Feb. 4, 1969 H. V. JACOBS ET AL 3,425,375

THREAD CONTROL

Filed Oct. 7, 1966

Sheet 1 of 2

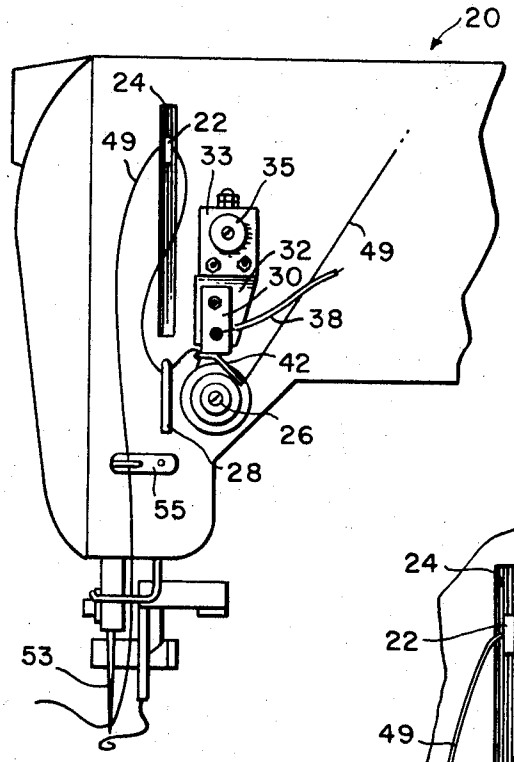


Fig. 1.

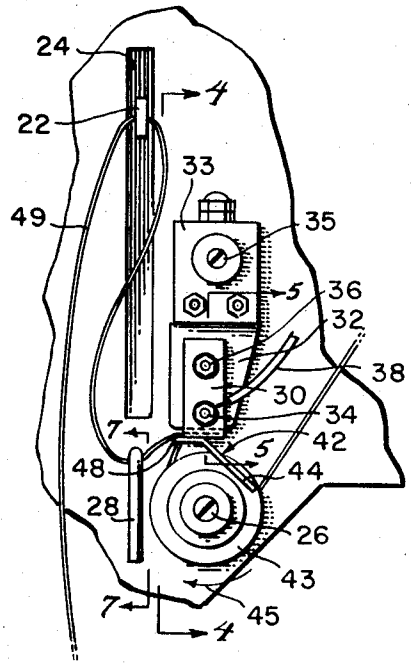


Fig. 2.

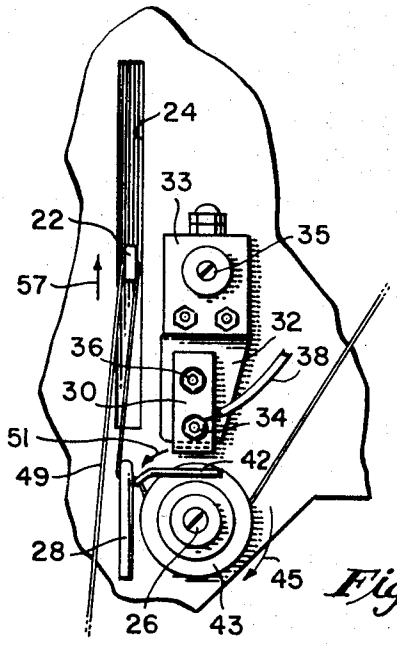


Fig. 3.

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Filed Oct. 7. 1966 Sheet 2 of 2

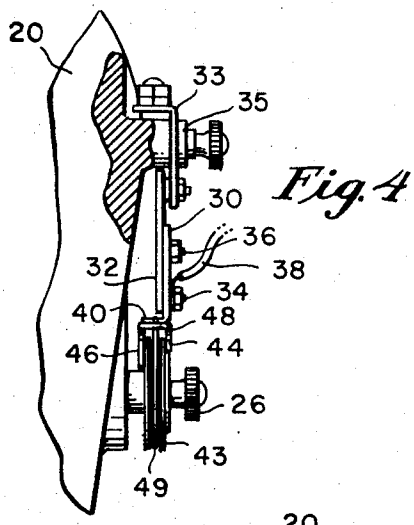


Fig. 4

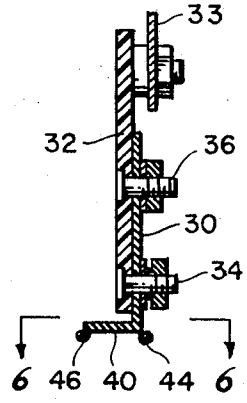


Fig. 5.

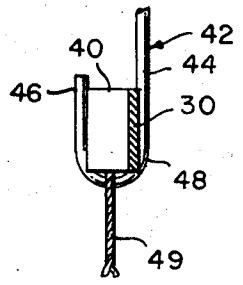


Fig. 6.

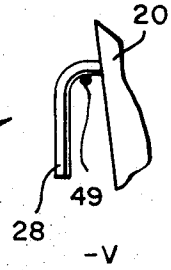


Fig. 7.

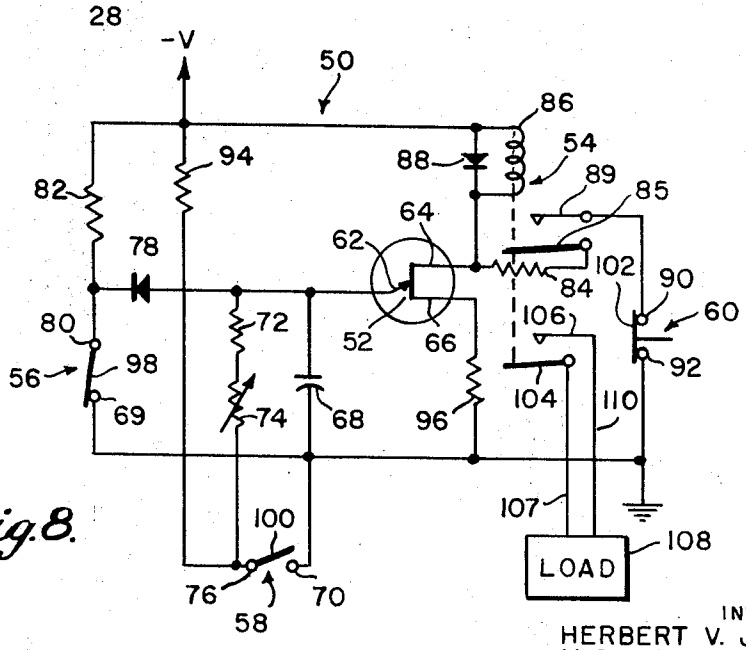


Fig. 8.

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THREAD CONTROL

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U.S. Cl. 112—218 5 Claims
Int. Cl. D05c *11/00;* G08b *21/00;* D03d *51/34*

ABSTRACT OF THE DISCLOSURE

A thread control for a sewing machine of the lock stitch type which comprises means responsive to the tension on the thread for providing a first signal when the thread is taut. The means responsive to the tension on the thread provides a second signal when the thread is not taut. Means responsive to the first and second signals are provided for determining that the thread is broken if the first signal is not received within a predetermined period after the second signal is received.

This invention relates generally to sewing machines and more particularly to a thread control for a sewing machine to determine breakage of the thread therein.

In industrial processes utilizing sewing machines, it is extremely advantageous to know when the thread in the machine has been broken. If the thread in the machine is broken without detection, the sewing process continues without any thread being used to fasten the product of the machine together. The end product is therefore useless unless the article may be run through the sewing machine again. In sewing machines of the type wherein a lock stitch is produced for fastening, the thread is constantly being drawn into tension as the thread is pulled to the needle by the take-up. However, when not being taken up, the thread is slack. Therefore, the thread in the machine is alternately not in tension and in tension even when not broken. When the sewing machine is in operation, the thread is primarily slack and, therefore, sensing the tension on the thread does not aid in determining whether or not the thread is broken.

It is, therefore, an object of the invention to overcome the aforementioned problems.

It is another object of the invention to provide a thread control which is adapted to determine the continuity of the thread in a sewing machine.

Another object of the invention is to provide a new and improved thread control which is adapted to determine whether the thread in a lock stitch type sewing machine is broken.

Another object of the invention is to provide a new and improved thread control having a novel sensing circuit for enabling determination of whether the thread is broken.

Another object of the invention is to provide a new and improved sensing circuit which is adapted to provide a control signal if a condition is not satisfied within a predetermined period of time.

These and other objects of the present invention are achieved by providing a thread control for a sewing machine comprising means responsive to the tension on said thread for providing a first signal when said thread is in tension and for providing a second signal when said thread is not in tension, means responsive to said first and second signals for determining that said thread is broken if said first signal is not received within a predetermined period after said second signal is received.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same

becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a fragmentary side elevational view of the head of a sewing machine embodying the invention;

FIG. 2 is an enlarged fragmentary side elevational view showing the co-action between the take-up and the thread tension;

FIG. 3 is an enlarged fragmentary side elevational view similar to FIG. 2 with the take-up in an intermediate position of the take-up cycle;

FIG. 4 is a sectional view taken along the line **4**—**4** in FIG. 2;

FIG. 5 is an enlarged sectional view taken along the line **5**—**5** in FIG. 2;

FIG. 6 is an enlarged sectional view taken along the line **6**—**6** in FIG. 5;

FIG. 7 is an enlarged sectional view taken along the line **7**—**7** in FIG. 2; and

FIG. 8 is a schematic diagram of the sensing circuit embodying the invention.

Referring now in greater detail to the various figures of the drawings wherein similar reference characters refer to similar parts, a sewing machine embodying the invention is generally shown at **20** in FIG. 1. The sewing machine **20** is basically a conventional sewing machine and except as otherwise stated hereinbelow may be of the type shown in Gray Patent No. 1,020,089, patented Mar. 12, 1912.

The sewing machine **20** includes a take-up **22** which is pivotably mounted and is adapted to be drawn up and down within a vertical slot **24**. The machine **20** further includes a thread tension **26** which is mounted below and adjacent the slot **24**. Adjacent the thread tension **26** is a guide **28** which is secured to the side of the head of the sewing machine **20** as best seen in FIG. 7.

In accordance with the invention, there is also provided with the sewing machine a copper bar **30** which is mechanically connected to but electrically isolated from the head of the machine. The copper bar **30** is fastened to the mounting block **32** which preferably comprises silicone or nylon by fasteners **34** and **36**.

As best seen in FIGS. 1, 4 and 5, the bar **30** is mounted above and adjacent the thread tension **26**. The mounting block **32** depends from a mounting bracket **33** which is secured to the head of the sewing machine **20** by a fastener **35**.

As best seen in FIG. 2, the fasteners **34** and **36** act as terminals to which electrical leads **38** are attached. The bar **30** is basically L-shaped and the bottom leg **40** thereof, as best seen in FIG. 5, extends horizontally toward the body of sewing machine **20**.

As best seen in FIGS. 2 and 3, the thread tension **26** includes a spring **42**. Spring **42** is mounted about the thread tension **26** to a pivotably mounted disc **43**. Disc **43** is conventionally mounted in the thread tension **26** so that it is adapted to be spring urged about the axis of the thread tension. The disc is normally urged in the direction of arrow **45**, shown in FIGS. 2 and 3. Therefore, the tendency of spring **42** is to be urged against copper bar **30**. Spring **42** is substantially U-shaped and, as best seen in FIGS. 2, 4 and 6, includes a pair of legs **44** and **46** and a U-shaped web **48** which is inclined at an angle from legs **44** and **46**.

As best seen in FIGS. 1, 2 and 6, the thread **49** passes about thread tension **26** up through the U-shaped web **48** of spring **42**, underneath guide **28**, through the opening in take-up **22**, and passed to the needle **53** via a guide **55**. As best seen in FIG. 2, when the thread **49** is slack, the spring **42** is urged against copper bar **30**, thus, providing a closed circuit in a sensing device as will hereinafter

be seen. The thread is slack during most of the cycle of the sewing machine. That is, only when the take-up **22** is rising, as shown in FIG. 3, is the thread **49** brought into tension. When the take-up **22** does rise and the thread is drawn into tension, the thread between guide **28** and spring **42** draws the spring **42** towards guide **28** which causes the spring to pivot in the direction of arrow **51**. This action opens the circuit between the spring **42** and bar **30**. When take-up **22** reaches its uppermost position, as shown in FIG. 2, the thread **49** slackens again. The disc **43** is urged by the spring action of thread tension **26** in the direction of arrow **45**. The spring **42** is, therefore, urged against bar **30** and thereby again closes the circuit therebetween. It can, therefore, be seen that the spring **42** is pivoted away from bar **30** each time the take-up **22** is moving in the direction of arrow **57**. The circuit formed between spring **42** and bar **30** is thereby opened each time a stitch is formed by sewing machine **20**.

The spring **42** because of its securement to the thread tension **26** is electrically grounded to the sewing machine **20**. The copper bar **30** is mounted to the sewing machine by mounting block **32** which is comprised of an insulating material. The copper bar **30** is therefore isolated electrically from the spring **42** unless they are actually in contact. The spring **42** and copper bar **30** therefore act as an electrical switch to provide an indication of whether or not thread **49** is in tension. Whenever the thread **49** is slack, the switch is closed. Conversely, the switch is opened each time the thread **49** is drawn into tension.

The sensing circuit **50** for determining whether the thread in the sewing machine **20** is broken is shown schematically in FIG. 8. Circuit **50** basically comprises a uni-junction transistor **52**, a relay **54**, a first switch **56**, a second switch **58** and a reset switch **60**. The uni-junction transistor **52** includes an emitter **62**, a first base **64** and a second base **66**. The emitter of uni-junction transistor **52** is connected to a capacitor **68** which is in turn connected to the first terminal **70** of switch **58**. The emitter is also connected via serially connected resistor **72** and variable resistor **74** to a second terminal **76** of switch **58** and to diode **78**. Diode **78** is connected to a first terminal **80** of switch **56** and via a resistor **82** to a negative source of voltage (−V).

The first base **64** of uni-junction transistor **52** is connected via a reistor **84** to the first arm **85** of relay **54** and, to a first end of coil **86** of relay **54** and to diode **88**. Diode **88** is connected across coil **86** which is connected at its other end to the negative source of voltage (−V). A first contact **89** associated with arm **85** of relay **54** is connected to a first terminal **90** of reset switch **60**. A second terminal **92** of reset switch **60** is connected to ground as are terminals **69** and **70** of switches **56** and **58**, respectively. Terminal **76** of switch **58** is connected to the negative potential via resistor **94**.

The second base **66** of uni-junction transistor **52** is connected to ground via resistor **96** and to the emitter **62** of the uni-junction transistor via capacitor **68**. Switch **56** further includes an arm **98** which is normally urged against terminal **69**. The switch **56** is a schematic representation of the electrical switch formed by spring **42** and bar **30**. That is, each time the spring **42** is drawn away from bar **30**, the arm **98** would likewise be disengaged from terminal **69** thereby opening switch **56**. Switch **56** is therefore normally closed.

Switch **58** includes an arm **100** which is normally urged away from terminal **70**. The switch **58** is preferably associated with the treadle switch of sewing machine **20** which would urge arm **100** against terminal **70** to close switch **58** when the sewing cycle of the sewing machine **20** is initiated. The switch **58** is thus normally open and when the sewing machine is started, arm **100** is closed against terminal **70**.

The reset switch **60** includes a spring urged arm **102** which is normally urged against terminals **90** and **92** thus closing the switch. When the arm **102** is pressed, it is urged away from the terminals **90** and **92** opening the switch and as will hereinafter be seen resetting the circuit.

Relay **54** also includes a second arm **104** and a terminal **106** associated therewith. Relay arm **104** is connected via a first line **107** to a load **108**. Terminal **106** is connected via a second line **110** to a load **108**. The arm **104** is normally urged away from terminal **106**. When the relay coil **86** is energized, the arm **104** is drawn against terminal **106** which thereby closes the circuit to load **108** and initiates operation thereof.

In operation, the uni-junction transistor **52** forms a voltage divider between the negative source of voltage (−V) and ground when the arm **98** of switch **56** is closed and arm **100** of switch **58** is open. The switch **56** is opened each time the sewing machine **20** makes a stitch. That is, each time the takeup is moved in the direction of arrow **51** as hereinbefore mentioned, the thread **49** is drawn into tension and switch **56** is thereby opened. If the thread should break, the spring **42** is not drawn away from bar **30** and thus switch **56** does not open.

Prior to starting the sewing machine **20**, switch **58** is open which causes the capacitor **68** to be charged to the potential of −V. The emitter **62** is therefore at a more negative potential than the base **64** of the uni-junction transistor. The uni-junction transistor **52** is thus cut-off and acts as a voltage divider.

Assuming that the sewing machine is started, switch **58** is closed thereby and that the thread in the sewing machine is continuous and operational, the closing of switch **58** by urging arm **100** against terminal **70** enables capacitor **68** to discharge through resistors **72** and **74**. The voltage at emitter **62** thereby starts to increase from −V towards ground. Since the thread is in operative condition, the switch **56** is opened and thereby causes capacitor **68** to be charged through diode **78** and resistor **82** and the capacitor is thus charged again to −V. The closing of arm **98** when the tension on the thread is released starts the discharge of capacitor **68** again. The voltage in emitter **62** therefore begins to rise. If the thread continues to remain operative, the switch **56** will again be opened prior to the voltage at emitter **62** increasing greatly enough to change the state of uni-junction transistor **52**. The operating condition of circuit **50** remains in this condition unless the switch **56** fails to open which is indicative that the thread is broken.

Assuming that switch **58** is closed as operation of the sewing machine is initiated and the thread in the sewing machine **20** is broken: As switch **58** is closed, the capacitor **68** begins to discharge. The voltage therefore begins to rise at the emitter **62**. The uni-junction transistor **52** is driven to saturation whenever the voltage at emitter **62** increases to a potential greater than the potential at base **64**. This saturation potential is reached at emitter **62** in a fixed period of time based on the values of capacitor **68** and resistors **72** and **74**. This period, which is referred to as the time constant, can be varied by adjustment of resistor **74** and is preferably preset to be substantially as long as it takes the sewing machine to sew two stitches at its top speed. Therefore, if the arm **98** does not open from terminal **69** within the time that it takes for the sewing machine to make two stitches, the voltage at emitter **62** exceeds the potential of base **64**.

When the emitter reaches the greater potential, the uni-junction transistor **52** becomes conductive between the first base **64** and emitter **62**. The capacitor **68** is then charged via emitter **62** and base **64** through relay coil **86**. The surging current through relay coil **86** causes arm **85** to be magnetically drawn against the terminal **89**. The closed circuit between arm **85** and terminal **88** completes a closed circuit from −V to ground through relay coil **86** which thereby continues to cause the relay arm **85** to remain magnetically drawn against terminal **89**. The second arm **104** of the relay **54** is also drawn towards coil **86** and contacts terminal **106** which thereby causes a complete circuit to load **108**. The load **108** is preferably com-

prised of an indicating light or alarm signal which warns that the thread in the sewing machine is broken. The load also preferably includes a device for closing or shutting off the machine.

The circuit **50** remains in this "warning" state until the reset switch **60** is opened by pressing arm **102** away from terminals **90** and **92**. The opening of the switch opens the circuit including relay coil **86** to prevent further flow of current therethrough and thereby causing arms **84** and **104** to be urged away from terminals **89** and **106**, respectively. The condition of the circuit is restored to its state prior to initiation of the operation of the sewing machine **20**.

It can therefore be seen that this invention provides a new and improved circuit for detecting a broken thread in a lock stitch type sewing machine. The operation of the circuit **50** is such that if after a predetermined period of time the spring **42** is not urged away from the bar **30** by action of the take-up, it indicates that the thread is broken. The sensing device is clamped into a state of equilibrium to indicate that the thread is broken and cannot be turned off until the reset switch **60** is actuated. The operation of the sewing machine may be turned off by the device and thereby enable someone to rethread the sewing machine prior to reoperation thereof. The solid state circuitry utilized in the circuit enables great reliability and is also inexpensive to operate because current drain is minimal.

Although the time constant in the preferred embodiment is equal in time to the sewing time of two stitches by the sewing machine **20**, by varying the resistance of resistor **74**, the time constant may be increased or decreased.

Load **108** may take many forms. It may also include a buzzer or other form of alarm in addition to a warning lamp to notify an operator that the machine is temporarily put out of order because of a thread breaking. The switch **56** which is schematically illustrative of the spring **42** and copper bar **30** thus generates two conditions. The first condition when the switch is open is indicative of the thread being in tension. The second condition when the switch is closed is indicative that the thread is slack. Circuit **50** utilizes the two conditions of the switch to determine a breakage in the thread. That is, the circuit **50** is operative in a first state in which relay **54** is not energized unless the first condition of the switch **56** is not detected within a predetermined period after the second condition of the switch **56** is first detected or in that predetermined period after the operation of the circuit **50** is initiated by closing switch **58**.

Without further elaboration the foregoing will so fully illustrate my invention, that others may, by applying current or future knowledge, readily adapt the same for use under various conditions of service.

What is claimed as the invention is:

1. A signalling device comprising a uni-junction transistor, a switch, delay means and an alarm, said transistor comprising an emitter electrode and two base electrodes, said transistor normally being non-conductive, the emitter of said transistor being connected to said switch via said delay means, said switch providing a first voltage to said emitter when in a first position and a lower second voltage when in a second position, said uni-junction transistor being driven conductive when said emitter reaches a predetermined voltage intermediate said first and said second voltages, said delay means delaying the build-up of voltage at said emitter when said switch is in said first position and dropping said emitter voltage to said second voltage when said switch is in said second position, said transistor being adapted to initiate said alarm when driven conductive, said delay means being adapted to delay the build-up of voltage at said emitter for a predetermined period of time so that if said switch remains in said first position for said time said alarm is initiated.

2. The invention of claim **1** wherein said switch is provided on a sewing machine having a thread tension means including a pivotably mounted spring, and a take-up for alternately drawing the thread taut and enabling the thread to be slack, said switch comprising said spring of said thread tension means and a conductive member mounted adjacent thereto, said switch being in said first position when the thread of said sewing machine is slack and in said second position when said thread is taut.

3. The invention of claim **1** and further including a relay having a coil, a first base of said transistor being connected to said coil of said relay, said relay being adapted to initiate said alarm when said uni-junction transistor is driven conductive.

4. The invention of claim **3** wherein said relay includes a pair of switches which are closed by energization of said relay, a first one of said switches of said relay initiating an alarm and a second of said switches locking said signalling device in a state to continuously operate said alarm.

5. The invention of claim **4** and further including a reset switch, said second switch of said relay being associated with said reset switch, said reset switch being adapted to de-energize said relay to enable said signalling device to return to its initial state and terminate operation of said alarm.

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U.S. Cl. X.R.

139—370; 200—61.18