APPARATUS AND METHOD OF SEWING NON-RAVELING SEAMS IN ARTICLES

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ABSTRACT OF THE DISCLOSURE

Apparatus for sewing non-raveling back-tack seams in articles, such as diapers, including at least one sewing machine having stitch forming means and reversible feed means, sensing means disposed in the path of articles presented to the sewing machine for sensing an edge of the article so presented and control means for reversing said feed means in timed relation to actuation of the sensing means to reverse the direction of feed of the article being sewn for a predetermined time interval to form reverse stitching in the article adjacent the edge thereof sensed by said sensing means.

The present invention relates to an apparatus for and a method of sewing articles and more particularly to the formation of non-raveling, backtacked seams in various articles, including prefold diapers. In the formation of many articles, a piece of sheet material is folded into a desired size and shape and the folded material is then stitched to maintain the same in folded condition. In the case of prefold diapers, the sheet material is in the form of textile fabric which is folded into a shape and size adapted to fit an infant without additional folding, and a pair of spaced apart, parallel lines of stitching extend longitudinally thereof between opposite ends to secure the fabric in the folded condition and assure that the diaper is maintained in a condition ready for use upon an infant.

The stitching in such sewn articles is subject to raveling and this is particularly true with those articles which are subjected to frequent and repeated launderings, such as is the case with diapers and many other types of garments. This raveling most frequently occurs at the end portion of the stitching corresponding to the edge of the article where independent fabric layers are secured together by the stitching.

Various attempts have been made to overcome this raveling problem and to reinforce the terminal end portions of the stitching. The most commonly used and most successful of these attempts is a procedure commonly referred to as “backtacking” wherein a relatively short line of reverse stitching is formed along and parallel to the regular line of stitching at the terminal end portion of the stitching wherein a raveling problem may arise.

Classically, this backtacking has been accomplished by the operator causing a sewing machine to sew a line of stitching to a point immediately adjacent an edge of the article and then turning the article around and causing the machine to sew a short distance back along and parallel to the line of stitching previously formed. Obviously, this is a time consuming and laborious procedure and adds considerably to the cost of producing these sewn articles particularly with prefold diapers since this procedure must be performed twice for each diaper.

With the more recent advent of sewing machines with reversible feed means, this backtacking procedure has been simplified to some extent and can be performed with such machines by manually reversing the feed means of the machine at the appropriate time and causing the machine to sew in a reverse direction without the necessity of turning the material. However, even with these machines, this backtacking procedure has heretofore still required a highly-skilled operator and the operator must give constant attention to the sewing operation. Even with a highly-skilled operator, the stitching in successive articles is very non-uniform since it is very difficult, if not impossible, to manually reverse the feed means at a common point on successive articles and to achieve a uniform length of reverse stitching therein.

It is, therefore, an object of the present invention to provide a novel apparatus for and method of sewing non-raveling, backtacked seams in successive articles wherein the seams include reverse lines of stitching adjacent edges of the articles, which lines of reverse stitching may be formed by an unskilled operator and are uniform in length and location in successive articles.

A more specific object of the present invention is to provide an apparatus of the character described wherein, once an article is presented thereto for stitching, the entire stitching operation thereupon will be performed without further acts or attention by the operator.

A further more specific object of the present invention is to provide a novel method of the character described wherein the articles are successively fed in a predetermined path of travel one at a time, a first line of stitching is formed in each successive article extending from the leading edge thereof for a first predetermined common extent, the direction of feed of the article is changed and a reverse second line of stitching is formed in the article along and parallel to the first line of stitching for a second predetermined common extent, and then the direction of feed of the article is changed back to the original direction and a third line of stitching is formed in the article for the remainder thereof.

A still more specific object of the present invention is to provide a novel apparatus for and method of sewing non-raveling, backtacked seams in successive prefold diapers wherein two spaced apart, parallel lines of stitching are formed in each diaper simultaneously and wherein relatively short reverse lines of stitching or backtacking are formed in each line of stitching adjacent an edge of each diaper.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a plan view of an apparatus incorporating the features of the present invention;

FIGURE 2 is a front elevational view of the apparatus shown in FIGURE 1;

FIGURE 3 is a fragmentary elevational view of a portion of the apparatus shown in FIGURE 2 looking in the direction of the arrow 3 in FIGURE 2;

FIGURE 4 is a view similar to FIGURE 3 looking in the direction of the arrow 4 in FIGURE 2;

FIGURE 5 is a fragmentary, partially schematic perspective view illustrating the sewing operation performed by the apparatus shown in FIGURE 1 and illustrating the method of the present invention;

FIGURE 6 is an enlarged fragmentary, perspective view of a portion of a diaper including a terminal end portion of the stitching formed by the apparatus and in accordance with the method of the present invention; and

FIGURE 7 is a schematic diagram of the electrical circuit and components of the apparatus shown in FIGURES 1 and 2.

Referring now to the drawings and more particularly to FIGURES 1 and 2, there is shown therein an apparatus, broadly indicated at 10, which incorporates the features of the present invention. This apparatus includes a frame, broadly designated at 11, which may be
of any character but which is illustrated as having suitable vertical supports 12 and a horizontal table top or work support 13.

First and second sewing machines 14, 15 are mounted on table top 13 in spaced apart, head-to-head relationship. Sewing machine 14, 15 are conventional in construction and are substantially identical except that sewing machine 15 is reversed from its normal arrangement and has minor modifications therein to adapt the same for the head-to-head arrangement with the sewing machine 15 for operation in this arrangement. These machines include base portions 16, 17, with base portion 16 being slidably mounted on table top 13 for adjustment toward and away from the base portion 17 to vary the spacing between the lines of stitching to be formed by sewing machines 14, 15. A threaded shaft 18 is threadably journaled on one vertical support 12 and is connected to base portion 16 for adjusting sewing machine 14 relative to sewing machine 15.

These sewing machines also include standard portions 20, 21 and overlapping arm portions 22, 23 fixedly carried by the standard portions 20, 21 respectively, and extending in an overlapping spaced relation to base portions 16, 17 and terminating at their outer free ends in head portions 24, 25. The head portions 24, 25 include vertically reciprocable needle bars 26, 27 which carry needles 28, 29 at their lower ends for cooperation with looper or balloon mechanisms (not shown) in the base portions 16, 17 of the sewing machines. The mechanisms define stitch forming means for forming spaced apart parallel lines of stitching 32, 33 (FIGURE 5) in successive articles 34, 35 presented thereto.

Head portions 24, 25 also include presser foot means 36, 37 (FIGURES 3 and 4) which include vertically reciprocable presser bars 40, 41 mounted in the head portions 24, 25 respectively, and presser feet 42, 43 carried by the respective lower ends of the presser bars 40, 41. In sewing machine 15, an adaptor 44 in the form of an elongate bar is provided and has one end thereof mounted on the lower end of presser bar 41 and presser foot 43 mounted on the other end thereof and facing in the same direction as presser foot 42 of sewing machine 14. Adaptor 44 has an opening 45 therein through which needle bar 27 and needle 31 extend and within which they reciprocate. Presser bars 40, 41 are downwardly biased in conventional manner by suitable springs (not shown) and presser foot means 36, 37 include means for raising presser bars 40, 41 to move the presser feet 42, 43 to inoperative position. These presser foot raising means include solenoids 46, 47, the plungers of which are connected by chains 50, 51 to rods 52, 53. Rods 52, 53 extend upwardly through standards 28, 29 and are connected by crank mechanisms or the like (not shown) to presser bars 40, 41 to raise the same upon energization of solenoids 46, 47.

When in operative position, presser feet 42, 43 cooperate with feed dogs 54, 55 respectively, (FIGURES 3 and 4) which are operated in conventional manner by rocker arms 56, 57 and eccentrics 60, 61 to feed articles past the stitch forming means for the formation of lines of stitching 32, 33 therein. Rocker arms 56, 57 are fixedly mounted on shafts 62, 63, respectively, and eccentrics 60, 61 are fixedly mounted on shafts 64, 65. Shafts 62, 64 and 63, 65 are respectively connected to conventional reversible drive means 66, 67 (FIGURE 7) which include operating levers 70, 71 for changing the direction in which the drive means drives the shafts and, therefore, changing the direction in which the feed dogs 54, 55 drive the successive articles to the stitch forming means. Therefore, reversible feed means is provided in each of the sewing machines 14, 15 as is conventional with this type of sewing machine.

In accordance with this invention, solenoids 72, 73 (FIGURES 2 and 7) are provided and have the plungers thereof respectively connected to operating levers 70, 71 for operating these levers upon energization of the solenoids. With sewing machine 14 which is in its normal position, lever 70 normally occupies and is biased toward a raised position and, in this position, the reversible drive means 66 drives feed dog 54 in a direction to feed the articles in a forward direction past the stitch forming means, as indicated in FIGURE 3, past the stitch forming means. Solenoid 72 is connected to lever 70 by a chain 74 and when energized will pull downwardly thereon to reverse the direction of feed of the feed dog 54.

Due to the reversed arrangement of the sewing machine 15, lever 71 normally occupies a biased lowered position and, in this position, reversible drive means 67 drives feed dog 55 in a direction to feed the articles in a forward direction past the stitch forming means, as indicated by the arrow in FIGURE 4. Solenoid 73 is connected to lever 71 by a rod 75 and when energized will push upwardly on lever 71 to move the same to a raised position and reverse the direction of feed of the feed dog 55.

Needle bars 40, 41 and reversible drive means 66, 67 are driven in conventional manner from main drive shafts 76, 77, respectively, by driving means 80, 81. The drive shafts 76, 77 have pulleys 80, 81 drivingly mounted thereon which have one end of drive belts 82, 83 respectively trained thereabout. It is noted that belt 83 is crossed to drive pulley 81 in the appropriate direction since sewing machine 15 is reversed from its normal arrangement. The other ends of belts 82, 83 are carried by pulleys 84, 85 mounted on a shaft 86. Shaft 86 is journaled for rotation in the vertical supports 12 and has a pulley 87 drivingly mounted thereon. A belt 90 is carried at one end by pulley 87 and at its other end by a pulley 91. Pulley 91 is carried by one end of a shaft 92, the other end of which is connected to a variable speed transmission 93 which in turn is connected to the output shaft 94 of a drive motor 95.

Variable speed transmission 93 has an operating lever 96 connected thereto and pivotally mounted on the housing of motor 95 for controlling the output speed thereof. Lever 96 is biased by a spring 97 to an inoperative position corresponding to the neutral or zero output speed position of the transmission 93 and has the plunger of a solenoid 98 connected thereon by a chain 99 for movement thereof and shifting of transmission 93 to its variable speed position.

A light source 100 is mounted on a bracket 101 which in turn is mounted by a bar 102 on table top 13 to position the light source 100 between head portions 24, 25 of sewing machines 14, 15 substantially in transverse alignment with needle bars 26, 27 and in vertically spaced relationship to the table top 13. The light beam from light source 100 is directed downwardly and table top 13 has an opening 103 therein immediately underlying the light source 100 and through which the light beam normally shines. A photoelectric cell 104 is mounted on the underside of table top 13 in vertical alignment with the light source 100 for normally receiving the light beam therefrom. Photoelectric cell 104 is of the type which generates electrical impulses in response to changes in the intensity or interruption of the light beam received thereby from the light source. Therefore, when an article, such as a prefold diaper, is presented to sewing machine 15 for stitching, the leading edge thereof will break the light beam between the light source 100 and the photoelectric cell 104 which will cause the photoelectric cell 104 to generate an electrical impulse.

The electrical circuit for apparatus 10 will now be described and includes a main circuit from an electrical source (not shown) to motor 95. In the drawings, this main circuit is illustrated (FIGURE 7) as a three-phase circuit defined by two power lines 105, 106 and a ground line 107 and includes a main or master switch 110. An electrical amplifier 111, which is of the type and conventional type, such as a triode amplifier tube and associated components, is provided and has the plate circuit
thereof connected by lines 112, 113 to main circuit lines 105, 107, respectively. A normally closed, manually operable switch 114 is connected by lines 115, 116 in the plate circuit of amplifier 111 for controlling the operation thereof and the operation of components connected thereto.

The grid circuit of amplifier 111 is connected by lines 120, 121 to photoelectric cell 104 for receipt and amplification of impulses therefrom. Upon receipt and amplification of such an impulse, photoelectric cell 111 closes first and second switches 122, 123. One side of switch 122 is connected by a line 124 to power line 105 and the other side thereof is connected by a line 125 to the power side of a relay device 126, illustrated in the drawing as a solenoid. The ground side of relay device 126 is connected by a line 127 to line 115 to complete a circuit through the relay.

Relay 126 controls a switch 130, one side of which is connected by a line 131 to line 124 through a normally closed, manually operable switch 132. The other side of relay controlled switch 130 is connected by a line 133 to the power side of a first foot lifting solenoid 47 and a line 134 connects line 133 to the power side of a second foot lifting solenoid 46. The ground side of solenoid 46 is connected by a line 135 to the ground side of lever operating solenoid 72 and the ground side of solenoid 47 is connected by a line 136 to the ground side of lever operating solenoid 73.

The ground sides of solenoids 72 and 73 are connected together by a line 137 and this line is connected by a line 140 to the ground side of transmission lever solenoid 98, which ground side is also connected by a line 141 to ground line 107 to complete the circuit to a presser foot lifting solenoids 46, 47. It is noted that when switches 130 and 132 are normally closed, solenoids 46 and 47 are normally energized and the presser feet 42, 43 are normally raised, but upon closure of switch 122, relay 126 is energized which opens switch 130 and deenergizes solenoids 46, 47 and permits presser feet 42, 43 to lower to operative, clamping position.

The other switch 123 controlled by amplifier 111 has one side thereof connected by a line 142 to power line 105 and a line 143 is connected at one end to the other side of switch 123 and at its other end to one side of a safety switch 144 which is normally closed, but manually operable to an open position. Safety switch 144 has the opposite side thereof connected by a line 145 to one side of a normally open switch 146 forming a part of a first timing means 147. The other side of switch 146 is connected by a line 150 to the power side of lever operating solenoid 72 and a line 151 connects line 159 and this power side of solenoid 72 to the corresponding power side of lever operating solenoid 73 to complete a circuit through these feed reversing solenoids and first timing means 147.

First timing means 147 also includes a relay 152, such as a solenoid which has the plunger thereof connected to switch 146 for moving the switch to closed position when energized and is also connected to a time delay means 153 which may be in the form of a dash pot or the like. The power side of relay 152 is connected by a line 154 to one side of a normally closed switch 155 of a second timing means 156. The opposite side of switch 155 is connected by a line 157 to the line 143.

Second timing means 156 includes a relay 160, such as a solenoid, which has the plunger 161 thereof connected to switch 155 and also connected to a time delay means 162 which also may be in the form of a dash pot or the like. Plunger 161 is also connected to a second switch 163 which is of the double acting type and has first contacts 164a, 164b and 165a, 165b. One of the contacts 164a, 164b of each of the sets is connected together by a line 166. Line 166 is connected by a line 167 to the power side of transmission lever operating solenoid 98.

The other contact 164a is connected by a line 170 to the output side of a powerstat 171, which may be in the form of an autotransformer. One contact of the input side of powerstat 171 is connected by a line 172 to line 125 through a suitable fuse 173 and the other input contact thereof is connected by line 174 to a line 175. Line 175 is connected to line 127 at relay 126 and to the ground side of relay 160 of second timing means 156. A line 176 connects the ground sides of relays 152 and 160 together.

The other contact 165b is connected by a line 177 to the line 143 and the power side of relay 160 is connected by a line 180 to line 143 for completing circuits to switch 163 and relay 160. Also, lines 181, 182 connect light source 100 to power and ground lines 106, 107 respectively, for normally energizing the same when master switch 110 is closed.

The operation of apparatus 10 and the method of the present invention will now be further described. In this connection, master switch 110 is closed, light source 100 is energized to shine a light beam downwardly, solenoids 46, 47 are energized to raise presser feet 42, 43 and motor 95 is supplied with power and is running. However, solenoid 98 is not energized and transmission 93 is therefore in neutral position and sewing machines 14, 15 are not being driven.

An article to be stitched is now presented to the sewing machines 14 and 15 and the leading edge thereof breaks the light beam between light source 100 and the photoelectric cell 104. In response thereto, photoelectric cell 104 generates an electrical impulse and this impulse is transmitted to amplifier 111 which operates to close switches 122, 123. Upon closure of switch 122, relay 126 is energized which opens switch 130 and deenergizes solenoids 46 and 47 which permits the presser feet 42, 43 to move downwardly into clamping relation to the article to be stitched and to clamp the same downwardly against the feed dog 54, 55.

Upon closure of switch 123, an energizing circuit will be completed to first and second timing means 147 and 156 and the relays 152 and 160 thereof. Relays 152, 160 attempt to move the switches of the timing means to their other positions, but are prevented from doing so by the time delay means 153, 162 for first and second predetermined time intervals. An energizing circuit is also completed to the transmission operating solenoid 98 through the powerstat 171 to cause solenoid 98 to move lever 97 and shift the transmission 93 to its slow speed position and cause the transmission 93 to drive sewing machines 14, 15 at a predetermined slow speed. The sewing machines 14, 15 operate at this slow speed to sew first lines of stitching of predetermined extent, such as stitching 33a (FIGURE 6).

After a first predetermined time interval, as for example sufficient for the first lines of stitching to have a predetermined extent of about one (1) inch and preferably of about five-eighths (5/8) inches in length, first timing means 147 will have timed out its cycle and time delay means 153 will permit relay 152 to move switch 146 to fully closed position. This completes an energizing circuit to solenoids 72 and 73 and causes the same to move the reversing levers 70 and 71 to a position reversing the reversible drive mechanisms 66 and 67 to reverse the direction of feed of the articles by feed dogs 54, 55 to form reverse second lines of stitching wherein a second predetermined extent, such as stitching 33b (FIGURE 6).

After a second predetermined time interval, as for example sufficient for the reverse second lines of stitching to extend back to a point adjacent but preferably not beyond the leading edge of the article, the second timing means 156 will have timed out its cycle and the time delay means 162 will permit the relay 160 to move switch 163 to open position. This will break the energizing circuit to relay 152 of first timing means 147 and reset the same and deenergize solenoids 72, 73. Reversing levers 70, 71 will therefore be permitted to move back to their
original positions and feed dogs 54, 55 will commence forward feeding the article again to form third lines of stitching, such as stitching 33c (FIGURE 6).

At the same time, switch 163 is moved to its other closed position with contacts 165 which bypasses powerstat 171 and completes a direct line energizing circuit from the main circuit to solenoid 98. Solenoid 98 will therefore be moved to fully energized position and will move transmission 93 to its full running speed position to drive the sewing machines 14, 15 at full running speed.

This forward direction of feed and full operating speed of sewing machines 14, 15 and the third lines of stitching being formed will continue until the trailing edge of the article being stitched moves out of vertical alignment with the light source 100 and permits a light beam to be re-established between the light source 100 and photoelectric cell 184. When this occurs, a signal will be given to amplifier 111 which will open the switches 122 and 123 and terminate operation of the apparatus 10. It is noted that upon termination thereof, the sewing machines 14, 15 will coast for a predetermined distance which will form tails of stitching beyond the trailing edge of the article being stitched, as shown in FIGURE 5.

It is preferred in the operation of the apparatus 10, and in accordance with the method of the present invention that the next successive article to be stitched be immediately presented to the apparatus 10 and the leading edge thereof will break the light beam and initiate another automatic sewing cycle. Under this arrangement, successive articles will be chained together by the chains or tails of stitching extending outwardly from the trailing edge of an article to the leading edge of the next successive article, as is also illustrated in FIGURE 5.

It is therefore believed apparent that the present invention provides for the formation of non-raveling, backtacked seams in successive articles more simply and economically and with a considerably higher degree of uniformity than has been heretofore possible.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

What is claimed is:

1. Apparatus for sewing non-raveling, backtacked seams in articles, such as diapers, comprising:
   (a) a sewing machine including stitch forming means for forming a line of stitching in an article presented thereto, and reversible feed means operatively associated with said stitch forming means for feeding articles to said stitch forming means to form said stitching,
   (b) sensing means operatively associated with said sewing machine and disposed in the path of articles presented to said sewing machine for sensing an edge of the article and being actuated thereby, and
   (c) control means connected to said feed means and responsive to said sensing means for reversing said feed means in timed relation to actuation of said sensing means to reverse the direction of the feed of the article being stitched for a predetermined time interval to form reverse stitching in the article adjacent the edge thereof sensed by said sensing means to prevent raveling of the stitching.

2. Apparatus according to claim 1 wherein first and second sewing machines are oppositely arranged in head-to-head, spaced apart relation and are connected to and controlled by said control means for forming spaced apart lines of stitching in the articles presented thereto.

3. Apparatus according to claim 2 wherein said sewing machines each includes presser foot means movable into and out of operative association with said feed means for cooperation with said feed means and said stitch forming means in the stitching of articles, and wherein said control means is connected to and controls the movement of said presser foot means in response to actuation of said sensing means.

4. Apparatus according to claim 2 wherein said sensing means is arranged between and in substantially transverse alignment with said stitch forming means of said sewing machines and is adapted to be actuated by the leading edge of an article presented to said sewing machine.

5. Apparatus according to claim 4 wherein said sensing means comprises a light source and a photoelectric cell disposed in spaced apart, superposed relation and adapted to have articles presented to said sensing means pass therebetween.

6. Apparatus according to claim 2 wherein said control means includes: timing means actuated by said sensing means and operable after said predetermined time interval for changing said feed means to its normal direction of feed.

7. Apparatus according to claim 2 including multi-speed drive means connected to said sewing machines for driving said stitch forming means and said feed means at variable speeds, and wherein said control means is connected to said drive means for varying the speed at which the same drives said stitch forming means and said feed means.

8. Apparatus according to claim 7 wherein said control means initiates operation of said drive means in response to actuation of said sensing means, and wherein said control means includes first timing means operable after a first predetermined time interval of operation of said drive means for reversing said feed means to reverse the direction of feed of the article being stitched, and second timing means operable after a second predetermined time interval of operation of said feed means for changing said feed means back to their normal direction of feed.

9. Apparatus according to claim 8 wherein said control means includes means for causing said drive means to drive said stitch forming and feed means at a determined slow speed during said first and second predetermined time intervals for the formation of the first and second lines of stitching at this slow speed and, in response to said second timing means changing said feed means back to their normal direction of feed, for causing said drive means to increase the speed at which the same drives said stitch forming and feed means to full operating speed.

10. A method of sewing non-raveling, backtacked seams in articles, such as diapers, comprising the steps of:
   (a) successively feeding the articles along a predetermined path of travel in a generally forward direction to and through a sewing station one at a time while
   (b) forming a first line of stitching extending from the leading edge of each successive article rearwardly thereof for a first predetermined common extent,
   (c) reversing the direction of the feed of the articles when the stitching has reached said predetermined extent and forming a reverse second line of stitching extending for a second predetermined common extent, and then
   (d) changing the direction of feed of the articles back to the forward direction and forming a third line of stitching for the remainder of the articles.

11. A method according to claim 10 wherein said spaced apart, parallel lines of stitching are formed in each successive article, and wherein the reversed direction of feed of the articles is continued until the second line of stitching is formed to a point adjacent the leading edge of each successive article.
12. A method according to claim 11 wherein the first and second lines of stitching are formed of a length of no more than about one (1) inch.

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