

In cases where the machine is of the kind described with reference to Figs. 1 to 18 (i. e. has no provision for interlooping the chains of loops) the bar 181, if provided, would require to receive

endwise to-and-fro movements and thereby insert the above-mentioned short traverse warps. This arrangement may be so designed that the need for inserting wefts can be obviated.

In certain cases, it may be desirable to adjust angularly the setting of the fingers 180 with respect to the needles 1, and for this purpose a mounting such as the lever 163 described with reference to Figs. 23 and 24 may be provided.

Means may be provided whereby the inserted wefts can be positively pressed into the fabric, and one form of such means is shown in Figs. 29 to 31. As therein shown, the bars 12 and 13 are dispensed with and in their place there is provided a rock-shaft 190 formed with teeth 191 and a curved guide bar 192, a space for the passage of the fabric B being left between the parts 190 and 192. The arrangement is such that, when the needle 1 reaches its rearmost position, the shaft 190 rocks clockwise to bring the teeth 191 into the vertical position in which they are shown in Fig. 29. This allows the weft C^1 to be freely inserted by the weft-inserting mechanism. Thereafter, the shaft 190 rocks counter-clockwise and brings the teeth 191 into contact with the inserted weft C^1, with the result that the latter is pressed tightly into the top of the fabric B as it is being locked therein by the topmost loops of the fabric.

The rock-shaft 190 would receive its required oscillatory motion from the main driving shaft 20 through the intermediary of any of the usual well-known mechanisms for such a purpose; for example, a lever arm (not shown) secured to the shaft 190 and a cam (not shown) secured to the shaft 20, the said cam being adapted to impart timed rocking movements to the arm.

The spacing of the teeth 191 may be such that they engage the weft at points several needle pitches apart, or they may be arranged to engage the weft between each two adjacent needles.

I wish it to be understood that although I have simply used the term "threads" throughout the foregoing specification, I wish this to cover and include all kinds of threads and yarns, whether of cotton, wool, linen, hemp, jute, silk, artificial silk, etc.

I claim:—

1. In a machine for forming a thread supplied thereto into a chain, an arcuate needle on a movable mounting, said needle being formed with a hook, a co-operating tongue on a separate movable mounting and arranged in the vicinity of said hook, and means for oscillating both said mountings differentially so that the needle advances for the hook to engage the thread and to guide a previously formed loop in said thread away from the hook, the tongue advances to receive said loop, the needle withdraws to form the engaged thread into a new loop, and then the tongue withdraws with the hook to cast-off the previously formed loop.

2. In a machine for forming a thread supplied thereto into a chain, an arcuate needle on a mounting movable about an axis, said needle being formed with a hook and an adjacent curved surface, a co-operating tongue on a separate mounting movable about the same axis, said tongue being arranged in the vicinity of said hook and curved surface, and means for oscillating both said mountings differentially about the said axis so that the needle advances for the hook to engage the thread and for the curved surface to guide a previously formed loop in said thread away from the hook, the tongue advances to receive said loop, the needle withdraws towards the tongue to form the engaged thread into a new loop, and then the tongue withdraws with the hook to cast-off the previously formed loop.

3. In a machine for manufacturing fabrics, a gang of arcuate needles on a movable mounting and having hooks, a gang of co-operating tongues on a separate movable mounting and arranged in the vicinity of said hooks, means for guiding threads to said needles, means for oscillating the needle-mounting, means for oscillating the tongue-mounting so that the tongues move differentially of the needles, the co-operative action between the needles and tongues forming said threads into chains, and means for interconnecting said chains to form a fabric.

4. In a machine for manufacturing fabrics, a gang of arcuate needles on a movable mounting, each needle being formed with a hook and an adjacent curved surface, a gang of co-operating tongues on a separate movable mounting, means for guiding threads to said needles, means for oscillating both said mountings differentially so that the needles advance for the hooks to engage said threads and for the curved surfaces to guide previously formed loops in said threads away from the hooks, the tongues advance to receive said loops, the needles withdraw towards the tongues to form the engaged threads into new loops and then the tongues withdraw with the hooks to cast-off the previously formed loops, which thus become parts of chains of loops, and means for interconnecting said chains to form a fabric.

5. A machine for forming threads supplied thereto into chains, comprising a gang of arcuate needles having hooks, a rock-shaft supporting said needles, a gang of tongues co-operating with the respective needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, means for oscillating both of said rock-shafts so that the needles and tongues move differentially, and deflectors for leading the said threads to the needles for formation into chains by the co-operative action of the needles and tongues.

6. A machine for manufacturing fabrics comprising a gang of arcuate needles having hooks a rock-shaft supporting said needles, a gang of tongues co-operating with the respective needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, means for leading threads to said needles, said leading means including deflectors for guiding the said threads into engagement with the hooks, means for oscillating both said rock-shafts differentially about their common axis, so that the needles advance for the hooks to engage the threads and to guide previously formed loops in said threads away from the hooks, the tongues advance to receive said loops, the needles withdraw to form the engaged threads into new loops and then the tongues withdraw with the hooks to cast-off the previously formed loops, which thus become parts of chains of loops, and means for interconnecting said chains to form a fabric.

7. In a machine for forming threads supplied thereto into chains, a needle on a movable mounting and having a hook adapted to receive a thread, a co-operating tongue on a separate movable mounting and arranged in the vicinity of said hook, a deflector formed with a sinuous passage for said thread, means for rotating said deflector which when rotated guides said thread sidewise across the said needle in order to be engaged by the hook, means for oscillating said

needle mounting and means for oscillating said tongue mounting so that the tongue moves differentially of the needle, the co-operative action between the needles and tongues forming the threads into chains.

8. A machine for forming threads supplied thereto into chains comprising a gang of arcuate needles having hooks, a rock-shaft supporting said needles, a gang of tongues co-operating with the respective needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, deflectors for leading the said threads to the needles, said deflectors being formed with sinuous passages for the threads, means for rotating said deflectors to move said threads sidewise into engagement with the hooks, and means for oscillating said rock-shafts differentially so that said needles and tongues co-operate to form the threads engaged by the hooks into chains.

9. A machine for manufacturing fabrics comprising a gang of arcuate needles formed with hooks, a rock-shaft supporting said needles, a gang of tongues co-operating with said needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft. means for guiding threads to said needles, means for differentially oscillating said rock-shafts about their common axis so that the needles advance to engage said threads and at the same time guide previously formed loops away from the hooks, the tongues advance to receive said loops, the needles withdraw to form the engaged threads into new loops and then the tongues withdraw to cast-off the preciously formed loops, means for traversing said thread-guiding means so that the threads are led across a plurality of needles, whereby the loops are interconnected to form a fabric, and means for leading stuffer warps between the needles for incorporation in the fabric between adjacent interconnected chains.

10. A machine as claimed in claim 2 including a take-up motion for the chains, said take-up motion comprising a rotary worm operatively connected to the two rock-shafts, a worm-wheel meshing with teeth on said worm, a take-up roller which receives said chains, and gearing operatively connecting said roller to said worm-wheel, said worm teeth comprising one which transmits rotational movements at intervals to the worm-wheel and one which locks said worm-wheel between said intervals against rotation.

11. In a machine for forming a thread supplied thereto into a chain, a needle on a movable mounting, said needle being formed with a hook, a curved surface adjacent said hook and a recess, a co-operating tongue on a separate movable mounting and arranged in continuously sliding engagement with the said recess, means for reciprocating said needle's mounting, additional means for reciprocating said tongue's mounting in accurately timed relationship with the needle's mounting so that the needle advances for the hook to engage the thread and for the curved surface to guide a previously formed loop in said thread away from the hook, the tongue advances along the recess to receive said loop, the needle withdraws towards the tongue to form the engaged thread into a new loop, and then the tongue withdraws to cast-off the previously formed loop.

12. A machine for manufacturing fabrics comprising needles formed with hooks and mounted for reciprocation, tongues adapted to co-operate with said needles and also mounted for reciprocation, said tongues being arranged in continuous sliding engagement with said needles for guidance thereby, means for supplying and guiding threads to said needles for formation into chains by the co-operative action of said needles and tongues, feed members mounted for rotation, means for supplying weft material to said feed members for insertion thereby as wefts in the said chains, means for reciprocating said needles, additional means for reciprocating said tongues differentially of said needles and means for rotating said feed members in timed relationship with said needles and tongues.

13. A machine for manufacturing fabrics comprising arcuate needles formed with hooks and having a movable support, tongues adapted to co-operate with said needles and having a separately movable support, said tongues being arranged in continuous sliding engagement with said needles for guidance thereby, means for supplying and guiding threads to said needles, means for oscillating said needle's support, additional means for oscillating said tongue's support differentially of the needle's support so that said needles and tongues co-operate to form said threads into chains, and means for supplying weft material to said needles for insertion thereby as wefts in the said chains.

14. A machine for manufacturing fabrics comprising a gang of curved needles having hooks, a rock-shaft supporting said needles, means for oscillating the needle-rock-shaft and needles, a gang of tongues co-operating with the respective needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, means for oscillating the tongue-rock-shaft and tongues, so that the latter move differentially of the needles, gearing for operating both said oscillating means, means for supplying threads to the respective needles, deflectors for displacing the said threads sidewise so as to be engaged by said hooks and formed by the co-operative action of the needles and tongues into chains of loops, and means for inserting wefts into said chains in order to form a fabric.

15. A machine for manufacturing fabrics comprising a gang of curved needles having hooks, a rock-shaft supporting said needles, means for oscillating the needle-rock-shaft and needles, a gang of tongues co-operating with the respective needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, means for oscillating the tongue-rock-shaft and tongues, so that the latter move differentially of the needles, gearing for operating both said oscillating means, means for supplying threads to the respective needles, deflectors for displacing the said threads sidewise so as to be engaged by said hooks and formed by the co-operative action of the needles and tongues into chains of loops, means for inserting wefts into said chains in order to form a fabric, and means for pressing the wefts into the fabric.

16. A machine for forming threads supplied thereto into chains comprising a gang of needles having hooks, a movable support for said needles, a gang of tongues co-operating with the respective needles, said tongues being arranged in continuous sliding engagement with said needles for guidance thereby, a movable support for said tongues, means for reciprocating the needle support, additional means for reciprocating the tongue support so that the needles and tongues move differentially and in accurately timed relationship, and means for leading the said threads

into engagement with the hooks of the needles for formation by the co-operative action of the needles and tongues into chains.

17. A machine for manufacturing fabrics comprising a gang of arcuate needles formed with hooks, a rock-shaft supporting said needles, a gang of tongues co-operating with said needles, a rock-shaft supporting said tongues and arranged co-axially of the needle-rock-shaft, means for guiding threads to said needles, means for oscillating said needle-supporting rock-shaft, additional means for differentially oscillating said tongue-supporting rock-shaft so that the needles advance to engage said threads and at the same time guide previously formed loops away from the hooks, the tongues advance to receive said loops, the needles withdraw to form the engaged threads into new loops and then the tongues withdraw to cast-off the previously formed loops, and means for traversing said thread-guiding means so that the threads are led across a plurality of needles, whereby the loops are interconnected to form a fabric.

18. A machine for manufacturing fabrics comprising needles on a movable support, said needles being formed with hooks, tongues on a separately movable support, each tongue being in sliding relationship with a needle, means for guiding a supply of threads to the needles, means for moving said needles' support towards and away from said guiding means, additional means for sliding said tongues along said needles so that the needles and tongues receive the following differential movements, namely, the needles advance for the hooks to engage the threads and to guide previously formed loops in said threads away from the hooks, the tongues advance to receive said loops, the needles withdraw to form the engaged threads into new loops and then the tongues withdraw with the hooks to cast-off the previously formed loops, which thus become parts of chains of loops, and means for traversing the thread-guiding means across a plurality of needles whereby the chains of loops are interconnected to form a fabric.

19. In a machine for forming a thread supplied thereto into a chain, a movable arcuate hook needle, means for lapping said thread on said needle by imparting to the thread a purely sidewise movement, a co-operating movable arcuate tongue slidably mounted in said needle, means for oscillating the hook needle and additional means for oscillating the tongue in accurately timed relationship with and differentially of said needle so that their co-operative action forms the thread into a chain.

20. In a machine for forming a thread supplied thereto into a chain, an arcuate needle on a movable mounting, said needle being formed with a hook, means for lapping said thread on said needle by imparting to the thread a purely sidewise movement, a curved surface adjacent said hook and a recess, a co-operating tongue on a separate movable mounting and arranged in the said recess, means for oscillating said needle's mounting, additional means for oscillating said tongue's mounting in accurately timed relationship with the needle's mounting so that the needle advances in an arcuate path for the hook to engage the thread and for the curved surface to guide a previously formed loop in said thread away from the hook, the tongue advances along the recess to receive said loop, the needle withdraws towards the tongue to form the engaged thread into a new loop, and then the tongue withdraws to cast-off the previously formed loop.

21. A machine for manufacturing fabrics comprising arcuate needles formed with hooks and mounted for oscillation, arcuate tongues adapted to co-operate with said needles and also mounted for oscillation, means for supplying threads to said needles, means for displacing said thread-supplying means purely sidewise in order to lap the threads on said needles, which co-operate with tongues to form said threads into chains, feed members mounted for rotation, means for supplying weft material to said feed members for insertion thereby as wefts in the said chains, means for reciprocating said needles, additional means for reciprocating said tongues differentially of said needles and means for rotating said feed members in timed relationship with said needles and tongues.

JAMES MORTON.