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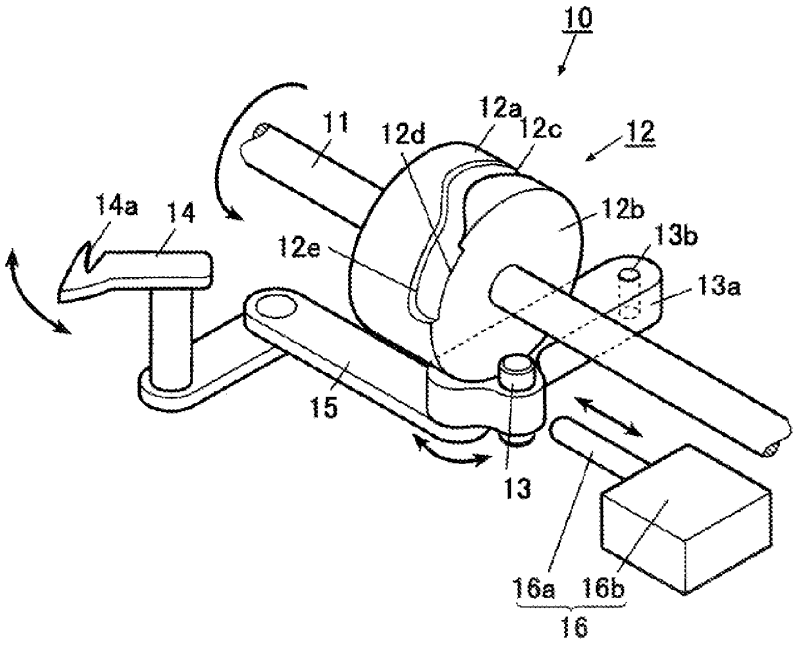
(54) Thread cut actuating device of sewing machine

(57) A thread cut actuating device includes a moving knife for cutting a thread, a driving shaft which rotates interlockingly with a driving motor, a cam having a cam groove for driving the moving knife, the cam being rotatable by the driving shaft; detecting means for detecting a rotating angle of the cam, a cam follower coupled to the moving knife, the cam follower being movable to engage with and move apart from the cam groove, and an actuator which, when actuated, moves the cam follower to engaged with the cam groove. The thread cut actuating device further includes control means for controlling the drive motor and the actuator so as to rotate the cam, stop the rotation of the cam when the rotational angle of the cam, at which the cam follower is able to enter the cam groove, is detected by the detection means, actuate the actuator, and resume the rotation of the cam after actuating the actuator.

Fig. 1



EP 2 000 570 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a thread cut actuating device of a sewing machine operable to cut a thread by actuating a moving knife in accordance with a cam which rotates interlockingly with a driving shaft.

BACKGROUND ART

[0002] Conventionally, for example, JP 2000-317178 A discloses a thread cut actuating device including a cam having a cam groove and provided on a driving shaft such as a lower shaft of a sewing machine, a cam follower disposed to face the cam groove, and an actuator which moves the cam follower so as to engage with or move apart from the cam groove. When cutting a thread, the cam follower is engaged with the cam groove by the actuator, whereby a moving knife is driven in accordance with the cam groove of the cam rotating interlockingly with the driving shaft.

[0003] Fig. 6 shows a portion of a thread cut actuating device 100 disclosed JP 2000-317178 A.

[0004] The thread cut actuating device 100 includes a groove cam 101 rotatably supported on a driving shaft (not shown), a cam follower 102 which is engageable with and separable from a groove portion 101a of the groove cam 101, and a actuating member 103 which is movable toward and away from the cam follower 102, and an actuator 104. When the actuator 104 is driven, the actuating member 103 moves the cam follower 102 to enter an opening portion 101b of the groove portion 101a. The cam follower 102 is coupled to a moving knife (not shown).

[0005] The driving operation of the actuator 104 is controlled by a control device (not shown). When an operator operates a thread cutting operating portion such as a pedal, a plunger 104a of the actuator 104 is moved upward in Fig. 6, thereby rotating the actuating member 103 around a shaft 103 a to push the cam follower 102 leftward in Fig. 6 and to move the cam follower 102 toward the opening portion 101b of the groove cam 101. At this time, the groove cam 101 is rotated together with a driving shaft, and the cam follower 102 placed inside the groove cam 101 from the opening portion 101b. The cam follower 102 is led to an inside of the groove portion 101 a by an edge portion 101c of the groove cam 101, and is thus engaged with the groove portion 101a. Then, the cam follower 102 is reciprocated in an almost axial direction of the groove cam 101 in conformity to a shape of the groove portion 101a so that the moving knife coupled to the cam follower 102 is reciprocated to cut a thread in cooperation with a fixed knife (not shown).

[0006] In this thread cut actuating device 100, when the cam follower 102 pushed and moved by the actuating member 103 collides with a groove wall 101d of the groove cam 101, the cam follower 102 greatly rebounds due to the shock, and collides with the actuating member 103, and repetitively collides with the groove cam 101 again and gradually converges. At this time, the groove cam 101 is rotating while the rebound is repeated, and relative positions of the cam follower 102 and the groove cam 101 which collide with each other are changed. In some cases, therefore, the cam follower 102 rebounding outward from the groove portion 101 a collides with an outside surface of the edge portion 101c, and is thus interposed between the edge portion 101c and the actuating member 103 and is stuck therebetween. In such a case, there is a problem in that the moving knife cannot be operated, and the thread cut actuating device 100 itself becomes inoperable. Moreover, in such a case, there is a problem in that a great mechanical load is generated in each portion, resulting in a breakage of the thread cut actuating device 100, for example, bending of the actuating member 103.

SUMMARY OF THE INVENTION

[0007] It is an object of the invention to enable a reliable thread cutting operation and to prevent a failure such as a breakage.

[0008] According to a first aspect of the invention, a thread cut actuating device (10) of a sewing machine (1) includes: a moving knife (14) for cutting a thread; a driving shaft (11) which rotates interlockingly with a driving motor (2); a cam (12) having a cam groove (12c) for driving the moving knife (14), the cam (12) being rotatable by the driving shaft (11); detecting means (3) for detecting a rotating angle of the cam (12); a cam follower (13) coupled to the moving knife (14), the cam follower (13) being movable to engage with and move apart from the cam groove (12c); and an actuator (16) which, when actuated, moves the cam follower (13) to engaged with the cam groove (12c).

[0009] The thread cut actuating device (10) is characterized in that it further comprises control means (4) for controlling the drive motor (2) and the actuator (16) so as to: rotate the cam (12); stop the rotation of the cam (12) when the rotational angle of the cam, at which the cam follower (13) is able to enter the cam groove (12c), is detected by the detection means (3); actuate the actuator (16); and resume the rotation of the cam (12) after actuating the actuator (16).

[0010] The detecting means is provided for detecting the rotating angle of the cam, and may be provided in the driving motor or on the driving shaft.

[0011] The driving shaft serves to rotate the cam, and may be a lower shaft or an upper shaft of the sewing machine, or another shaft coupled to the lower shaft or the upper shaft.

[0012] Moreover, the cam may be directly fixed to the driving shaft such as the lower shaft or the upper shaft, or may be fixed to a rotating shaft interlocking with the driving shaft.

[0013] The driving motor serves to rotate the driving

shaft, and may be a sewing machine motor or another motor which is provided only for cutting a thread.

[0014] According to a second aspect of the invention, the control means (4) controls the driving motor (2) such that, when resuming the rotation of the cam (12), the cam (12) is rotated at a low rotating speed.

[0015] The "low rotating speed" is a rotating speed that is lower than a rotating speed of the cam before the stoppage of the rotation of the cam, and is a rotating speed that is suitable for leading the cam follower, which has entered an inlet of the cam groove, into the cam groove continuously after the entering into the inlet.

[0016] According to the first aspect of the invention, when the detecting means detects the rotating speed of the cam, at which the inlet of the cam groove is placed at such a position that the cam follower can enter, the control means carries out a control for temporarily stopping the driving motor. In other words, the rotation of the cam is temporarily stopped so that it is possible to ensure a time required for the convergence of the rebound of the cam follower. Accordingly, it is possible to prevent the device from being stopped due to an engagement of the cam follower with an edge portion in the vicinity of the inlet of the cam groove or from being broken by a mechanical load in that case. Consequently, a thread cutting operation can be reliably carried out so that reliability and durability of the sewing machine can be enhanced.

[0017] Moreover, the control means stops the driving operation of the motor when the detecting means detects the rotating angle of the cam at which the cam follower can enter the cam groove, and drives the motor again after the cam follower enters the inlet by the driving operation of the actuator. Consequently, it is not necessary to strictly control a driving timing of the actuator with respect to such a timing as to meet the rotating angle of the cam, that is, the angle at which the cam follower can enter the inlet of the cam groove. Thus, it is possible to considerably relieve an operation failure caused by a shift of the timing. In other words, the cam follower moved by the driving operation of the actuator can enter the inlet of the cam groove more reliably. Accordingly, the thread cutting operation can be carried out more reliably so that the reliability of the sewing machine can be enhanced.

[0018] According to the second aspect of the invention, the cam starts the rotation at a low rotating speed after a temporary standby of the cam. Even if a standby time of the cam is insufficient for the convergence of the rebound of the cam follower, consequently, the cam is rotated at a low rotating speed after the standby time so that the time required for the convergence of the rebound of the cam follower can be ensured. In other words, it is possible to more effectively eliminate, through the low rotation, drawbacks that a thread cutting failure of the thread cut actuating device is caused by a jump of the cam follower out of the cam groove due to the rebound of the cam follower and the stoppage of the thread cut actuating device is generated by the engagement of the cam follower with the edge. Accordingly, it is possible to provide a sewing machine having a higher reliability and durability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a perspective view of a thread cut actuating device of a sewing machine.

Fig. 2 is a block diagram showing a relationship between a driving unit of the sewing machine and devices coupled thereto.

Fig. 3 is an explanatory view showing a cam groove of a cam.

Figs. 4A and 4B are explanatory views showing a relationship between a transition of a rotating angle position of the cam groove and positions of a cam follower and a plunger of an air cylinder.

More specifically, Fig. 4A shows a state in which the cam follower is entered the cam groove from an inlet of the cam groove by the plunger, and Fig. 4B shows a state in which the cam follower is introduced into the cam groove along an edge of the cam groove.

Fig. 5 is a flowchart showing a thread cutting control of the driving unit.

Fig. 6 is an explanatory view showing a portion of a conventional thread cut actuating device.

DETAILED DESCRIPTION

[0020] Hereinafter, embodiments of the present invention will be described below in detail with reference to the drawings. The following embodiments do not limit the scope of the invention.

[0021] In a sewing machine 1 according to an embodiment of the invention, when an operator manipulates a thread cutting switch so that a signal for giving an instruction for cutting a thread is generated, for example, a thread cut actuating device 10 is operated to automatically cut a thread through a cooperation of a moving knife with a fixed knife.

[0022] As shown in Figs. 1 and 2, the sewing machine 1 includes a sewing machine motor 2 acting as a driving motor which serves to rotate an upper shaft (not shown) provided in a direction in which an arm portion extends, an encoder 3 acting as detecting means provided on the upper shaft or the sewing machine motor and serving to detect a rotating angle of the upper shaft, a lower shaft 11 acting as a driving shaft coupled to be rotated synchronously with the upper shaft, and a driving unit 4 acting as "control means" for controlling various operations of the sewing machine 1 including a thread cutting operation.

[0023] When the sewing machine motor 2 is driven through the control of the driving unit 4, the upper shaft is rotated to operate a well-known needle bar vertical moving mechanism. Moreover, the lower shaft 11 is ro-

tated interlockingly with the rotation of the upper shaft so that well-known shuttle and feeding mechanisms are operated. At this time, the rotating angle of the upper shaft is detected by the encoder 3 and is output to the driving unit 4. Moreover, the upper shaft and the lower shaft 11 are interlocked with each other at a certain rotation ratio. Therefore, rotating angles of the lower shaft 11 and a cam 12 fixed to the lower shaft 11 which will be described below can also be detected from the rotating angle of the upper shaft which is detected by the encoder 3.

[Thread Cut Actuating Device]

[0024] Next, the thread cut actuating device 10 will be described in detail.

[0025] As shown in Fig. 1, the thread cut actuating device 10 includes the cam 12 provided on the lower shaft 11 and rotated with the rotation of the lower shaft 11, a cam follower 13 provided movably in an almost disposing direction of the lower shaft 11 through an engagement with a cam groove 12c provided on the cam 12, a moving knife 14 coupled to the cam follower 13 through a coupling link 15 and rotated in a predetermined direction interlockingly with a movement of the cam follower 13, and an air cylinder 16 for pressing and moving the cam follower 13 toward the cam 12 side.

[0026] The cylindrical cam 12 is concentrically fixed and supported on the lower shaft 11. More specifically, the cam 12 is rotated integrally with the lower shaft 11. As described above, the encoder 3 can detect the rotating angle of the lower shaft 11 and can thus detect the rotating angle of the cam 12 provided on the lower shaft 11. An outer peripheral surface 12a of the cam 12 is provided with the cam groove 12c with which the cam follower 13 can be engaged. The cam groove 12c is formed to be displaced in an axial direction so as to cause the moving knife 14 to carry out a reciprocating operation corresponding to the rotation of the cam 12.

[0027] The cam follower 13 is supported in a certain position on an end face 12b side of the cam 12 through a cam follower support member 13a. Moreover, the cam follower support member 13a is supported rotatably around a rotating fulcrum 13b provided on a sewing machine frame which is not shown. Consequently, the cam follower 13 is reciprocated within a rotating range of the cam follower support member 13a.

[0028] The cam groove 12c has an outlet 12h and the cam follower 13 moved along the cam groove 12c from the outlet 12h is led outward from the cam groove 12c to return the cam follower 13 to a standby position (a position shown in Fig. 1).

[0029] When the lower shaft 11 is rotated, the cam 12 is also rotated so that the cam follower 13 is moved in an almost longitudinal direction of the lower shaft 11 along the cam groove 12c. The movement of the cam follower 13 rotates the moving knife 14 through the coupling link 15.

[0030] The moving knife 14 having a concave hook portion 14a provided in a tip portion is disposed to be reciprocated and rotated between a shuttle mechanism and a throat plate (not shown). The moving knife 14 hooks and catches a needle thread and a bobbin thread which are led downward from the throat plate through the hook portion 14a by a forward rotation (in a downward direction of Fig. 1). Moreover, the moving knife 14 is rotated backward (in an upward direction of Fig. 1) to come in contact with a fixed knife (not shown) provided in a predetermined position below the throat plate, thereby cutting the needle and bobbin threads. Accordingly, the fixed knife and the moving knife 14 function as "thread cutting means". The needle thread may be caught by the hook portion 14a of the moving knife 14 in at least one place of a loop of the needle thread formed below the throat plate.

[0031] In the case in which the cam follower 13 is placed in a maximum displacing position 12g of the cam groove 12c, the moving knife 14 is moved most forward to catch the needle and bobbin threads. Then, the moving knife 14 is moved backward to cut the caught threads through the movement of the cam follower 13 returned from the outlet 12h to the standby position. Moreover, the moving knife 14 is provided to stand by in a position in which the sewing work of the sewing machine 1 can be prevented from being disturbed in the case in which the cam follower 13 is not engaged with the cam groove 12c.

[Mechanism of Engagement of Cam follower with Cam Groove]

[0032] Next, detailed description will be given to a mechanism for moving the cam follower 13 to be engaged with the cam groove 12c.

[0033] The air cylinder 16 has at least a plunger 16a provided opposite to the end face 12b of the cam 12 with a tip portion thereof interposing the cam follower 13 therebetween, and a driving portion 16b for driving the plunger 16a. When the plunger 16a is driven by the driving portion 16b, it is moved to be expanded and contracted from the driving portion 16b. Moreover, the driving portion 16b is controlled to be driven by the driving unit 4. At this time, the plunger 16a in a non-operation of the air cylinder 16 stands by in a position in the vicinity of the cam 12. When the plunger 16a is operated through the driving operation of the driving portion 16b, it abuts on the cam follower 13 to press the cam follower 13 toward the cam 12 side, thereby moving the cam follower 13. Accordingly, the air cylinder 16 functions as an "actuator".

[0034] Fig. 3 is an explanatory view showing the cam groove 12c provided in the cam 12.

[0035] As shown in Fig. 3, the cam groove 12c is provided with an inlet 12d for causing the cam follower 13 to slide into the cam groove 12c in a boundary position between the outer peripheral surface 12a and the end face 12b in the cam 12. The air cylinder 16 is disposed on the end face 12b side provided with the inlet 12d with respect to the cam 12, and the cam follower 13 is provided

between the plunger 16a of the air cylinder 16 and the end face 12b of the cam 12 in a non-cutting operation.

[0036] As shown in Figs. 4A and 4B, when the lower shaft 11 is rotated by the driving operation of the sewing machine motor 2, the cam 12 is rotated so that a rotating angle position of the cam groove 12c with respect to the cam follower 13 is relatively varied. At this time, when the inlet 12d of the cam groove 12c is arranged side by side with the cam follower 13, the sewing machine motor 2 is controlled to be stopped through the driving unit 4 which will be described below so that the rotations of the lower shaft 11 and the cam 12 are stopped. In other words, the cam 12 is stopped in a state in which the inlet 12d of the cam groove 12c is positioned in a side portion of the cam follower 13. In a position at which the inlet 12d and the cam follower 13 are arranged side by side, an angle of the upper shaft is constant. By detecting the angle of the upper shaft through the encoder 3, the sewing machine motor 2 is controlled such that the inlet 12d and the cam follower 13 are coincident with each other.

[0037] Next, the air cylinder 16 is driven by the control of the driving unit 4 so that the plunger 16a is rapidly moved to be extended toward the cam 12 side. As shown in Fig. 4A, consequently, the cam follower 13 is moved toward the inlet 12d side of the cam groove 12c and thus collides with a wall surface 12e of the cam groove 12c. Through a shock caused by the collision, the cam follower 13 rebounds. At that time, the plunger 16a of the air cylinder 16 is still set in the extending state. Therefore, the cam follower 13 collides against the tip of the plunger 16a and is thus returned from the inlet 12d to an inside of the cam groove 12c again. At this time, even if the cam follower 13 further rebounds, it is returned to the cam groove 12c through the plunger 16a again. By repeating the operation, the rebounding motion of the cam follower 13 gradually converges.

[0038] The sewing machine motor 2 is stopped by the control of the driving unit while the rebounding motion of the cam follower 13 converges. Consequently, the inlet 12d of the cam groove 12c is maintained in an opposed position to the plunger 16. Therefore, it is possible to reliably carry out the convergence of the rebounding motion of the cam follower 13.

[0039] Then, the lower shaft 11 restarts the rotation at a low rotating speed (e.g., 170 rpm) through the driving unit 4. Consequently, the cam 12 is rotated so that a rotating angle position of the cam groove 12c with respect to the cam follower 13 is changed. As shown in Fig. 4B, therefore, the cam follower 13 is led to the inside of the cam groove 12c through an edge 12f provided in a terminal portion of the inlet 12d of the cam groove 12c and is thus moved in conformity to a shape of the cam groove 12c. Thus, the moving knife 14 connected to the cam follower 13 through the coupling link 15 is rotated with the movement of the cam follower 13 to catch the needle and bobbin threads and to slide together with the fixed knife, thereby carrying out the thread cutting operation.

[0040] The plunger 16a of the air cylinder 16 is controlled by the driving unit 4 to continuously maintain an extending position (a position shown in Fig. 4A) until the cam follower 13 is introduced into the cam groove 12c through the edge 12f. In other words, the plunger 16a of the air cylinder 16 elastically presses the cam follower 13 toward the cam 12 side by an air pressure. When the cam 12 is rotated until the cam groove 12c reaches a position shown in Fig. 4B, the air cylinder 16 is operated so that the plunger 16a is moved in a contraction so as to be pulled into the driving portion 16b.

[Driving Unit]

[0041] Next, a portion related to the control of the thread cut actuating device 10 in the function of the driving unit 4 will be described in detail with reference to a flowchart of Fig. 5.

[0042] The driving unit 4 is electrically connected to a thread cutting switch (not shown) provided in a predetermined position of the sewing machine 1. For example, in a state in which a sewing work is ended to stop the sewing machine motor 2 in a predetermined upper needle position, when the thread cutting switch is operated by an operator (Step S1 : YES), the driving unit 4 controls the driving operation of each portion in the thread cut actuating device 10, thereby cutting a thread.

[0043] More specifically, the driving unit 4 first drives the sewing machine motor 2 (Step S2) to rotate the lower shaft 11, thereby rotating the cam 12. At this time, the driving unit 4 detects the rotating angle position of the cam 12, that is, the rotating angle position of the cam groove 12c through an output of the encoder 3. When the cam 12 is rotated until the inlet 12d of the cam groove 12c is positioned in the side portion of the cam follower 13 (the state shown in Fig. 4A) (Step S3 : YES), the driving unit 4 stops the sewing machine motor 2 (Step S4).

[0044] Next, the driving unit 4 operates the air cylinder 16 and controls the plunger 16a to be extended toward the cam 12 side (Step S5). As described above, consequently, the cam follower 13 is pushed and moved to the inlet 12d side of the cam groove 12c. Then, the driving unit 4 drives the sewing machine motor 2 at a low speed after maintaining a predetermined time stopping state and carries out a control for rotating the lower shaft 11 and the cam 12 at a low rotating speed (e.g., 170 rpm) (Step S6).

[0045] It is desirable that a stopping time required for a stroke from the stoppage of the sewing machine motor 2 to a low rotation should be short (e.g., about 100 ms). Moreover, it is desirable to obtain a time required for the convergence of the bound of the cam follower 13 against the wall surface 12e based on an empirical rule and to set the stopping time to be equal to or more than the time thus obtained, for example.

[0046] When the cam 12 is rotated until the cam follower 13 is introduced into the cam groove 12c through the edge 12f (the state shown in Fig. 4B) (Step S7 ; YES), thereafter, the driving unit 4 controls the air cylinder 16

such that the plunger 16a is moved to be contracted toward the driving portion 16b side (Step S8).

[0047] Subsequently, the driving unit 4 drives the sewing machine motor 2 at a normal cut driving speed (Step S9) and rotates the lower shaft 11 and the cam 12 in the rotating angle position in which the cam groove 12c of the cam 12 is engaged with the cam follower 13 (Step S10 : YES). Thus, the moving knife 14 is rotated with the movement of the cam follower 13 so that the thread cutting operation is carried out as described above. When the cam follower 13 gets out of the outlet 12h of the cam groove 12c to reach the rotating angle position of the cam 12 in which the cam follower 13 and the cam groove 12c are disengaged from each other (Step S10 : NO), the driving unit 4 stops the sewing machine motor 2 (Step S11). The processing of the driving unit 4 is ended.

[0048] According to the embodiment, when the encoder 3 detects the rotating angle of the cam 12 at which the cam follower 13 can enter the inlet 12d of the cam groove 12c, the driving unit 4 controls the sewing machine motor 2 to temporarily stand by. Also in the case in which the cam follower 13 bounds by a reaction to a collision with the wall surface 12e of the cam groove 12c, consequently, the sewing machine motor 2 is controlled to temporarily stand by. Therefore, the cam 12 is rotated with the cam follower 13 jumping out of the cam groove 12c. Thus, it is possible to reduce a possibility that the cam follower 13 might not be introduced into the cam groove 12c. In other words, the rotation of the cam 12 is temporarily stopped through the temporary standby of the sewing machine motor 2. Consequently, it is possible to provide a time required for the convergence of the bound of the cam follower 13. Therefore, it is possible to eliminate a drawback that the cam follower 13 is not introduced into the cam groove 12c but slips therefrom and the moving knife 14 is not operated, resulting in a non-execution of the thread cutting operation. In addition, it is possible to eliminate a drawback that the thread cut actuating device 10 is stopped due to the engagement of the cam follower 13 with the edge 12f of the cam groove 12c or the thread cut actuating device 10 is broken by a mechanical load in that case. Accordingly, it is possible to provide the sewing machine 1 including the thread cut actuating device 10 for carrying out an operation more reliably so that the reliability and durability of the sewing machine 1 can be enhanced more greatly.

[0049] Moreover, the plunger 16a of the air cylinder 16 is placed in the extending position (the position shown in Fig. 4A) until the cam follower 13 is introduced into the cam groove 12c through the edge 12f. Also in the case in which the cam follower 13 is moved to get out of the cam groove 12c through the reaction to the collision with the wall surface 12e of the cam groove 12c, therefore, the cam follower 13 collides against the plunger 16a and is thus braked to be positioned on the inside of the inlet 12d of the cam groove 12c. Accordingly, it is possible to provide the sewing machine 1 including the thread cut actuating device 10 for carrying out the operation still more reliably so that the reliability and durability of the sewing machine 1 can be enhanced further greatly.

[0050] In addition to the functions and advantages, after the sewing machine motor 2 is temporarily stopped, the cam follower 13 enters the inlet 12d through the driving operation of the air cylinder 16 and the sewing machine motor 2 is then driven again. Consequently, it is not necessary to strictly control a driving timing of the air cylinder 16 with respect to such a timing as to obtain the rotating angle of the cam 12, that is, the angle at which the cam follower 13 can enter the inlet 12d of the cam groove 12c. Thus, it is possible to considerably relieve an operation failure due to a shift of the timing. In other words, the cam follower 13 to be moved through the driving operation of the air cylinder 16 can enter the inlet 12d of the cam groove 12c more reliably. Accordingly, it is possible to provide the sewing machine 1 having the thread cut actuating device 10 for carrying out the operation more reliably so that the reliability of the sewing machine 1 can be enhanced more considerably.

[0051] Furthermore, the time required for the stroke from the stoppage of the sewing machine motor 2 to the low rotation is short (e.g., about 100 ms). Therefore, the operator rarely feels that the thread cutting operation of the thread cut actuating device 10 is slow due to the stoppage. Accordingly, it is possible to provide the sewing machine 1 including the thread cut actuating device 10 which can carry out the operation more reliably without damaging a comfort obtained by an automatic thread cutting operation. Thus, the reliability of the sewing machine 1 can be enhanced more greatly.

[0052] After the cam follower 13 enters the inlet 12d of the cam groove 12c, furthermore, the driving operation of the sewing machine motor 2 is started at a low rotating speed (e.g., 170 rpm). Even if the standby time of the sewing machine motor 2 is insufficient for the time required for the convergence of the bound of the cam follower 13, consequently, the sewing machine motor 2 is driven with the low rotation after the standby time. Consequently, it is possible to ensure the time required for the convergence of the bound of the cam follower 13. In other words, it is possible to more effectively eliminate, by the low rotation, a drawback that the bound of the cam follower 13 causes the jump of the cam follower 13 out of the cam groove 12c, resulting in a thread cutting failure of the thread cut actuating device 10 or the stoppage of the thread cut actuating device 10 is generated due to the engagement of the cam follower 13 with the edge 12f. Accordingly, it is possible to provide the sewing machine 1 having a higher reliability and durability.

[Other Embodiments]

[0053] Although the sewing machine 1 has the shuttle mechanism in the embodiment, it is also possible to employ a sewing machine which does not have the shuttle mechanism, for example, a sewing machine for forming a seam by means of a looper.

[0054] While the sewing machine serves to cut the thread in cooperation of the moving knife with the fixed knife, moreover, the invention may be executed in a thread cut actuating device for cutting the thread by means of only the moving knife.

[0055] Furthermore, each of the portions may be changed without departing from the features of the structures described in the embodiment. For example, an instruction for cutting a thread through the thread cutting switch may be a thread cutting instruction input from a touch panel display or a thread cutting command incorporated into a sewing program of a sewing machine for carrying out a sewing work by using sewing data.

[0056] Moreover, the low rotating speed (e.g., 170 rpm) and the time (e.g., about 100 ms) required for the stroke from the stoppage of the sewing machine motor 2 to the low rotation are only illustrative and it is apparent that the numeric values are not restricted.

[0057] Although the air cylinder 16 is used as the actuator in the embodiment, moreover, it is also possible to employ other configurations (e.g., a solenoid) in so far as the same function can be implemented.

Claims

1. A thread cut actuating device (10) of a sewing machine (1), the thread cut actuating device (10) comprising:

a moving knife (14) for cutting a thread;
a driving shaft (11) which rotates interlockingly with a driving motor (2);
a cam (12) having a cam groove (12c) for driving the moving knife (14), the cam (12) being rotatable by the driving shaft (11);
detecting means (3) for detecting a rotating angle of the cam (12);
a cam follower (13) coupled to the moving knife (14), the cam follower (13) being movable to engage with and move apart from the cam groove (12c); and
an actuator (16) which, when actuated, moves the cam follower (13) to engaged with the cam groove (12c),

characterized in that the thread cut actuating device (10) further comprises control means (4) for controlling the drive motor (2) and the actuator (16) so as to:

rotate the cam (12);
stop the rotation of the cam (12) when the rotational angle of the cam, at which the cam follower (13) is able to enter the cam groove (12c), is detected by the detection means (3);
actuate the actuator (16); and
resume the rotation of the cam (12) after actuating the actuator (16).

2. The thread cut actuating device (10) according to claim 1, wherein the control means (4) controls the driving motor (2) such that, when resuming the rotation of the cam (12), the cam (12) is rotated at a low rotating speed.

Fig. 1

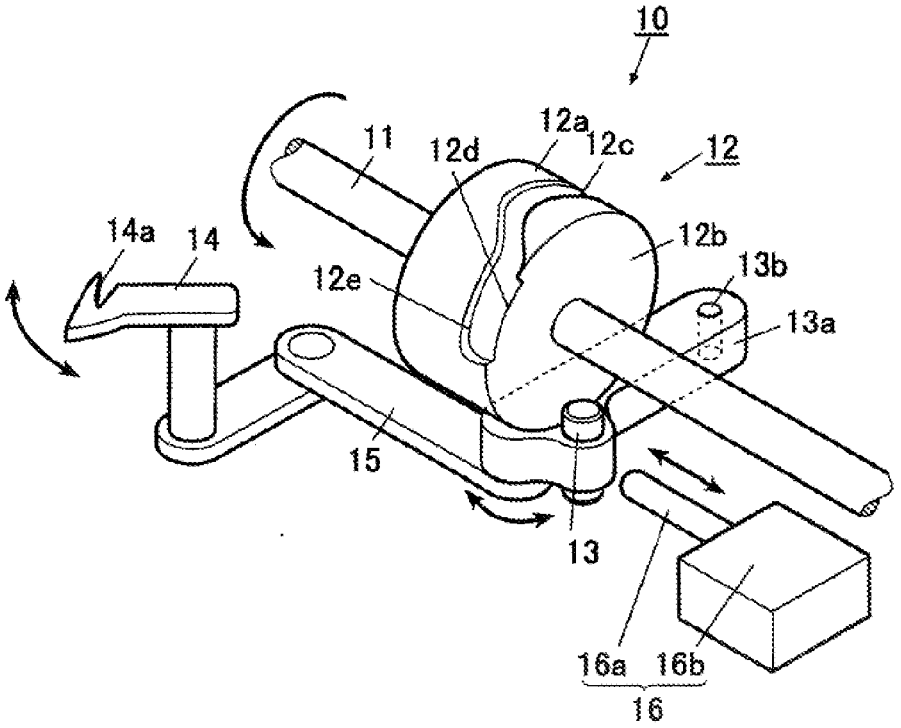

10
11
12a
12d
12c
12
14a
14
12b
13b
12e
13a
15
13
16a
16b
16

Fig. 2

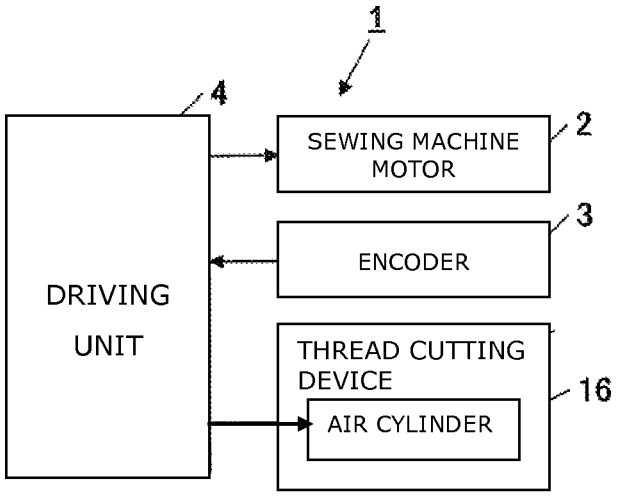

1
4
SEWING MACHINE MOTOR
2
3
ENCODER
DRIVING UNIT
THREAD CUTTING DEVICE
16
AIR CYLINDER

Fig. 3

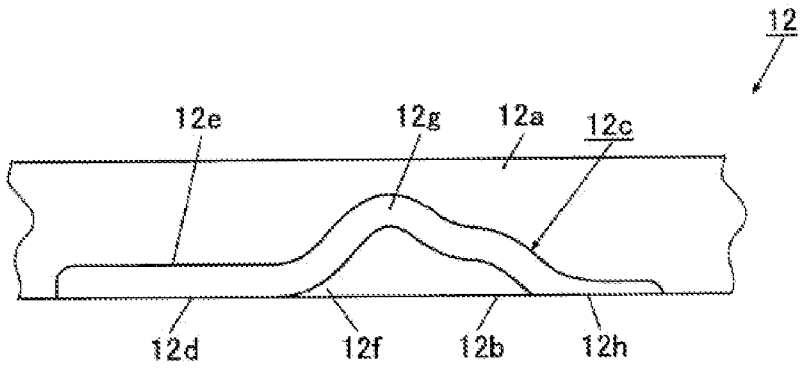


Fig. 4A

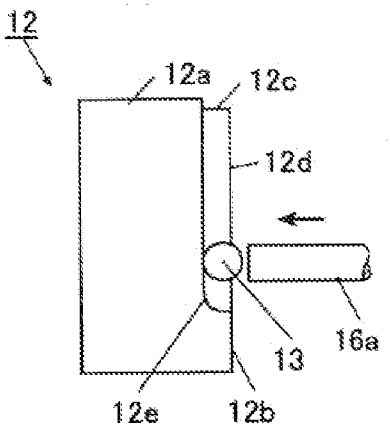


Fig. 4B

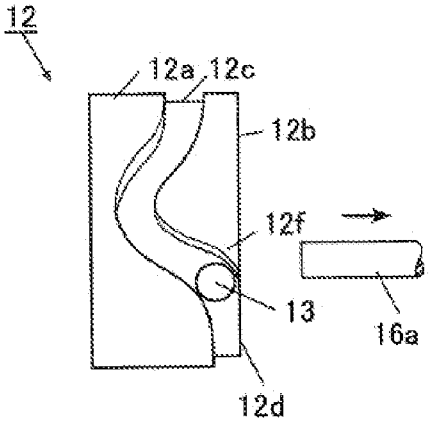


Fig. 5

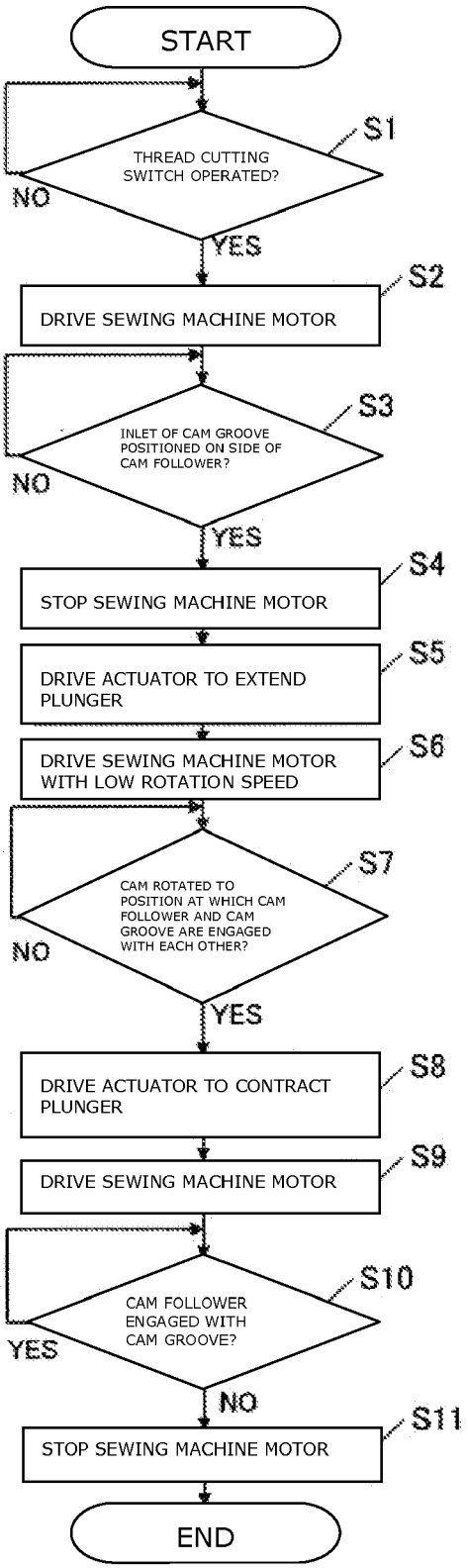
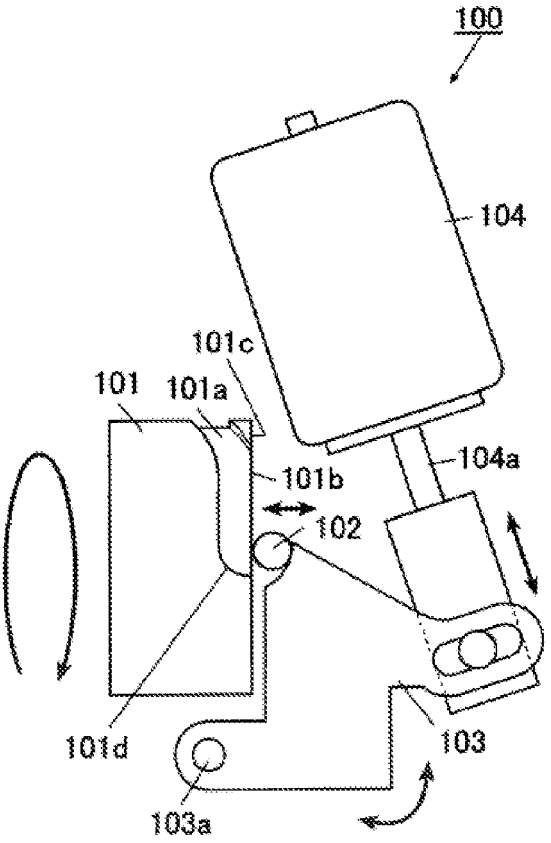

START
S1
THREAD CUTTING SWITCH OPERATED?
NO
YES
S2
DRIVE SEWING MACHINE MOTOR
S3
INLET OF CAM GROOVE POSITIONED ON SIDE OF CAM FOLLOWER?
NO
YES
S4
STOP SEWING MACHINE MOTOR
S5
DRIVE ACTUATOR TO EXTEND PLUNGER
S6
DRIVE SEWING MACHINE MOTOR WITH LOW ROTATION SPEED
S7
CAM ROTATED TO POSITION AT WHICH CAM FOLLOWER AND CAM GROOVE ARE ENGAGED WITH EACH OTHER?
NO
YES
S8
DRIVE ACTUATOR TO CONTRACT PLUNGER
S9
DRIVE SEWING MACHINE MOTOR
S10
CAM FOLLOWER ENGAGED WITH CAM GROOVE?
YES
NO
S11
STOP SEWING MACHINE MOTOR
END

Fig. 6



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 7444

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 September 2008	Herry-Martin, D

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