May 6, 1969 D. R. CASH 3,442,234

AUTOMATIC NEEDLE RETRACTING QUILTING MACHINE

Filed Feb. 1, 1966 Sheet 1 of 3

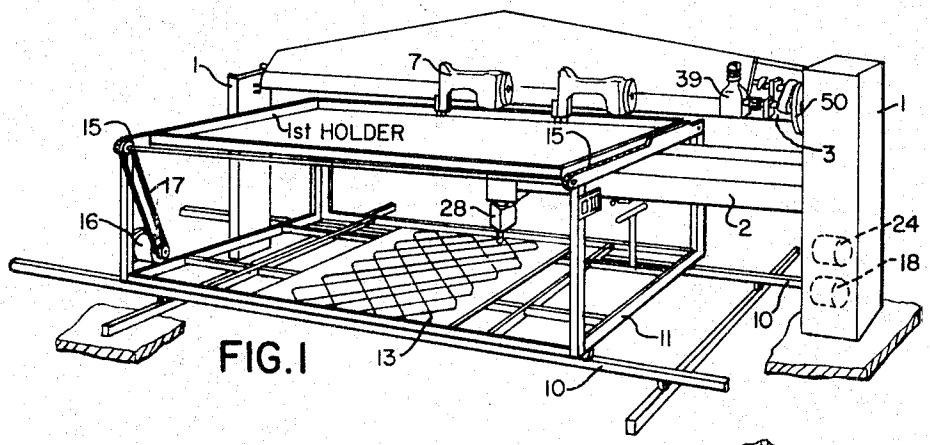


FIG.1

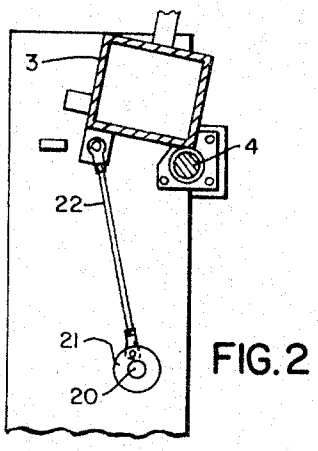


FIG.2

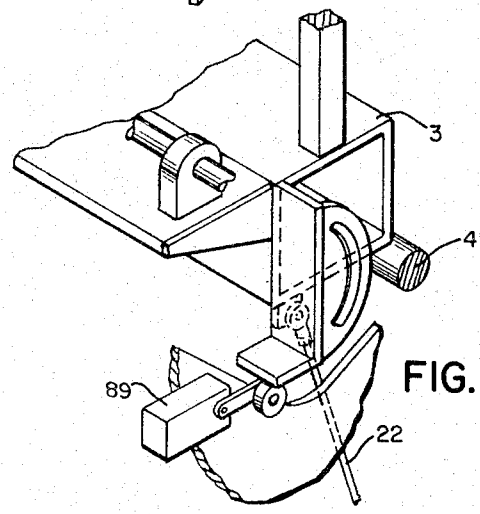


FIG.3

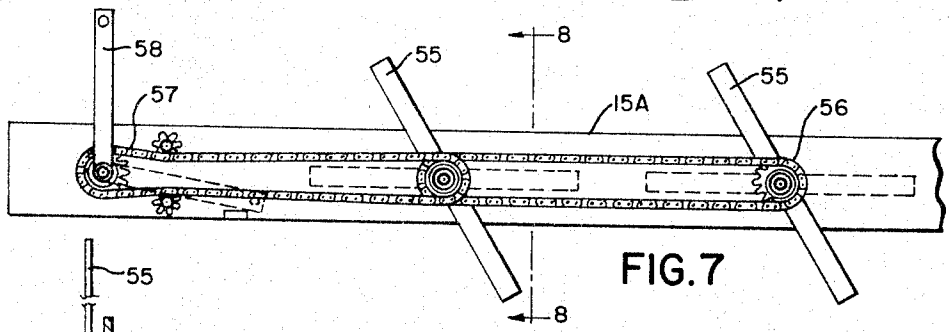


FIG.7

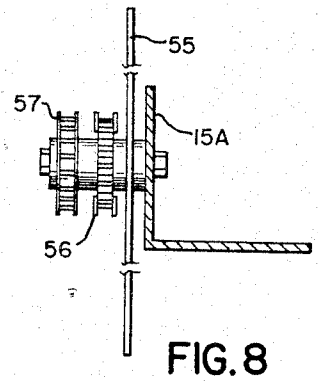


FIG.8

INVENTOR.
DAVID R. CASH
BY Arthur Robert
HIS ATTORNEY

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AUTOMATIC NEEDLE RETRACTING QUILTING MACHINE

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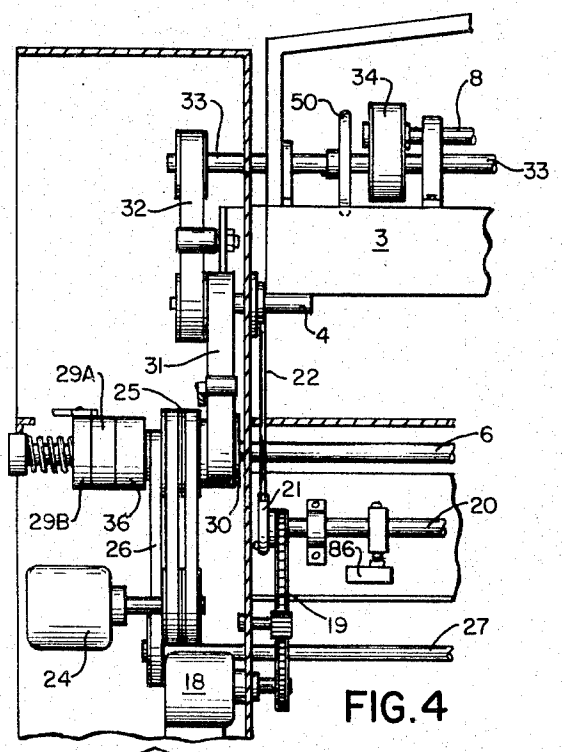


FIG. 4

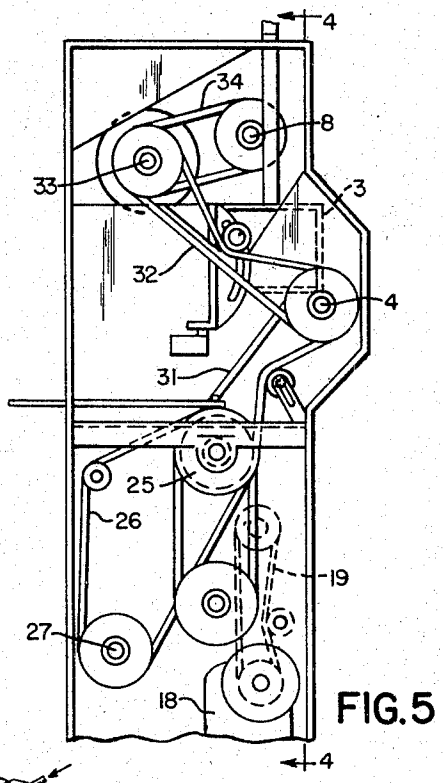


FIG. 5

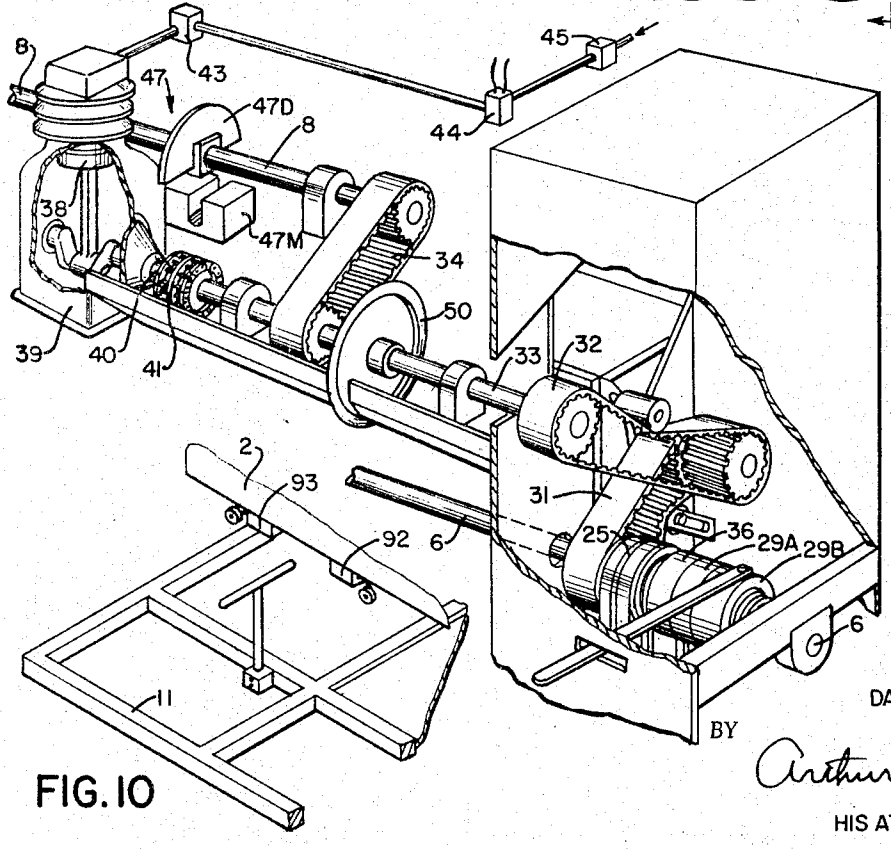


FIG. 6

FIG. 10

INVENTOR.
DAVID R. CASH

BY Arthur J. Robert

HIS ATTORNEY

May 6, 1969 D. R. CASH 3,442,234

AUTOMATIC NEEDLE RETRACTING QUILTING MACHINE

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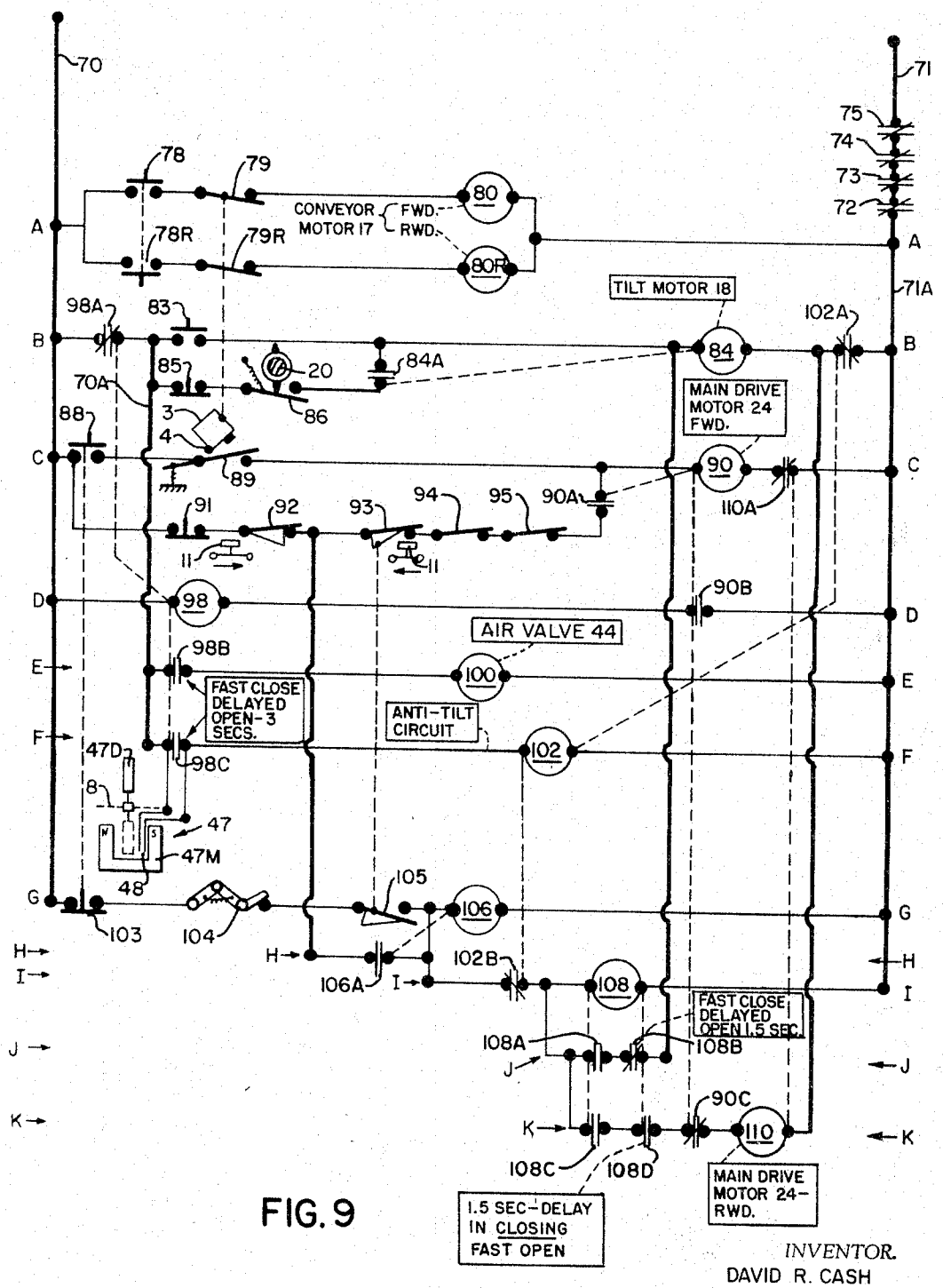


FIG. 9

INVENTOR.
DAVID R. CASH

BY Arthur Robert

HIS ATTORNEY

United States Patent Office

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AUTOMATIC NEEDLE RETRACTING QUILTING MACHINE

David R. Cash, Louisville, Ky., assignor to James Cash Machine Co., Louisville, Ky., a corporation of Kentucky

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Int. Cl. D05b *11/00, 35/00, 69/02*
U.S. Cl. 112—118
13 Claims

ABSTRACT OF THE DISCLOSURE

A quilting machine wherein a frame-mounted follower drives a carriage-mounted guide-track to move a carriage-mounted quilt along a path reproducing a sewing line design while a frame-mounted sewing machine sews that design into the quilt. At the end of one sewing cycle plus a small fraction of the next, the apparatus operates automatically to stop the sewing operation, retract the needle, move the sewing head away from the quilt and move the carriage reversely to the starting point. Now the carriage is moved rearwardly to a cutting point where a carriage-mounted cutter is operated to cut the sewing thread permitting the quilt to be removed.

One type of quilting apparatus presently employed conventionally comprises: (A) a quilt-holder across which an unsewn quilt-forming workpiece is stretched and clamped; (B) a loading table for supporting a quilt-holder while an unsewn workpiece is loaded thereon or a sewn workpiece is unloaded therefrom; and (C) a quilting machine including (1) a sewing machine having a needle-operating mechanism and a stitch-locking mechanism, (2) a support means having (a) a base frame supporting the stitch-locking mechanism and (b) a head frame supporting the needle-operating mechanism and mounted on the base frame for motor-powered pivotal movement between operative and out-of-the-way positions; (3) carriage means mounted on the base frame to support the quilt-holder for back and forth movement both longitudinally and transversely; (4) motor-powered conveyor means mounted on said carriage means for transporting the quilt holder forwardly into and rearwardly out of its operative position on the carriage means; (5) guide track means establishing the pattern of carriage movement to be followed in sewing the workpiece with a given design or stitching; and (6) motor-powered drive means for operating the sewing machine and simultaneously moving the guide track means to manipulate the carriage means in accordance with the sewing design guide.

Once the motor-powered drive means is energized, the sewing machine and carriage means will continue in operation through one sewing cycle and automatically shut down when the carriage means returns to the starting point. Conventional operation presently requires the manual retraction of the needles from the workpiece, the manual closing of the tilt motor circuit to raise the head frame to its inoperative position and the manual severance of each individual thread to remove the quilt holder from the quilting machine. These manual operations take

the time of skilled labor and correspondingly reduce production and increase cost.

The principal objects of the present invention are: to improve the appearance of the sewn design; to effect a substantial decrease in the time required to free a quilt holder for removal from the quilting machine with a corresponding increase in production and decrease in cost; and to simplify and speed up the thread-cutting operation.

More particularly, one object of the present invention is to improve the sewing operation in a manner which effects an improvement in the appearance of the sewn design. This object is achieved by providing the quilting apparatus with control means for stopping the sewing operation automatically after the carriage means has moved through one full sewing cycle and a small fraction of the next.

Other particular objects are: to retract the needles automatically upon the completion of the sewing operation; and to tilt the head frame automatically upon the retraction of the needles. These objects are accomplished by providing the needle operating mechanism with mechanical means operative, when actuated, to turn the needle operating mechanism sufficiently to retract the needles and by providing control means for actuating the needle retraction means in response to the completion of the sewing operation and for actuating the head frame tilting motor automatically upon the retraction of the needles.

An additional object is to accomplish the foregoing particular objectives and automatically return the carriage means to its starting point after the head has been tilted. This additional object is accomplished by additionally providing the sewing machine drive train with means permitting it to be driven in one direction but not in the reverse and by providing a control means, which is operative, in response to the tilting of the head frame, to re-energize the main drive in the reverse direction long enough to return the carriage means to its starting point.

Another particular object is to simplify and speed up the thread-cutting operation. This particular object is accomplished by arranging the carriage means for movement from its starting position to a cutting position, which is located rearwardly a short distance sufficient to stretch the threads between the sewing needle and the 1st holder, and by providing the upper carriage with a thread cutter which, in said cutting position, may be manually actuated to cut the stretched threads.

The invention is illustrated in the accompanying drawings, wherein:

FIG. 1 is a perspective and somewhat schematic view of a quilting machine constructed in accordance with my invention;

FIG. 2 is a cross-sectional view of the head frame in its tilted or inoperative position, this view also showing the head frame tilting means;

FIG. 3 is a fragmentary perspective view showing the head frame in its untilted operative position and also showing its relationship to a head frame operated limit switch;

FIG. 4 is a broken front-end elevational view of that

side of the machine, which appears at the right in FIG. 1, the front end of the casing being broken away in this view to show portions of the tilting motor drive train and of the main drive train for the sewing machine and the carriage means;

FIG. 5 is a side elevation of the drive shown in FIG. 4 with the casing broken away;

FIG. 6 is a broken (and somewhat schematic) rear-end perspective view of that portion of the sewing machine drive, which appears in the right side of FIG. 1, the casing being broken away and some of the parts omitted for the sake of clarity;

FIG. 7 is a front end elevation of the cutting means on the front end of the conveyor;

FIG. 8 is a section taken along line 8—8 of FIG. 7;

FIG. 9 is a circuit diagram of the control means; and

FIG. 10 is a fragmentary view showing the relationship of the carriage means to the control switches adjacent the starting and stopping positions of the carriage means.

Conventional structure

The quilting machine shown in FIG. 1 conventionally comprises:

(A) A base frame of the A frame type including

(1) a pair of horizontally-spaced upright standards, **1**,
(2) a pair of horizontally-elongate vertically-spaced cross frames **2** and **3** extending from the upper end portion of one standard to the other with the lower cross frame **2** rigidly secured to both standards **1** and
(3) trunnion means **4** pivotally mounting the upper cross frame or head frame **3** on the standard **1** for tilting movement between the operative sewing position shown in FIG. 3 and the inoperaitve tilted position shown in FIG. 2;

(B) A sewing machine having a stitch-locking mechanism (not shown) with its bobbin drive shaft **6** (FIGS. 4–6) on the lower fixed cross frame **2** and a needle-operating mechanism or sewing head **7** with its needle drive shaft **8** (FIGS. 4–6) mounted on the upper tiltable head cross frame **3** for movement therewith;

(C) Carriage means including

(1) a lower carriage **10** mounted on the floor for forward-rearward movement and
(2) an upper carriage **11** mounted on the lower carriage for forward-rearward longitudinal movement therewith and for right-and-left or side-to-side transverse movement relative thereto;

(D) An endless guide track **13** mounted on upper carriage **11** to establish the pattern of carriage movement for a given endless sewing line design;

(E) A holder conveyor **15** mounted on the upper carriage **11** for quilting-operation movement therewith and for forward-rearward movement relative thereto between a rear position and the front operative sewing position in which it supports a 1st holder during the sewing operation; and

(F) Drive means including

(1) a reversible conveyor-drive motor **16** mounted on the upper carriage **11** for moving the 1st holder conveyor **15** forth and back between its rear and front positions,
(2) a tilt motor **18** mounted in a base frame standard **1** for moving the tiltable head frame **3** between its operative and tilted positions, the tilt motor **18** being connected through chain **19** and shaft **20** to move a wheel **21** on shaft **20** rotationally in one direction and thereby reciprocate crank arm **22** in raising and lowering head frame **3**, and
(3) a main quilting machine drive having a main drive motor **24** mounted in a base frame standard **1** for driving the carriage and sewing machine means simultaneously, this motor **24** being operatively connected through three drive trains to drive the guide track **13**, the stitch locking mechanism and the needle-operating mechanism, respectively.

All three drive trains emanating from motor **24** in the main drive include a common belt-driven main pulley **25**. In the drive train for the guide track **13**, the belt-driven main drive pulley **25** operates through a belt **26**, horizontal cross shaft **27** and follower **28** to drive guide track **13** through a suitable track-engaging gear. In the drive train for the stitch-locking mechanism, belt-driven main pulley **25** is fixed to a sleeve (not shown) which is mounted for free rotation on bobbin drive shaft **6**, and operates to drive the bobbin drive shaft **6** through a clutch interposed between said sleeve and shaft **6**, the clutch having one part **29A** connected to the sleeve and another part **29B** slidably keyed to the shaft **6** and spring biased toward (and into operative driven relationship with) said other clutch part **29A**. In other words, the stitch-locking mechanism is driven from pulley **25** and its fixed sleeve, through clutch parts **29A** and B and shaft **6**. In the drive train for the needle-operating mechanism, bobbin drive shaft **6** is connected through pulley **30** (fixed to the shaft **6**) and belts **31**, **32** to cross shaft **33** and through belt **34** to the sewing-head drive shaft **8**.

The Invention

Now, in accordance with my invention, the quilting machine, illustrated in the drawings, also includes:

(A) Means in the sewing machine drive train, for transmitting power in one direction only so that, when the carriage means is moved forwardly during the sewing operation and then reversely, the sewing machine will operate to sew during said forward movement but will not operate at all during said reverse movement;

(B) Mechanical means operative, when actuated, to turn the needle-operating mechanism sufficiently to retract the needles;

(C) Cutting means mounted on the holder conveyor for movement therewith to a cutting position wherein said cutting means is operative, when actuated, to cut threads extending from the needles of the sewing head to the 1st holder and means for actuating said cutting means; and

(D) Control means operating automatically (1) to stop the motorized drive for the carriage means and the sewing machine at the end of a sewing operation embracing one full sewing cycle, plus a fraction of the next, (2) to energize the needle retracting means automatically when the main drive is stopped, (3) to energize the head-tilting means automatically after the needles are retracted and (4) to effect the reversal of the main drive to return the carriage means to its starting point after the head frame has been tilted.

One way power transmitting means in the sewing machine drive train

As seen in FIGS. 4–6 and as previously noted, the sewing machine drive train includes: main drive motor **24**; main pulley **25** with its fixed sleeve; two-way clutch **29A** and **29B**; the bobbin drive shaft **6**; and needle-operating drive train parts **31–34** connected between shaft **6** and sewing head drive shaft **8**. In accordance with my invention, a one-way clutch is interposed in the drive train for both mechanisms of the sewing machine, between the fixed sleeve on which main drive pulley **25** is mounted and the clutch part **29A**. Accordingly, a one-way clutch, having an inner part, not shown, and an outer part, **36**, is mounted on said fixed sleeve between drive pulley **25** and clutch part **29A** with its inner part (not shown) fixed to the fixed sleeve and with its outer part **36** connected to clutch part **29A**. With this arrangement, the pulley **25** drives the belt **26** leading to the follower in both directions, while the pulley **25** drives the outer part **36** of the one-way clutch one way but not the other. Since suitable one-way clutches are old, and well known, its details are not illustrated.

With this one-way clutch arrangement, the main drive

from motor **24** is effective, during the sewing operation, to operate the sewing machine and to move the carriage means forwardly in accordance with the design established by the guide track **13**. However, when the main drive motor **24** is reversed, the movement of the drive train for the carriage means will be reversed but the drive train for the sewing machine will be interrupted at one-way clutch **36** so that the entire sewing machine remains stationary and inoperative.

Mechanical needle retraction means

As seen in FIG. 6, the drive train for the needle operating mechanism, between belt **32** and the drive shaft **8** on the sewing head **7**, includes: a transverse shaft **33** mounted on the front side of the head frame **3**; and a belt **34** connecting the shaft **33** to the sewing head drive shaft **8**. In the preferred forms of my invention, this (**33–34, 8–7**) portion of the sewing head drive train is provided with mechanical needle-retracting means which may conveniently be connected directly to either the sewing head drive shaft **8** or shraft **33**.

In the preferred embodiment shown, this mechanical means comprises: (1) a member **38** connected directly to shaft **33** for reciprocation synchronously with the sewing needles between one upper limit, corresponding to the fully extended or lowest position of the needles, and another lower limit corresponding to the fully retracted or highest position of the needles; and (2) means for moving that reciprocating member to its low (needle-high or needle-retracted) limit at the end of the sewing operation.

While the provision, of a suitable reciprocating member **38** and reciprocating means therefor, may be accomplished in any of a variety of ways, I prefer the simple and inexpensive arrangement shown wherein the piston **38** of a single cylinder air compressor **39** is connected through the projecting end **40** of the compressor's piston-reciprocating crankshaft to the drive train shaft **33** for movement therewith during the sewing operation; and means is provided for supplying the cylinder of compressor **39** with compressed air when the sewing operation is finished to force the piston **38** downwardly to its lowest limit and thereby operate the needle drive train sufficiently to move the needles to their highest or fully retracted position.

To this end, the projecting end **40** of the crankshaft has its end face located closely adjacent to (and axially aligned with the) end face of shaft **33**, each shaft is provided with a pinion and both pinions are connected together for simultaneous rotation through an encircling chain **41**, which meshes with both pinions, and the cylinder of the compressor **39** is connected serially through a normally-open pressure-controlled vent air valve **43** and a normally-closed electrically-controlled supply air valve **44** to a suitable compressed air source **45**.

As hereinafter explained, the "Control Means" operates automatically to control the operation of the normally-closed electrically-controlled supply air valve **44**. It should suffice here to note: that, during the quilting operation, the compressor **39** is vented through air valve **43**, hence, while the compressor operates with the sewing machine, it does not operate against an air pressure head; and that, at the end of the sewing operation, the control means operates automatically to open the supply air valve **44**. Consequently, compressed air now passes through air valve **43** at a pressure sufficient to close it and also sufficient to force the piston **38** downwardly to its lowest needle-retracted position and hold it there. The air valve **44** remains open for 3 seconds only and then automatically closes. In its closed position, it vents the compressor **39** to atmosphere through a small vent opening causing the pressure on the compressor to drop. When this pressure falls to a predetermined value below that of the compressed air line, the vent air valve **43** automatically opens to provide a more or less instantaneous venting.

If the quilting operation ends with the piston **38** in its uppermost dead-center position or if there is a compressed air failure at that time, then, in either event, the opening of the air valve **44** will fail to bring about the needle-retraction movement of the piston **38**. Upon such failure, and so long as the needles project downwardly beyond a safely retracted position, it is desirable automatically to prevent any continuance of the operation of the machine. This prevention can be accomplished through suitable electrical circuitry suitably controlled by magnetic device **47** in FIGS. 6 and 9 which, through magnetically-controlled switch **48**, maintains the machine shut down so long as the needles are not fully retracted. The full retraction of the needles may now be manually effected in the conventional manner through hand wheel **50** suitably mounted on the sewing head drive train, e.g., shaft **33**.

Before passing, we note that magnetic device **47** comprises: a U-shaped permanent magnet M (or **47M**) arranged underneath sewing head operating shaft **8**; and a semi-circular magnetically permeable disc D (or **47D**) mounted on needle-operating shaft **8** to rotate therewith. During a half revolution, disc **47D** passes from its highest position, which corresponds to the fully-retracted or highest position of the needles, to its lowest position, which corresponds to the fully-extended or lowest position of the needles.

In its lowest position, the disc **47D** extends wholly within the interspace between the upright legs of the U-shaped magnet **47M** wherein it has its maximum reluctance-reducing effect and its maximum flux-increasing effect. In its highest position, it is spaced upwardly from the upper end of the interspace between the upright legs of the U-shaped magnet **47**; hence, has little or no effect on either the reluctance of the magnet **47M**, which is at a maximum or the flux density thereof, which is at a minimum. At some point between these limits, say 90 to 120° one way or the other out of the lowest position, the disc D will reach an operating position corresponding to the safely retracted position of the needles.

The change in flux density, which occurs when the disc **47D** moves downwardly into or upwardly out of its operating position, is used to close and open a switch **48** and thereby influence a control circuit. The magnetic device **47** is inoperable for control purposes when the needles come to a stop above their safely retracted position. The magnetic device **47** is operative for control purposes when the needles come to a stop in any position below their safely retracted position. They are safely retracted (or extended) when they do not project sufficiently to be subjected to damage or to cause damage upon movement of the carriage means.

Thread-cutting means

It will be clear that when the 1st holder and the carriage means are returned to their starting position following the completion of the sewing operation, the holder conveyor **15** will be in a corresponding "starting" position and that upon the movement of the conveyor **15** from its starting position rearwardly a short distance, to what is herein called the cutting position, each sewing thread will be stretched from its retracted sewing needle rearwardly to the sewn quilting assembly of said 1st holder on the conveyor.

In accordance with the thread-cutting feature of my invention, a rotatable knife blade **55** is provided for a given sewing head **7** and mounted on the front end **15A** of the conveyor **15** in position to cut the stretched thread when the conveyor is in its cutting position and the blade is appropriately moved (rotated or oscillated). With two horizontally-spaced sewing heads **7**, two similarly-spaced rotary cutting blades **55** are provided. These blades are interconnected for contemporaneous rotation by a chain **56** extending from one blade to another and geared to both. Both blades are contemporaneously rotated by a

chain 57 extending from one blade to a crank handle 58 and geared to both. The handle 58 may also be mounted on the front end 15A of the holder conveyor 15.

Control means and operation

The control means, as illustrated in FIG 9, receives power from power lines 70 and 71, the latter being connected directly to line 71A through four safety switches numbered 72 through 75. Between lines 70 and 71A, the control means includes circuits designated A through K some controlling the operation of conventional means in a conventional manner and others controlling the operation of means provided in accordance with the present invention.

Briefly stated, the control means circuits A–K operate as follows: (A) conveyor circuit A functions, through forward and rearward branches, to control conveyor motor 16; (B) untilting circuit B and its bypass control the operation of tilt motor 18 in the untilting direction only; (C) quilting circuit C controls the operation of the quilting motor 24 in the quilting direction; (D) alerting circuit D functions to condition circuits E, F, G and H for a 3-second operation following the end of the quilting operation and circuits G and H for an additional 3-second operation following the 1st 3-second operation; (E–F) the 3-second needle-retracting and anti-tilt circuits E and F function, during their common 3-second operating period, respectively to retract the needles and to prevent the tilting of the head frame, while circuit F additionally functions to close circuit I at the beginning of the 2nd and 3-second period; (G–H) 6-second control circuit G and its holding circuit H function, during the second 3 seconds of their 6-second operating period, to supply power up to control circuit I; (I) control circuit I functions to cause tilt circuit J to be energized during the first half of the second 3-second period and the circuit K to be energized during the second half of the second 3-second period; (J) tilt circuit J functions, during its 1½-second operating period, to control the tilting of the head frame; and (K) reversing circuit K functions, during its 1½-second operating period, to control the reverse operation of the carriage means drive motor 24.

To facilitate an understanding of the control means, it is hereinafter described in the course of my description of the operation of the quilting machine.

Operation

The operation description assumes: that the conveyor 15 is provided with a 1st holder; that the carriage means is in its starting position; that the sewing needles are retracted; that the head frame 3 is tilted; and that the conveyor 15 is ready to move the front end of the 1st holder forwardly through the space between the lower and upper cross frames 2 and 3 into the starting position for the sewing operation.

Stated generally, the operation proceeds as follows: energize the "forward movement branch" of a circuit A to move the conveyor forwardly to carry the 1st holder into its starting position; energize untilting circuit B to return the tilted head frame 3 from its tilted position to its operative position; energize the quilting and alerting circuits C and D to conduct the sewing operation from the starting position through the sewing line design back through the starting position to a stop position which is slightly beyond the starting position through quilting circuit C and, through circuit D, to condition circuits E and F at the beginning of the quilting operation for energization at the end thereof; energize circuits E and F for a 3-second period and G and H for a 6-second period following the end of the quilting operation to retract the needles through circuit E to prevent the tilting of the head frame through circuit F and to energize a control circuit G and its holding circuit H for controlling subsequent operations during two successive 1½-second periods; energize control circuit I and tilt circuit J to tilt the head frame during the first 1½-second period; energize the reversing circuit K during the second 1½-second period to reverse the movement of the carriage means to return it and the 1st holder to the starting position; energize the rearward movement branch of conveyor circuit A to carry the 1st holder back to a thread-cutting position; cut the thread; and then proceed with the removal and replacement of the holder.

Conveyor circuit A—forward movement branch

The operation is instituted by manually closing and holding closed PB (push button switch) 78 to energize the forward movement branch of conveyor circuit A extending from line 70 through a forward branch including PB 78, N/C (normally closed) LS (limit switch) 79 and relay coil 80, to an intermediate power line 71A. This energizes relay coil 80 which (through circuitry not shown) controls the energization of the conveyor drive (motor 16) to cause it to move the conveyor forwardly. When the forwardly moving conveyor carries the 1st holder into the starting position, PB 78 is released to shut down that operation.

Untilting circuit B

The apparatus is now ready for the "untilting" movement of the tilted head frame from its tilted position to its operative position. This is accomplished by momentarily closing PB 83 manually to close and energize tilt motor 18 through the untilting circuit B extending from line 70 through N/C RC (relay contacts) 98A, N/O (normally open) PB 83, relay coil 84, N/C RC 102A, to line 71A.

The initial energization of relay coil 84 starts the tilt motor 18 and simultaneously closes N/O RC 84A to close the bypass around N/O PB 83 except for N/O LS 86.

The initial operation of tilt motor 18 causes the tilt frame 3 to leave its tilted position and thereby permit spring-biased N/O LS 86 to close and energize the bypass holding circuit for circuit B. This maintains the tilt motor 18 in operation until the head frame 3 reaches its operative position.

When the head frame 3 reaches its operative position, it operates (1) to open N/C LS 79 (and 79R) in the forward (and reverse) branches of circuit A and thereby insure against the energization of relay coil 80 (or 80R) through the accidental closure of PB 78 (or 78R), (2) to reopen N/O LS 86 in the B circuit bypass and thus de-energize relay coil 84 to shut down the head frame drive motor 18, and (3) to close N/O LS 89 in the quilting circuit C and condition it for the closure required to start the quilting operation.

Quilting circuit C and alerting circuit D

The C circuit extends from line 70 through N/O PB 88, N/O LS 89, relay coil 90 and N/C RC 110A to 71A and includes a bypass around N/O PB 88 and N/O LS 89 comprising N/C PB 91, N/C LS 92 and 93, and N/C switches 94 and 95, which open when the thread breaks, and N/O RC 90A. The head frame closure of N/O LS 89 in quilting circuit C simply readies the C circuit for manual closure at N/O PB 88. The quilting operation is instituted after the head frame is returned to its operative position and the untilting circuit B de-energized.

The quilting operation is instituted by manually closing N/O PB 88 momentarily to effect a momentary energization of circuit C. The momentary energization of the C circuit and its relay coil 90, contemporaneously (1) starts the main drive (motor 24) to institute the quilting operation, (2) closes N/O RC 90A in the now-closed bypass holding circuit, which maintains circuit C and its relay coil 90 energized, (3) closes N/O RC 90B to energize an alerting circuit D, and (4) opens N/C RC 90C in the reverse carriage means circuit.

The alerting circuit D extends from line 70 through relay coil 98 and N/O RC 90B to 71A. It is energized at

the beginning of the quilting operation by the energization of the B circuit relay coil **90** which closes the D circuit N/O RC **90B**. When energized, it functions, through its energized relay coil **98**, to open N/C RC **98A** between power line **70** and line **70A**. This cuts off the supply of power to the de-energized B, E and F circuits at the beginning of the quilting operation and keeps them de-energized up to the end of the quilting operation. By keeping circuits E and F de-energized during the quilting operation, the alerting circuit D maintains them in condition for their 3-second operation beginning at the end of the quilting operation.

The carriage means brings the quilting operation to an end when it passes slightly but sufficiently beyond the starting point to engage N/C LS **93** in the C circuit bypass and through that engagement simultaneously de-energize the C circuit and its relay coil **90**. The de-energization of coil **90** opens the D circuit at N/O RC **90B**.

As indicated before, the de-energization of quilting and alerting circuits C and D results in the energization of the 3-second needle retraction and anti-tilt circuits E and F. The simultaneous termination of the quilting operation results in the simultaneous energization of the 6-second auxiliary and auxiliary-holding circuits G and H.

3-second needle-retraction and anti-tilt circuits E and F, 6-second auxiliary and auxiliary holding circuits G and H

The 3-second needle-retraction circuit E extends from line **70** through N/C RC **98A**, line **70A**, N/O RC **98B**, and relay coil **100** to line **71**. The 3-second anti-tilt circuit F extends from line **70** through the N/C RC **98A**, line **70A**, N/O RC **98C**, and relay coil **102** to line **71A**. The N/O RC's **98B** in circuit E and **98C** in circuit F close fast but are of the slow or delayed opening type. Each is instantly closed when D circuit relay coil **98** is energized. But, when that relay coil **98** is de-energized at the end of the quilting operation, neither **98B** nor **98C** opens instantly. On the contrary, both remain closed for a 3-second period and then open automatically.

When the E circuit is closed and energized, it functions, through its energized relay coil **100**, to energize the electrically-operated air valve **44** for 3-seconds and thereby actuate the means which retracts the needles over that 3-second period. When the F circuit is energized, it functions, through its energized relay coil **102**, to open N/C RC **102A** in the untilt circuit B for 3 seconds and thereby prevent the energization of untilt circuit B and the resulting movement of the frame during that 3-second period.

The 6-second auxiliary circuit G extends from line **70** through N/C PB **103**, NC toggle switch **104**, N/O LS **105**, and relay coil **106** to line **71A**. It is closed at the end of the quilting operation when the carriage means, in opening the C circuit at N/C LS **93**, simultaneously closes the G circuit momentarily at N/O LS **105**. The momentary closure of the G circuit energizes its relay coil **106** which operates to maintain itself closed by closing N/O RC **106A** in the auxiliary holding circuit H. The 6-second auxiliary holding circuit H extends from line **70** through N/C switches **91** and **92** in the C circuit bypass, the now closed N/O RC **106A** in the H circuit, and relay coil **106** in the G circuit to line **71A**. It functions through N/O RC **106A** to close the I circuit up to the now open N/C **102B** which will close when the 3-second F circuit and its relay coil **102** are de-energized at the end of their 3-second operating period.

From the foregoing, it will be clear: that the quilting and alerting circuits C and D are energized at the beginning of the quilting operation and de-energized at the end thereof; that the needle-retraction and anti-tilt circuits E and F are energized at the end of the quilting operation for a 3-second period, during which they function to retract the needles and prevent the head from being tilted during the needle retraction operation; and that the auxiliary circuit G and auxiliary holding circuit H are also energized at the end of the quilting operation for a 6-second period including a first 3-second period for circuits E and F and a second 3-second period embracing 1st and 2nd halves of 1½ seconds each.

At the end of the first 3-second period common to circuits E–F and G–H, circuits E and F will be de-energized by the opening of their fast-closing slow-opening N/O RC's **98B** and **98C** with the consequent de-energization of their relay coils **100** and **102**. The de-energization of F circuit relay coil **102** energizes the control circuit I through which the tilting and reversing circuits J and K are controlled over successive halves of the second 3-second period.

Control circuit I

The I circuit extends from line **70** through N/C switches **91** and **92** in the C bypass and through the now closed N/O RC **106A** in the H circuit, N/C RC **102B** and relay coil **108** in the I circuit to line **71A**. With the de-energization of the F circuit and its relay coil **102**, the N/C RC **102B** recloses to energize the I circuit and its relay coil **108**. This results in the successive energization of the 1½-second tilting circuit J and the 1½-second reversing circuit K.

1½ second frame tilting circuit J

This circuit extends from line **70** through N/C switches **91** and **92** in the C circuit bypass, the N/O RC **106A** in the auxiliary holding H circuit, N/C RC **102B** in the I circuit and N/O RC **108A** and N/C RC **108B** in the J circuit, relay coil **84** and N/C RC **102A** in the untilting B circuit to **71A**. At the end of the 3-second interval when F circuit relay coil **102** de-energizes and I circuit relay coil **108** energizes, N/O RC **108A** in the J circuit closes instantly but NC RC **108B**, which is a fast-closing but slow-opening relay, delays its opening for 1½ seconds; hence, the J circuit is energized for 1½ seconds to operate tilt motor **18** through coil **84** and thereby tilt the head frame.

1½ second reversing circuit K

The K circuit extends from line **70** through N/C switches **91** and **92** in the C circuit bypass through N/O RC **106A** in the H circuit, N/C RC **102B** in the I circuit, N/O **108** C and D, N/C RC **90C** and relay coil **110** in the K circuit to N/C RC **102A** in the B circuit to **71A**. With the energization of relay coil **108** in the I circuit, its N/O RC **108C** in the K circuit closes instantly while its N/O relay contact **108D**, which is of the slow-closing type, closes only after a delay of 1½ seconds. Consequently, the K circuit will not close until the end of the 1½ second J circuit operating interval.

When N/O RC **108D** in the K circuit closes, relay coil **110** in the K circuit will be energized to open the forward movement circuit of the main drive motor **24** and to close the rearward movement circuit thereof and thereby return the carriage means to the starting point where it strikes N/C LS **92** in the C bypass circuit and the H, I, J and K circuits to shut the machine down. The machine, with the needles retracted, the frame tilted and the carriage means shut down in the starting position, is now ready for the rearward movement of the conveyor **15** through the operation of the rearward movement branch of circuit A.

Conveyor circuit A—rearward movement branch

The reaward movement operation is instituted by manually closing PB **78R** to energize the rearward movement branch extending from line **70** through PB **78R**, N/C LS **79R**, relay coil **80R** and **71A**. This energizes relay coil **80R** which (through circuitry not shown) controls the energization of the conveyor drive motor **16** to cause it to move the conveyor rearwardly. When the rearwardly moving conveyor carries the 1st holder into the

thread-cutting position, push button 78R is released to shut down that operation.

Now the quilting machine is in position for the thread-cutting operation which immediately precedes the removal and replacement of the 1st holder.

Circuit of magnetic switch 48

As noted, circuit E is energized at the end of the quilting operation for a 3-second period during which the needles are retracted. Upon a failure of the needles to be retracted, it is desirable to prevent circuit F from operating through the de-energization of its relay coil **102** to energize the tilting and reversing circuits J and K. Since this may be accomplished by maintaining relay coil **102** energized, such energization is provided for by connecting magnetic switch **48** across N/O RC **98**C in circuit F.

With this arrangement, if the needles fail to be safely retracted during the normal 3-second operating period of circuit F, then switch **48** will be closed by the operation of magnetic device **47** to maintain circuit F closed beyond its normal 3-second period and thereby maintain its relay coil **102** energized. As indicated before, so long as relay coil **102** is energized, its N/C RC **102**B in the I circuit will remain open and thereby prevent the energization of the I, J, and K circuits.

With respect to the "Mechanical Needle Retraction Means," it will be noted: that the needle retraction member **38** is mounted for constrained reciprocating movement between "extended" and "retracted" positions respectively corresponding to the extended and retracted positions of the sewing needle; that it is connected to the sewing head drive to be reciprocated thereby cyclically during the sewing operation in synchronism with the sewing needle; that, upon the termination of the sewing operation, cylinder **39** will be energized (through air valve **44** and compressed air source **45** under the control of the needle-retracting circuit E) to urge the retraction member **38** non-cyclically in its retraction direction only; and that, if member **38** is in an extended position when so urged, it will move in its retraction direction only and stop in its fully "retracted" position and it will contemporaneously operate, through its connection with the sewing head drive, to drive the sewing head non-cyclically in the needle retracting direction only and thereby retract the sewing needle to and stop it in its fully retracted position.

Having described my invention, I claim:

1. An improved quilting machine for sewing a workpiece cyclically in accordance with the endless pattern of a given sewing line design, comprising:

(A) an A-frame including a cross head frame;

(B) a sewing head on the head frame;

(C) a movable carriage means underlying the sewing head;

(D) motorized means for driving the sewing head and contemporaneously moving the carriage means from a given starting point cyclically in accordance with said pattern;

(E) start means to energize the motorized drive means at the beginning of a sewing operation;

(F) stop means to de-energize the motorized drive means at the end of a sewing operation;

(G) a needle-retraction member

(1) mounted for constrained reciprocating movement between "extended" and "retracted" positions respectively corresponding to the extended and retracted positions of the sewing needle, and

(2) mechanically connected to the sewing head drive to be continuously driven cyclically thereby during the sewing operation in synchronism with the sewing needle; and

(H) retraction-member moving means operating contemporaneously, in response to the termination of the sewing operation with the needle in an extended position,

(1) to move said retraction member only in its retraction direction and stop it in its fully "retracted" position, and

(2) through the connection of said retraction member with the sewing head drive, to move the sewing needle only in its needle retraction direction and stop it in its fully retracted position.

2. The machine of claim **1**, wherein:

(A) said reciprocating needle-retraction member is in the form of the piston of a cylinder; and

(B) said retraction-member moving means includes a valve, which is operative, when actuated, to connect that cylinder to a source of fluid under pressure.

3. The machine of claim **1**, wherein:

(A) said reciprocating needle-retraction member is in the form of the piston of an air compressor which has a piston operating crank shaft operably connected to said sewing head drive; and

(B) said retraction-member moving means includes a valve, which is operative, when actuated, to connect that cylinder to a source of compressed air.

4. The machine of claim **1** including:

(A) means mounting the sewing head for movement away from its operative sewing position to a spaced position;

(B) means operative, when actuated, to move the sewing head to said spaced position;

(C) means operative, when the sewing operation is completed and the needle retracted, to actuate said sewing head moving means to move it to its spaced position; and

(D) means for rendering the sewing head moving means inoperative so long as the needle is not retracted.

5. The machine of claim **4** includes:

(A) means for rendering the sewing head moving means inoperative so long as the needle is not retracted.

6. The machine of claim **4** including:

(A) a workpiece conveyor mounted on the carriage means for movement therewith and, when actuated, for rearward movement relative thereto to extend the sewing thread over the space between the front end of the conveyor and the sewing head; and

(B) cutting means mounted on the front end of the workpiece conveyor for cutting said thread.

7. The machine of claim **6**, wherein:

(A) said cutting means includes:

(1) a knife mounted on the workpiece conveyor for movement from an inoperative position through a cutting position; and

(2) knife-operating means mounted on said conveyor.

8. The machine of claim **1** including:

(A) means, controlled by the movement of said carriage means, to operate said stop means after the carriage means has moved through one full sewing cycle and a fraction of another sewing cycle.

9. The machine of claim **8** including:

(A) means operative, after said sewing operation has been completed, to reverse said motorized means to move the carriage means back to said starting point.

10. The machine of claim **8**, wherein:

(A) the motorized drive means includes

(1) a reversible drive motor,

(2) a sewing head drive train having a one-way clutch operatively connecting the sewing head to the drive motor during the sewing operation and disconnecting it from that motor when the drive is reversed, and

(3) reversing means operative, when actuated, to reverse said drive motor to effect a reverse movement of said carriage means.

11. The machine of claim **10** including:

(A) means mounting the sewing head for movement

away from its operative sewing position to a spaced position;

(B) means operative, when actuated, to move the sewing head to said spaced position; and

(C) means operative, after the sewing operation has been completed and the needle retracted, to actuate said sewing head moving means to move it to its spaced position.

12. The machine of claim **11** including:

(A) means for actuating said reversing means in response to the movement of the sewing head to its spaced position.

13. The machine of claim **12** including:

(A) means, controlled by the reversed movement of the carriage means, to stop said drive motor upon

the return of said carriage means to its starting position.

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RICHARD J. SCANLAN, JR., *Primary Examiner.*

GEORGE V. LARKIN, *Assistant Examiner.*

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