United States Patent [19]

Schmedding et al.

[11] **3,783,811**

[45] **Jan. 8, 1974**

[54] **SEWING MACHINE**

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[73] Assignee: **Bergenfield Development Co., Inc.,** Dumont, N.J.

[22] Filed: **Aug. 20, 1970**

[21] Appl. No.: **65,672**

Related U.S. Application Data

[62] Division of Ser. No. 720,632, April 11, 1968, Pat. No. 3,595,188.

[52] **U.S. Cl.** ..... **112/218 R,** 112/155, 112/219 R, 200/61.18

[51] **Int. Cl.** **B65h 59/26**

[58] **Field of Search** ..... 112/219 A, 219 R, 112/218 R; 200/61.18

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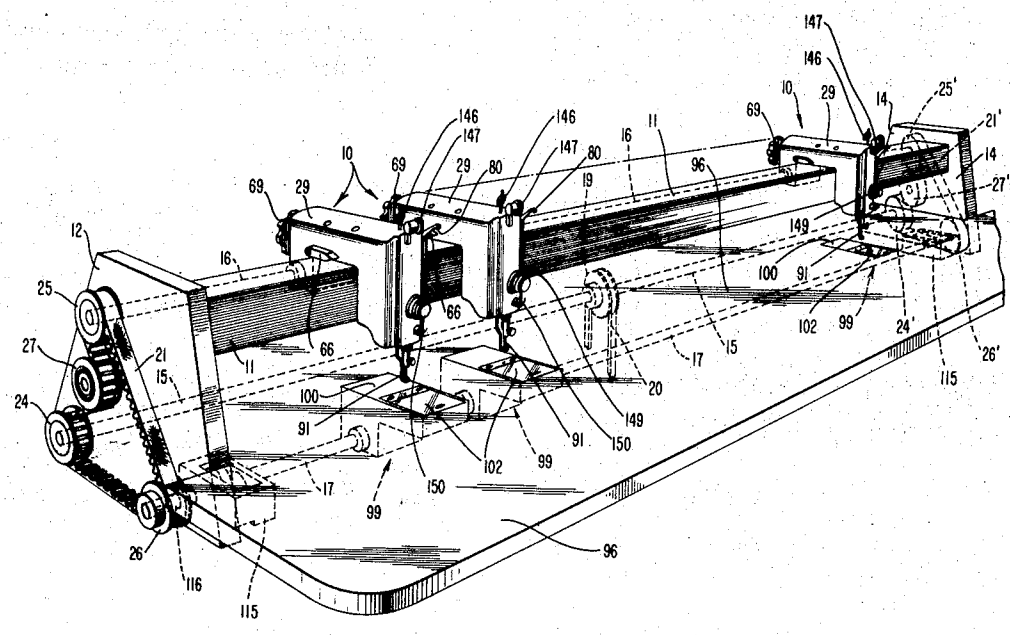
Primary Examiner—H. Hampton Hunter

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[57] **ABSTRACT**

Sewing machine, here illustrated as a machine for simultaneously embroidering a plurality of pieces of goods with an identical pattern or for embroidering a plurality of identical patterns on a single piece of goods. The illustrative machine comprises a plurality of embroidering stations, a plurality of embroidering mechanisms each of which is disposed at a respective embroidering station, and means for traversing the goods relative to the mechanisms at the stations to embroider the goods in accordance with the pattern.

9 Claims, 15 Drawing Figures



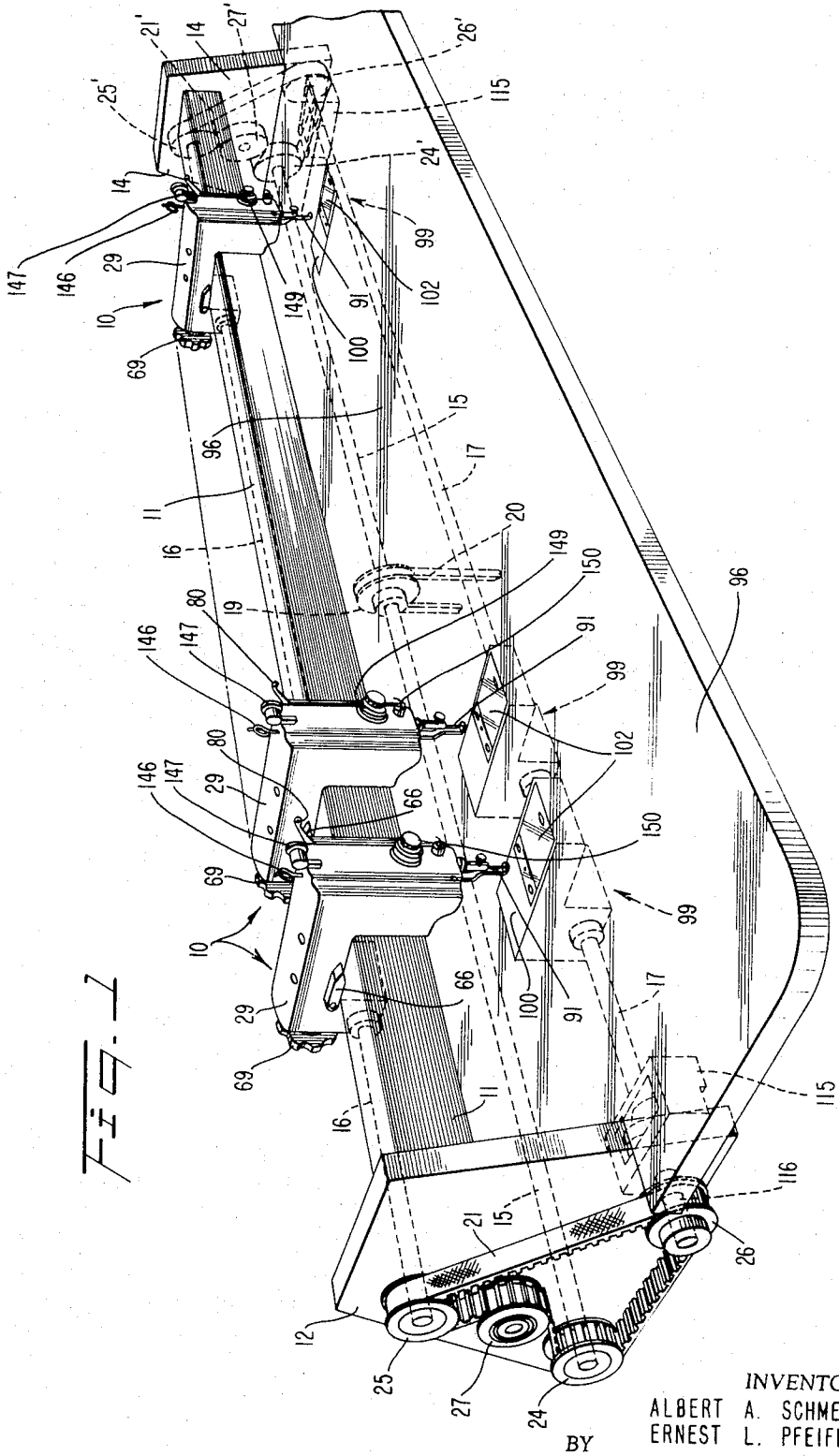


FIG. 1

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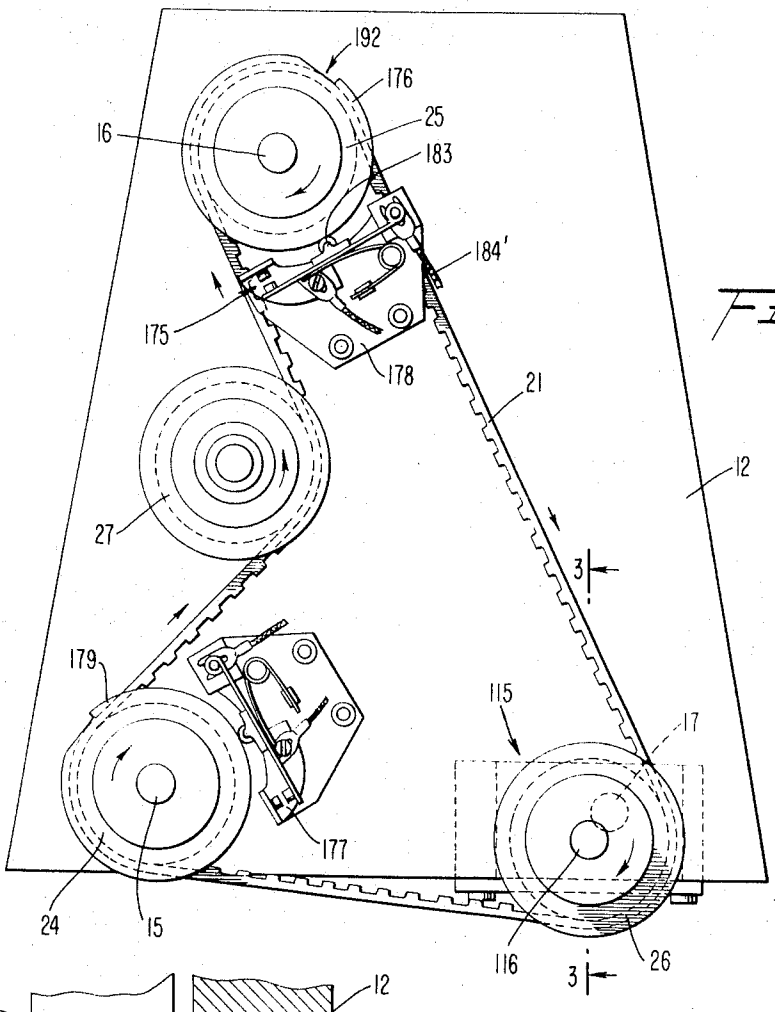


Fig. 2

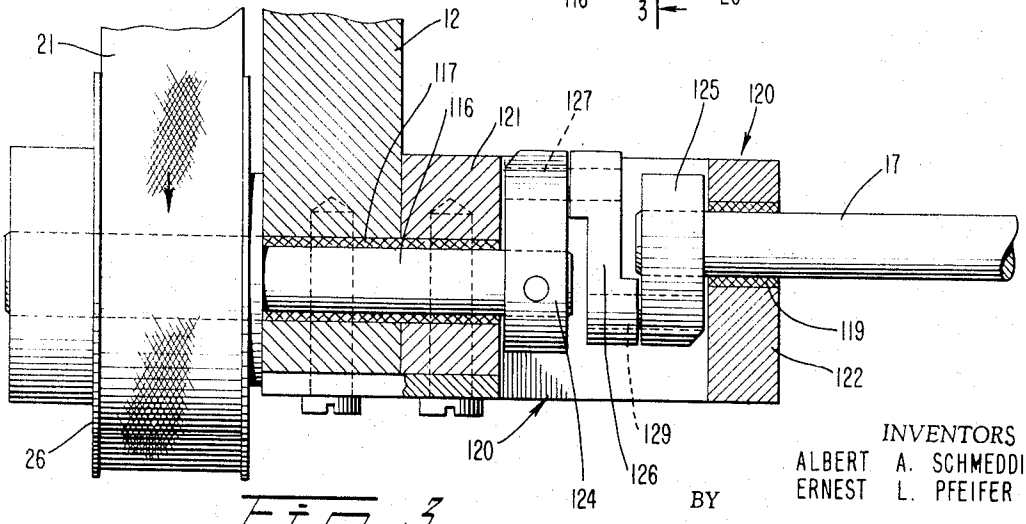


Fig. 3

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Fig. 4

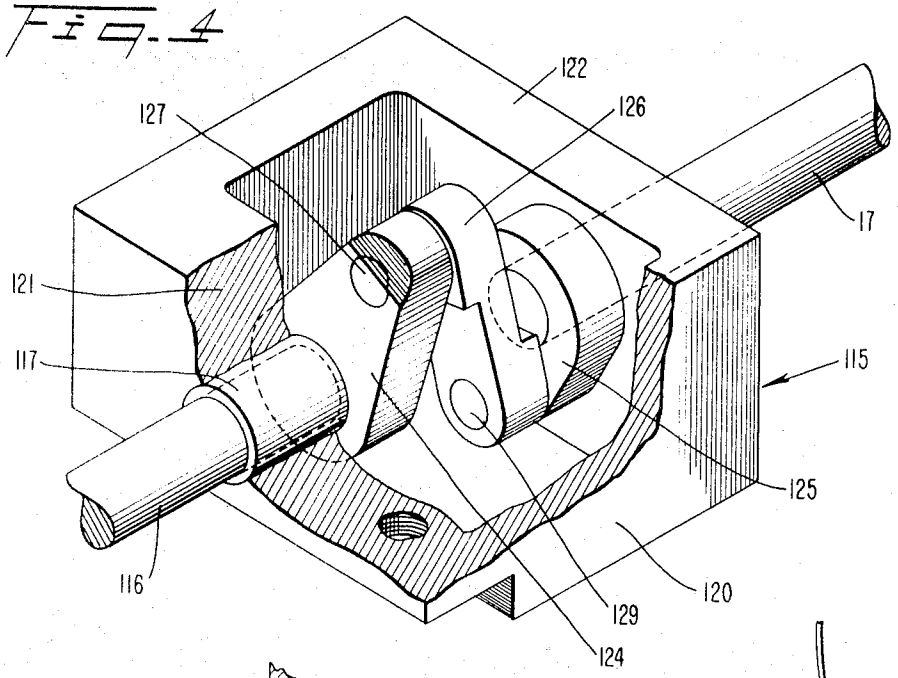
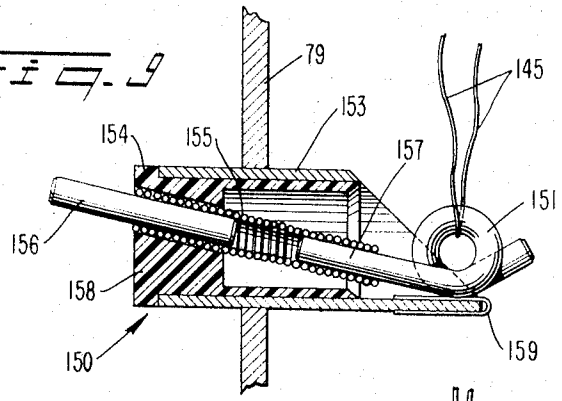


Fig. 9



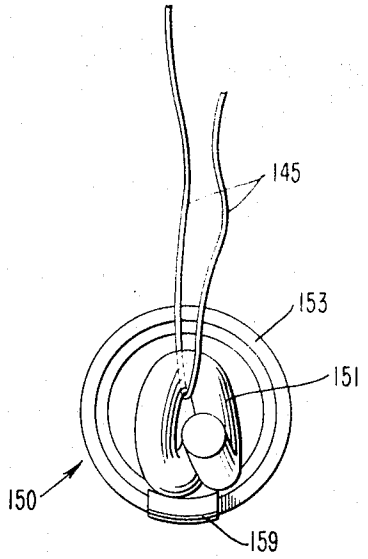


Fig. 11

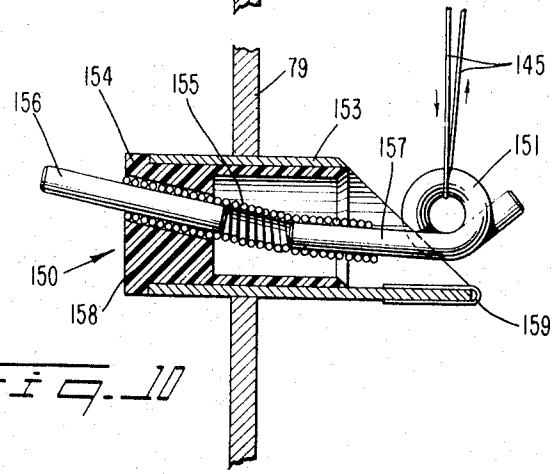


Fig. 10

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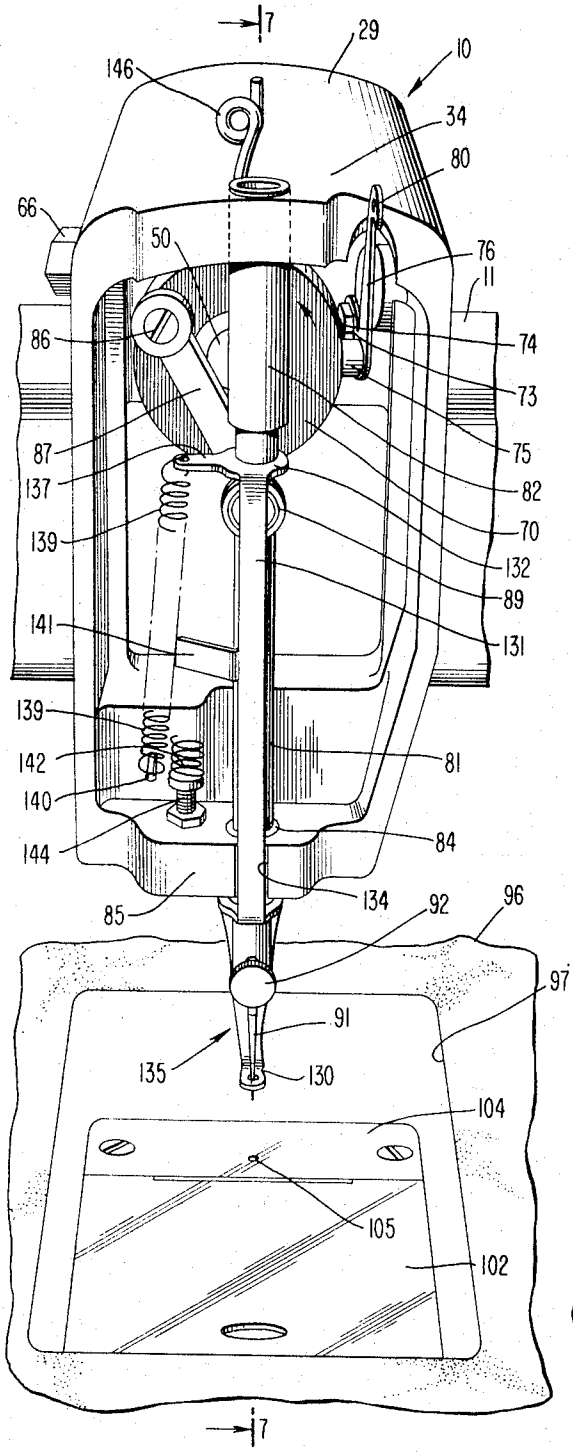


Fig. 5

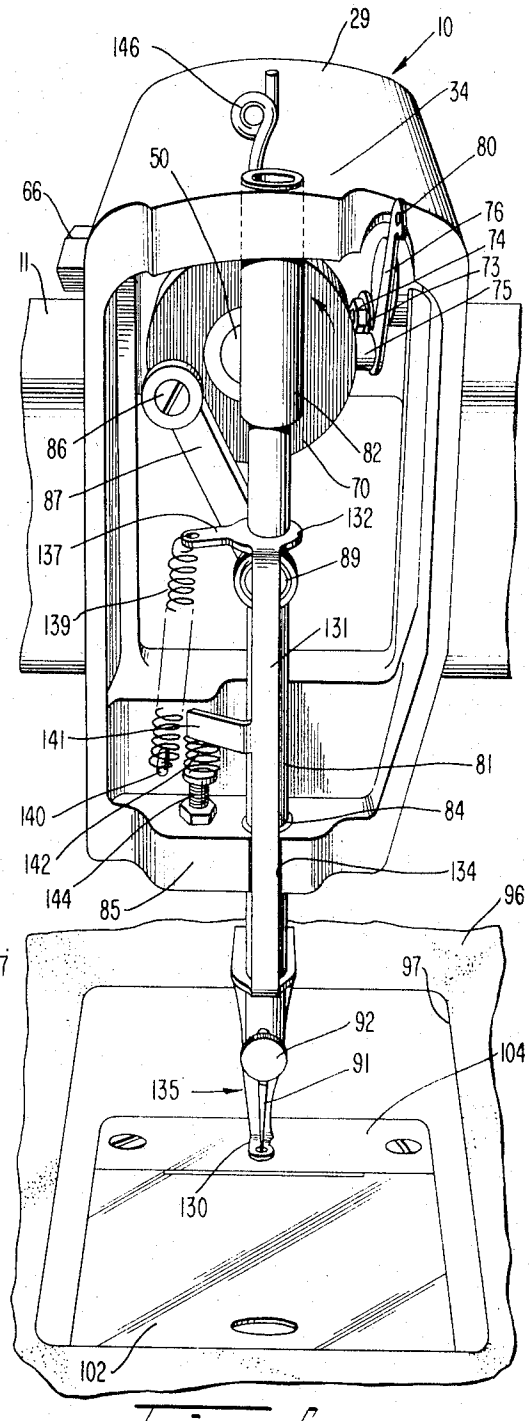
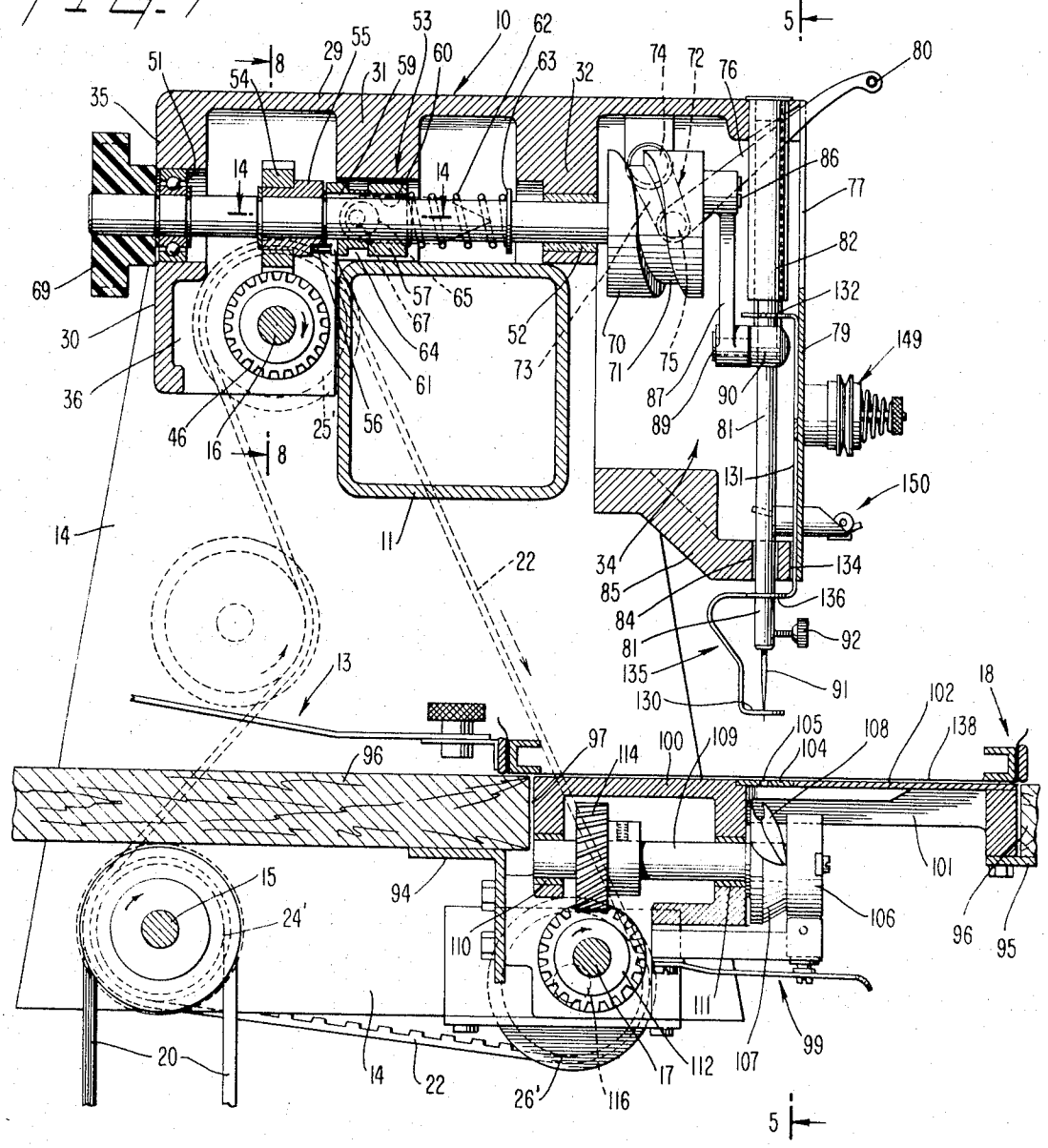


Fig. 6

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Fig. 7



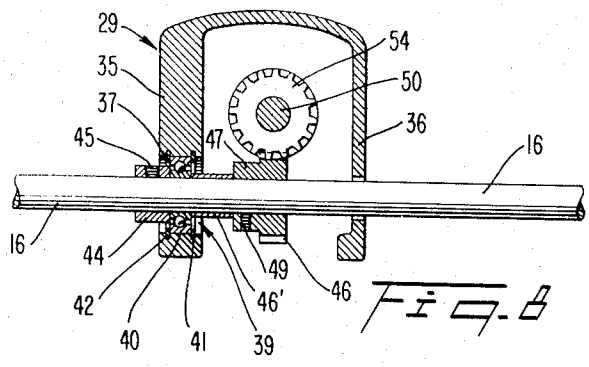


Fig. 8

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Fig. 12

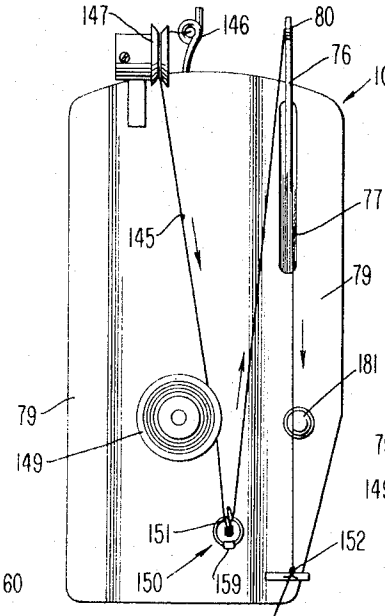
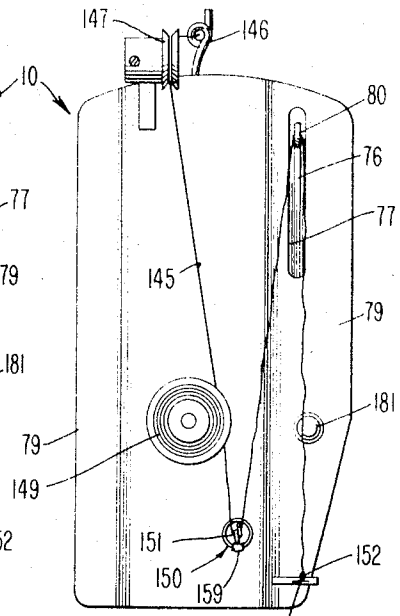


Fig. 13



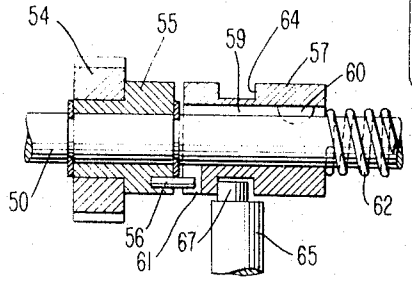


Fig. 14

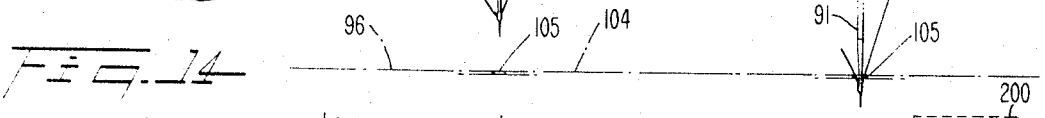
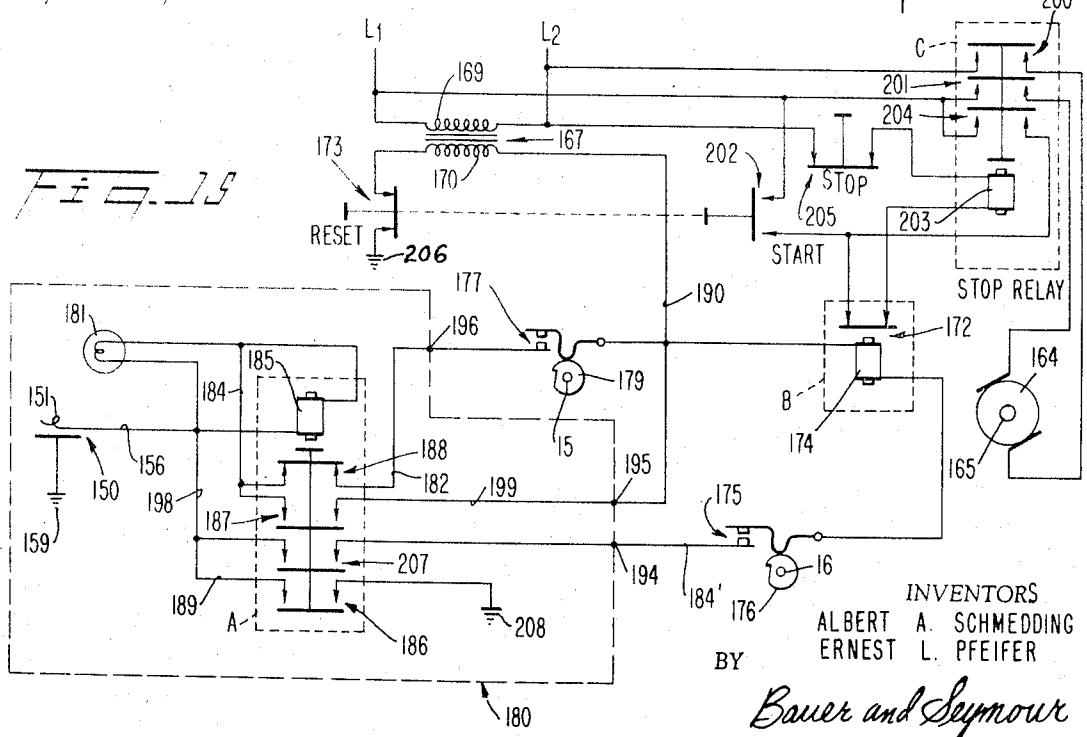


Fig. 15



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SEWING MACHINE

This application is a division of application Ser. No. 720,632, filed Apr. 11, 1968, for Sewing Machine, now U.S. Pat. No. 3,595,188.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a sewing machine, in the embodiment shown such machine having a plurality of sewing stations. The illustrative machine is adapted to hold pieces of goods which are to be embroidered simultaneously in the same pattern. At each station there is positioned an embroidering mechanism in the form of a sewing head and associated looper, the goods being traversed relative to the mechanisms by a pantograph device which follows a pattern or template.

2. Description of the Prior Art

Prior art multiple head embroidery machines have employed a plurality of aligned heads carrying needle bars, the heads being disposed above respective embroidering stations provided with means for positioning goods to be embroidered. A pattern following device, such as a jacquard control mechanism, is provided for moving the goods at the embroidering stations relative to the heads of the machine.

In such prior machines, the needle bars of the heads have been driven by branch shafts coupled to a common drive shaft which itself is driven from one end and each looper is coupled to its respective needle bar branch shaft by mechanism housed in a hollow vertical throat or pedestal of the head casting or housing and by its individual variable speed coupling. The load upon the common drive shaft, particularly under normal conditions which require rapid starting and stopping of the machine, tends to twist the common drive shaft substantially, so that various ones of the heads may run appreciably out of phase with respect to the other heads. Additionally, the throats or pedestals severely limited the field size or embroidery pattern and interfered with the connection between the pantograph and the hoops or other supports for the goods.

Further, although a clutch has been provided in each of the drive trains from the said common drive shaft to the needle bars, whereby any one of the heads may be disconnected, such clutches have had an operating wheel which is mounted upon and rotates with the needle bar branch shaft within the sewing head which forms a major part of each drive train. Such clutch operating wheels are difficult to grasp and operate when a head is running.

Prior multiple head sewing machines such as embroidery machines have incorporated thread tension responsive means to stop the entire machine upon the breaking or depletion of a thread being applied by any one sewing mechanism of the machine. Such means, however, has been complicated and prone to failure. No satisfactory means has been provided for indicating which head of the machine has the broken or depleted thread. Searching for the broken thread is unduly time-consuming, since the break in a thread may not be readily apparent.

Prior machines have employed retractable presser or stripper feet which in their lower terminal position lightly engage or are disposed close to the upper surface of the goods being sewed. The present machine incorporates novel means for altering such lower terminal position of the feet, whereby to accommodate the machine to the handling of goods of different thicknesses.

SUMMARY OF THE INVENTION

The multiple head sewing machine of the invention includes improved means to drive the needle bars and loopers of all of the sewing mechanisms simultaneously from a common drive means, improved individual clutch means for each mechanism to permit the stopping of any desired one of the mechanisms while the machine is in operation, improved thread tension responsive means to stop the entire machine at an advantageous point in its operating cycle upon the breaking or depletion of a thread being applied by any one sewing mechanism of the machine, novel signalling means to indicate the particular sewing mechanism the thread of which is broken or depleted, and means for raising the stripper foot associated with each head from contact with the goods before the goods is shifted relative to the needle to form the design being embroidered. The improved means contemplated by the invention for mounting and driving the sewing heads and loopers permits more advantageous mounting of the holders for the goods, the application of larger patterns to larger fields and the embroidering of yard goods and continuous ribbons.

BRIEF DESCRIPTION OF THE DRAWING

The above and further objects and novel features of the invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressely understood, however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a somewhat simplified view in perspective of an illustrative multiple head embroidery machine in accordance with the invention, only three of the heads of the machine being shown, the cams and breaker points or contacts operated thereby associated with one of the means for driving the opposite ends of the upper and lower drive shafts being omitted for clarity of illustration, and the means for holding and moving the goods to be embroidered being omitted;

FIG. 2 is a view in end elevation of the upper portion of the machine, the view being taken in the direction from left to right in FIG. 1;

FIG. 3 is a view in vertical axial section through an end of the looper driving shaft, the section being taken along the line 3—3 of FIG. 2, certain of the parts being shown in elevation;

FIG. 4 is a view in perspective of one of the two variable speed couplings employed to drive the looper drive shaft, portions of the walls of the coupling housing being broken away;

FIG. 5 is a view in perspective of a sewing head of the machine and the part of the table associated therewith, the front cover plate of the head being removed, the needle being shown in raised position near the start of its downward stroke, the view being taken from line 5—5 of FIG. 7, the embroidery station providing means being omitted;

FIG. 6 is a view similar to FIG. 5 but with the needle bar shown later in its downward stroke and with the

point of the needle about to enter the goods (not shown) being embroidered;

FIG. 7 is a view in vertical section through a sewing head and an associated looper of the illustrative machine, the section being taken generally along the line 7—7 of FIG. 5, certain of the parts being shown in elevation;

FIG. 8 is a fragmentary view in vertical section through a sewing head, the section being transverse to the length of the head and taken along line 8—8 of FIG. 7;

FIG. 9 is a fragmentary view in vertical section through a thread break detector employed in each head of the illustrative machine, the detector incorporating a switch which is here shown in closed position;

FIG. 10 is a view similar to FIG. 9, but with the switch in open position;

FIG. 11 is a fragmentary view in front elevation of the thread break detector, the view being taken in the direction from right to left in FIG. 9;

FIG. 12 is a somewhat schematic view in front elevation of a sewing head in accordance with the invention, the needle being shown as just having started its downward stroke, the thread tension lever being in substantially its uppermost position, and the thread extending between the thread tensioning means on the head and the eye of the needle being under appreciable tension;

FIG. 13 is a view similar to FIG. 12 showing parts of the sewing head in the position which they assume in a later portion of the sewing cycle, the point of the needle being shown as having descended so as to pass downwardly through the goods (not shown) being embroidered, the thread tension lever being in the upper portion of its downward stroke, and the thread extending between the thread tensioning means on the sewing head and the eye of the needle being in slack condition;

FIG. 14 is a fragmentary view in horizontal section through the clutch of a sewing machine head, the section being taken along the line 14—14 of FIG. 7, certain of the parts being shown in plan; and

FIG. 15 is a diagram of the motor control and thread break detector and signalling circuit which is employed in the disclosed machine of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, there is shown in FIG. 1 a multiple head sewing machine adapted for use with means, which is not shown in FIG. 1 but is schematically shown in FIG. 7, which provides a plurality of embroidery stations one of which is associated with each sewing machine, that is, a sewing head and its associated looper. In such embroidery machine the embroidery station providing means, which is shown at 13 in FIG. 7, is adapted to support goods to be embroidered. Such means 13 has a plurality of embroidery stations thereon, of which one is schematicaaly shown at 18. The means 13, and thus all of the embroidering stations 18, are moved in unison by a pattern following device which is conventional in the art and is not here shown.

A plurality of similar sewing machine heads 10 are mounted upon a horizontal upper rail 11 which is supported above a main horizontal table 96 by two similar spaced, parallel end supports 12 and 14. Such manner of supporting the sewing heads provides a clear path therebeneath in a direction from the front to the rear of the machine, so that the goods being sewn or embroidered need not be limited in length. The drive for the sewing heads 10 is provided by an upper main horizontal drive shaft 16 which, as shown, is deposited rearwardly of the rail 11 and passes through a rear lower portion of each of the sewing heads. The vertically reciprocable needle bar 81 of each head is driven by means drivingly connected to shaft 16, such means including a shaft 50 within the housing of each head which is shown more particularly in FIGS. 7 and 14 and will be described hereafter.

The sewing machines shown are of the two-thread, lock stitch type, wherein the sewing heads 10 apply a first, upper or needle thread to the goods, and a looper 107 (FIG. 7) applies a second, lower or under thread thereto. The lock between threads is formed by passing the upper thread around the lower thread and tightening the two threads together in the goods being sewed.

A lower horizontal longitudinally extending shaft 17, which drives the loopers associated with each of the sewing heads of the machine, is disposed beneath the table of the machine. Shaft 17 is driven at its opposite ends through variable speed couplings 115, the couplings having at their input ends stub shafts 116 which are driven in synchronism with the shaft 16 by Timing belt and sprocket means which are shown more particularly at the left of FIG. 1 and in FIG. 2. Thus at the rear of the machine there is provided a horizontal longitudinally extending lower shaft 15 which is driven by a motor (not there shown) through the medium of a V-belt 20 entrained over a pulley 19. At each end of the machine, outwardly of the supporting members 12 and 14, through which the ends of shafts 15, 16, and 116 extend, there is provided identical Timing belt and sprocket driving means which synchronizes the rotation of the shafts 16 and 116 and maintains them accurately in phase. Thus outwardly of support 12 there is a Timing belt 21 which is entrained over sprockets 24, 25, and 26 which are affixed to shafts 15, 16, and 116, respectively. Outwardly of support 14 there is a Timing belt 21 which is entrained over pulleys 24', 25', and 26' (FIG. 1) which are affixed to shafts 15, 16, and 116, respectively. Belts 21 may be tensioned by adjustable idle pulleys 27, as shown. By reason of such driving of the shafts 16, 116, and 17 by shaft 15, the twisting of such shafts under rapid starting and stopping conditions is minimized, whereby the needle bars and loopers of the various sewing machines are maintained accurately in phase.

The frame or housing 29 of each sewing head 10 is of generally U-shape in side elevation, as shown in FIGS. 1 and 7. Housing 29, which is hollow and generally downwardly open, has a depending rear skirt 30, a first rear intermediate rib 31, a second intermediate rib 32, spaced forwardly of rib 31, and a vertical hollow front portion 34 within which the vertically reciprocable needle bar 81 and its driving means are mounted. The upper portion of the rear wall or skirt 30 is thickened at 35 to provide support for a bearing 51, received in a bore in housing portion 35, which supports the rear end of the shaft 50 of the sewing head. A portion 36 of wall 30 is of somewhat thinner section. As shown in FIG. 8, the horizontal driving shaft 16 is journalled in a bearing 39 mounted in the housing 29 of the sewing head 10. Such bearing, which is of the type known as a ball bearing, has an outer race 40 which is fixedly held within a bore 37 in a thickened portion 35 of the housing 29 between an inner and an outer spring ring

41 and 42, respectively, disposed in annular grooves in bore 37. The inner race of the bearing is positioned on shaft 16 by a spacer sleeve 46' and a collar 44 which is secured to the shaft as by a pin or Allen screw 45.

Affixed to the shaft 16 within the housing 29 there is a helical gear 46 having a collar 47, the collar being secured to shaft 16 as by a set screw 49 in abutment with spacer 46'. It will be apparent that with such construction any one of the sewing heads 10 may be removed from the machine upon the loosening of the shaft 16 from each of its bearings 39 and helical gears 46, as well as the removal of the end driving sprockets from the shaft, so that the shaft may be readily withdrawn axially from all of the heads. Following this the desired heads 10 are removed frm the rail 11, and the shaft 16 with its bearings and helical gears are reassembled within the remaining sewing heads 10, and the shaft 16 is then remounted in supports 12 and 14.

The needle bar driving shaft 50 of each sewing head is rotatably supported at its rear in the above mentioned ball bearing 51 and adjacent its forward end in a sleeve bearing 52 which is mounted in a bore in the rib 32 of the housing 29. Meshing with the helical gear 46 on shaft 16 is a second helical gear 54, gear 54 being affixed to a sleeve 55 which is mounted on shaft 50 for rotation with respect thereto. The sleeve 55 and the gear 54 thereon are retained from travel axially with respect to the shaft 50 by spring rings received within annular grooves in the shaft 50 at each end of the sleeve 55. Gear 54 and sleeve 55 are selectively drivingly connected to shaft 50 by a clutch 53, which is constructed as follows.

Within an eccentric blind bore in the forward face of the sleeve 55 there is mounted a forwardly extending pin 56. A reciprocable sleeve 57 mounted upon shaft 50 forwardly of sleeve 55 is keyed to the shaft for rotation therewith through the medium of a key 60 affixed to the shaft and received within an axially extending groove 59 in the inner surface of the sleeve 57. At one location angularly thereabout the sleeve 59 is provided with a rearwardly open recess 61 which selectively accurately receives the forward end of the eccentric pin 56. It will be seen that the gear 54 may be drivingly connected to the shaft 50 through the medium of the clutch sleeve 57 in only one angular position of such parts relative to each other. Thus the required phase relationship between the needle bar 81 and the looper 107 of the individual sewing machine is restored when the sleeve 57 is returned to its rearward, engaged or driving position, shown in FIG. 7, after having been operated to disconnect the needle bar driving shaft 50 from the shaft 16.

The sleeve 57 is constantly urged into its rearward, clutch-engaged position, by a coil compression spring 62 which is telescoped about shaft 50 forwardly of the sleeve 57, and which acts between the forward end of sleeve 57 and an abutment ring 63 affixed to shaft 50, as shown. The clutch sleeve 57 may be shifted axially of the shaft 50 selectively to disengage and engage the clutch by the following means. An annular groove 64 is provided in the outer surface of clutch sleeve 57, such groove receiving an eccentric projection or pin 67 (FIG. 14) on the inner end of a clutch operating cross shaft 65 which is journalled in the housing 29 on one side thereof and extends outwardly therethrough. A lever 66 affixed to the outer end of shaft 65 may be thrown in one direction to retract the clutch sleeve 57 forwardly against the pressure of spring 62 to disengage the clutch; when such lever 66 is thown in the other direction, the spring 62 thrusts sleeve 57 rearwardly so that pin 56 on sleeve 55 may be received within recess 61 on sleeve 57. For a purpose to more fully appear hereafter, the engagement of pin 67 with the radial wall of groove 64 during clutch disengagement tends to prevent rotation of sleeve 57 and shaft 50.

Mounted upon the rear end of the shaft 50 is a hand wheel 69 by which the needle bar 81 of the head 10 may be manually driven, as for reengaging the clutch, positioning the needle 91, or as required for servicing or adjustment of the sewing head mechanism. Affixed to the forward end of shaft 50 coaxially thereof and within the portion 34 of the head there is a circular cylindrical element 70 which functions both as a barrel cam for driving a thread tensioning lever 76 of the sewing head and as a crank for reciprocating the needle bar 81 of the head vertically. Element 70 has a curved parallel sided cam groove 71 in its peripheral surface, such groove receiving a cam follower roller 75 on the outer end of an arm 73 of a bell crank 72 which is mounted for oscillation about a horizontal pivotal support 74 affixed to the frame 29 of the head. The thread tensioning lever 76, which forms the second arm of the bell crank, extends outwardly through a vertical slot 77 in a plate 79 which covers the forward end of the housing 29 of the head. Lever 76 has at its outer end a guiding eye 80 through which the upper thread 145, which is applied by the sewing head 10, passes in its travel to the needle, as shown in FIGS. 12 and 13.

The needle bar 81, which is in the form of a circular rod, is guided at its upper end within a vertical sleeve 82, the upper end of the sleeve being affixed to the upper wall of portion 34 of the housing 29 of the head, as shown in FIG. 7. The lower portion of the needle bar 81 is guidingly received within a short vertical sleeve 84 coaxial of sleeve 82, sleeve 84 being affixed to a lower forward part 85 of the portion 34 of the housing. Driving connection between the element 70 on shaft 50 and the needle bar 81 is effected by an eccentrically mounted crank pin 86 on the forward end of the element 70, a connecting rod 87 pivotally secured at its upper end to the pin 86 and at its lower end to a pivot pin 89 which projects rearwardly from a boss 90 connected to the needle bar. The lower end of the needle bar is provided with a vertical blind bore receiving the upper, shank end of the eedle 91, the needle being retained in such bore by a needle retaining screw 92.

As shown in FIG. 7, the machine has longitudinally extending lower frame members 94 and 95 which extend from end to end thereof and which, with other frame members, not shown, support the table 96. Frame members 94 and 95 are connected at their ends by the lower ends of supports 12 and 14, the lower end of the latter, in which one end of the drive shaft 15 is journalled, being shown in FIG. 7. At an opening 97 through the table 96 in alignment with each of the sewing heads 10 and the embroidery stations 18 on the member 13 there is provided a looper unit 99, the upper portion 100 of the housing of which is disposed in the opening 97 through the table with the flat upper surface of housing portion 100 flush with the top of the table. As shown, the forward end of the looper unit is supported upon the frame member 95, and the rear end of the looper unit is secured to the downwardly extending flange of frame member 94. The forward end por-

tion 101 of the looper unit frame presents a rectangular opening therethrough which provides access to the bobbin of the looper, such opening being covered by a removable plate 102, the upper surface of which lies flush with the top of the table 96.

A further, fixed cover portion 104, rearwardly of plate 102, is provided with a vertical needle receiving hole 105 therethrough. The lower or under thread is supplied by a bobbin (not shown) disposed within a bobbin holder 106 and is fed to a rotatable looper 107 which is affixed to the forward end of a looper driving shaft 109. The looper 107, which is of conventional construction, has a hook 108 thereon which rotates with the looper 107 and the shaft 109. As is well known in the art, upon the descent of the needle through the goods being sewed, the loop of the upper or needle thread 145 which is formed beneath the goods is taken by the point of the hook 108 on the looper and is passed around the bobbin, which contains the lower or under thread and a tensioning device for such lower thread. At this time, the loop in the needle thread is permitted to enlarge under substantially no tension by the descent of the needle thread take-up lever 76. After the upper thread has been passed about the lower thread, the two threads are tightened together to form a lock stitch.

The looper rotating shaft 109 is mounted for rotation in rear and forward bearings 110 and 111, respectively, in the looper frame, shaft 109 being rotated by the shaft 117 through the medium of meshing helical gears 112 and 114 which are affixed to shafts 17 and 109, respectively. The shafts 109 and the loopers 107 carried thereby of the various sewing machines are all similar and are drivingly connected so as to be rotated in synchronism and in phase. In order to rotate the looper of a round bobbin, lock stitch sewing machine at a slower speed when the upper and lower threads were being looped together than during the remainder of the rotation of the looper there was formerly provided a variable speed coupling for each looper, such coupling being interposed in the driving train therefor. In accordance with the present invention, only two variable speed couplings 115 are provided, one at each end of the looper drive shaft 17. This results in a more rugged, trouble free, and economical machine.

Since the two couplings 115 are identical, only one is particularly shown and described. Such variable speed coupling is shown in detail in FIGS. 3 and 4. As there shown, the inner end of a stub shaft 116 which is driven by the Timing belt 21 through the sprocket 26, is mounted for rotation in a sleeve bearing 117 which is mounted in a bore in the lower part of support member 12 and an aligned bore in one side 121 of a housing 120 for the coupling. The confronting outer end of the looper drive shaft 17 is mounted in a bearing 119 in the opposite wall 122 of the housing. Affixed to the inner end of the stub shaft 116, as by being pinned thereto as shown, is a first, longer crank 124 disposed within the housing. A second, shorter crank 125, also within the housing, is affixed to the outer end of the looper drive shaft 17. A link 126 connects the crank pin 127 on crank 124 to the crank pin 129 on crank 125. Such variable speed coupling, which is conventional, is so disposed relative to the shafts 116 and 17 as to drive the looper 107 at a slower speed as the point or horn 108 thereof approaches, passes by, and leaves the path of the needle 81 than during the remainder of the rotation of the looper.

The sewing machine of the invention is provided with a presser foot which substantially engages the upper surface of the goods being sewed or embroidered from the time the needle enters the goods until the needle is withdrawn therefrom, thereby functioning to aid in retaining the goods in place and to prevent its substantial rising as the needle is withdrawn from it. Such presser foot, however, is provided with means whereby it is elevated from the goods upon the upward travel of the needle after having been withdrawn therefrom, so that the goods is free for travel in whatever direction is required of it by the pattern following mechanism before the next downward stroke of the needle. The presser foot 130 and its operating mechanism are particularly shown in FIGS. 5, 6, and 7.

Stripper foot 130 is formed as an integral lower part of a slide member 131, the upper and intermediate portions of which are straight and are disposed vertically. The upper end of member 131 is provided with a horizontal collar 132 which surrounds and is slidable with respect to the needle bar 81. The lower end of the straight vertical portion of slide 131 is received within a forwardly open shallow vertical groove 134 in the lower portion 85 of the portion 34 of the frame of the sewing head, and is retained therein by the central lower edge portion of the cover plate 79. At its lower end the member 131 is bent rearwardly to form a generally C-shaped portion 135, the upper end of which is horizontal and has a hole 136 therethrough guidingly receiving the lower end of the needle bar 81. Below such C-shaped portion, member 131 is bent vertically and then forwardly to form the horizontal presser foot 130. Such foot has a vertical, needle-receiving hole therethrough, as shown.

Extending sidewardly from the collar 132 on slide member 131 is a horizontal arm 137 integral therewith. A coil tension spring 139, which constantly yieldingly urges the slider 131 in a downward direction, has its upper tang secured to the outer end of arm 137 and its lower tang secured to a spring anchoring pin 140 affixed to the lower forward portion of the housing of the sewing head inwardly of the cover plate 79. Travel of the slide member downwardly, however, is limited by its engagement with the boss 90 affixed to the needle bar 81. It will thus be apparent that the slide member 131 travels with the needle bar 81 from the uppermost position of the latter downwardly through the position shown in FIG. 5 and toward the position thereof shown in FIG. 6 wherein the stripper foot 130 lightly engages or is preferably a short distance above the upper surface of the goods 138 being embroidered. As the stripper foot moves downwardly past the position thereof shown in FIG. 5, a laterally extending arm 141 on the slide member engages the upper end of a coil compression spring 142, the lower end of which is affixed to the upper end of a machine screw 144 threaded into the portion 85 of the frame of the head in alignment with the arm 141. Thus as the needle bar descends the slide member 131 travels freely downwardly therewith until the arm 141 engages the upper end of the spring 142, after which spring 142 progressively opposes the coil tension spring 139. When the force exerted by spring 142 equals that exerted by spring 139, further travel of the slide member 131 downwardly ceases. The screw 14 may be adjusted vertically to determine the termi-

nus of downward travel of the presser foot **130** as commanded by the thickness of the goods **138**, the screw being held in adjusted position by a lock nut, as shown.

When a sewing head is disconnected from the drive shaft by means of its clutch **56, 57** for any reason without stopping the entire machine, it may be necessary or desirable that the needle **91** and foot **130** be retained in raised position (FIG. 7) to permit free movement of cloth on table **96**. Without means to prevent it, the needle and foot would creep to their lowermost positions due to the torsional forces applied to shaft **50** by the pull of tension spring **139** and the drag of continuously rotating gear **54, 55** on shaft **50**. The clutch mechanism when in disengaged position functions as a brake to override the above mentioned torsional forces and thus prevents undesired rotation of shaft **50**. The braking is effected by the frictional engagement between pin **67** and the radial wall of annular groove **64** under the compression of spring **62**.

Each sewing head **10** is provided with its individual upper thread **145** which is fed thereto from a spool or bobbin, not shown. Thread **145** passes through a pigtail guide **146** mounted on top of the frame of the head to a guide roll **147**, and then to an adjustable thread tensioning device **149** and is shown as being of the conventional washer type. From the tensioning device **149** the thread **145** travels downwardly through a pigtail guide **151** on a thread break detector means **150**, to be described, upwardly to the guiding eye **80** on the thread tensioning lever **76**, downwardly to a fixed lower pigtail guiding eye **152** on cover plate **79**, and thence to the eye of the needle **91**.

As is conventional with sewing machines of the type shown, when the needle **19** is in its fully elevated position, the thread tensioning lever **76** is in its lowermost position. As the needle starts down, the lever **76** moves rapidly toward its fully elevated position, as shown in FIG. **12**, causing the upper thread **145** to become tight in the portion of its run between the tensioning device **149** and the eye of the needle **91**. In all other relative positions of the needle and the thread tensioning lever **76** the thread **145** in such run thereof is relatively slack or untensioned. One of such other positions is shown in FIG. **13**, wherein the needle is continuing its downward travel after it has penetrated the goods **138** and the lever **76** is also travelling downwardly. Breakage of the upper thread **145** thus virtually always occurs when such run of the thread is tensioned as shown in FIG. **12**.

The machine of the invention incorporates means whereby the breakage of a thread both energizes a signal device associated with the particular sewing machine whose thread has broken, and also deenergizes the driving means for all of the sewing heads of the machine and quickly brings the sewing machines to a stop. The thread break detector means and the machine controlling elements and circuit associated therewith are shown in FIGS. **2, 9, 10, 11**, and **15**.

As shown in FIG. **12**, the pigtail guide **151** of the thread break detector **150** is disposed laterally between and below both the tensioning means **149** and the lever **76**. Guide **151** thus forms the thread **145** into a salient or V-shaped run with the guide **151** at the bottom thereof. Guide **151**, which forms a part of the thread break detector, is mounted for resilient deflection upwardly by the unbroken thread **145** when the parts of the sewing machine are in the position shown in FIGS. **10** and **12**. Guide **151** also forms the upper of two cooperating electrical contacts which are opened when the thread is tensioned as in FIG. **12** and which are closed during all other portions of the cycle of the sewing machine. If, however, the thread **145** should break, the contacts associated with the thread break detector remain closed throughout the entire cycle and, as a result, not only energize the above-mentioned signalling device but cause the driving means for the entire machine to be deenergized.

The construction of the thread break detector **150** is shown more particularly in FIGS. **9, 10**, and **11**. As there shown, the detector is mounted upon the cover plate **79** for the head of the machine, there being a tubular metallic body **153** which projects through an opening in the cover plate and is affixed thereto. The forward end of body **153** is cut along a forwardly and downwardly inclined plane. Within the tube **153** there is disposed an electrical insulator **154** having a forward tubular skirt portion and a transverse solid portion **158** at the rear end thereof. The rear end of electrically conductive coil spring **155** is affixed to insulator **154** by being telescoped within a downwardly and forwardly inclined bore **160** through the rear portion **158** of the insulator, electrical connection to the rear end of the spring being effected by a conductor **156** which is forcibly embraced by the rear end of the spring. Telescoped within the forward end of spring **155** and forcibly engaged therewith, with its rear end spaced somewhat from the forward end of the conductor **156**, is the shank **157** of the electrically conductive pigtail guide **151**, the lower surface of which acts as a first, upper contact of the two cooperating contacts of the thread break detector. The other, lower contact of the detector is here made in the form of a removable U-shaped clip **159** which is telescoped over the forward lower edge of the tubular body **153** and makes secure electrical contact therewith. The frame of the sewing machine is grounded, as shown in the circuit diagram in FIG. **15**, to be described, so that when the pigtail guide **151** is in its lower position (FIGS. **9** and **11**) the conductor **156** is connected to ground.

As shown, when the thread **145** in the portion thereof passing through the guide **151** is slack or substantially untensioned, the guide **151** lies in it lowermost position and the contacts of the thread break detector are closed. When, however, such run of the thread **145** is tensioned, the thread pulls the guide **151** upwardly, thereby to flex the spring **155** and to separate the two contacts of the detector. As above mentioned, should the thread **145** of a sewing head be broken or depleted when it would otherwise normally be tensioned to separate such contacts as shown in FIG. **10**, the contacts then engage each other whereby the signalling means **181** associated with such sewing head is energized and the entire machine is brought to a stop.

The manner in which such signalling device and the machine controlling circuit operates will be more fully understood upon consideration of FIGS. **2** and **15**. As shown in the latter of such figures, the multiple head sewing machine is driven by a motor **164** having a motor shaft **165**; shaft **165** is drivingly connected to the lower main driving shaft **15** of the machine by the belt **20** shown in FIGS. **1** and **7**. The motor **164** is supplied with operating current from a source L_1, L_2 through the normally open contacts of switches **200** and **201** of a relay C. It will be apparent that when the contacts of switches **200** and **201** are closed, the motor **164** will be

connected to the current source to start the motor, the motor remaining running until such switches are opened.

To start motor **164** the coil **203** of relay C is energized by source L_1, L_2 through a temporarily manually closed starter switch **202**, and the normally closed switch **172** of a relay B. The thus energized coil **203** closes switches **200** and **201**, thus energizing the motor, and also closes a switch **204** in a holding circuit which connects said coil across the source through switch **172** independently of starter switch **202**. The switches of relay C will accordingly remain closed and the motor energized until coil **203** is deenergized by opening a stop switch **205** manually or opening switch **172** in a manner hereinafter described in response to the thread break or depletion detector **150**.

As shown in FIG. **15**, the control circuit for the machine includes a voltage step-down transformer **167** having a primary winding **169** connected to the current source L_1, L_2 and a secondary winding **170** which is connected in and powers the control circuit. The control circuit is so constructed and arranged that upon the breaking or depletion of any one of the upper threads **145** being applied by the respective sewing heads of the machine the coil **174** of the relay B is energized by the control circuit, whereby to open the contacts of switch **172** and to stop the motor **164**.

A first terminal of the secondary winding **170** of the transformer **167** is connected to ground **206** through a normally closed reset switch **173** mechanically connected to starter switch **202**, the one being open when the other is closed. The second terminal of the secondary winding is connected to a first terminal of the coil **174** of relay B. The other end of the relay coil **174** is connected to a first contact of a periodically opened and closed contact set **175**. The other, second contact of such set is connected by a wire **184'** to a terminal **194** of a circuit portion **180**. Between the second terminal of the secondary winding **170** and the relay coil **174** there is connected a wire **190** which leads to a terminal **195** of the circuit portion **180**.

A first contact of a second periodically opened and closed contact set **177** is connected to wire **190**, the other contact of such set being connected to a terminal **196** of the circuit portion **180**. Although only one circuit portion **180** is shown in FIG. **15**, there is actually a plurality of such circuit portions, one for each sewing head **10**, the respective terminals **194**, **195**, and **196** of all said circuit portions being connected in series, so that, as above explained, the breaking of any one thread **145** not only energizes the respective signalling means **181** but also stops the entire machine. Since all of the circuit portions **180** are identical, only one need be described.

A wire **182**, which is connected to terminal **196**, leads to one fixed contact of a normally closed contact set **188** of a relay A, the other fixed contact of such set being connected through a wire **184** to one terminal of its respective signal light **181** which is mounted upon the front cover plate **79** of the respective sewing head. The other terminal of signal light **181** is connected by a wire **198** and a normally open switch **207** of relay A to terminal **194**. The above described conductor **156** of the thread break detector **150** is connected to wire **198**, as shown.

Also connected to wire **198** through a wire **189** is the first contact of a normally open third contact set **186** of relay A, the other contact of such set being connected directly to ground **208**. A normally open fourth set of contacts **187** of relay A has one contact thereof connected to lead **184** and the other contact thereof connected through a wire **199** to terminal **195**. The movable contactors of relay A are connected to move together, but are electrically insulated from each other. Such contactors are raised to close contact sets **186**, **207**, and **187** and to open contact set **188** when the coil **185** of relay A is energized. One terminal of coil **185** is connected to wire **184** and the other terminal thereof is connected to wire **198**.

The cam operated contact sets **175** and **177** are shown more particularly in FIG. **2**. Both of such contact sets are here constructed similarly to the low tension breaker points on an automobile, the movable contact of each set being constantly urged toward contact-closed position by a leaf spring, and being opened by a cam acting through a cam follower affixed to the movable contact. In the embodiment shown, the contact sets **175** and **177** are actuated by cams **176** and **179**, which are affixed to shafts **16** and **15**, respectively, as shown in FIG. **2**. Since such contact sets are similar, only set **175** need be specifically described.

An electrically insulating contact supporting member **178** is secured to the outer face of support member **12**. The fixed contact of the set is secured to member **178**; the movable contact is mounted on one end of an electrically conducting lever arm which is pivotally mounted on member **178**, the other end of the lever arm being connected through the pivot means to coil **174**. Intermediate the length of the lever arm there is mounted a cam follower roll **183**, which bears upon the rim of the outer flange of sprocket **25**, such rim forming the cam **176**. The cam **176** is of circular shape coaxial of shaft **16** throughout its circumference with the exception of a cut out zone **192** wherein the leading end has an abrupt radially inwardly extending shoulder, the remainder of such zone constituting a ramp, the radius of which progressively increases until it reaches the radius of the remainder of the cam at the trailing end of such zone. The parts supporting and operating the contact set **175**, including the cam **176** and cam follower **183**, are so constructed and arranged that the contact set **175** remains open at all times with the exception of the period when the cam follower **183** rests upon the leading and intermediate portions of the cut out portion **192** of the cam **176**. Similarly contact set **177** remains open at all times except during the period when the cam follower is in the cut out zone of cam **179**. The sprocket **24** (and thus the cam **179**) is affixed to shaft **15** in such angular position that the contact set **177** is closed during that period in the sewing cycle in which the upper thread **145** is tensioned, as described in connection with FIG. **12**, and is open at all other times. The contact set **175** and cam **176** are similarly positioned relative to shaft **16**, except that cam **176** is angularly disposed to close contact set **175** a short interval after contact set **177** is closed by cam **179**. Both cams are angularly adjustable relative to the driving shafts therefor.

The thread breakage detectors **150** of the respective sewing heads and the control circuits of which they are parts function as follows. When an upper thread **145** of a sewing head **10** is depleted or breaks, the upper contact **151** of the thread detector **150** of such head remains in engagement with the lower ground contact

159 thereof during that portion of the sewing cycle when such contacts would have been open if the thread were unbroken. As we have seen, the contact set 177 is closed during such portion of the cycle. When the contacts of the detector 150 are closed at the same time as the contacts of the contact set 177, the signal light 181 of the sewing head whose thread 145 has broken is energized by secondary winding 170 through wire 190, contact set 177, wire 182, contact set 188, and wire 184, and through wires 198 and 156, upper contact 151, the lower ground contact 159 of detector 150, ground return 206 and reset switch 173.

Simultaneously with the energization of the signal light 181, the coil 185 of relay A of the respective circuit portion 180 is energized by current flowing from winding 170 and wire 182 through such coil and to ground 159, 206 through wires 184, and 156 and the contacts of the detector 150. Energization of such relay coil 185 causes the normally open contact sets of switches 186, 207, and 187 to close and contact set 188 to open. Closed switch 187 completes a holding circuit for relay coil 185 through wire 190, wire 199, switch 187, wire 184, coil 185, wire 156, and the contacts of detector 150 to ground 206. Such holding circuit bypasses the contact set 177, and thus the relay coil 185 remains energized after the opening of contact set 177 as shaft 15 and cam 179 continue to rotate. An independent direct connection to ground for the signal light 181 and coils 185 and 174 of relays A and B, respectively, is simultaneously established through wire 198, wire 189, and the now closed switches 186 and 207. Such independent connection to ground, which is in parallel with the first mentioned connection to ground at 159 through the contacts of the detector 150, carries the greater part of the current required to energize the signal light 181 and the relay coils 185 and 174, and thus removes any possibility of unduly heating and weakening the current-carrying spring 155 of the thread break detector 150 should such signal light and relay coils remain energized for an extended period.

The described energization of the relay coil 185 of any one of the circuit portions 180 and the closing of its switches 186 and 207 also results in energization of the relay coil 174 when contact set 175 is subsequently closed. Thus upon the breakage of a thread 145 at any one of the sewing heads 10 of the machine, relay coil 174 is energized, when contact set 175 is closed, through a circuit from secondary winding 170 of transformer 167 to relay coil 174, contact set 175, wire 184', switch 207, and ground 206 by the above described alternate paths (1) through wire 189 and switch 186, and (2) through wire 156 and the contacts of the detector 150. The energization of relay coil 174 opens switch 172, thus breaking the holding circuit for relay coil 203 and thereby stopping the motor 164. Relay B remains energized only during the short period during which contacts 175 are closed. Motor 164 is preferably one of the type known as a "Unibrake" electric motor, which stops very quickly upon the opening of switches 200 and 201. The parts of the described machine may be so constructed and arranged that in the event of the breakage of a thread 145 at any of the sewing heads the machine will stop with all of the needle bars 81 of the heads in a raised position to allow rethreading. Timing in this respect may be varied by adjusting the cam 176 to vary the closing time of contacts 175.

Upon the stopping of the machine by the breakage of a thread 145, the lighted signal light 181 will immediately inform the operator which sewing head has the broken thread. The operator then rethreads such sewing head. During this time the relay coil 185 of the sewing head 10 being rethreaded will remain energized through the holding circuit and the signal light 181 of such head will remain energized. To start motor 164, the start switch 202 is momentarily manually closed, thereby monentarily opening reset switch 173. The circuit break at the latter opens the holding circuit for relay coil 185 and thus deenergizes it, so that switches 186, 207, and 187 are opened and switch 188 is closed, and the previously energized signal light 181 is deenergized. The control and signal circuit is now in its initial, operative or ready condition. The closing of switch 202 reenergizes relay coil 203 and starts the motor as described above.

Although only one embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be especially understood that various changes, such as in the relative dimensions of the parts, materials used, and the like, as well as the suggested manner of use of the apparatus of the invention, may be made therein without departing from the spirit and scope of the invention as will now be apparent to those skilled in the art.

We claim:

1. The combination with a sewing machine having a reciprocable needle, drive means for cyclically reciprocating said needle, means to guide a thread from a supply to the eye of the needle and means to tension the thread between the supply and needle during only a part of each cycle of operation of the needle, of control means for automatically rendering said drive means inoperable to reciprocate the needle upon failure of said thread tensioning means to tension the thread, said control means including a thread tension detector comprising a member having a first end adapted to be secured to a fixed support and an arm extending a substantial distance outwardly from said first end, means forming a first, fixed electrical contact affixed to said arm adjacent the outer end thereof, an electrically insulating body affixed to the first end of the member, an elongated electrically conducting coil spring extending generally parallel to and spaced from said arm, a first terminal means supported on the insulating body to which the first, inner end of the spring is secured, a thread guide secured to the second, outer end of the spring, and means affixed to the thread guide forming a second, movable contact which engages the first contact when the thread is untensioned, the thread guide being adapted to form a salient zone in the thread, whereby when the thread in said salient zone is subjected to appreciable tension the two contacts are separated.

2. The combination as claimed in claim 1, wherein the first end of the member is generally in the form of a sleeve, the insulating body is a bushing mounted within the sleeve, the terminal means is a metal rod which extends through the bushing, and the first end of the spring is telescoped over and makes electrical connection with the outer end of the rod.

3. The combination as claimed in claim 2, wherein the member is made of electrically conductive metal and is adapted to form a second terminal of the detector, and wherein the first contact is formed as a clip

which is removably telescoped over the outer end of said arm.

4. The combination of claim 1 including signal means and means for automatically energizing the signal means upon failure of said thread tensioning means to tension the thread.

5. The combination of claim 1 wherein said control means functions, upon such failure, to effect stoppage of the needle at a predetermined approximate position in its cycle to facilitate rethreading thereof.

6. In a sewing machine having a reciprocable needle, drive means for cyclically reciprocating said needle and means for tensioning a thread between a source and the needle, the combination therewith of an electrical control system comprising a source of electrical energy, a signal circuit connected across said source comprising a first normally closed switch, a second normally open switch, an electro-magnet and a third normally open switch adapted to be opened by said electro-magnet when the same is energized, said switches and electro-magnet being connected in series, a fourth normally open switch adapted to be closed by said electro-magnet when the same is energized, means for opening said first switch when the thread is under tension, means for momentarily closing the second switch during a portion only of each cycle of operation of the needle when the thread is normally under tension, whereby upon failure of the thread tensioning means to tension the thread, said first and second switches are simultaneously closed and said electro-magnet is energized, and a holding circuit connected across said source comprising in series said electro-magnet and said first and fourth switches, said electro-magnet when energized being adapted to close said fourth switch.

7. A sewing machine as defined in claim 6 comprising electrical signal means connected in parallel with said electro-magnet.

8. A machine as defined in claim 6 comprising normally open switch means adapted to be closed by said electro-magnet when the same is energized, another circuit connected across a source of electrical energy comprising in series a second electro-magnet, said normally open switch means and a normally open circuit breaker, means for momentarily closing said circuit breaker in synchronism with said second switch, whereby said second electro-magnet is energized following initial energization of said first-named electro-magnet, and normally closed switch means adapted to be opened by said second electro-magnet when the same is energized to de-energize said drive means.

9. A machine as defined in claim 8 comprising a normally closed reset switch in said holding circuit.

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