Oct. 17, 1950 L. ROSEMAN 2,526,279

DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

Filed Sept. 23, 1944 6 Sheets-Sheet 1

Fig. 1

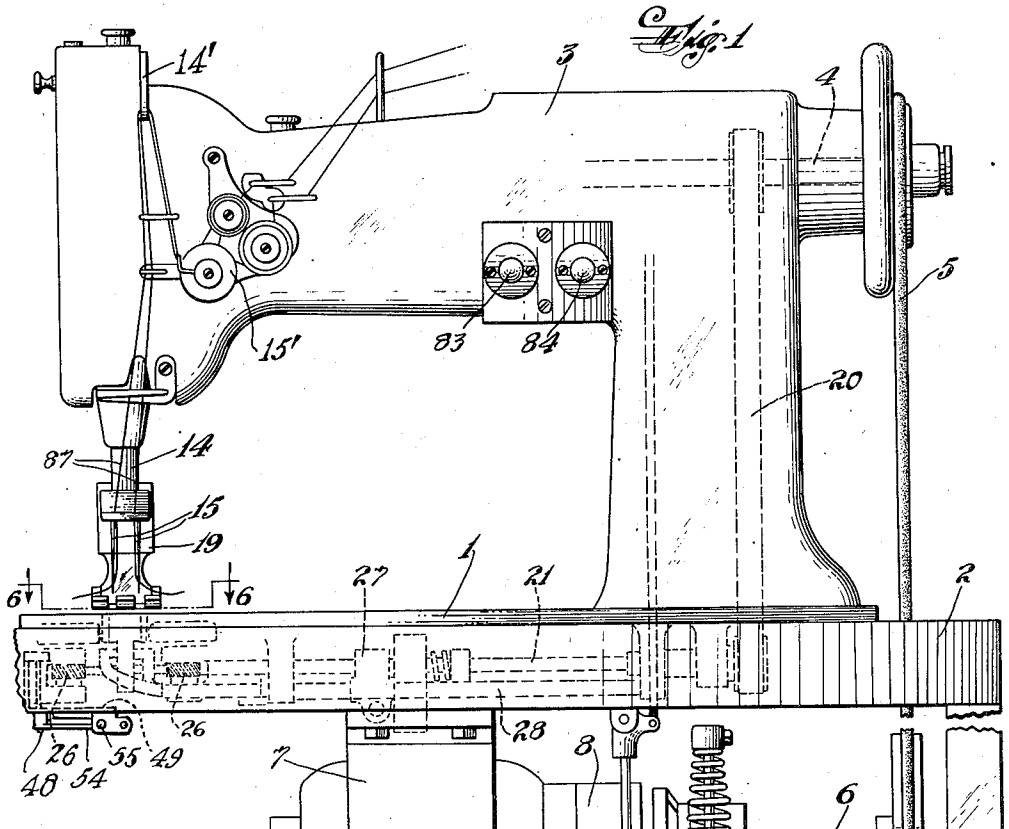
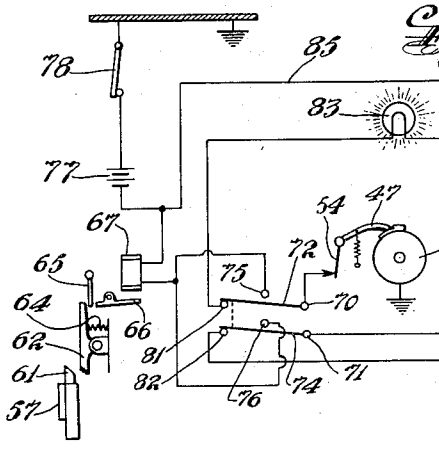


Fig. 1a



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Oct. 17, 1950 L. ROSEMAN 2,526,279

DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

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Fig. 2

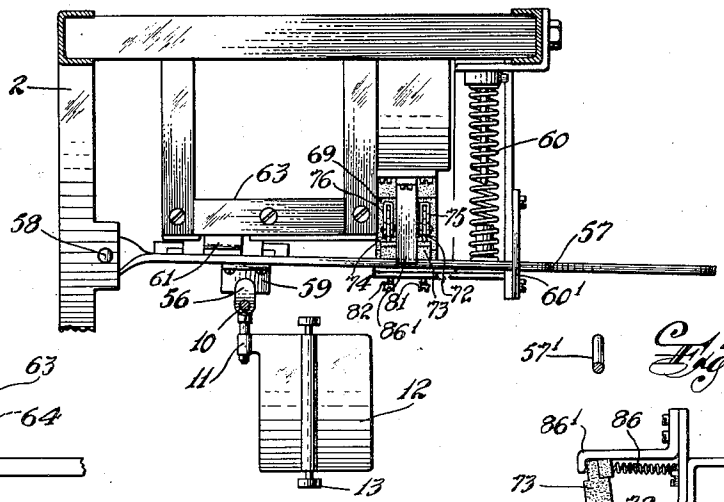


Fig. 4

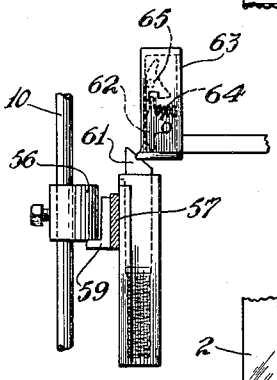


Fig. 5

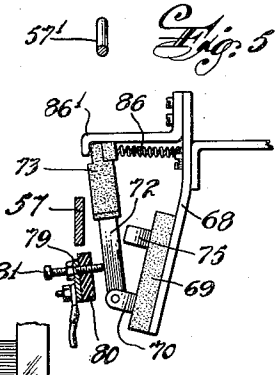


Fig. 3

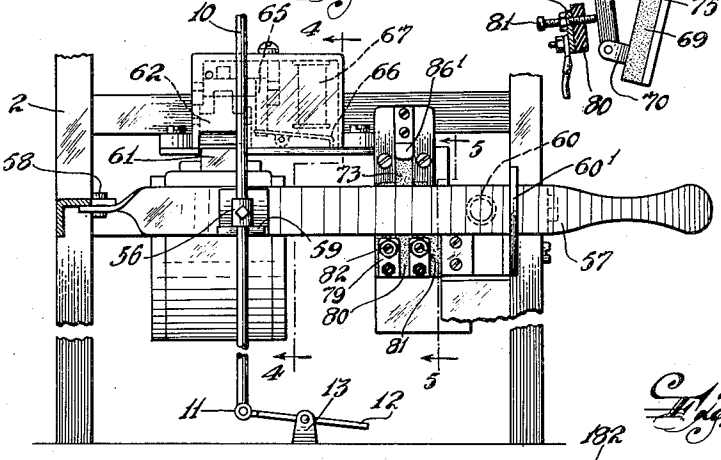


Fig. 33

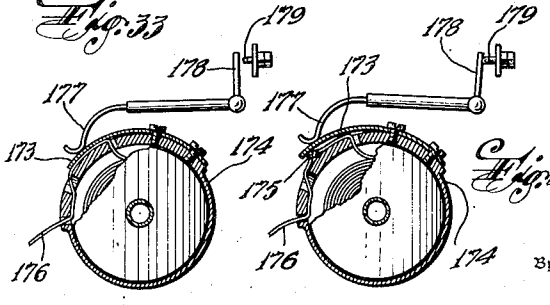
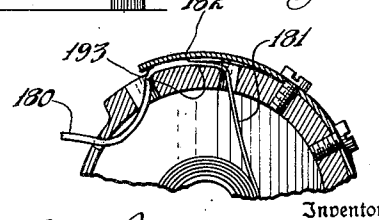


Fig. 34

Fig. 35



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DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

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Fig. 6

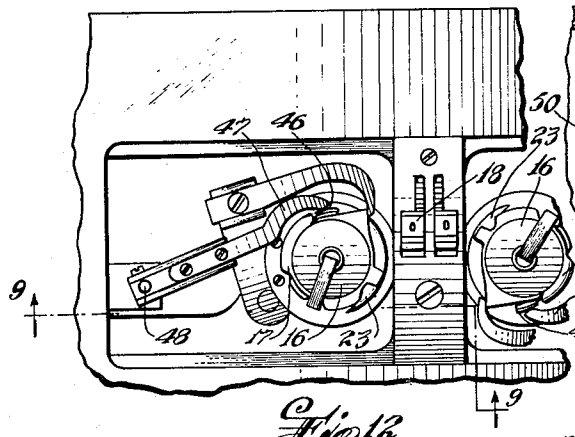


Fig. 9

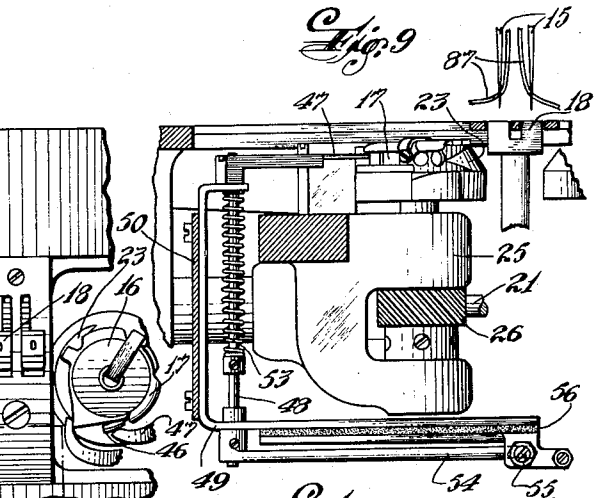


Fig. 12

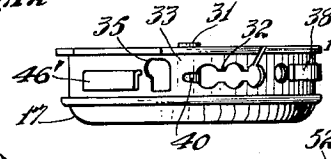


Fig. 11

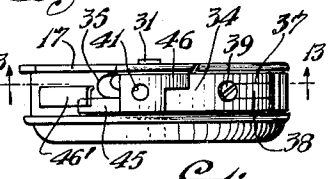


Fig. 7

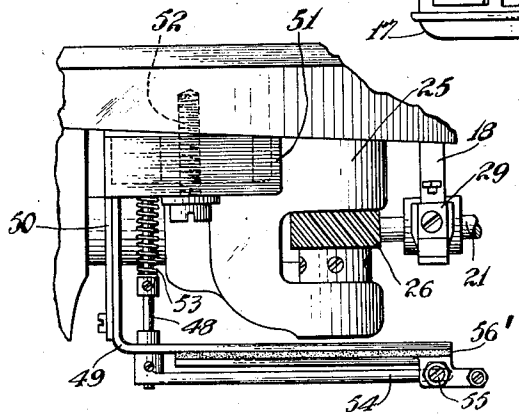


Fig. 8

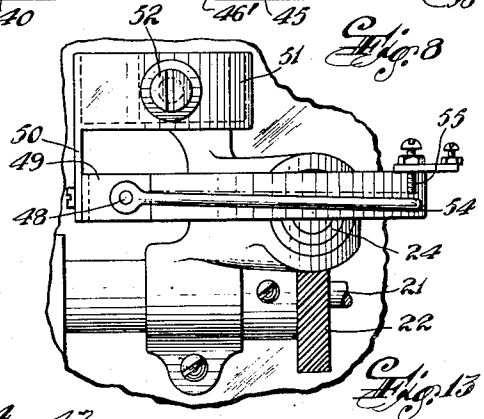


Fig. 10

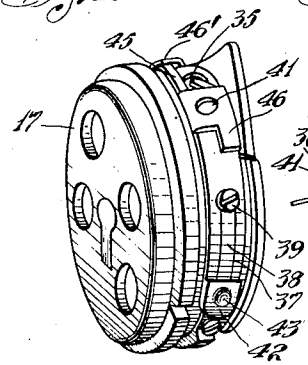


Fig. 14

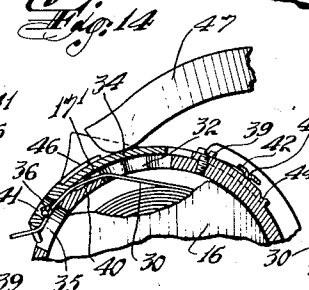
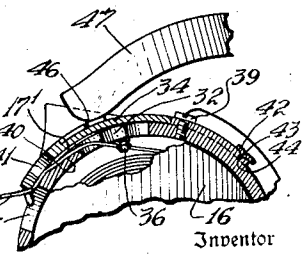


Fig. 13



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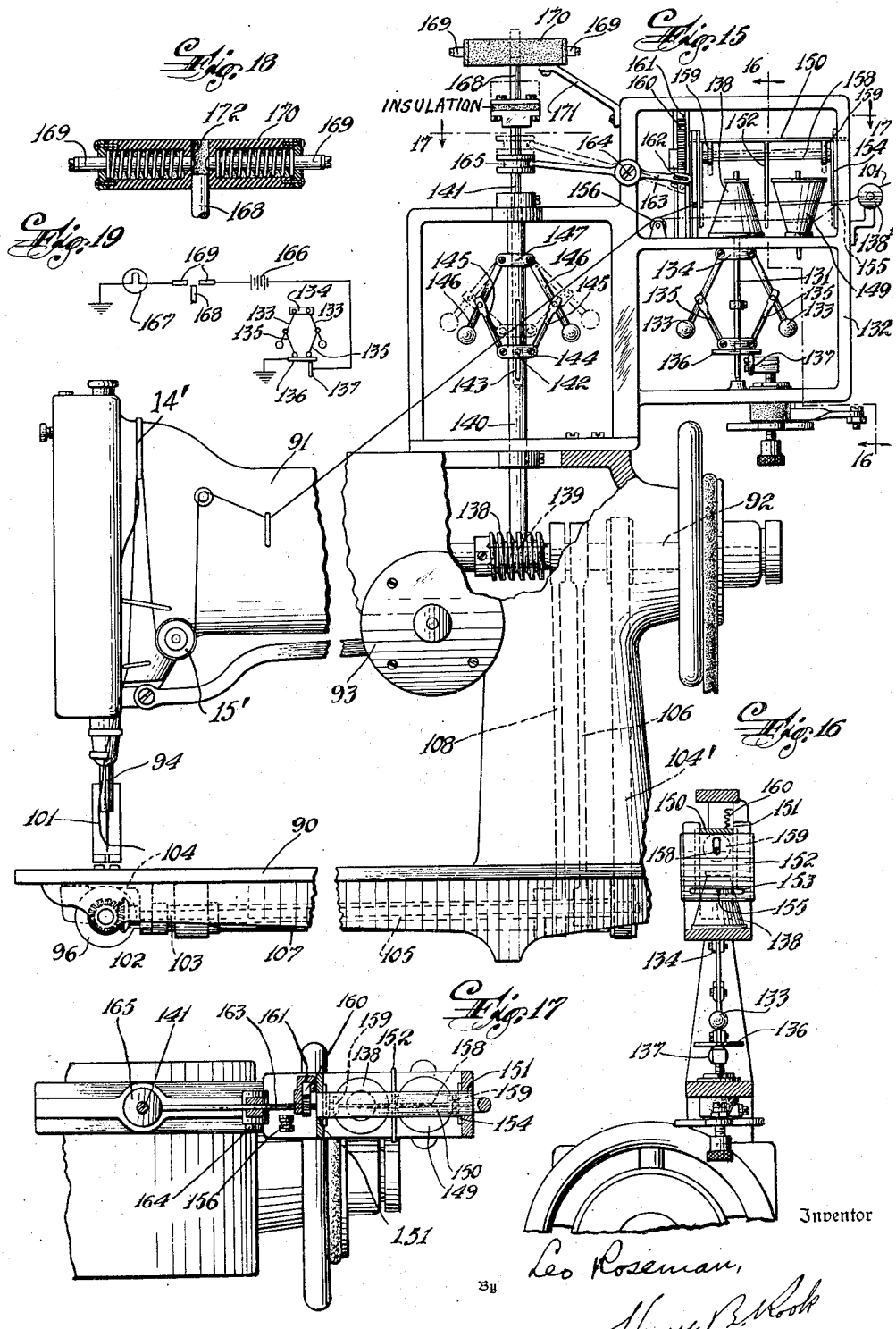
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Oct. 17, 1950 L. ROSEMAN 2,526,279

DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

Filed Sept. 23, 1944 6 Sheets-Sheet 4



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DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

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Fig. 20

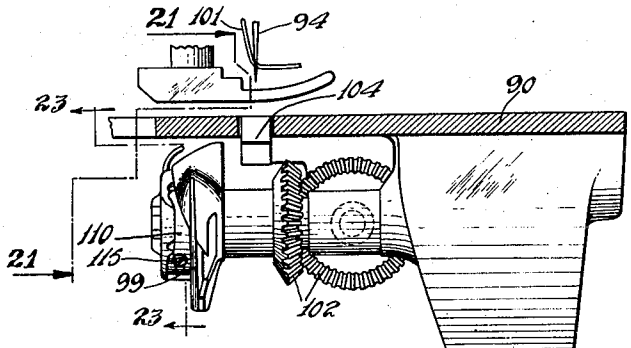


Fig. 21

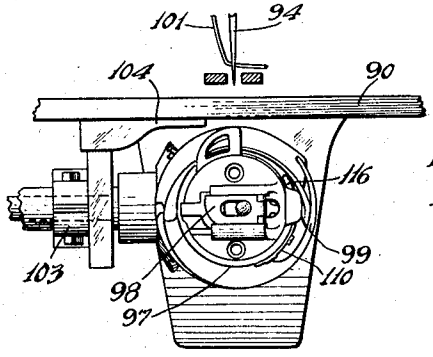


Fig. 23

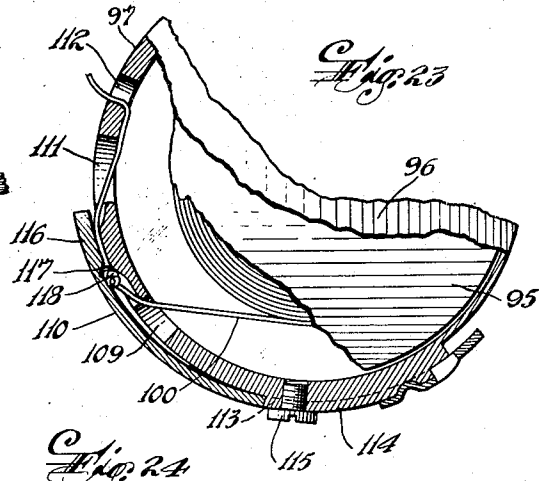
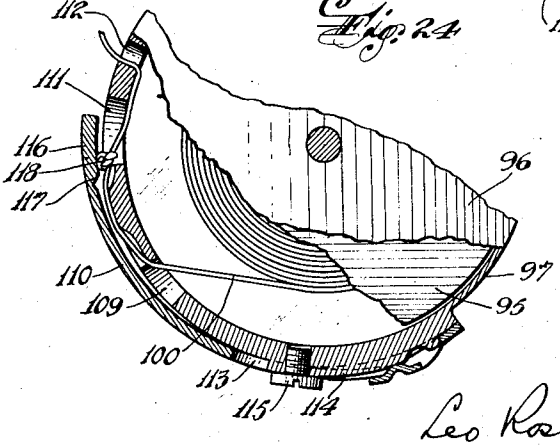


Fig. 24



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DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

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Fig. 28

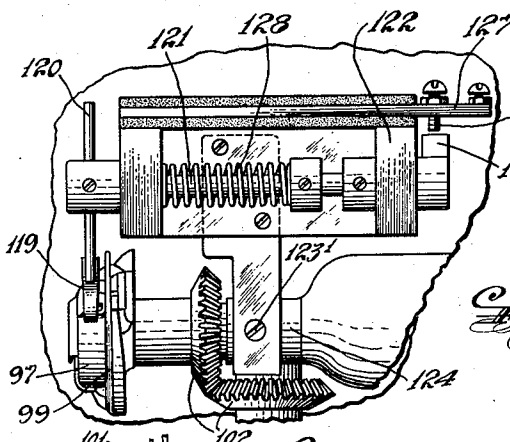


Fig. 26

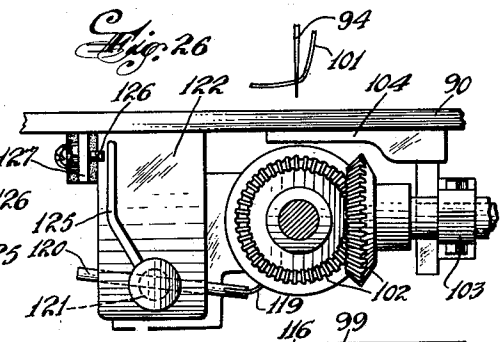


Fig. 27

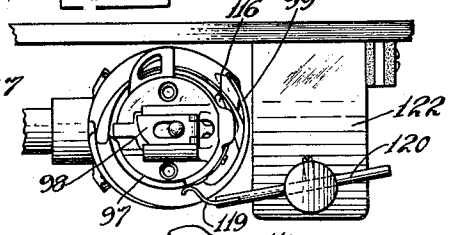


Fig. 25

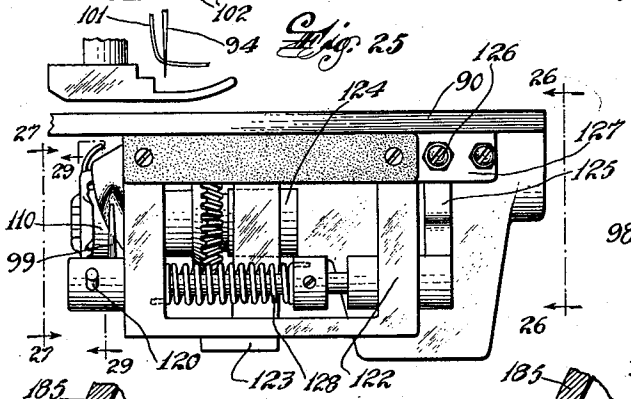


Fig. 22

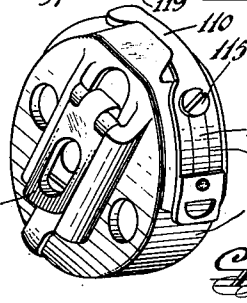


Fig. 32

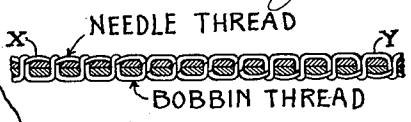


Fig. 29

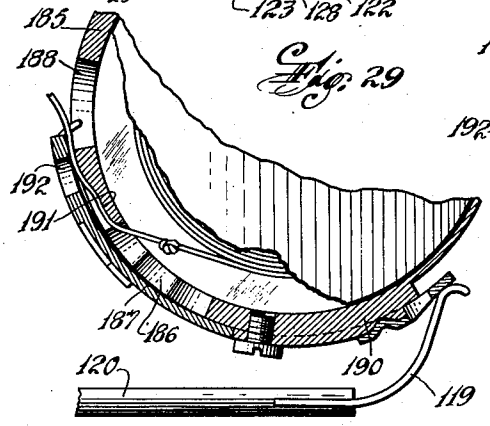
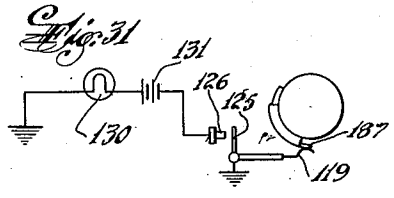


Fig. 30

Fig. 31



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Patented Oct. 17, 1950 2,526,279

UNITED STATES PATENT OFFICE

2,526,279

DEVICE FOR PRODUCING WARNING PRIOR TO EXHAUSTION OF BOBBIN THREAD

Leo Roseman, Newark, N. J.

Application September 23, 1944, Serial No. 555,534

21 Claims. (Cl. 112—218)

1

This invention relates in particular to sewing machines and other types of machines that include bobbins, shuttles or the like, and especially contemplates a novel and improved method of and mechanism for automatically effecting a warning, or for stopping or preventing starting of the machine, or for performing some other operation or producing some result upon or prior to exhaustion of the bobbin thread.

It is well known that in the ordinary operation of sewing machines, especially in commercial production of sewed articles, the bobbin thread runs out or becomes exhausted, without previous warning to the operator, about every ten to twenty minutes, and frequently before the sewing of the article has been completed. The exhausted bobbin must be replaced, which is often troublesome, especially when the work or folding or guiding attachments overlie the bobbin cases; it being difficult to remove such attachments before the sewing operation on an article is completed; and, moreover, the stitching is interrupted which leaves loose ends on the threads to be trimmed and causes a "patched" appearance in the stitches at the point where stitching was interrupted and resumed. Furthermore, in many instances when the bobbin thread runs out before the line of stitching is completed, it is necessary to remove the stitches that have been formed and to start another line after a new supply of bobbin thread has been provided.

Not infrequently, the bobbin thread runs out but the needle thread on the upper surface of the work appears as if the stitching were normal, so that incomplete stitching continues for long periods without discovery that the bobbin thread is exhausted, which requires repeating the sewing operation and causes substantial loss of time.

It is, of course, desirable that the stitching should not be interrupted and that, if possible, bobbin thread replacements should be made after sewing of one article has been completed and before sewing of another has been started. On special work the operator often removes the bobbin before the stitching of an article is completed to ascertain whether enough thread remains to complete the sewing and thereby avoid such interruption in the line of stitches. This is troublesome and time-wasting procedure. My invention overcomes these difficulties and disadvantages and ensures that the operator shall be warned or that the machine shall be stopped to avoid exhaustion of the bobbin thread at an undesirable time.

A prime object to my invention is to provide

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a simple and reliable method and mechanism of the character described wherein a change in or variation of, or addition to the bobbin thread shall be made artificially at a predetermined distance from the end of thread to effect or control the production of the warning or the stopping of the machine, or some other operation or result at a predetermined time prior to the exhaustion of the thread and soon enough before completion of the sewing operation to ensure adequate thread to finish the stitching.

Further objects are to provide mechanisms which shall be adaptable to many different types of sewing machines without change in the fundamental structure of the machines, and to provide such a mechanism which shall embody novel and improved features of construction wherein said change in, variation in the condition of, or addition to the bobbin thread shall cooperate with the tension spring on the bobbin case to produce a certain result, for example to actuate an electric circuit for operating a signal or for controlling stop mechanism for the machine.

A further object is to provide a mechanism of this character wherein said cooperation of said bobbin thread with said tension spring shall vary the tension on the bobbin thread, and means responsive to said variation in tension shall be provided to produce a certain result, e. g. operate a signal, etc.

It is known that a change in tension on the bobbin thread will cause a change in the amount of the needle thread used in lock-stitch sewing machines. In my Patent No. 1,647,148, I have described means responsive to variations in feeding movement of the needle thread for controlling an electric circuit, to operate a signal, when the amount of the thread being used varies during a sewing operation.

Another object of my invention is to utilize such means responsive to variation in the amount of the needle thread consumed, in combination with said mechanism wherein the tension on the bobbin thread is changed by cooperation of the bobbin thread and the bobbin tension spring, whereby to operate a signal, etc.

In sewing machines including such a combination and wherein the speed of operation may be suddenly and often changed by manual control, the amount of the needle thread consumed, may be varied by such speed changes during normal operation so as to produce a false signal, and accordingly another object of my invention is to provide novel and improved means for compensat-

ing for said sudden-speed changes and thereby to prevent false signals.

A further object is to utilize in combination with said mechanism that is actuated by the bobbin thread, means for preventing starting of the sewing machine or another machine after said mechanism has been actuated and until said mechanism has been restored or reset manually or automatically to its initial normal condition, for example, upon replacement of the exhausted bobbin and resetting of the tension spring, whereby to ensure, for example, that the machine will not be accidentally started without adequate bobbin thread.

Other objects, advantages and results of the invention will be brought out by the following description in conjunction with the accompanying drawings in which

Figure 1 is a front elevational view of a sewing machine having applied thereto a mechanism embodying my invention for warning of the approaching exhaustion of the bobbin thread and for preventing starting of the machine until it is in proper condition for operation.

Figure 1*a* is a wiring diagram of the electrical circuit forming a part of the said mechanism.

Figure 2 is a fragmentary horizontal sectional view on the line 2—2 of Figure 1.

Figure 3 is a side elevational view of a part of a stop mechanism observing the same from the line 3—3 of Figure 1.

Figure 4 is a transverse vertical sectional view on the line 4—4 of Figure 3.

Figure 5 is a similar view on the line 5—5 of Figure 3.

Figure 6 is an enlarged fragmentary top plan view of the bed portion of the machine observing the same from the line 6—6 of Figure 1, and showing the slide cover plates removed.

Figure 7 is a front elevational view of the parts shown in Figure 6.

Figure 8 is a bottom plan view thereof.

Figure 9 is a vertical longitudinal sectional view on the line 9—9 of Figure 6.

Figure 10 is an enlarged detached perspective view of the bobbin case.

Figure 11 is an edge view of the bobbin case, observing the same from an angle slightly different from that shown in Figure 10.

Figure 12 is a similar view showing the tension spring removed.

Figure 13 is an enlarged fragmentary sectional view of the right-hand bobbin shown in Figure 6, taken approximately on the line 13—13 of Figure 11 and showing the normal positions of the feeler of the electrical switch mechanism and the thread tension spring therefor.

Figure 14 is a similar view showing the positions of the feeler and the tension spring after the latter has been actuated by a knot in the bobbin thread.

Figure 15 is a front elevational view of a sewing machine having another form of my invention applied thereto.

Figure 16 is a vertical sectional view on the line 16—16 of Figure 15.

Figure 17 is a horizontal sectional view on the line 17—17 of Figure 15.

Figure 18 is an enlarged vertical sectional view through one of the switches of the electrical signaling circuit.

Figure 19 is a wiring diagram of the electrical signaling circuit controlled by the needle thread.

Figure 20 is an enlarged fragmentary side elevational view of the portion of the machine containing the bobbin and sewing hook.

Figure 21 is an elevational view taken from the line 21—21 of Figure 20.

Figure 22 is an enlarged detached perspective view of the bobbin case.

Figure 23 is an enlarged vertical sectional view on the line 23—23 of Figure 20, showing the normal position of the tension spring on the bobbin case.

Figure 24 is a similar view showing the position of the tension spring after the latter has been actuated by a knot in the bobbin thread.

Figure 25 is a view similar to Figure 20 showing a modification of the feeler and circuit closing mechanism especially designed for use with the type of sewing machine shown in Figure 15, but wherein the tension of the bobbin thread is not varied.

Figure 26 is an elevational view taken from the plane of line 26—26 of Figure 25.

Figure 27 is a like view taken from the plane of line 27—27 of Figure 25.

Figure 28 is a bottom plan view of the parts shown in Figure 25.

Figure 29 is an enlarged vertical sectional view through a bobbin case showing the normal position of the feeler and of the tension spring on the bobbin case.

Figure 30 is a similar view showing the position of the tension spring after it has been actuated by the knot in the bobbin thread.

Figure 31 is a wiring diagram of the electrical signaling circuit controlled by the feeler.

Figure 32 is an enlarged longitudinal vertical sectional view through two pieces of material joined together by a lock stitch such as is formed by the machines hereinbefore mentioned.

Figure 33 is a schematic view, with portions broken away and shown in section, illustrating another form of bobbin and another manner of actuating the tension spring and circuit closing mechanism by the knot on the bobbin thread, the parts being shown in their normal positions.

Figure 34 is a similar view showing the manner of operation of the tension spring and circuit closer by the knot on the bobbin thread, and

Figure 35 in a view similar to Figure 33 showing another modification of the invention.

Referring particularly to the form of the invention shown in Figures 1 to 14 inclusive, for the purpose of explaining the principles of the invention I have shown it in conjunction with a known type of "Singer" sewing machine, particularly the machine generally known as "112-w-140," and for simplicity many parts of the machine have been omitted while other parts are only schematically illustrated because they are not essential to an understanding of my invention. It should be understood that no change of structure in the sewing machine is necessary, except in the bobbin tension spring hereinafter described.

Generally describing the machine it includes a bed plate 1 which is shown as mounted on a table or bench 2 and which has a goose neck or main frame 3 in which is journaled a drive shaft 4 which is driven by a belt and pulley connection 5 from a drive shaft 6 which is adapted to be connected and disconnected from an electric motor 7 through a suitable clutch 8 which is controlled by a lever 9 which is normally spring influenced upwardly in known manner and is pulled downwardly through a pull rod 10. This pull rod 10 is pivotally connected at 11 to a

treadle 12 which is pivotally connected at 13 to the floor beneath the machine so that upon oscillation of the treadle the rod will be pulled down and permitted to rise so that the clutch 8 may be engaged and disengaged to start and stop the machine respectively.

Mounted in the goose neck 3 is thread take-up lever 14' and tension device 15', and a needle bar 14 which carries two needles 15 each to cooperate with a bobbin 16 which is mounted in a bobbin case 17 in the usual manner. Between the bobbin cases is a known feed dog 18 cooperating with a presser foot 19 for feeding work under the needles.

As usual, the needle bar is driven from the shaft 4, and this shaft also has a belt and pulley connection 20 with a shaft 21 journaled on the bed plate of the machine and having a helical gear 22 for each sewing hook 23 which is mounted on a shaft 24 journaled in the saddle 25 and carrying a helical gear 26 meshing with the corresponding gear 22. As shown, there is an eccentric and push rod connection 27 between the shaft 21 and a feed rock shaft 28 which is connected to the feed dog 18 for reciprocating the latter, and the shaft 21 has the usual eccentric and lever connection 29 with the dog 18 for moving the latter up and down.

Now, referring more particularly to the novel features of my invention, the bobbin cases 17 remain stationary during operation of the machine and each has rotatably mounted therein a bobbin 16 on which is wound the bobbin thread 30. The bobbin is removable and the bobbin case has a central spindle 31 on which the bobbin is rotatable. The bobbin case also has a slot 32 in its side walls through which the thread 30 from the bobbin is pulled outwardly and between a portion 33 of the outer surface of the bobbin case and a tension spring 34 so that said tension spring frictionally presses the thread between itself and the bobbin case to create tension on the thread. The thread is led outwardly from beneath the tension spring into another opening 35 which is partially overlaid by the tension spring.

The tension spring is mounted on the case for longitudinal movement and to be actuated by a knot or protuberance 36 on the bobbin thread at a predetermined distance from the inner end of the thread. More specifically, the spring has a longitudinal slot 37 through which extends a guide rib 38 on the bobbin case, and the spring is held against displacement by a headed screw 39. The bobbin case has an extra deep thread guide groove 40 leading outwardly from the slot 32 to permit free passage of the knot, and the tension spring has an opening 41 normally overlying the outer end of said guide groove so that as the bobbin thread is pulled from the bobbin the knot 36 will engage the edges of the opening 41 and pull the tension spring longitudinally of itself or circumferentially of the bobbin case until the knot reaches the opening 35 in the case, whereupon the knot will become disengaged from the opening 41 and the thread will continue to move without affecting the tension spring. Movement of the tension spring with the knot continues until the knot is freed from the opening 41. The portion of the tension spring rearward of the opening 41 continues to press the thread between itself and the smooth surface 17' of the bobbin case between the slot 32 and the outlet opening 35, so that the normal tension on the bobbin thread is maintained or unchanged.

For normally yieldingly holding the tension spring against movement by the thread the spring may have a resilient portion 42 provided with a stud or protuberance 43 to snap into and out of a depression 44 in the rib 38 on the casing, so that when the stud 43 is in said depression 44, the spring will be yieldingly held against movement but can be moved under the tension on the bobbin thread when the knot 36 engages the hole 41. To prevent the bobbin spring from being pulled away from the bobbin case in such a manner as to relieve the tension on the thread the spring may have a finger 45 slidable beneath a guide flange 46' on the bobbin case.

In accordance with this form of the invention, the knot 36 will be formed in the thread at a predetermined distance from the end thereof which is initially wound on the bobbin 16, that is, the terminal end, so that while the thread is wound on the bobbin and the bobbin is in use on a machine, the tension spring will be actuated as above described at a predetermined time prior to the total removal of the thread from the bobbin, i. e. prior to exhaustion of the bobbin thread. As shown, the spring 34 of each bobbin case has a ledge 46 which when the tension spring is in its normal position during operation of the machine as shown in Figures 6, 10 and 13 is frictionally abutted by one end of a feeler 47, the other end of which is connected to a pivot rod 48 which is rotatably mounted in a bracket 49 secured to one arm 50 of a hanger which includes a box-like head portion 51 which conveniently may be secured to the bed plate of the machine by one of the screws 52 by which the hook shaft saddles 25 are mounted on the bed plate. The pivot rod 48 is normally actuated by a spring 53 to hold the feeler 47 in contact with the bobbin tension spring, with a slight pressure which will permit the needle thread loop to pass between the feeler and the tension spring at each stitch and without affecting the sewing operation in any manner. The pivot rod 48 also carries a switch arm 54 which is adapted to cooperate with a contact screw 55 which is mounted upon the bracket 49 and insulated therefrom by a strip of insulation 56'. During normal operation of the machine each feeler 47 is held in engagement with its respective tension spring, and each switch arm 54 is held in spaced relation to its corresponding screw 55 by the spring 53. When the knot 36 in either bobbin thread engages the opening 41 of the corresponding tension spring, said spring will be slid longitudinally from the position shown in Figure 13 to the position shown in Figure 14 so as to move the ledge 46 from beneath the feeler 47 and permit the spring 53 to swing the switch arm 54 into contact with the screw 55. In accordance with the invention, this operation may be utilized for producing any desired result or for performing any desired operation, such as closing the electrical circuit of a visible or audible signal, or closing the circuit through automatic stop mechanism for the machine.

As shown, both a visible signal and a mechanism which will prevent starting of the machine after it has once been stopped by the operator following the warning given by the signal, are provided.

More specifically describing the mechanism, the pull rod 10 has a laterally projecting shoe 56 thereon and a starting control lever 57 is pivotally mounted at one end as at 58 on the bench 2 and has a lug 59 which normally is located under

the shoe 56 to prevent the pull rod from being pulled downwardly in such a manner as to engage the clutch 8 and start the machine. A compression spring 60 normally holds the lever 57 in this position against a stop member 60'.

In order to start the machine it is necessary to swing the starting control lever 57 against the influence of the spring 60 to move the lug 59 from beneath the shoe 56, which can be conveniently accomplished by swinging a knee-lifter 57' which is generally attached to a sewing machine for lifting the presser foot by use of the operator's knee. The lever 57 is releasably held in this position by engagement of a spring actuated latch bolt 61 carried by the lever, with a latch tongue 62 which is pivotally mounted in a fixed casing 63 and normally is influenced into latching position by a spring 64. The latch tongue is normally locked in latching position by a locking lever 65 which is controlled by a detent 66 that is in turn actuated by an electromagnet 67 for releasing the locking lever 65 (see Figures 3, 4 and 1a). This electromagnetic latch mechanism may be of any suitable construction, for example such as is embodied in known types of electromagnetic door openers.

Mounted on a suitable bracket 68 on the bench 2 is an insulating switchblock 69 having two terminal posts 70 and 71 to each of which is connected a blade one of which, 72, is rigidly connected by an insulated cross-piece 73 to the other switch blade 74. On the switch block 69 are also mounted two contact elements 75 and 76 to cooperate with the respective blades 72 and 74, and both of these two contact elements are connected to one terminal of the electromagnet 67, the other terminal of which is connected to one terminal of a low-voltage source of electricity 77 the other terminal of which is connected to one terminal of a main switch 78 which may be grounded on the bed plate of the machine. Mounted on a bracket 79 at the side of the switch blades 72 opposite the switch block 69 is a block of insulation 80 in which are mounted two adjustable contact screws 81 and 82. One of these screws is connected to one terminal of a signal lamp 83, corresponding to the left-hand bobbin 16, while the other screw 82 is connected to one terminal of a lamp 84 which corresponds to the right-hand bobbin 16. The other terminals of the lamps are connected together and to the source of electricity by a wire 85. The terminals 70 and 71 of the switch are connected respectively to the contact screws 55 corresponding to the respective bobbins. The bobbins are of course grounded on the bed of the machine as are also the feelers 57, pivot rods 48 and switch arms 54.

In operation, when both bobbins are filled and the machine is at rest, the starting control lever 57 is in the position shown in Figure 2 so as to prevent starting of the machine by manipulation of the treadle. In this position the switch blades 72 and 74 are influenced into contact with the screws 81 and 82 by a spring 86 and the electromagnet 67 is deenergized. Before starting the machine, the exhausted bobbin must be replaced and the bobbin tension spring must be reset to its normal position. Then the operator swings the lever 57 by pressure on the knee-lifter to cause the latch bolt 61 to engage the latch tongue 62 and thus hold the lug 59 out of the path of the shoe 56, so that the operator through the treadle 12 may control the starting, stopping, and the speed of the machine at will. As the lever moves, it engages the cross piece of insulation 73 on the switch so as to actuate the switch blades 72 and 74 into engagement with the contact members 75 and 76.

During operation of the machine, the bobbin thread is withdrawn from the bobbin and interlocked with the needle threads 87 to form lock stitches as shown in Figure 32. When the knot 36 of either bobbin thread actuates the corresponding bobbin tension spring 34 as above described, the corresponding switch arm 54 will be actuated into contact with its screw 55 so as to close the circuit. Thereupon the electromagnet 67 will be energized to release the lever 57, whereupon the corresponding signal lamp 83, 84 will be lighted. The machine will continue to operate and the lug 59 will abut the side of the shoe 56 until the operator deliberately manipulates the treadle to raise the pull rod to stop the machine.

As a rule, the knot will be located in the thread so that there will be adequate thread on the bobbin to finish the sewing operation, i. e., to stitch to the end of the article being sewed, after the signal has been produced, and operation of the machine usually will be continued until the end of the article is reached. This avoids interruption of stitching and ensures a minimum of waste of thread.

When the pull rod 10 is raised to stop the machine, the shoe 56 thereby is moved above the lug 59 and then the lever 57 will be moved farther under the influence of the spring 60 so as to locate the lug 59 under the shoe and prevent accidental starting of the machine. It is, of course, possible for the operator to deliberately push the lever 57 and disengage the lug from the shoe so as to permit operation of the machine, but the electromagnet 67 will become energized so that the latch tongue 62 will not hold the lever 57 and this condition will continue until the bobbin tension spring 34 has been reset to open the corresponding switch 54, 55, which ordinarily will not be done until after the bobbin has been replaced. However, if the operator desires to continue the operation of the machine for any purpose before the bobbin has been replaced and without holding the starting control lever, she may simply open the main switch 78 which will prevent energization of the electromagnet 67 and thereby permit the starting lever to be locked in the position to permit starting and operation of the machine.

It should be pointed out that the use of the presser foot knee-lifter for actuating the starting control lever 57 is especially convenient. When the machine stops, generally it is necessary to adjust the work before starting again, and the presser foot is lifted, by swinging the knee-lifter to the right in Figure 1, which at the same time sets the starting control lever. This one simple movement of the knee-lifter performs two operations at the same time and leaves the operator's hands free for adjusting the work. After the control lever has been set, further movement of the knee-lifter will operate only the presser foot.

Another form of the invention is shown in Figures 15 to 24 where the production of the warning is controlled by variations in the tension on the bobbin thread. For convenience, the invention is shown in conjunction with a "107-w-1 Singer" sewing machine which includes the usual bed 90 from which projects the usual goose neck 91 in which is journaled the drive shaft 92 which drives known mechanism 93 through known

means, for oscillating the needle bar which has the usual needle 94 to produce zig zag stitching. Cooperating with the needle is a bobbin 95 which is inserted in a bobbin case having the usual base 96 and a removable cover or cap 97 which is separably connected to the base by a latch 98. The usual sewing hook 99 cooperates with the bobbin thread 100 and the needle thread 101 in known manner and is driven by beveled gearing 102 mounted on the underside of the bed 90. The beveled gearing 102 is driven by a shaft 103 journaled on the bed of the machine and having a belt and pulley connection 104' with the drive shaft 92. Mounted on the shaft 103 is a tubular shaft 105 which has the usual eccentric and connecting rod connection 106 with the drive shaft 92 and is also connected at 103 to the feed dog 104 of the machine for moving the latter up and down. A rocker shaft 107 is connected to the feed dog to reciprocate the latter and has the usual eccentric and connecting rod connection 108 with the drive shaft 92. As hereinbefore mentioned, all of these parts of the machine are old and well known and are only schematically illustrated.

The bobbin case 97 has the usual opening 109 through which the thread is drawn outwardly over the outer surface of the case cover beneath a tension spring 110. The case cover also has a second opening 111 through which the thread is drawn inwardly from the tension spring and thereafter threaded outwardly through a guide opening 112.

One end of the tension spring 110 has a slidable connection with the bobbin case cover which includes a longitudinal slot 113 in the spring slidable upon a rib 114 on the case cover, and the spring is held in the case cover by a headed screw 115. The other and free end of the tension spring has a shoe 116 which normally bears upon the thread to create the necessary tension but which provides a shoulder 117 for engagement by a knot or other protuberance 118 on the bobbin thread as the thread is pulled from the bobbin so that the tension spring will be moved with the bobbin thread and knot until the knot approaches the opening 111 in the bobbin case, whereupon the knot will become disengaged from the spring and the shoe 116 will release the tension on the thread.

Means responsive to this change in tension is provided for producing a desired result, for example, to operate a signal. This means is similar to that shown in my Patent No. 1,647,148 but is more sensitive and adjustable and includes a centrifugal governor having a vertical shaft 131 journaled in a frame 132 on the goose neck 91 and having a pair of weighted arms 133 pivotally connected to a collar 134 on the shaft and also pivotally connected by links 135 to a disc 136 which is vertically slidable on the shaft and constitutes one element of an electric switch, the other element of which is a roller 137 mounted on the superframe 132 in insulated relation thereto. Also, rigidly connected to the shaft 131 is a spool 138' around which passes one or more turns of the needle thread 101 between the needle and a tension device 138' which controls the tension on the thread from the source of supply such as the spool. With this construction when the machine is in operation the needle thread 101 is interlocked with the bobbin thread 100 to form lock stitches as shown in Figure 32, and as the needle thread is pulled through the machine it rotates the centrifugal governor shaft 131 so as to raise the weighted arms 133 by centrifugal action and elevate the disc 136 out of contact with the roller 137. Should the amount of the needle thread consumed decrease, for example by a decrease in tension in the bobbin thread as shown at X in Figure 32, the speed of rotation of the governor shaft 131 will decrease so as to allow the disc 136 to descend and contact with the roller 137. Conversely, an increase in tension on the bobbin thread will cause an increase in the amount of needle thread consumed as shown at Y in Figure 32, which in turn will increase the speed of rotation of the governor shaft, so that by placing contact roller 137 above the disc 136, the disc will contact the roller upon an increase in tension on the bobbin thread.

If desired, the disc 136 and roller 137 may be connected in circuit with a signal lamp and a source of electricity to indicate when the tension in the thread varies as above described, especially where the machine is automatic and operates at substantially uniform speed.

Where sudden and large variations in the speed of the machine occur, for example when the machine is manually controlled by a treadle and a clutch, I provide mechanism for ensuring substantially uniform normal speed of operation of the governor shaft 131 regardless of variations in speed of the machine, so as to avoid false signals. This mechanism is shown as comprising a worm 138 on the machine drive shaft 92 with which meshes a worm gear 139 on a vertical countershaft 140 which is journaled in the superframe 132. The upper portion of this shaft is tubular and has vertically slidable therein a secondary shaft 141 which is connected by a pin 142 extending through a slot 143 in the shaft 140 to a collar 144 which is vertically slidable on said shaft 140. Said collar is pivotally connected by links 145 to weighted levers 146 which are pivotally connected to a collar 147 fixed on the shaft 140, so that variations in speed of rotation of the shaft 140 will cause the weighted levers and consequently the shaft 141 to be raised and lowered. In order to prevent the governor shaft 131 from being materially affected by changes in speed of the machine; in other words, to ensure that the shaft 131 shall operate at substantially uniform speed, regardless of the speed of the machine, the spool 138 is made approximately conical and the thread is moved lengthwise of the spool as the speed of the machine changes. For example, upon an increase in the speed of the machine, the thread will be moved from a smaller to a larger diameter of the spool while upon a decrease in speed of the machine the thread will be moved from a larger diameter to a smaller diameter. Of course, the spool will not be exactly conical, but the surface thereof will be especially shaped to conform to the variable extent of movement of the collar 144 for different speeds of the machine, it being known that the weighted levers and collar 144 will have smaller movement for each increment of increase in speed, the largest movement being during a change from the lowest to a slightly higher speed.

For the purpose of moving the thread on the spool 138 and to make movement thereof easy and uniform, I preferably utilize an idler spool 149 which is identical with the spool 138 but arranged in upside down relation thereto and provide a thread guide mechanism cooperating with said two spools, which includes a frame having a top piece 150 mounted for vertical movement in guide slots 151 in the superframe.

Between the spools the frame has an arm 152 which has a horizontal thread guide slot 153 and at the side of each spool opposite said arm is an arm 154 which has a thread guide hole 155. The needle thread passes through said guide holes and guide slot and once or twice around each of the spools 138 and 149, over a guide pulley 156, through the usual guides and tension device on the machine, and thence to the needle.

For moving the frame 150 up and down to guide the thread longitudinally of the spools, I have shown a cam shaft 158 which has a pair of cams 159 underlying the cross-piece 150 of the thread guide frame, and said shaft has thereon a pinion 159 which meshes with a straight rack bar 160 slidably mounted in the guide 161 on the superframe. The rack bar 160 has a pin and slot connection 162 with a lever 163 which is pivotally mounted intermediate its ends at 164 on the superframe and has its other end fitted in a grooved collar 165 fixedly connected to the shaft 141, so that as said shaft 141 moves up and down, the rack bar 160 will be reciprocated to rotate the cams 159 and move the thread guide frame. Obviously, as the shaft 141 moves upwardly due to an increase in speed of the shaft 140, the thread guide frame will be moved downwardly to guide the thread to a larger diameter of the spools 138 and 149.

The disc 136 of the governor is electrically grounded on the machine and the roller 137 is connected in circuit with a source of electricity 166, a signal such as the lamp 167 and another switch to prevent false signals. This latter switch comprises a contact plunger 168 mounted on, insulated from and movable longitudinally with the shaft 141 relatively to two spring contact rods 169 which are slidable in an insulated casing 170 that is mounted on a suitable fixed support, for example a bracket arm 171 connected to the superframe 132. The contact rods 169 are normally influenced into an opening 172 in the casing 170 at opposite sides of the plunger 168 so that as the plunger moves into said opening, it will contact both rods 169 and close the circuit. Normally the plunger 168 is in the position shown in Figure 18 to open the circuit, but when the machine starts the plunger is moved upwardly between the two rods 169 to close the circuit. As will be understood from the foregoing, when the machine starts in operation, the disc 136 will be separated from the roller 137 so that normally there will be no signal. However, upon a reduction in tension of the bobbin thread due to engagement of the knot 118 on the bobbin thread with the bobbin tension spring 110, the speed of rotation of the governor shaft 131 will be reduced so as to cause the disc 136 to contact with the roller 137, close the circuit and energize the signal 167. While it is not important, it will also be understood that should the needle thread or bobbin thread break, the signal will be operated in the same way.

After the signal has been operated, the operator may continue the sewing operation to the end of the article being sewed.

In Figures 26 to 31 inclusive is shown another form of feeler and circuit control mechanism which is designed for machines of the type shown in Figure 15, but where it is not desired to change the tension of the bobbin thread. The bobbin case cap 185 has a slot 186 in its side walls through which the bobbin thread is pulled outwardly between the free end of the tension spring 187 and outer surface of the bobbin case

and thence outwardly from beneath said spring over a hole 188, this structure being in general similar to that shown in Figures 13 and 14.

The tension spring has a slidable connection with the bobbin case cover, which includes a slot 189 into which projects a rib 190 on the case cover. Said cover has a thread guide groove 191 leading outwardly from the slot 186 and the tension spring has an opening 192 similar to the opening 41 to be engaged by a knot in the bobbin thread for moving the tension spring in the same manner described in connection with Figures 13 and 14.

Said movement of the tension spring controls the operation of a circuit closer which includes a feeler that may be a metal strip or wire having a curved finger 119 carried at one end of an arm 120 which is rigidly connected to and laterally projects from a rotatable shaft 121 journaled in the arms of a U-shaped bracket 122 which is carried by a hanger 123 that is secured by a screw 123' on the bearing 124 of the hook operating shaft. This affords a simple manner of fastening the prefabricated attachment on one ordinary type of sewing machine without any substantial modification of the machine. Connected to the shaft 121 also, is a switch contact arm 125 which cooperates with a contact screw 126 mounted on a plate 127 which is secured to the bracket 122 in insulated relation thereto.

When the bobbin and tension spring are in their normal positions as shown in Figure 28, the end of the tension spring opposite the hole 192 projects from a ledge on the bobbin case cover and the feeler finger 119 engages said end of the tension spring and is held in spaced relation to the bobbin case cover thereby. Also the switch contact arm 125 is held in spaced relation to the screw 126, a tension spring 128 being provided for influencing the shaft 121 to hold the feeler wire and the switch contact arm in said positions. When the tension spring 187 is actuated by the knot on the bobbin thread, it is pulled from beneath the feeler wire which is thereby permitted to move toward the bobbin case cover, and this movement also causes the contact arm 125 to engage the screw 126.

The switch 125, 126 may be connected in any suitable electrical circuit for producing any desired result, or the arm 125 might be utilized for mechanically operating a part, e. g. a mechanical signal, but as shown in Figure 31, the switch is connected in circuit with a signal lamp 130 and a source of electricity 131 so that when the switch is closed the lamp 130 will be energized to indicate that the knot on the bobbin thread has reached the tension spring, for example, to indicate that the bobbin thread is near exhaustion.

Another modification of the invention is shown in Figures 33 and 34 where the bobbin tension spring 173 has one end rigidly connected to the bobbin case 174 as usual and its free end adapted to be pushed upwardly away from the bobbin case by a knot or other protuberance 175 on the bobbin thread 176 as the latter is pulled from the bobbin. Normally a feeler 177 may rest upon the tension spring 173 and be connected to a switch contact arm 178 so as to hold the latter in spaced relation to a contact screw 179, and thus when the bobbin spring 173 is actuated by the knot said feeler lever 177 will be oscillated to close the switch 178 and 179 which may be connected in for example a signal circuit as hereinbefore described. As shown, the feeler

arm 177 is shorter than the switch arm 178 so that the small movement of the former is magnified at the free end of the switch arm.

Instead of utilizing a knot or some artificial protuberance on the bobbin thread, the thread may include two or more sections 180 and 181 of different diameters as shown in Figure 35 so that as one section moves from beneath the bobbin tension spring 182 and another moves under said tension spring, the spring will be moved to cooperate, for example with a feeler lever as above described. Of course, also, the variation in diameter of the bobbin thread will vary the amount of needle thread consumed, so that, for example, a signal could be effected by sensitive governor mechanism shown in Figures 15–17.

A groove 193 of a depth or width greater than the diameter of the thread section of smaller diameter but less than the diameter of the other section, may be provided in the outer surface of the bobbin case beneath the tension spring, so that the section of larger diameter will project out of said groove farther than the section of smaller diameter, whereby normal tension on the thread will be maintained while the larger section is passing along said groove and the tension will be reduced when the smaller section reaches the groove; and a signal could be effected under control of this change of tension by use of a sensitive governor mechanism like that shown in Figures 15 to 17, as described.

Furthermore, it will be understood that other devices which are responsive to changes in the bobbin thread tension, may be used instead of that shown in Figures 15 to 17.

If desired, the change in the character of the condition of the bobbin thread may be produced by applying to the thread a bead or a drop of a plastic composition or by waxing the thread.

During the formation of lock stitches, if the bobbin thread tension is decreased slightly, the bobbin thread is drawn by the needle thread to the upper surface of the work being sewed, as shown at X in Figure 32, and accordingly if the thread has a section of different color adjacent to the end thereof when said colored section reaches the work, the stitches formed thereby will be clearly visible and thus indicate the approaching exhaustion of the bobbin thread.

Furthermore, it will occur to those skilled in the art that instead of having the longitudinally or circumferentially slidable bobbin tension spring, the bobbin thread might actuate a swinging shoe so as to wedge the latter under the tension spring and reduce the tension on the bobbin thread. Also the tension spring itself might be made to swing laterally under influence of the knot in the bobbin thread.

In certain types of sewing machines, the shuttle or hook body has a portion which projects beyond the bobbin case, and a feeler such as hereinbefore described could not be used because it would interfere with rotation of the hook and formation of stitches or would be damaged by the hook. In such cases, I contemplate using a feeler which reciprocates or oscillates in timed relation to rotation of the hook so as to withdraw from and contact with the tension spring periodically as the hook moves into and out of position between said feeler and said tension spring.

In some cases, it may be desirable to permit greater variation in the adjustment of the bobbin tension spring to regulate the bobbin thread tension than is possible with the structures heretofore described, and for that purpose I may utilize interchangeable tension springs having different strength or tension.

While I have shown and described several different forms of invention in connection with several different types of machines, it should be understood that this is primarily for the purpose of illustrating the principles of the invention and that the construction of the invention might be widely changed and the invention may be utilized in conjunction with other types of machines, all within the spirit and scope of the invention.

The terms "wound thread" or "wound bobbin thread" as used in the appended claims are intended to include a quantity of thread or the like wound upon itself, or, thread wound upon a simple core, or thread wound upon a core having a flange at one end only, or thread wound upon a spool having a flange at each end; and also said terms include shuttles and similar devices. The phrase "indicating means" in said claims is intended to include the signal lamps or other signal devices as well as the mechanism for stopping the machine and means for performing some other operation or producing some result.

What I claim is:

1. The combination of a sewing machine having a wound bobbin thread which is unwound during operation of said machine, a bobbin case for said bobbin, a mechanism to be actuated at a predetermined time during operation of said machine, and a device on said bobbin case for controlling actuation of said mechanism, said bobbin thread having means to cooperate with said device for initiating actuation of said mechanism.

2. The combination of a machine having a wound bobbin thread which is unwound by and during operation of said machine, an electric circuit controller to be actuated at a predetermined time during operation of said machine including a part adjacent to the path of movement of said thread as the latter is unwound, said thread having means at a predetermined portion of its length to engage said part for initiating actuation of said circuit controller, and electrically operated mechanism connected in circuit with and controlled by said circuit controller.

3. The combination of a machine having a wound bobbin thread which is unwound by and during operation of said machine, a bobbin case having a thread tension spring movably mounted thereon, said thread having means at a predetermined portion of its length for momentarily moving said tension spring as said thread is unwound, an electric circuit controller actuated by said tension spring upon said movement thereof, and an electrically operated device connected in circuit with and controlled by said circuit controller.

4. A bobbin case having a thread outlet opening, and a part bodily movably mounted on the exterior of the case in relation to said opening such that said part normally is stationary during withdrawal of normal thread, but will be momentarily engaged and moved by engagement therewith of a protuberance on said thread.

5. A bobbin case having a thread outlet opening, and a tension spring movably mounted on the exterior of said case in relation to said outlet opening such that thread withdrawn from said case slides and is frictionally gripped between said spring and said case and said spring is normally stationary but will be momentarily

engaged and moved by a protuberance on said thread.

6. The combination set forth in claim 2 with the addition of means manually actuated for controlling starting and stopping of said machine, and wherein said mechanism includes means for preventing operation of said manually actuated means after the latter has been operated to stop the machine.

7. The combination of a machine having a bobbin with a thread thereon which is unwound during operation of said machine, a bobbin case for said bobbin, a tension device on said case for normally holding said bobbin thread under tension, an electric circuit controller responsive to a change in tension in said bobbin thread, said thread having means at a predetermined portion of its length to cooperate with said device to change said tension, and an electrically operated device connected in circuit with said circuit controller.

8. The combination with a lock-stitch sewing machine including a needle thread, a wound bobbin thread, means for maintaining said bobbin thread under tension, and means for manipulating said needle thread and said bobbin thread to form lock-stitches, of means for varying the tension on said bobbin thread at a predetermined time during operation of said machine such that upon an increase or a decrease in said tension, the amount of needle thread used in making stitches is increased or decreased respectively, and means responsive to variations in the amount of needle thread consumed.

9. The combination of a lock-stitch sewing machine including a needle thread, a wound bobbin thread having a variation in its character at a predetermined portion of its length, means for maintaining said bobbin thread under tension, and means for manipulating said threads to form lock-stitches, said portion of said bobbin thread cooperating with said tension-maintaining means to vary the tension on said bobbin thread such that upon an increase or a decrease in said tension, the amount of needle thread used in making stitches is increased or decreased respectively, and means responsive to variations in the amount of needle thread consumed.

10. The combination described in claim 8 with the addition of means operable in timed relation to the speed of said sewing machine for regulating the effect on said responsive means of said variations in consumption of the needle thread so that the operation of said responsive means will be uniform regardless of changes in speed of operation of said machine.

11. The combination set forth in claim 8 with the addition of a signal controlled by said responsive means so that said signal will be operated at said predetermined time in the operation of said machine.

12. The combination of a machine having a wound bobbin thread which is unwound by and during operation of said machine, an electric circuit controller to be actuated at a predetermined time during operation of said machine, said thread having means at a predetermined portion of its length for initiating actuation of said circuit controller, manually actuated means for controlling starting and stopping of said machine, a starting control lever which when in one position prevents movement of said manually actuated means to start the machine, a lock normally to hold said control lever in another position to release said manually actuated means, electromagnetic means for actuating said lock to release said control lever, and means connecting said circuit controller in circuit with said electromagnetic means for actuating the latter when said circuit controller is actuated by said portion of said thread.

13. The combination of a machine having a wound bobbin thread which is unwound during operation of said machine, and a mechanism to be actuated at a predetermined time during the operation of said machine, said bobbin thread having means for controlling actuation of said mechanism, manually actuated means for controlling starting and stopping of said machine, a starting control lever which when in one position prevents movement of said manually actuated means to start the machine, a lock normally to hold said control lever in another position to release said manually actuated means, means for actuating said lock to release said control lever, and means cooperating with said mechanism to actuate said lock-releasing means when said mechanism is actuated by said means on said thread.

14. For use with means to indicate approaching exhaustion of the bobbin thread in a lock-stitch sewing machine having a wound bobbin thread which is unwound by and during operation of said machine, a bobbin case having a thread tension spring which is movably mounted, and a wound bobbin thread having means at a predetermined portion of its length for momentarily moving said tension spring as said thread is unwound.

15. The combination with a wound bobbin thread having an abnormal portion, of a bobbin case having a movable part on the exterior thereof to be engaged by said abnormal portion of the thread, a device to be actuated, and an operative connection between said device and said part for actuating said device upon movement of said part.

16. For use with means for controlling the actuation of a device by an abnormal portion of the bobbin thread in a machine wherein said bobbin thread is consumed during the operation of the machine, a bobbin case having a thread outlet opening, and a part movably mounted on the exterior of the case in relation to said opening such that said part normally is stationary during withdrawal of normal thread, but will be moved when engaged by said abnormal portion of said thread.

17. The combination of a machine having a wound bobbin thread which is unwound during operation of said machine, a device normally in one position, said bobbin thread having means for actuating said device into another position upon approaching exhaustion of said thread, a signal controlled by said device and operated when the latter is in its second position, means for controlling starting and stopping of said machine, and mechanism cooperating with said device when the latter is in said second position for preventing operation of said starting and stopping means after the latter has been operated to stop the machine while said device is in its said second position, said signal indicating that the supply of bobbin thread is insufficient and said mechanism preventing starting of the machine with an insufficient supply of bobbin thread.

18. The combination with a lockstitch sewing machine having stitch-forming devices including a needle and a loop taker, of a wound locking thread supply about which said loop taker passes each loop of needle thread and which is

unwound and interlocked at a certain point with the needle thread during operation of said machine, said locking thread having an abnormal portion at a predetermined point in its length, and means including a part between said wound thread supply and said point of interlocking of said locking thread and the needle thread directly engaged by said abnormal portion of said locking thread during unwinding of said thread for performing an operation in timed relation to said engagement of said part with said portion of said thread.

19. The combination as defined in claim 18, wherein said abnormal portion comprises a protuberance on said thread and said part is disposed adjacent the path of movement of said protuberance from said supply to said interlocking point and is constructed to permit its momentary actuation out of said path by said abnormal portion without interruption in the unwinding of said locking thread.

20. The combination of a machine having a wound bobbin thread which is unwound during operation of said machine, a mechanism to be actuated at a predetermined time during the operation of said machine including a part adjacent to the path of movement of said thread as the latter is unwound, said bobbin thread having means to engage said part for controlling actuation of said mechanism, and means manually actuated for controlling starting and stopping of said machine, and said mechanism including

means for preventing operation of said manually actuated means after the latter has been operated to stop the machine.

21. The combination with a lockstitch sewing machine having stitch-forming devices including a needle, a loop taker, of a wound locking thread supply about which the loop taker passes each loop of needle thread and from which the thread is unwound and interlocked at a certain point with said needle thread during operation of said machine, the character of said locking thread being varied in a predetermined manner at a predetermined portion of its length, and means including a plurality of elements at least one of which is directly engaged by said varied portion of said locking thread between said wound supply and said point of interlocking during unwinding of said thread for performing an operation.

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