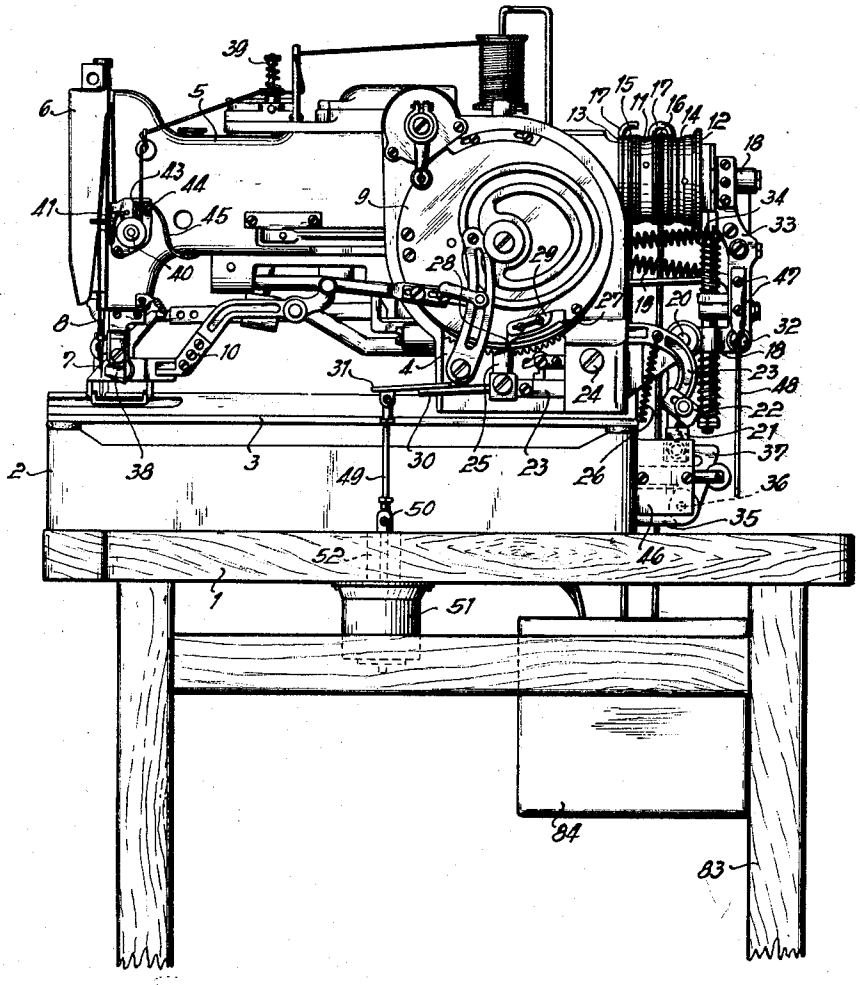
Jan. 13, 1959 K. WINZ 2,868,151

THREAD CONTROLLED AUTOMATIC STOP DEVICE FOR SEWING MACHINES

Filed July 19, 1956 2 Sheets-Sheet 1

FIG. 1



INVENTOR
KARL WINZ
BY
ATTORNEY

Jan. 13, 1959 K. WINZ 2,868,151

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FIG. 2

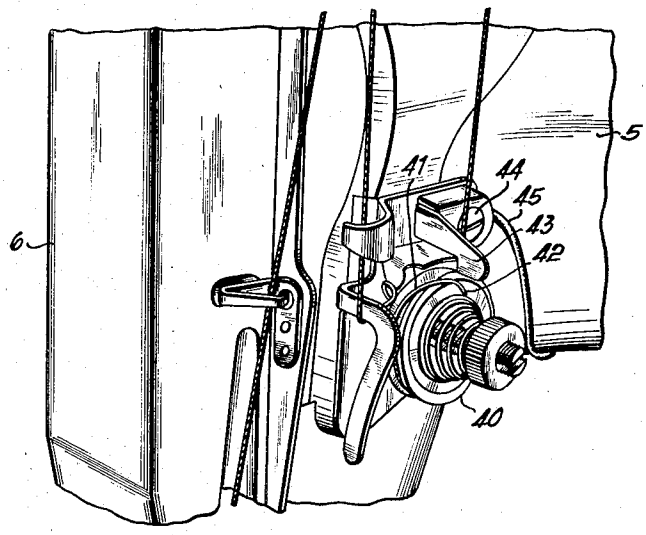
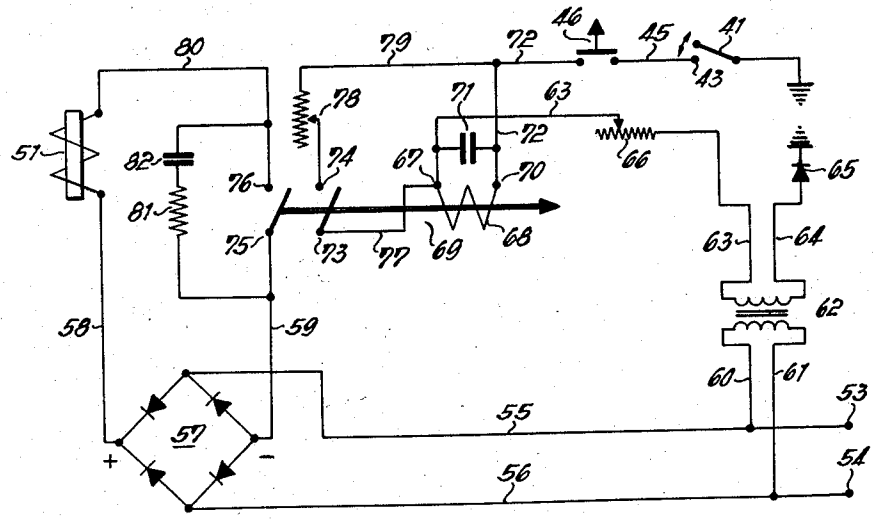


FIG. 3



INVENTOR
KARL WINZ
BY
Hull Nau
ATTORNEY

United States Patent Office 2,868,151
Patented Jan. 13, 1959

2,868,151

THREAD CONTROLLED AUTOMATIC STOP DEVICE FOR SEWING MACHINES

Karl Winz, Kaiserslautern, Pfalz, Germany, assignor to G. M. Pfaff A. G., Kaiserslautern, Pfalz, Germany, a corporation of Germany

Application July 19, 1956, Serial No. 598,872

Claims priority, application Germany August 2, 1955

13 Claims. (Cl. 112—219)

The present invention relates to sewing machines and more particularly to a thread controlled automatic stop device for stopping the operation of a machine upon failure or breakage of the upper or needle thread, to avoid damage to the parts or mechanism of the machine as well as related drawbacks and defects.

Among the objects of the invention is the provision of a thread controlled automatic stop device of the above type which is simple and compact in construction as well as reliable in operation and which can be manufactured at low cost and readily incorporated in conventional machine designs without requiring material changes or exchange of component parts thereof.

It has already been proposed to provide automatic stop means for a sewing machine comprising essentially an interrupting or contact device controlled by the periodic tension of the upper thread and inserted in the electrical circuit of a release element, such as a relay or the like, adapted to initiate the stopping of the operation of the machine upon discontinuance of the periodic thread tension in the event of a failure or breakage of the thread. The thread tension varies periodically during successive stitching operations due to the action of the thread take-up and tension devices of usual construction, whereby to set up periodic current pulses in the electrical circuit in the rhythm of the stitching operations. In order to prevent operation of the release element by the periodic current pulses during normal operation, there is provided an additional interrupter or contact device is series with the thread controlled interrupter, said additional contact device being operated directly and continuously from an operative part or organ of the machine, to effect a periodic current interruption in the rhythm of the stitching cycles independently of periodic thread tension variations. The two contact devices inserted in series with the release element are so related or phased relative to one another that one contact device is opened while the other contact device is closed and vice versa, whereby, in the case of normal operation of the machine, the circuit of the release element is substantially continuously interrupted, thus preventing a control or stoppage of the operation of the machine under normal operating conditions. In the event of a failure or breakage of the thread, the thread controlled contact device remains closed over a prolonged period, whereby the directly operated contact device causes the establishment of a continued periodic current energizing the release element and initiating the automatic stopping of the operation by disconnecting the driving motor of the sewing machine.

Various arrangements have become known to effect a thread controlled operation of the contact device, such as a contact roller engaging the thread and periodically closing a cooperating stationary contact. The interrupting contact device is advantageously connected between the thread tension device and the thread take-up or pull-off lever of the machine. The direct or continuously operated contact device is controlled by any suitable moving part of the machine and may be in the form of a

contact disc or equivalent current interrupter operated by the arm shaft of the sewing machine or its driving motor.

By the present invention there is provided an improved monitoring and automatic stop device advantageously controlled by the periodic upper thread tension and which is simple and compact so that it can be attached or incorporated in conventional machine constructions without change or exchange of component parts. This object and result is achieved by the invention essentially by the use of a single interrupter or contact device controlled in synchronism with the periodic thread tension and connected in the circuit of a suitable release element such as a relay adapted upon energization to initiate the stopping of the operation of the machine.

In order to prevent a response of the relay under normal operating conditions, there are further provided according to the invention time delay means, either electrical or mechanical, adapted to retard the response or attraction of the relay armature during a predetermined time period, in such a manner as to prevent energization thereof and operation of the stop device under normal conditions, in the manner to be described in greater detail hereafter.

The invention, as to its further objects and novel aspects, will be better understood from the following detailed description of a preferred practical embodiment, taken in reference to the accompanying drawings forming part of this specification and wherein:

Fig. 1 is a side elevational view of a button hole sewing machine embodying improved automatic stop means according to the invention;

Fig. 2 shows, on an enlarged scale, the thread tension device, the thread take-up spring and the thread controlled periodic interrupter embodied in Fig. 1; and

Fig. 3 is an electrical circuit diagram of the automatic control system of the invention.

Like reference numerals identify like parts in the different views of the drawings.

Referring more particularly to Fig. 1, the table top **1** supports the base **2** of a button hole sewing machine of conventional construction comprising a bed plate **3**, an upright **4**, an upper arm **5** and a needle head **6** all of conventional design and construction. Mounted within the head **6** is a reciprocating and laterally displaceable needle bar **8** to which is secured the needle **7**, said bar being operated in a known manner (not shown) by the main driving or arm shaft of the machine.

The machine shown furthermore comprises a cam disc **9** for the control of the fabric displacing frame **10**. Fixedly mounted upon the arm shaft of the machine are a pair of driving pulleys **11** and **12** cooperating with loosely mounted or idler pulleys **13** and **14**, the latter being connected through belts **15** and **16** with separate driving pulleys of different diameter secured to the shaft of the driving motor (not shown). The belts **15** and **16** may be displaced by means of a belt shift device **17** attached to the upper end of a start-stop lever **18** pivoted at **20** and subject to the action of the spring **19**, to urge the belts **15** and **16** into engagement with the idling pulleys **13** and **14**, respectively, during standstill or in the inoperative position of the machine, as shown in Fig. 1.

Although the invention is herein described with specific reference to a button hole sewing machine, it will be evident that the improved automatic stop device as disclosed may be used with equal advantage in connection with other types of sewing machines having a periodic thread tension device adapted to control an electrical interrupter under normal operating conditions.

Attached to the lower end of the start-stop lever **18** is a ratchet **21** adapted to engage or cooperate with a pawl **22** secured to or integral with one end of a control

lever 23 which is rotatably mounted about a bolt or pivot 24 and carries a nose or cam 25 at its opposite end, said cam being normally urged by a spring 26 into the path of a pair of teeth or projections 27 and 28 of a control segment 29 secured to the cam disc 9. There is further shown a pressure plate 31 attached to the arm 30 of the control lever 23 and a stop lever 33 being rotatably mounted upon the start-stop lever 18 about a pivot screw 32, lever 33 being subject to the action of a further tension spring 34.

A starting lever 37 is journalled about a bolt or pin 36 connected between two projecting arms or brackets 35 attached to the base 2. The lever 36 may be operated manually, by means of an electromagnet or in any other suitable manner.

The button hole sewing machine shown furthermore comprises a cutting knife 38 mounted upon the head 6, a first thread tension device 39 mounted upon the top of the arm 5 and a further tension device 40 and associated thread take-up spring 41 of usual construction and mounted upon the side of the head 6 and more clearly shown in Fig. 2.

The operation of the machine described is as follows. Starting is effected by hand or foot operation through actuation of the starting lever 37, this resulting in a clockwise rotation of the start-stop lever 18. As a result, the pawl 22 of the control lever 23 due to the tension by the spring 26 engages the lower tooth of the ratchet 21, retaining the lever 18 in this position. Simultaneously with the operation of the lever 18, the belt 16 is shifted from the idler pulley 14 upon the driving pulley 12 and the belt 15 is shifted from the idler pulley 13 upon the idler pulley 14 due to the displacement of the belt device 17 by the lever 18. Since, as pointed out, the belt 16 cooperates with the larger one of the two driving pulleys of the motor, the machine starts to rotate at the higher one of its two operating speeds determined by the diameters of the driving pulleys.

At the termination of a sewing or stitching cycle, the tooth 27 upon the disc 9 engages the cam 25 of the control lever 23 for the first time, whereby the pawl 22 of the lever 23 moves from the lower tooth to the upper tooth of the ratchet 21 as a result of a slight anticlockwise rotation of the lever 33. This, in turn, causes an anticlockwise rotation of the spring-urged start-stop lever 18 to such an extent as to cause the belt shift device 17 to move the belt 16 from the driving pulley 12 upon the idler pulley 14 and to move the belt 15 from the idler pulley 14 upon the driving pulley 11. Since, as pointed out, the belt 15 cooperates with the driving pulley of smaller diameter upon the motor shaft, the machine continues to rotate at reduced operating speed.

In order to effect an operation as described, it is understood that the pulleys 11 and 13 have a lesser width than the pulleys 12 and 14, these and other details immaterial to the understanding of the present invention being omitted from the specification and drawing for the sake of clarity and simplicity of disclosure.

While the machine is running at reduced speed, the projection 28 upon engaging the cam 25 actuates the lever 23 a second time, thus fully releasing and causing a return of the start-stop lever 18 to its initial position shown in the drawing and finally stopping the operation of the machine by the stopping lever 33. Among others, this results in a stopping of the operation of the cutting knife 38.

In case of breakage of the upper thread during the operation, it is necessary to stop the machine in order to prevent continued operation of the cutting knife 38 and to avoid other defects. This may be obtained, according to the invention, by a successive actuation of the control lever 23 in the manner described, with this difference, however, in this case, that the lever is no longer controlled by the projections 27 and 28 of the control segment 29, but rather by a consecutive depression of the pressure plate 31 by the automatic stop mechanism.

In an embodiment of the invention of this type, the monitoring of the upper thread and stopping of the operation of the machine in the event of thread failure is effected in the manner further described in and understood from the following.

Mounted within the oscillating path of the thread take-up spring 41 is a contact arm 43 or the like secured to the head 6 of the machine by means of a screw 44, Fig. 2. The contact 43 which may be of any suitable shape is electrically insulated from the metal parts of the machine, the latter serving as a return connection of the electric circuit. The end 42 of the take-up spring 41 connected to the metal parts of the machine, is urged against and engages the contact 43 in the nonoperative or relaxed condition of the thread, that is, including the condition of thread failure or breakage.

An electric conductor 45 connects the contact 43 with a normally open switch 46 supported by the base 2. The switch 46 is automatically closed by an arm 48, secured to the stop lever 33 by means of fastening screws 47, upon starting of the machine by the operation of the control lever 46. A pull rod 49 is connected to the pressure plate 31 by a link joint, said rod being, in turn, articulated to the armature 50 of an electromagnet or solenoid 51 secured to the underside of the table top 1. The table top has an opening 52 to afford free passage of the armature 50.

Fig. 3 shows the electric wiring diagram of the system disclosed. The terminals 53 and 54 of a suitable power source, such as an A. C. power line or house lighting circuit, are connected through leads 55 and 56 to a bridge rectifier comprising four rectifying elements, such as dry or contact rectifiers, connected in conventional manner. The output leads 58 and 59 of the rectifier supply direct current for the operation of the electromagnet 51. The power terminals 53 and 54 are furthermore connected through a pair of leads 60 and 61 to the primary winding of a step-down transformer 62, the output leads 63 and 64 of said transformer serving to supply a suitable voltage for the operation of a relay 69 to be described hereafter.

Lead 64 is connected through a rectifier 65 to ground or the metal parts of the machine serving as a return circuit, while lead 63 is connected through a variable resistor 66 to one terminal 67 of the winding 68 of the relay 69. Shunted across the terminals 67 and 70 of the relay winding is an electrical capacitor 71, while a lead 72 connects the relay terminal 70 with one terminal of the switch 46. The other terminal of the switch is connected to the contact 43 of the interrupter through a lead 45, the cooperating contact 41 being connected to ground or the metal mass to complete the electrical circuit.

Contacts 41 and 43 form the periodic interrupter controlled by the thread tension, in the manner described hereinbefore. The relay 69 has a first pair of operating contacts 73 and 74, and a second pair of contacts 75 and 76, respectively. The relay terminal 67 is connected through a lead 77 to the contact 73, the cooperating contact 74 being connected by way of a variable resistor 78 and lead 79 to the other relay terminal 70.

The electromagnet 51 is connected to the output lead 58 of the rectifier 57, on the one hand, and to the output lead 59, on the other hand, through a lead 80 and by way of the relay contacts 75 and 76. The latter are shunted by a series network comprising a resistor 81 and capacitor 82 to minimize or prevent arcing or sparking of the contacts, in a manner well known. The electrical control device, except for the switch 46 attached to the machine and the contact or interrupting devices 41 and 43, is advantageously mounted in a housing 84 supported by the frame 83 of the sewing machine.

In a device of the type described, the monitoring of the thread and stopping of the operation of the machine

will be further understood from the following. In the nonoperative or standstill condition of the machine, the switch **46** is in the open position as shown in Fig. 3, it being released by the arm **48** by the start-stop lever **33**. The control circuit of the relay **69** is therefore interrupted, whereby the take-up spring **41**, in case of loose thread, engages with its end **42** the contact arm **43**. If the machine is now started by the operation of the starting lever **35**, the switch **46** is closed and the relay circuit is now subject to the action of the operation of the periodic contact device **41**, **43**. The latter causes an opening and closing of the circuit in the rhythm of the stitching operations, thus setting up a series of current pulses in the manner described and understood from the foregoing. Operation of the relay **69** is prevented, however, by the delay of the current pulses by the delaying network comprised of the series resistor **66** and parallel capacitor **71**. This delay network is so designed and/or adjusted by the control of the resistor **66** to have a time constant or electric delay time at least equal to a pulse duration, whereby to prevent a current flow through and energization of the relay winding **68** under normal operating conditions of the machine.

In the event of a thread failure or breakage, on the other hand, the interrupter or contact device remains closed, since the spring **42** continuously engages the contact **43**, whereby to cause an operation of relay **69** and to close its contacts **73**, **74** and **75**, **76** respectively. The electromagnet **51** is thus energized and operates the control lever **23** for the first time, whereby to reduce the operating speed in substantially the same manner as described. Immediately thereafter, the electromagnet **51** is again deenergized as a result of the closing of the additional relay contacts **73** and **74** shunting the winding **68** through the resistor **78**, thereby causing a release of the relay armature. The time of release of the relay **69** may be controlled by the adjustment of resistor **78**.

After release of the relay **69**, the latter is energized a second time, thus causing energization of the magnet **51** followed by a repeated operation of the control lever **23** and complete stopping of the machine, in substantially the same manner as described and understood from the foregoing. Switch **46** is then again opened and the system restored to its initial operating condition.

Looked at from another angle, the resistor **66** and capacitor **71** form a low-pass filter having a cut-off frequency below the operating or interrupting frequency of the switch **41**, whereby to prevent any appreciable current flow through the relay winding **68** under normal operating conditions. Upon failure of the thread, the interrupting frequency becomes zero, that is, the current changes from A. C. to D. C., resulting in reduced impedance or increased current flow sufficient to energize the relay **68**.

In place of an electric delay of the response of the relay or equivalent release element, mechanical delay means may be provided, such as in the form of suitable damping devices retarding the movement of the relay armature.

While, in the foregoing, the automatic stop device of the invention has been described in connection with a step-by-step speed reduction, that is, first from full speed to intermediate speed and then from intermediate speed to zero, by means of the special multiple shifting device, shown for illustration, it is understood that the machine may be stopped directly by the solenoid or equivalent electrical actuating device in a single step, such as by energizing a circuit breaker adapted to interrupt the motor supply current, the special design and mode of operation of the stopping device being immaterial as far as the invention is concerned.

The new control system, according to the invention, is also suitable for use with multi-needle machines, in which case the contacts **41** and **43** of all the needle heads are connected in parallel, whereby the operation of the machine will be automatically stopped upon failure or breakage of any of the threads of the individual sewing heads.

Furthermore, it will be evident that the invention applies with equal advantage to all kinds of sewing machines having a periodic thread tension device, such as embroidery machines, quilting machines and the like.

In the foregoing, the invention has been described with reference to a specific illustrative device. It will be evident however, that modifications and variations, as well as the substitution of equivalent parts or elements for those shown herein for illustration, may be made without departing from the spirit and scope of the invention as set forth in the appended plans. The specification and drawings are accordingly to be regarded in an illustrative rather than in a limiting sense.

I claim:

1. In an automatic stop device for sewing machines and the like, an oscillatable element controlled by periodic thread tension during the operation of the machine, an electric circuit including a source of current and interrupting contact means normally urged to closed position and controlled by said element, to periodically open and close said circuit and to produce a series of current pulses at the oscillating rhythm of said element, current responsive means controlled by said circuit to stop the operation of said machine, and electric time delay means in said circuit to retard said current pulses by time periods, to prevent energization of said current responsive means during operation of said element.

2. In an automatic stop device for sewing machines and the like, an oscillatable element controlled by periodic thread tension during the operation of the machine, an electric circuit including a source of direct current and a pair of interrupting contacts normally urged to closed position and controlled by said element, whereby to periodically open and close said circuit and to produce a series of current pulses at the oscillating rhythm of said element, current responsive means controlled by said circuit to stop the operation of said machine, and electric time delay means in said circuit to retard said current pulses by time periods at least equal to a current pulse duration, to prevent energization of said current responsive means during operation of said element.

3. In an automatic stop device of the type claimed in claim 2, said delay means consisting of an electric time delay network connected between said source and said current responsive means.

4. In an automatic stop device as claimed in claim 2, said time delay means consisting of a network comprising a series resistor and parallel capacitor connected between said source and said current responsive means.

5. In an automatic stop device for sewing machines and the like having an oscillatable element controlled by periodic thread tension variations during successive stitching operations, an electric control circuit including a source of current and a pair of interrupting contacts normally urged to closed position and controlled by said element, to periodically open and close said circuit and to produce a series of current pulses at the oscillating rhythm of said element, an electromagnetic relay having a winding inserted in said circuit, a time delay network connected between said source and said relay, to retard said current pulses by a time period at least equal to a current pulse duration, to prevent a response of said relay during normal operation of said machine and to cause energization thereof upon cessation of the oscillation of said element due to thread failure, and means controlled by said relay to stop the operation of said machine.

6. In an automatic stop device as claimed in claim 5, wherein said time delay network is comprised of a resistor in series with and a capacitor shunted across said relay winding.

7. In an automatic stop device as claimed in claim 5,

wherein said last mentioned means is of the type operable in successive steps to first reduce the speed of and thereafter to fully stop said machine, means to control said last means by said relay, and further means to deenergize said relay upon lapse of a predetermined time period upon response thereof, to consecutively operate said stopping means by said relay, thereby to fully stop said machine in the event of thread failure.

8. In an automatic stop device as claimed in claim 5, wherein said last mentioned means is of the type operable in successive steps, to first reduce the speed of and thereafter to fully stop said machine, said relay having a first pair of contacts and a second pair of contacts being normally open and closed upon excitation of said winding, means including said first pair of contacts to control said last mentioned means by said relay, and a resistor in series with said second pair of contacts and shunted across said relay winding, to deenergize said relay upon lapse of a predetermined time period upon response thereof, whereby to consecutively operate and stopping means by said relay, to fully stop said machine in the event of thread failure.

9. In an automatic stop device for sewing machines and the like having a thread tension device and an oscillatable thread take-up spring controlled by the periodic thread tension during successive stitching cycles of said machine, an insulated contact cooperating with said spring to provide a periodic interrupter, said spring normally urged into closed position with said contact, an electrical circuit including said interrupter, a source of current and a relay, to produce a pulsed current in said circuit during normal operation of said machine, an electric time delay network connected between said source and said relay to retard said current pulses normally to prevent a response of said relay during oscillation of said take-up spring and to cause energization of said relay upon cessation of the spring oscillations due to thread failure, and stopping means controlled by said relay to stop the operation of said machine.

10. In an automatic stop device as claimed in claim 8, wherein said time delay network is comprised of a resistor in series with a capacitor in shunt relation with said relay.

11. In an automatic stop device as claimed in claim 8,

wherein said last means is of the type operable in successive steps to first reduce the speed of and to thereafter fully stop said machine, means to control said last means by said relay, and further means to deenergize said relay upon lapse of a predetermined time period upon response thereof, to step-by-step operate said stopping means upon the occurrence of a thread failure.

12. In a motor driven sewing and the like machine having means to periodically tension the thread during a predetermined phase of successive stitching cycles, a switch normally urged to closed position and arranged to be periodically opened in synchronism with the tensioning of said thread, electrical stop-motion means for said machine, an electrical circuit including a source of current, a relay to operate said stop-motion means and said switch, to produce a series of current pulses in said circuit at the rhythm of the stitching cycles during normal operation of the machine, and electric time delay means in said circuit, to retard said current pulses by predetermined time periods, to prevent energization of said relay during normal operation of said machine.

13. In a motor driven sewing and the like machine having means to periodically tension the thread during a predetermined phase of successive stitching cycles, a switch normally urged to closed position and arranged to be periodically opened in synchronism with the tensioning of said thread, electrical stop-motion means for said machine, an electric circuit including a source of direct current, a relay to operate said stop-motion means and said switch, to produce a series of current pulses at the rhythm of the stitching cycles during the normal operation of the machine, and a series-resistance and parallel-capacitor network connected between said source and relay, to prevent energization of said relay during normal operation of said machine.

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