Dec. 26, 1967 L. BONO 3,359,933

THREAD-CUTTING MECHANISM FOR SEWING MACHINES

Filed Feb. 8, 1965 2 Sheets-Sheet 1

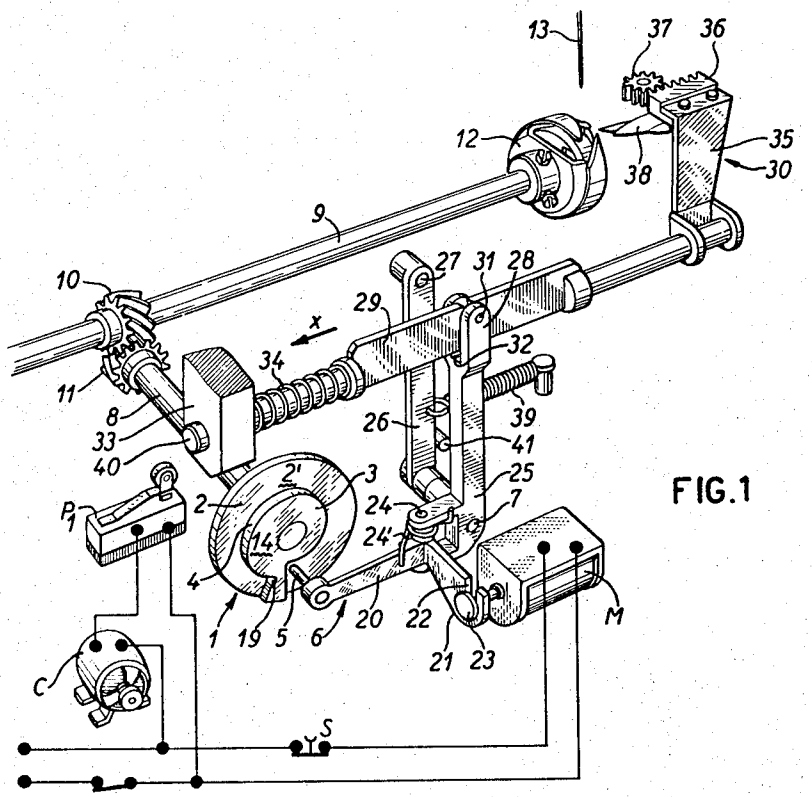


FIG.1

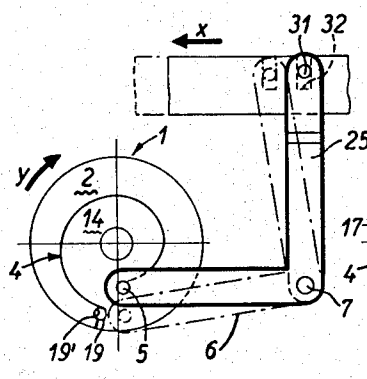


FIG.2

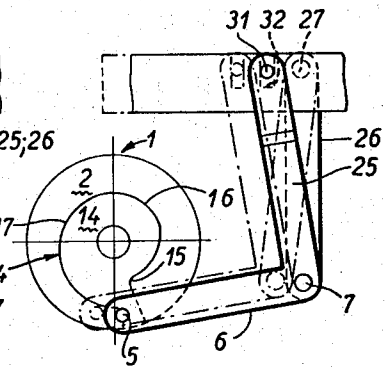


FIG.3

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THREAD-CUTTING MECHANISM FOR SEWING MACHINES

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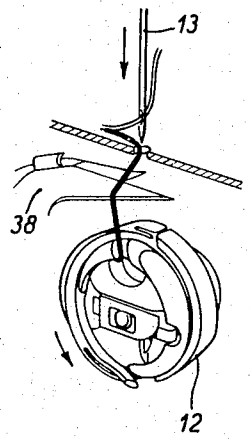


FIG.4

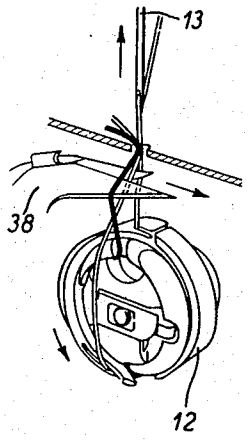


FIG.5

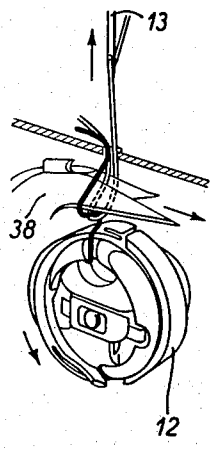


FIG.6

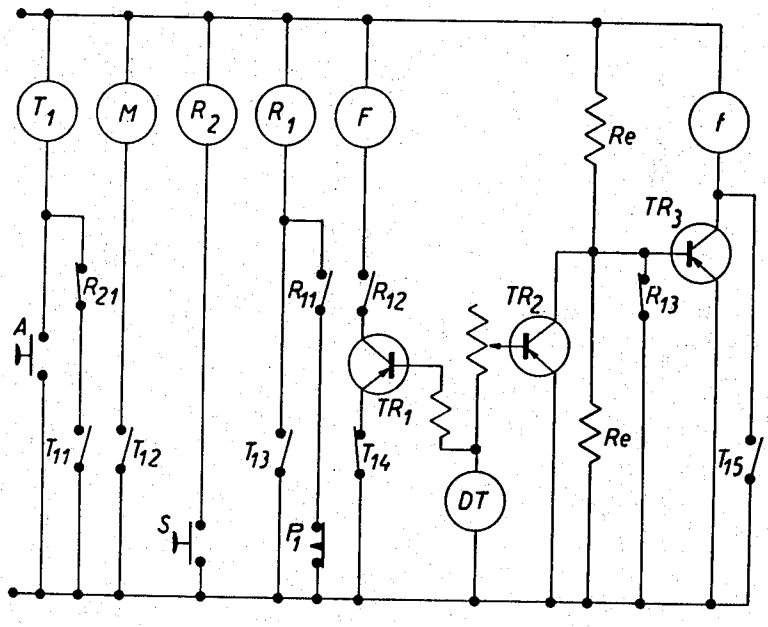


FIG.7

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THREAD-CUTTING MECHANISM FOR SEWING MACHINES

Luigi Bono, Pavia, Italy, assignor to Necchi Società per Azioni, Pavia, Italy

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5 Claims. (Cl. 112—252)

ABSTRACT OF THE DISCLOSURE

A thread cutting device for a sewing machine comprising a linearly displaceable cutter assembly comprising a pair of cutter blades and a drive means for linearly displacing the assembly in timed sequence relative to the sewing needle and to the needle hook, said drive means including a cam and lever assembly which is connected to said cutter assembly and is adapted to linearly displace same at a first reduced speed in preparation for the cutting of the thread and then at a highly accelerated speed to cut the thread.

This invention refers to a servo-mechanism, attached to a sewing machine, capable of cutting the sewing threads and stopping the machine with the needle in a predetermined position. The main purpose of this invention is to provide a simple apparatus that is capable of automatically effecting an operating cycle which, if executed manually, would take an excessive length of time and would require lengthy and difficult manipulations by the operator. It is a further object of the invention to provide a thread cutting apparatus that is simple and reliable.

The servo-mechanism which is the object of the present invention is combined with a sewing machine provided with an operating electric device connected with the main shaft of the machine and with a needle assembly on a needle bar connected with said main shaft, and includes a control member, driven by the main shaft of the machine through ordinary transmission means and wheel with a fixed timing as regards the reciprocating and vertical displacements of the needle bar. A thread cutter and kinematic means connect said control member and said thread cutter. Said control member comprises a cam capable of preparing the cutting operation of the thread cutter and by a constraint means capable of creating a rigid union between the control member, the kinematic means and the thread cutter at the end of the action of the cam, when said member has taken an angular position corresponding to the predetermined position of the needle, at the stopping of the machine, in order that, with reference to said angular position, there is a rotation of the control member followed by the cutting of the threads by the thread cutter, and a return rotation of the control member, caused by an elastic return means connected with said kinematic means, for effecting the stopping of the machine with the needle in a predetermined position when an operating electric means, operated by said kinematic means at the end of the cutting operation of the sewing threads, has effected the connection between the machine and its operating device.

The advantages and the characteristics explained above as well as further ones will appear during the following description, given as an example, and in the enclosed drawings in which:

FIG. 1 is a general perspective view of the servo-mechanism of this invention.

FIGS. 2 and 3 represent a detail of the servo-mechanism in two successive operating stages.

FIGS. 4, 5 and 6 represent another detail of the servo-mechanism in three successive operating stages.

FIG. 7 represents the electric circuit of the servo-mechanism.

In the figures we have indicated with numeral **1** a control member comprising a cylindrical disc **2** on a face **2'** of which is fixed rigidly a cam **3** having a control surface **4** capable of cooperating with pin **5** of the finger **6** to oscillate the finger around fulcrum **7**. Said control member **1** is rigidly keyed on a shaft **8** which is rotated by the shaft **9** through a pair of gears **10** and **11**; the transmission ratio between the shaft **8** and the shaft **9** is equal to 1 to 2. At one end of the shaft **9** is fixed the hook **12** cooperating with needle **13** for the formation of the sewing stitches.

The control surface **4** is deliminted by the face **2'** of the cylindrical disc **2** and the face **14** of the cam. The radial development of the profile of the control surface **4** determines the oscillations of the finger **6** around pin **7** (FIGS. 2 and 3). Said profile, starting from point **15**, is developed by an increasing radius up to point **16**, with a constant radius up to **17**, and then with an increasing radius up to the end point. The control surface of the cam ends with a surface having a semi-cylindrical shape at **19** for engagement with the pin **5** of the finger **6**. In alignment with **19** and in the face **2'** of the disc **2** is a hole **19'** (FIG. 2). The whole of the surface **19** and the hole **19'** compose a restraint means, the operation of which will be specified in the following pages.

The finger **6** is composed by an L-shaped lever having an arm **20** carrying on its free end the pin **5**, and an arm **21** provided on its free end with a slot **22** for engagement with the keeper **23** of an electromagnet M. In the junction of the two arms **20** and **21** the finger **6** is pivoted at **24** on the fork shaped end of a rod **25** pivoted in turn on a pivot **7** on the lower end of another rod **26** which is pivoted at **27** on the base plate of the machine. The finger **6**, in compliance with the above description, can oscillate, due to the action of the cam, around the fulcrum **7**, and comprises a rigid structure with the rod **25** to oscillate, in an orthogonal direction in respect to the previous direction against the action of the spring **24'**, around the pivot **24** due to the effect of the electromagnet M. The rod **25** remains fixed and acts as a support during the oscillations of the finger **6** about the pivot **24**.

The upper part of the rod **25** ends in a fork **28** in which is received the rod **29** for supporting the thread cutter **30**. The kinematic connection between the rods **25** and **29** is by means of the coupling of the pivot **31** carried by the rod **25** with the slit **32** provided in the rod **29**. The rod **29** is carried at one end on a bearing **33** provided on the base plate of the machine and is free to slide axially within said bearing against the action of a spring **34** wound on the rod and fixed at one end to a ring **29'** of the rod **29** and on the other end to the bearing **33**. The group of members placed between the control member **1** and the thread cutter **30**, including the finger **6**, the two levers **25** and **26**, and the rod **29**, will be referred to in the following pages as kinematic means of connection between the control member and thread cutter. The thread cutter comprises a support rod **35** connected with the rod **29** and carrying on its upper end a rack **36** engaging with a gear **37** rotatably mounted on the base plate of the machine. The knife **38** is operated by the rotation of the gear **37** with which it is operatively connected. The thread cutter described here is used in sewing machines of the type making groups of stitches in which the feeding of the fabric is effected with means different from the usual toothed feed dog. The device which is the object of this invention is however capable of operating other types of thread cutters which can be attached also to machines equipped with the usual toothed feed dog.

The servo-mechanism is adapted to work at a low speed as regards the rotation of the machine members. As will

be described in the following pages, the machine is stopped in a single turn of the shaft of the cam and the shock deriving from such an excessively high deceleration of the revolving members would cause an excessive stress in the machine members. Therefore, before the servo-mechanism starts operating, there is interposed a device for reducing the speed of the main shaft of the machine.

The drive of the machine members is by means of a unit C, including an electric motor, a clutch and a brake of the type, for instance, with magnetic power, which will be called in the following pages "device for operating the machine." Said unit C is connected in a manner known but not shown with the main shaft of the machine. The shaft **9** is connected in a manner known but not shown with the main shaft and turns twice as fast as the main shaft. The servo-mechanism includes also a magnet M, a micro-switch **P1** and other electric components which will be illustrated in the description of the working of the device, which description will be given hereunder.

To start the machine, the operator presses the push-button A closing the circuit of the remote control switch **T1** (see FIG. 7) to cause excitation of **T1** which is followed by: the closing of the contact **T11** to maintain the excitation of **T1**; the closing of **T12** on the circuit of the magnet M with the consequent excitation of this magnet; the closing of **T13** with the consequent excitation of the relay **R1**; the opening of **T14** in the circuit of the brake; the closing of **T15** for the direct excitation of the clutch *f* and consequent starting of the machine at full speed. The excitation of the magnet M actuates keeper **23** to pivot finger **6** around the pivot **24** and away from contact with the cam **3**. The control member **1** rotates, during the normal working of the machine, in the direction of the arrow Y (FIG. 2). Upon excitation of the relay **R1** there follows: the closing of the contact **R11** to maintain self-excitation; the closing of **R12** and the opening of **R13** for preparing respectively the circuits of the brake and of the clutch for the following.

At the end of the sewing operation, the operator presses the push-button S thus exciting the relay **R2** which opens the contact **R21** on the branch of the remote control switch **T1** with the consequent deenergization of this switch. The contacts **T11, T12, T13, T14, T15** are reset in the positions shown in the figure causing the following effects:

T13 is opened, but it does not cause the deenergization of **R1** since this is self-excited through **R11**.

The excitement of the brake F in the collector circuit of transistor **TR1** on the closing of **T14**, with the voltage of the base of the transistor adjusted by the tachometer dynamo D.T. driven by the machine.

The excitement of the clutch *f* through the circuit of the transistor **TR3** controlled by the pre-amplification stage of transistor **TR2** for reversing the phase, controlled in its turn by the voltage of the D.T. By means of the excitement of the clutch and the brake through the D.T. according to the circuit diagram we obtain the regulation of the speed on a reduced value in respect to the standard value, which value depends on the parameters of the circuit.

Deenergization of M and consequent rotation of the finger **6** towards the cam. M is deenergized with a certain time delay such that the finger turns towards the cam when the speed of the machine is stabilized on the new reduced value. After the deenergization of M, the spring **24'** causes the rotation of the finger **6** around the pivot **24** towards the cam **1**. Due to the relative position between finger and cam, the pin **5** will become engaged with the surface **4** only when the cam is in the angular position of FIG. 1 wherein the pin can engage point **15**, the smallest radius of the profile. In any other position of the cam the pin **5** will engage face **14** and will engage the surface **4** only when the cam has reached the angular position of the figure.

The movement of the cam **3**, the needle **13**, and the hook **12** is in timed relation and during the complete sewing cycle, corresponding to a descending stroke of the needle and the following upward stroke, the cam makes one turn while the hook makes two complete rotations. When the pin **5** enters into contact with the surface **4** the rotation of the cam oscillates the rigid unit of finger **6** and rod **25** around the pivot **7**; the rod **29** is displaced axially against the action of the spring **34** in the direction of the arrow *x* thus causing rotation of gear **37** by means of the rack **36**, and at the same time a first oscillation of the blades **38**. One of the blades maneuvers the lower thread, as shown in the FIG. 4, displacing it laterally and preparing the second part of the thread cutting preparation stage. This oscillation ends when the point **16** on the cam is brought in contact with the finger **5**. Sliding of the finger **6** on the surface 4 of the cam between the points **16** and **17** of the profile produces no oscillation of the unit of finger **6** and rod **25** and consequently the thread cutter remains motionless; as previously stated, the arc of the profile between **16** and **17** has a constant radius. When the pin **5** contacts the surface **4** between the points **17** and **18** there is a further axial displacement of the rod **29** and the blades have a further oscillation which completes the preparation stage for the cutting of the two sewing threads. FIGS. 5 and 6 show the relative position of the blades and the sewing threads after completion of the preparation stage for the cutting.

The knotting of the two threads occurs on the other blade of the knife. The displacement of the lower thread is effected by one blade of the knife **38** in the first part of the stage for preparing the cutting, and the knotting of the threads on the other blade of the knife in the second part of said stage permits a supplementary quantity of the two threads to be obtained from the bobbin and spool in order to permit the resumption of sewing without any danger of the needle becoming unthreaded. In FIG. 2 there is represented the position of the cam, the finger **6** and the rod **25** at the beginning of the operation described above (full line) and at the end of said operation (line with dashes and dots). The rod **26** up to this time has not been moved, due to the action of the cam on the finger, around its pivot **27**. When the pin **5** engages the surface **19** it enters into the hole **19'** provided on the fare of the disc **2**. Further rotation of the disc **2** prodoces oscillation of the unit comprising finger **6** and rod **25** around the pivot **27** together with the rod **26**. The unit of finger **6** and rods **25** and **26** behaves as a rigid whole and is compelled to oscillate around the pivot **27** against the action of the spring **39**. To that oscillation, characterized by great acceleration, follows the breaking of the threads caused by the violent movement of the blades **38** on the sewing threads which, in the previous stage of the cycle, had come into contact with the blades **38** in the manner illustrated. FIG. 3 shows the relative positions of the finger **6**, rod **25** and rod **26** at the beginning (full line) and at the end of the stage for cutting the threads (dot and line).

With reference with the electric schema FIG. 7 in the cutting stage of the threads, the end **40** of the rod **29**, in its axial excursion, operates to open the switch **P1** to deenergize **R1**. The excitement of the brake and the clutch is stopped due to the opening of **R12** which opens the circuit of the brake, and the closing of **R13** that causes the cutoff of the transistor **TR3** through which the clutch was fed. The machine will thus remain free from the clutch and the brake in order that spring **39** may draw the rods **26** and **25**, the finger **6** and the control member **1** to the positions illustrated in the figure with the rod **26** against the stop **41**. The control member **1** in its counterclockwise rotation, operates through the shaft **8**, gears **10–11**, shaft **9** and the usual members connecting said shaft with the needle bar, not shown in the figure, to position the needle in its higher position corresponding with the angular position of said control member in FIG. 1.

What is claimed is:

1. A thread cutting and stopping mechanism in combination with a sewing machine having a stitch forming

mecahnism, comprising a cutter, means mounting the cutter in an initial position adjacent the stitch forming mechanism, means for moving the cutter from said initial position toward said stitch forming mechanism at a predetermined speed and in timed relation with the stitch forming mechanism to a second position where said cutter is adapted to engage the sewing threads, means for moving the cutter after said engagement at a speed greater than said predetermined speed to sever the threads, and means for returning the cutter to said initial position and stopping the needle in a preselected raised position clear of the work, wherein the means for moving the cutter comprises a pinion, a rack in engagement with the pinion, and means for translating the rack, the means for translating the rack comprising a cam, abutment means integral with the cam, and a lever system connecting the cam and rack, wherein said lever system comprises a movable support and a first bell crank lever pivotally mounted on said movable support for pivotal movement about a selected axis, a second bell crank level pivotally mounted on one arm of said first level for pivotal movement about an axis normal to said selected axis, and means pivotally connecting the other arm of said first lever to the rack.

2. A device as in claim 1 further including means for pivoting the second bell crank lever into and out of contact with the cam.

3. A device as in claim 2 wherein the means for pivoting the second bell crank lever comprises an electromagnet and return spring and means for energizing and de-energizing the magnet at will.

4. A device as in claim 3 wherein the movable support comprises an arm, means pivotally mounting the arm on a fixed support, a stop fixed to the fixed support, and spring means urging the arm into engagement with the stop.

5. A device as in claim 4 wherein the means for returning the cutter to said initial position comprises a spring and means connecting the spring to the rack.

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JORDAN FRANKLIN, *Primary Examiner.*

J. R. BOLER, *Examiner.*