March 26, 1957 A. AXELSSON 2,786,256

APPARATUS FOR TYING THREADS IN A CLOTH JOINING OPERATION

Filed Oct. 30, 1953 2 Sheets-Sheet 1

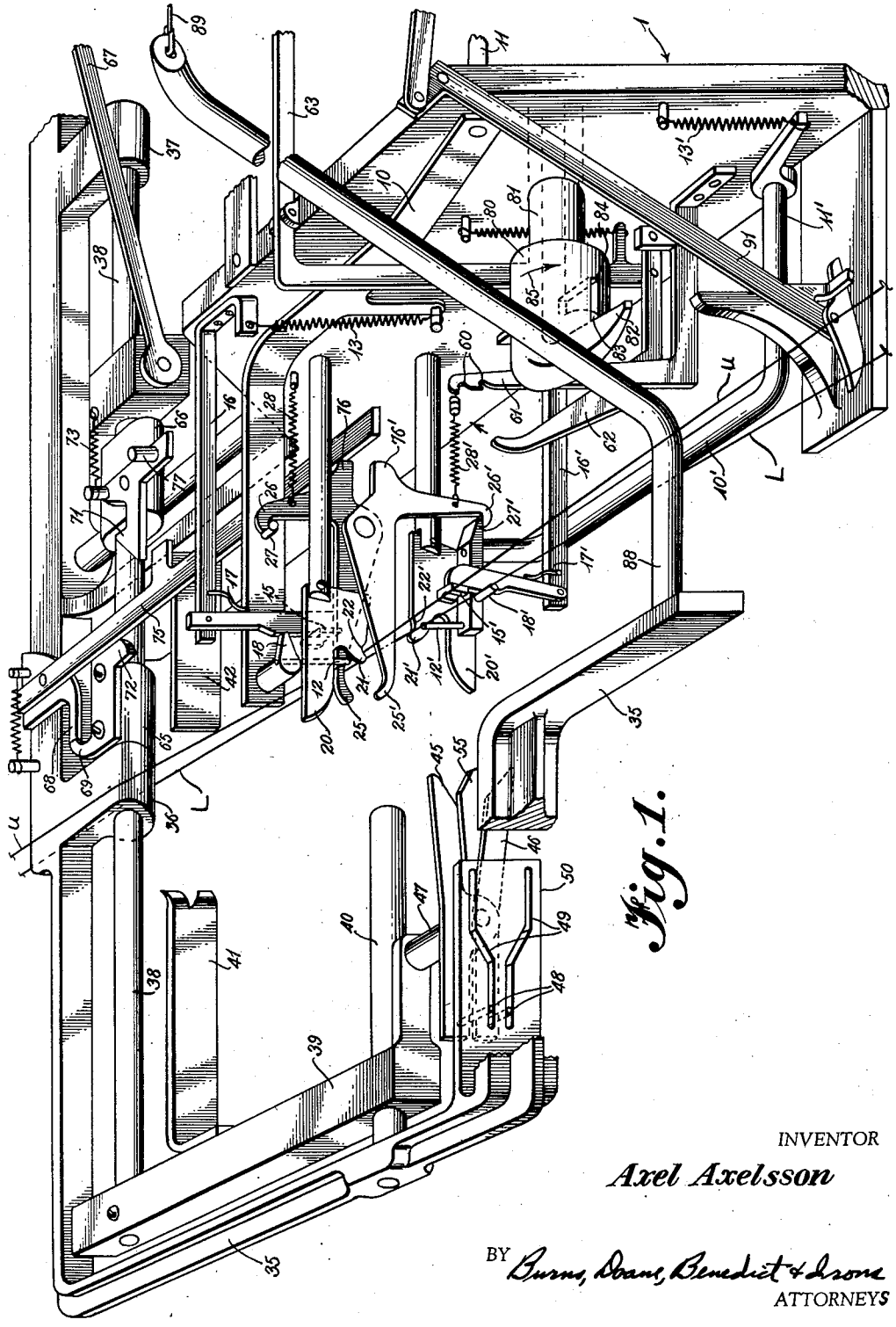


Fig. 1.

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Fig. 2.

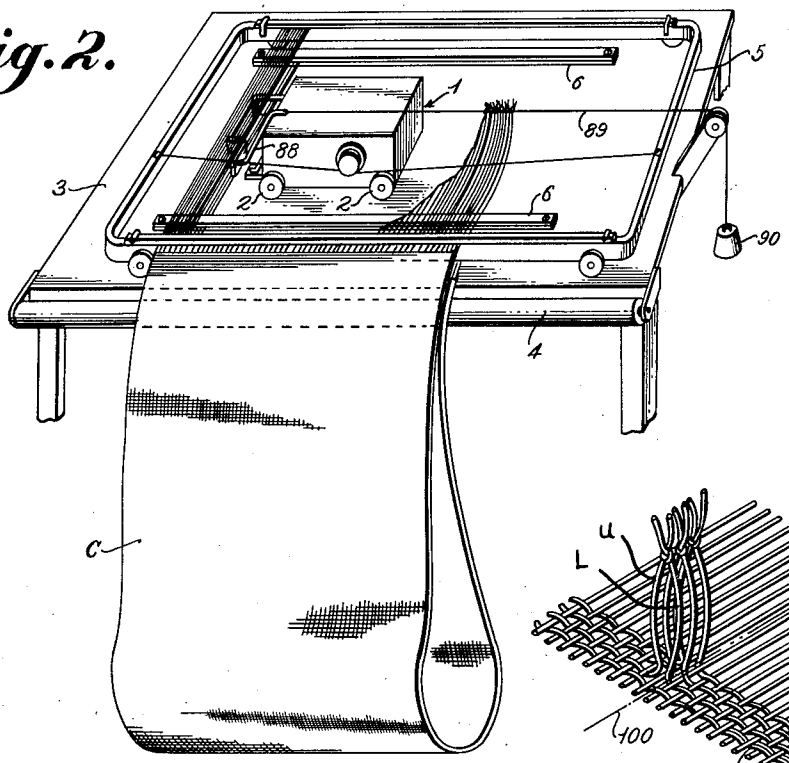


Fig. 5.

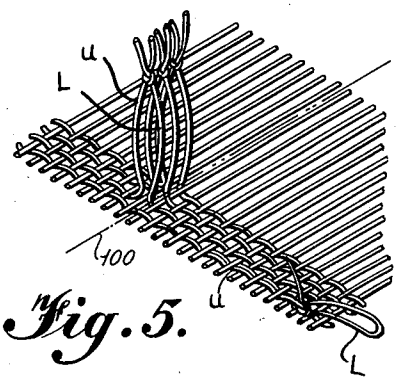


Fig. 3.

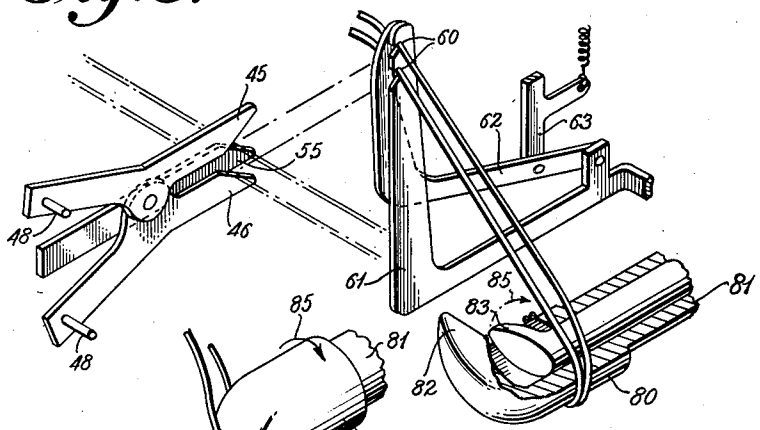
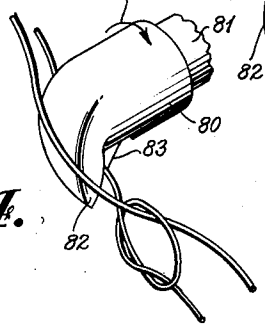


Fig. 4.



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2,786,256

APPARATUS FOR TYING THREADS IN A CLOTH JOINING OPERATION

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Application October 30, 1953, Serial No. 389,384

7 Claims. (Cl. 28—1)

This invention relates generally to apparatus for joining ends of cloth to make an endless belt such as extensively used for felts, bleach cloths, et cetera in the papermaking industry. More particularly, the invention relates to an automatic tying machine for tying the ends of the warp threads in a piece of cloth in such a manner that one end of each thread may be used in drawing the other end of the thread through the weft or filling threads in the cloth to produce a smooth seamless joint between the two ends of such cloth.

Up to the present time it has been the practice in the production of papermaking felts to remove the cloth from the loom upon completion of the weaving so there remains at both ends of such cloth a fringe of approximately 24 inches of unwoven warp threads. These end warp threads enable the joining of the two ends of the cloth so that the cloth may be made into an endless belt.

The actual joining of the cloth ends has been performed by hand in four separate distinct operations. The two ends of the cloth with the unwoven warp threads extending therefrom are placed in overlapping parallel relation and the worker, as the first operation, selects the edge threads from each end of the cloth which constitute the initial two threads for the tying operation. The second operation consists in the worker's tying the two threads together so that an overhand knot is tied in one thread with the loop of such knot enclosing the other thread. This other thread remains untied to the knotted thread except for being enclosed by the knot. In the final operation hereinafter described, this knot in the first thread acts as the eye of a needle in drawing the other untied thread through the weave of the cloth.

As the third operation, the worker traces the first knotted thread from the point where it extends out of the weave to a point in the cloth, as for example twenty-four inches inwardly of the first weft or filling. In the fourth operation, the thread which has been traced from the end of the cloth is drawn out of the cloth so that the knot tied to the other untied thread causes such other thread to fold back around the knot loop while being drawn through the weave by such knot. This drawing operation causes the untied thread from the opposite end of the cloth to replace the one being drawn out of the cloth.

After these four separate operations have been performed with the first two edge threads, one from each end of the cloth, the four steps are repeated successively for each pair of ends of every warp thread across the width of the cloth. The fourth or drawing operation for the successive threads is spread over a range of distances inwardly from the end of the cloth so that in the final product the extended warp threads which have been drawn into the weave terminate at several different positions along the length of the cloth to provide an aggregate friction sufficient to hold the two joined ends together.

The hand operation above-described presently used in joining cloth ends is a tedious and indeed time consuming operation to produce the smooth seamless joint necessary in felts, bleach cloths, et cetera. It will readily be appreciated that an error in the third operation, namely tracing the thread back through the cloth, may result in drawing out of the weave in the fourth operation a thread which has not been previously tied. Such a mistake is a costly error requiring a considerable amount of the worker's time to correct. The chance of making such an error is always possible when one pair of the thread ends is tied and drawn into the cloth before the thread ends adjacent thereto have been tied.

In the apparatus and method of this invention three of the four operations presently used in joining cloth ends are performed automatically and the fourth operation extremely simplified. Thus the apparatus selects the proper threads from the two cloth ends, ties such threads and moves on to the next pair of ends to repeat the operation. This sequence is successively performed by the machine across the entire width of the cloth being joined until all of the warp threads have been properly joined. The tying of all of the threads before the drawing operation removes the necessity for the third hand operation set forth above, namely tracing the threads through the cloth, since, after tying all of the knots, it is possible to simultaneously or successively draw the threads through the weave without encountering the danger of drawing a thread from the weave which has not been previously tied. In the method of joining, the drawing operation is simplified by quickly identifying the proper thread to be drawn and simultaneously drawing the threads to complete the joint.

Accordingly, it is a principal object of this invention to provide a method and apparatus for joining cloth ends which will substantially reduce or eliminate the tedious hand labor required in present practices of joining cloth ends to make papermaking felts, bleach cloths, et cetera.

It is a further object of this invention to provide a method and apparatus for joining cloth ends at an extremely high rate of speed.

It is another object to provide a method of tying and a tying machine which will tie one of two selected threads around the other for use in joining cloth ends in producing endless cloth belts as used in the papermaking industry.

It is an additional object of this invention to provide a method of cloth joining utilizing identifying filling threads at spaced points adjacent one end to quickly identify and assist in drawing the appropriate warp threads from the weave for the proper distance after they have been tied to the respective warp threads of the other cloth end to be joined.

With the foregoing and other objects in view, which will appear as the description proceeds, the invention resides in the combination, arrangement of parts, details of construction and methods hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of the appended claims without departing from the spirit of the invention.

Referring to the drawings:

Figure 1 is a diagrammatic perspective view of a form of the tying apparatus of this invention;

Figure 2 is a diagrammatic perspective view showing the tying machine in operation with the two layers of fringe warp threads from the cloth ends being joined retained in the tying frame;

Figure 3 is a detail perspective view illustrating the initial steps in the knot tying operation of the machine.

Figure 4 is a perspective view illustrating the completion of the knot by the knot tying mechanism, and

Figure 5 is a perspective view illustrating portions of the cloth ends being joined and the manner of drawing the tied threads through the weave of the cloth.

Referring to Figure 2, which shows the tying machine in its operative relation to the cloth ends being tied, a

carriage 1 is illustrated mounted on wheels 2 which are suitably driven so as to move the carriage progressively across the table 3 in step-by-step motion as each of the successive ends of the warp threads of the cloth C are tied. The table 3 on which the tying machine operates may be suitably provided with a roller 4 mounted along one edge thereof to support the ends of the cloth as they approach the frame 5 which surrounds the carriage 1 and serves to retain the unwoven fringe warp threads extending from one of the ends of the cloth in parallel overlapping relation to the fringe warp threads of the other cloth end so as to be selectable by the tying machine in its progressive joining of the successive pairs of warp threads. A pair of frames 6 are secured to the table 3 in spaced parallel relation on opposite sides of the path of movement of the carriage 1 during the tying operation and serve to rigidly support the lower set of fringe warp threads from one of the ends of the cloth C in a layer overlapping the fringe warp threads held in frame 5. Thus the frames 5 and 6 retain the layers of warp threads from the two ends of the cloth C so as to present to the tying machine a thread from each layer in the operation of the machine in tying the successive knots.

Figure 1 provides a diagrammatic showing of the specific elements carried by the carriage 1 in moving across the table 5 (Figure 2) to select transfer, cut, hold, and tie the successive pairs of warp threads from the two ends of the cloth to be joined. For simplification the illustration on the drawing in Figure 1 shows only one of the threads U from the upper layer of warp threads and one of the threads L from the lower layer of warp threads of the cloth ends to be joined.

The mechanism utilized in selecting a thread from the upper and lower layers of warp threads held by the frames 5 and 6 consists of two substantially symmetrical systems of devices, namely an upper selector and a lower selector. The upper selector consists of an arm 10 mounted on an oscillating shaft 11 and carrying at its outer end a thread selecting needle 12. A spring 13 normally retains the arm 10 in its uppermost position so that the thread engaging portion of the selector needle 12 will be above the plane of the upper layer of warp threads U. The shaft 11 may be suitably oscillated by a radial arm extending therefrom engaging a cam which is continuously rotated during operation of the machine. The Fleischer Patent 2,039,157, April 28, 1936, illustrates such an operating action and also shows operating mechanisms which may be used in actuating the various devices described hereinafter, timed to the speed of machine operation.

The lower selector has a similar arm 10' mounted on an oscillating shaft 11' and carrying a lower selector needle 12' urged toward its lowermost position by a spring 13' so that the thread engaging portion thereof will be beneath the lower layer of warp threads L. The shaft 11' may be suitably oscillated similarly to shaft 11.

The selector needles 12 and 12' have a small cross section approximating the diameter of the threads to be selected from the two parallel layers of warp threads. However, for purposes of illustration, these selector needles have been greatly enlarged. In actuality the selector needles are such that only one thread at a time, engaged by the needle end which may be notched, can be carried along by the needle during its downward or upward motion for the needle 12 and 12', respectively. The threads in the two layers held by the frames 5 and 6 extend transversely to the direction of movement of the machine with the selector needles oscillating substantially perpendicularly of the tying machine.

In order to insure that the edge threads in the parallel layers of warp threads do not move past the path of the selector needles 12 and 12', but on the contrary are retained in the most favorable position relative to the selector needles when the latter are moved towards the layers of threads, there is provided on the carriage 1 thread tappets 15 and 15' which present edges facing the layers of threads to be tied. The edge faces of the tappets 15 and 15', during the motion of the needles 12 and 12' towards the layers of threads are situated in a plane parallel to the plane in which the needles are moving and thus are located in a manner relative to the axis of the needles that the respective needles with certainty will catch the edge threads in the layers of warp threads provided that the machine has been fed forward sufficiently towards the threads that such edge threads will rest against the edges of the respective tappets.

In the embodiment shown on the drawings, the thread tappets 15 and 15' are pivoted on arms 16 and 16', respectively, and urged by springs 17 and 17' toward guides 18 and 18', respectively, carried by the holders for the selector needles 12 and 12'. The links pivotally securing the thread tappets 15 and 15' to the arms 16 and 16', respectively, have guide surfaces of such a shape that when the selector needles 12 and 12' have reached or just passed the threads U and L, the thread tappets will be swung away from the selector needles and, on return motion of the selector needles will return so as to properly position the next successive pair of threads to be tied.

To the side of and near the end of the path of movement of the selector needles 12 and 12', thread hooks 20 and 20' are provided into which the respective threads U and L, carried along by the needles 12 and 12', are delivered. The thread hooks 20 and 20' have respectively a nose portion 21 and 21' about which the thread is moved by the appropriate selector needle and a notch 22 and 22', respectively, which serve to temporarily retain the threads out of the path of movement of the selector needles 12 and 12'.

Referring, for example, to thread U, when it is guided by the selector needle 12 on downward movement of such needle towards the ridge of the nose 21, the thread will be carried along by the needle to beyond the point of the nose and will slip down below the latter so that upon upward movement of the needle 12 the thread will be caught by the nose 21 and during continued upward motion of the needle will slide along the bottom side of the nose up to the notch 22 where it will remain out of the way of the path of the needle 12. It will be readily appreciated that the action of the lower selector needle 12' in moving the thread L around the nose 21' will be similar to the above-described operation of the movement of thread U. In Figure 1 the two threads U and L are illustrated subsequent to their movement past the respective noses 21 and 21' of the thread hooks 20 and 20'. Although the two thread hooks 20 and 20' are slightly offset relative to one another, the notches 22 and 22' of such hooks are at approximately the same level and substantially opposite one another, so that the threads U and L when retained in the respective notches will be quite close to each other.

When the edge threads U and L caught on the end of the selector needles 12 and 12' are carried along with the latter for delivery into the thread hooks 20 and 20' they strike during this path of movement pivoted bell cranks 25 and 25', respectively, which have at the other end of each crank, hooks 26 and 26' adapted to engage locking lugs 27 and 27' carried by the arms 10 and 10', respectively. Springs 28 and 28' normally retain the respective hooks 26 and 26' out of engagement with their locking lugs 27 and 27'. However, upon engagement of a thread with the crank 25 or 25', the hook on the other end of the crank engages its locking lug and prevents the arm 10 or 10' from returning to its original position after the selector needle 12 or 12' has delivered a thread into the thread hook 20 or 20'.

Accordingly, as long as a thread rests in the respective thread hook the crank remains actuated and the arm 10 or 10' will therefore remain locked so that a selector needle will not be moved back far enough in its path to select a second thread from the layer of warp threads

before the first thread has been removed from the thread hook by the subsequent tying and cutting operations. It will readily be appreciated that each of the selector needles 12 and 12' will be individually locked after each has selected the edge thread from its layer of warp threads.

By the operation of the above-described elements a pair of threads U and L have been selected from the edge of the parallel layers of warp threads and moved toward one another to be held in the notches 22 and 22' of the thread hooks 20 and 20'. These two isolated threads U and L next must be transferred to the tying mechanism, the threads cut off from their attachment to one side of the frames 5 and 6 and then tied to complete the operation of the machine.

Carriage 1 is provided with a horizontal front frame 35 which is connected at one side of the machine to the carriage and moves forward between the two layers of warp threads when the machine is operating in joining the parallel layers of threads. The frame 35 is provided, at one side of the machine, with bearings 36 and 37 which slidably receive a rod 38 connected to a carriage member 39 adapted to reciprocate relative to the frame 35 guided by a guide pin 40 mounted in the frame 35.

The carriage member 39 carries a rearwardly directed knife 41 which cooperates with a stationary knife 42 secured to the carriage 1. On the rearward reciprocation of the carriage member 39, the knife 41 severs the selected threads U and L positioned in notches 22 and 22' of the thread hooks 20 and 20'. The carriage member 39 further carries a transfer mechanism which effects transfer of the isolated threads U and L from the thread hooks 20 and 20' to a holding means which cooperates with the knot tying mechanism to be described hereinafter.

A pair of movable transfer tongs 45 and 46 are pivotally mounted on a stud 47 carried by the carriage member 39. The forward end of each of the tongs 45 and 46 is beveled so that upon movement of the carriage member 39 toward the isolated threads U and L, these tongs will collect the two threads for transfer to the tying mechanism. The opposite end of each tong has a guide pin 48 which engages a groove or slot 49 formed in a guide plate 50 carried by the front frame 35.

A third transfer tong 55 is provided intermediate the movable tongs 45 and 46 and is rigidly mounted on the stud 47 with its pointed end directed so as to move between the threads U and L upon the rearward reciprocation of the carriage member 39. By reason of the formation of the grooves or slots 49 as the carriage member reciprocates toward the threads U and L, the movable tongs 45 and 46 will move toward one another and pick up the two threads U and L which are being held by the thread hooks 20 and 20'. The pointed end of the intermediate tong 55 will move between the two threads U and L and prevent the beveled ends of the tongs 45 and 46 from moving the two threads together. Thus the transfer mechanism maintains the threads U and L separated in transferring such threads to the tying device.

On forward movement of the carriage member 39, the transfer tongs 45, 46, and 55 pick up the parallel threads U and L and the knives 41 and 42 move together to sever the threads from their connection with one side of the frames 5 and 6. The threads are then conveyed toward the tying mechanism and delivered into spaced jaws 60 in a stationary holding tong 61. As the threads are moved into the jaws 60 a movable holding tong 62 pivoted to the carriage 1 closes against the tong 61 to firmly grip the two threads and pull them from the transfer tongs 45, 46, and 55, which latter tongs then move forward in the direction of the operating motion of the machine while opening due to the cooperation of the guide pins 48 with slots 49 in readiness for the following transfer action.

The movable tong 62 is actuated by a lever 63 which may be operated by a suitable cam to effect closing of the tong 62 against the stationary tong 61 at the proper time to retain the threads U and L in the spaced jaws 60. It will be readily appreciated that the pivot point of the tong 62 is situated sufficiently behind the tong 61 so that while opening it will sink far enough relative to the jaws 60 of the stationary holding tong that the pair of threads carried along by the transfer tongs 45, 46 and 55 can be moved horizontally toward the stationary tong 61 and be caught by the movable tong 62 when the latter closes.

As described hereinbefore, the carriage member 39 is connected to the rod 38 journaled in bearings 36 and 37 and guided by pin 40. To effect reciprocation of the carriage member 39, a sleeve 65 is secured to the rod so as to move therewith. A second sleeve 66 is slidably mounted on the rod 38 and is caused to reciprocate relative thereto by a connecting rod 67 connected to a suitable crank (not shown), which crank will be continuously actuated during the operation of the machine.

A spring actuated pawl 68 is pivotally mounted on the frame 35 so as to lockingly engage a hook 69 secured to the sleeve 65 mounted on the rod 38. A snatch hook 71 is pivotally mounted on the sliding sleeve 66 so as to be engageable with a second fixed hook 72 on the sleeve 65. A spring 73 normally urges the snatch hook 71 to a position where, upon full forward movement of the sleeve 66, such snatch hook will engage the fixed hook 72 on the sleeve 65. Engagement of hooks 71 and 72 effects an interconnection between the sleeves 65 and 66 so that reciprocation of the sleeve 66 will cause the carriage member 39 to reciprocate, thus transferring and severing the selected threads U and L from the thread hooks 20 and 20' to the spaced jaws 60.

Since the transferring mechanism including tongs 45, 46 and 55 must not move to transfer the threads U and L until two such threads have been properly positioned in the thread hooks 20 and 20', means is provided for preventing interconnection of the sleeves 65 and 66 unless there are two threads properly positioned in the thread hooks 20 and 20'. This means consists of a bar 75 pivoted with the spring actuated pawl 68, with the outer end thereof movable into a space between the heels 76 and 76' on the bell cranks 25 and 25' respectively.

When the bell cranks 25 and 25' are actuated by the presence of a thread being moved into the notch 22 and 22' of the thread hooks, the heels 76 and 76' of such crank arm will be sufficiently spaced to permit the outer end of the bar 75 to move therebetween. The snatch hook 71 is provided with a pin 77 which, upon forward movement of the sleeve 66, engages the bar 75 causing such bar to move between the heels 76 and 76' and at the same time unlatching the spring actuated pawl 68 from hook 69. Continued movement of the sleeve 66 in the same direction will effect latching of the hooks 71 and 72 and, upon return movement, the carriage 39 will be reciprocated along with the sleeve 66.

On the other hand, in the event that the thread hooks 20 and/or 20' do not contain a thread therein, the crank arms 25 and/or 25' will not be actuated to permit the free end of bar 75 to move between the heels 76 and 76'. In this situation, the pin 77 will not be able to force the bar 75 to unlatch the pawl 68 and hook 69, but instead the spring 73 will yield on forward movement of sleeve 66 so that the snatch hook 71 will be pivoted so as to not be engageable with the hook 72. Thus, although the sleeve 66 is continually reciprocated it will not become connected with the sleeve 65 to cause reciprocation of carriage member 39 unless two threads, for example U and L, are properly positioned within the thread hooks 20 and 20'.

As described hereinbefore, the transfer tongs 45, 46 and 55 deliver the threads U and L from the thread hooks 20 and 20' into the spaced jaws 60 where they are firmly held by the tong 62 moving into engagement therewith. During this delivery operation, the threads have been severed by the knives 41 and 42 so that such threads are now properly positioned for the tying operation.

A tying head 80 is secured to a shaft 81 journaled in

the carriage 1 and suitably driven to rotate in the direction of arrow 85 in timed relation to the movements of the other mechanisms of the tying machine. The tying head has an integral radially elongated beak 82 extending from the outer end thereof and a parallel short beak 83 which is connected to a rod concentrically mounted within the shaft 81 so as to be axially movable therewithin and thus effect movement of the short beak 83 relative to the outer beak 82 in a plane common to the beaks. The short beak 83 extends outwardly through a slot 84 extending radially from the center of the head 80.

Axial movement of the rod which carries the short beak 83 may be effected to cause opening and closing of the beaks 82 and 83 timed with the rotation of the shaft 81 to grip a thread therebetween in tying the knot, as will be described hereinafter. The actuation of the rod enclosed within the shaft 81 to operate the short beak 83 must be effected to open and close the beak twice in rather quick succession during two complete revolutions of the tying head 80.

As the tying machine moves forward toward the parallel layers of warp threads in successively tying each of the outermost edge pair of threads, the front frame 35 is moved between the parallel layers of warp threads. A thread guiding rod 88 is secured to the front frame 35 so as to move between the threads U and L and the upper and lower layers of warp threads to be tied. This thread guiding rod has a cord 89 connected to the upper end thereof which, as shown in Figure 2, extends rearwardly across the machine and is maintained properly tensioned by a weight 90. This cord serves, as the machine moves across the tying table, to support the tied threads in the manner shown in Figure 2.

To remove the threads from the tying head 80 subsequent to the formation of each knot, a lifting lever 91 is pivotally mounted on the carriage 1 and actuated so as to lift the threads U and L from the tying head upwardly along the thread guiding rod 88 and thus on to the cord 89 where they are supported.

The operation of the tying head 80 in conjunction with the holding tongs 61 and 62 which retain the threads U and L in the spaced jaws 60 and lifting lever 91 which removes the formed knot from the tying head 80 is as follows:

The two threads U and L are inserted into the jaws 60 and held between the cooperating tongs 61 and 62 so as to occupy a substantially horizontal position obliquely above the tying head 80. During the rotation of the tying head 80 in the direction of arrow 85, the outer beak 82 and short beak 83 are maintained closed and thus move upwardly past the tongs 61 and 62, then in front of the pair of threads U and L, and finally, after a half revolution and owing to the above-mentioned oblique position of the threads, the beaks dive down behind the threads. During the course of one revolution of the tying head 80 a loop will thereby be formed around the root of the beak. Towards the end of this first revolution the beaks 82 and 83 will be caused to open in such a manner that the thread L enters the space therebetween while extending across the loop formed by both threads. The cut ends of the threads are still gripped in the jaws 60 and at the next moment the beaks close firmly together about the thread L, leaving the thread U free from the grip of the two beaks due to the restricted gripping surface of the short beak 83 against beak 82 and spacing between threads U and L at the point of beak opening. Upon continued rotation of the tying head the threads are pulled from the jaws 60 between the tongs 61 and 62, which tongs soon thereafter open themselves in readiness to receive the next pair of threads from the transfer tongs 45, 46 and 55.

The tying head continues its rotation while holding the end of thread L. In the meantime the pair of threads, with one thread on either side of the thread guiding rod 88, are lifted higher and higher by the lifting lever 91, which causes the loop formed by both threads to slide off the tying head 80, whereby a knot is formed in thread L, since the end of this thread remains held by the beak and is pulled through the loop on removal thereof from the tying head. During the further action of the lifting lever 91 on the threads, and the continued rotation of the tying head, the knot will gradually be tightened more and more until the beaks finally move below the horizontal position and the beaks open, releasing the end of the thread L. The lifting lever 91 now moves the tied threads further upward and delivers them with the knot astride the suspension cord 89 and subsequently lowers itself in readiness for a similar operation on the succeeding knot. Immediately after having released the end of the thread L, the beaks 82 and 83 close again so that they are closed when the tying head again passes the tongs 61 and 62 in which a new pair of threads will ordinarily already have been received.

In the tying operation of the apparatus of this invention, the two selected threads U and L from the edge of the parallel layers of warp threads are continuously maintained apart from one another. Thus, in the final tying performed by the tying head 80, the threads are maintained separated by the holding tongs 61 and 62 due to the spacing between the jaws 60. The beaks 82 and 83 upon rotation of the tying head 80 close only upon the end of the lower thread L so that although a loop is formed by both of the threads, only the end of thread L will be drawn through the loop when such loop is drawn off of the tying head 80. Accordingly the loop in thread L will be formed into a knot such as illustrated in Figure 4 while the loop formed in thread U will uncurl, leaving such thread extending through the loop of the knot in thread L. Since the end of thread U is not grasped between the beaks 82 and 83 such end will not be pulled through the loop and no knot will be formed in such thread.

After all of the warp threads have been cut and tied by the machine in the manner hereinbefore described, the knot formed in the thread L will serve as a needle eye in pulling the thread U through the weave of the cloth adjacent the fringe unwoven warp threads. Figure 5 presents a diagrammatic illustration of the two ends of a woven cloth set in abutting relation along a joint line 100, with the unwoven fringe warp threads from each end tied in the manner disclosed above. Inwardly of the end of the cloth from the junction line 100 the threads L will be drawn to pull the threads U into the weave of the cloth such as has been done with the first thread shown in Figure 5. The remaining threads L will be similarly used to pull the threads U for varying distances into the edge of the cloth so that the final joined product will be characterized by having the warp threads U interwoven into the opposite end of the cloth in place of the original warp threads L to produce an interweaving to effect a strong smooth joining of the two cloth ends.

It will be readily appreciated that the threads U cannot all be drawn into the cloth in place of the threads L for the same distance, since such a practice would merely produce an opening in the cloth at that particular distance. Thus there must be a variance in the distance in which the various threads U are drawn into the adjacent end of the cloth. After the threads have been drawn through the weave of the cloth in the manner described, the knotted ends of the threads will slide off the end of the respective threads U, and having served their purpose, the free exposed ends of both threads may be trimmed off so as to remove any exposed threads, leaving a smooth seamless joint for the cloth ends.

Since the threads from one end of the cloth must be drawn into the weave of the other end of the cloth in forming the joint and the thread ends must be staggered as to their relative terminal point within the cloth to

form an effective joint between the ends, it is desirable that means be provided to effectively draw the various threads as a single operation. Since the tying machine has completely tied all of the pairs of warp thread ends it is possible to simultaneously draw the threads into the end of the cloth weave as a single operation rather than to successively draw such threads as each is tied by hand as is the present practice. To enable such a single drawing operation, the cloth which is to be joined may be appropriately prepared prior to tying the fringe ends of the warp threads with the above-described tying machine.

In weaving the cloth on a loom, toward the end of the appropriate length of cloth, one of the loom harnesses is raised with all of the other harnesses remaining down and an extremely strong identifying thread as, for example, a double nylon thread, run through as the filling for the cloth. The loom is then returned to its normal operation for the weaving of two or three inches more of cloth following which a different harness is raised and again an identifying thread such as a double nylon thread run through across the cloth.

Such a weaving practice will be repeated over a sufficient length of the cloth so that each of the harnesses will have been raised once with all of the others at that moment remaining down and a strong identifying thread inserted as the filling for the cloth. It will readily be appreciated that the identifying threads inserted every two or three inches will serve to identify the warp threads carried by the particular loom harness which was up when the thread was inserted, since the warp threads for that harness will be above the particular identifying thread. It is the purpose to utilize these identifying threads after the tying operation by the tying machine to quickly draw all of the warp threads for one particular harness from the cloth and thus as described hereinbefore draw into the weave of the cloth the threads from the opposite cloth end.

In view of the force necessary to draw simultaneously all of the warp threads as were carried by one harness of the loom, it may be necessary to utilize the identifying thread which was inserted as the filling as a means to draw in a metal wire or similar rigid slender member in place of the nylon thread. Thus after the tying operation this wire may be lifted to pull away say every sixth thread through the cloth, assuming that every sixth thread in the weaving web was carried by the same harness. Further, due to the high frictional resistance to pulling threads through a long length of cloth, it may be necessary to perform the drawing operation by use of identifying threads or wires in two or more steps. Thus such an identifying thread would be inserted across the weave as a filling at, say, distances of six and twelve inches removed from the end of the cloth. Then the first identifying thread, six inches from the cloth end, could be used to pull the threads through the weave to that point, and the second identifying thread, at twelve inches, used to pull the threads into the weave for the remaining distance, leaving the threads interwoven for twelve inches within the cloth end.

Having thus described my invention, what I claim is:

1. In a device for joining cloth ends, a carriage movable progressively past the overlying ends of the warp threads in the cloth ends to be joined as each pair of respective warp threads are tied, thread selector means mounted on said carriage for selecting a thread from each of the layers of warp threads in the cloth ends, transfer tongs for collecting the successive pairs of selected threads and delivering such selected pairs of threads in spaced relation to a tying mechanism, said tying mechanism comprising holding tongs and a rotatably mounted tying head, said holding tongs having spaced thread jaws for receiving the selected threads from said transfer tongs and retaining said selected threads spaced to extend obliquely across said tying head, said tying head having at its outer end a radially elongated beak and a short beak parallel to said elongated beak, said short beak being mounted for movement relative to said elongated beak in a plane common to the two beaks whereby a thread may be gripped between said elongated beak and said short beak upon closing of the two beaks, said tying head being rotatable and said beaks being movable relative to one another timed so that said beaks are closed during one revolution of said tying head in forming a loop in said selected threads around said tying head and are opened and closed subsequent to said loop formation to grip one of said selected threads, and means for drawing said loop off of said tying head while said one thread remains gripped by said beaks to thereby form an overhand knot in said one thread around the other of said selected threads.

2. In a device for joining cloth ends, a carriage movable progressively across the overlying ends of the cloth to be joined in step-by-step motion, a pair of selector needles reciprocable on said carriage in a direction normal to the plane of the cloth ends and having thread engaging end portions, means for reciprocating said needles toward the edge thread of the overlying ends of cloth to respectively select a thread from each cloth end for joining, holding tongs, transfer tongs reciprocable parallel to the plane of the cloth ends for moving the two selected threads in spaced relation to said holding tongs, a rotatable tying head having a fixed elongated outer beak and a short inner beak, said short beak being parallel to said outer beak and movable relative thereto, said tying head rotating adjacent said holding tongs to loop the selected threads around the root of said head, said beaks opening and closing after formation of the loop to grasp one of the selected threads across said loop, and means for drawing said loop off of said tying head while said one selected thread remains grasped by said beaks whereby said one thread forms an overhead knot around the other thread.

3. In a device for joining cloth ends as recited in claim 2, wherein said transfer tongs comprise a pair of pivotally mounted members movable toward one another upon reciprocation of said tongs in moving the selected threads to said holding tongs, and a stationary intermediate member positioned between the pivoted members for maintaining said selected threads in spaced separated relation during transfer to said holding tongs.

4. In a device for joining cloth ends as recited in claim 3 wherein said holding tongs comprise a fixed tong having spaced thread receiving jaws and a movable tong actuatable to retain the selected threads in said spaced jaws as delivered thereto by said transfer tongs.

5. In a device for joining cloth ends, a carriage movable progressively across the overlying ends of the cloth to be joined in step-by-step motion, a pair of selector needles reciprocable on said carriage in a direction normal to the plane of the cloth ends and having thread engaging end portions, said needles being reciprocable toward the edge thread of the overlying ends of cloth to respectively select a thread from each cloth end for joining, thread hooks adjacent said selector needles forming temporary rests for each of the threads selected by said needles out of the reciprocating path of said needles, holding tongs, transfer tongs reciprocable parallel to the plane of the cloth ends for moving the two selected threads from said thread hooks in spaced relation to said holding tongs, a rotatable tying head having a fixed elongated outer beak and a short inner beak, said short beak being parallel to said outer beak and movable relative thereto, said tying head rotating adjacent said holding tongs to loop the selected threads around the root of said head, said beaks opening and closing after formation of the loop to grasp one of the selected threads across said loop, and means for drawing said loop off of said tying head while said one selected thread remains grasped by said beaks whereby

said one thread forms an overhand knot around the other thread.

6. In a device for joining cloth ends, a frame for retaining the end unwoven warp threads of each end of the cloth to be joined in parallel overlying layers, a carriage movable progressively past the overlying ends of the warp threads in said frame as each successive pair of warp threads is tied, thread selector means mounted on said carriage for selecting the edge thread from each of said parallel layers, transfer tongs for collecting the two selected threads and delivering said selected threads in spaced relation to a tying mechanism, thread cutting means operable with said transfer tongs for severing the selected threads from their connection with one side of said frame, said tying mechanism comprising holding tongs and a rotatably mounted tying head, said holding tongs having spaced thread jaws for receiving the severed ends of said selected threads from said transfer tongs and retaining said selected threads separated to extend obliquely across said tying head, said tying head having a radially elongated beak at its outer end and a short beak parallel to said elongated beak, said short beak being mounted for movement relative to said elongated beak in a plane common to the two beaks whereby a thread may be gripped between said beaks, said tying head being

rotatable and said beaks being movable relative to one another timed so that the said beaks are closed during one revolution of said tying head in forming a loop in said selected threads around said tying head and are opened and closed subsequent to said loop formation to grip one of said selected threads, and means for drawing said loop off of said tying head while said one thread remains gripped by said beaks to thereby form an overhand knot in said one thread around the other of said selected threads.

7. In a device for joining cloth ends as recited in claim 6 wherein a pair of thread hooks are mounted adjacent said thread selector means whereby said selector means move the selected threads into temporary engagement with said thread hooks and said transfer tongs collect the two selected threads from said thread hooks.

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