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[54] **SEWING MACHINE WITH A PRINTED CIRCUIT SWITCH AND VARIABLE SPEED CONTROL MEANS**

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[52] **U.S. Cl.** **112/220**

[51] **Int. Cl.** **D05b 69/14**

[58] **Field of Search** ..... 112/220, 221, 219 R, 112/219 A

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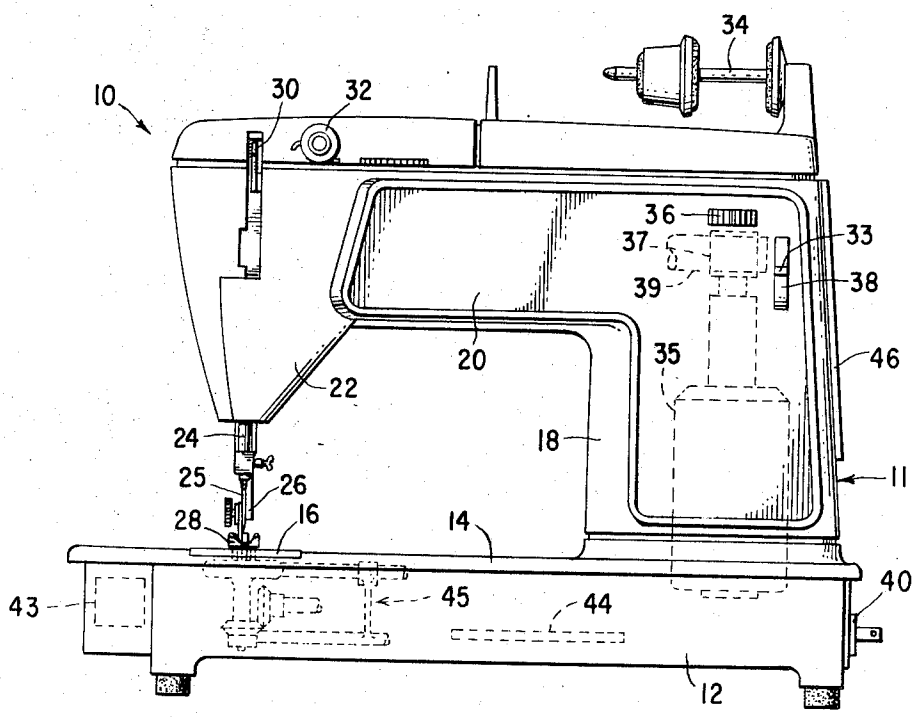
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[57] **ABSTRACT**

A sewing machine is provided with a printed circuit switch and a cooperating control means whereby the mechanisms thereof can be selectively operated with variable speed in a forward direction or in a reverse direction such that the conventional handwheel of a sewing machine can be eliminated. Additionally, a sewing machine may be operated without the use of the conventional operator-actuated foot controller connected to the machine.

9 Claims, 6 Drawing Figures



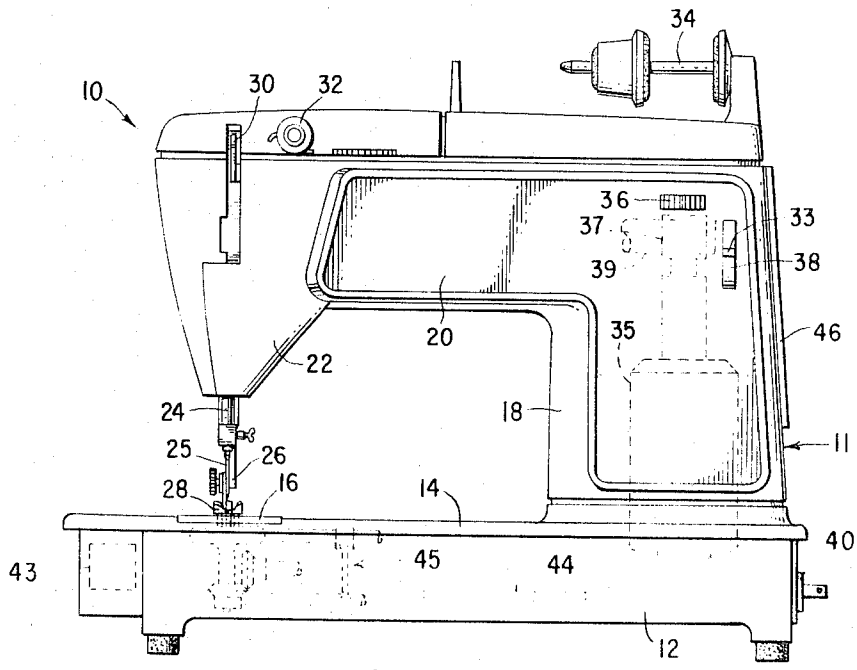


Fig. 1

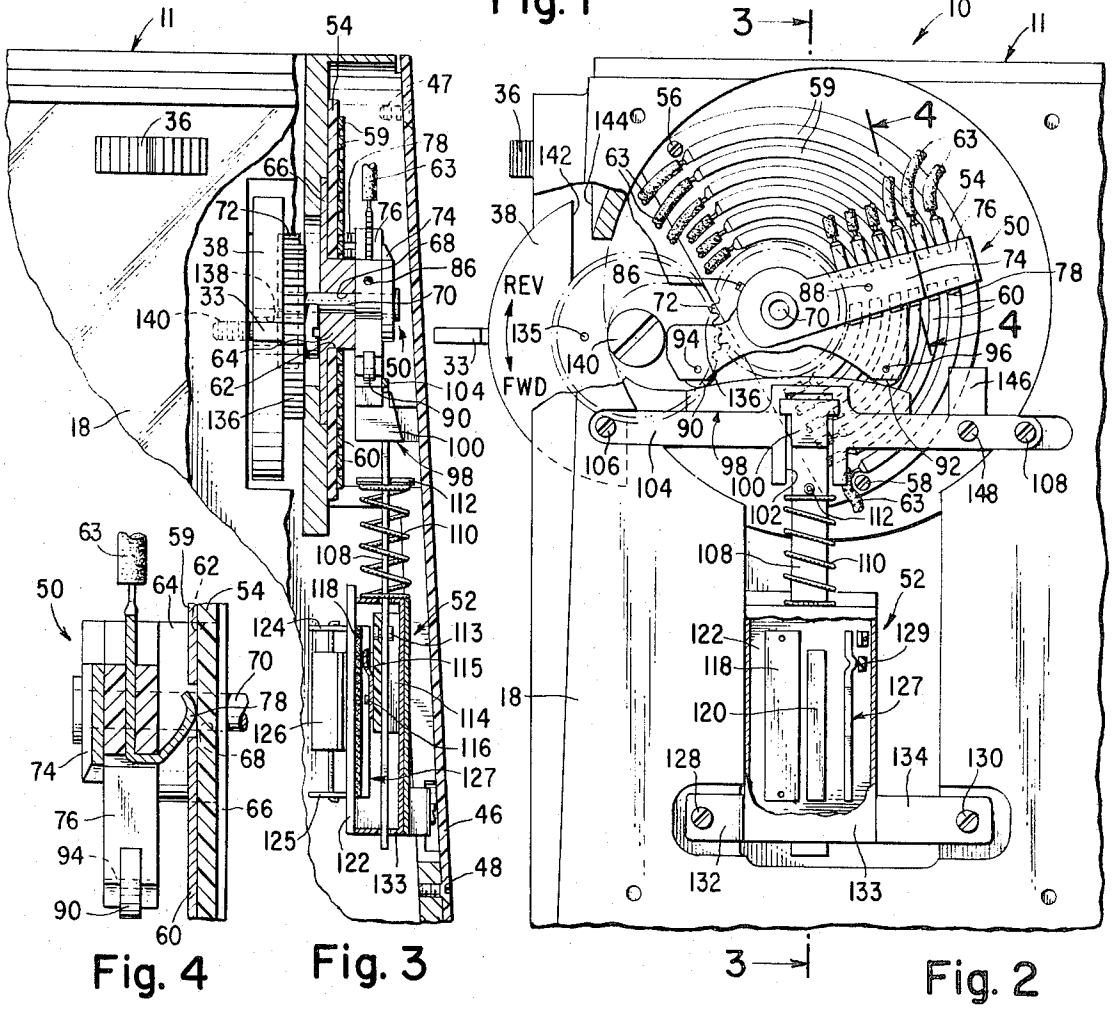


Fig. 4

Fig. 3

Fig. 2

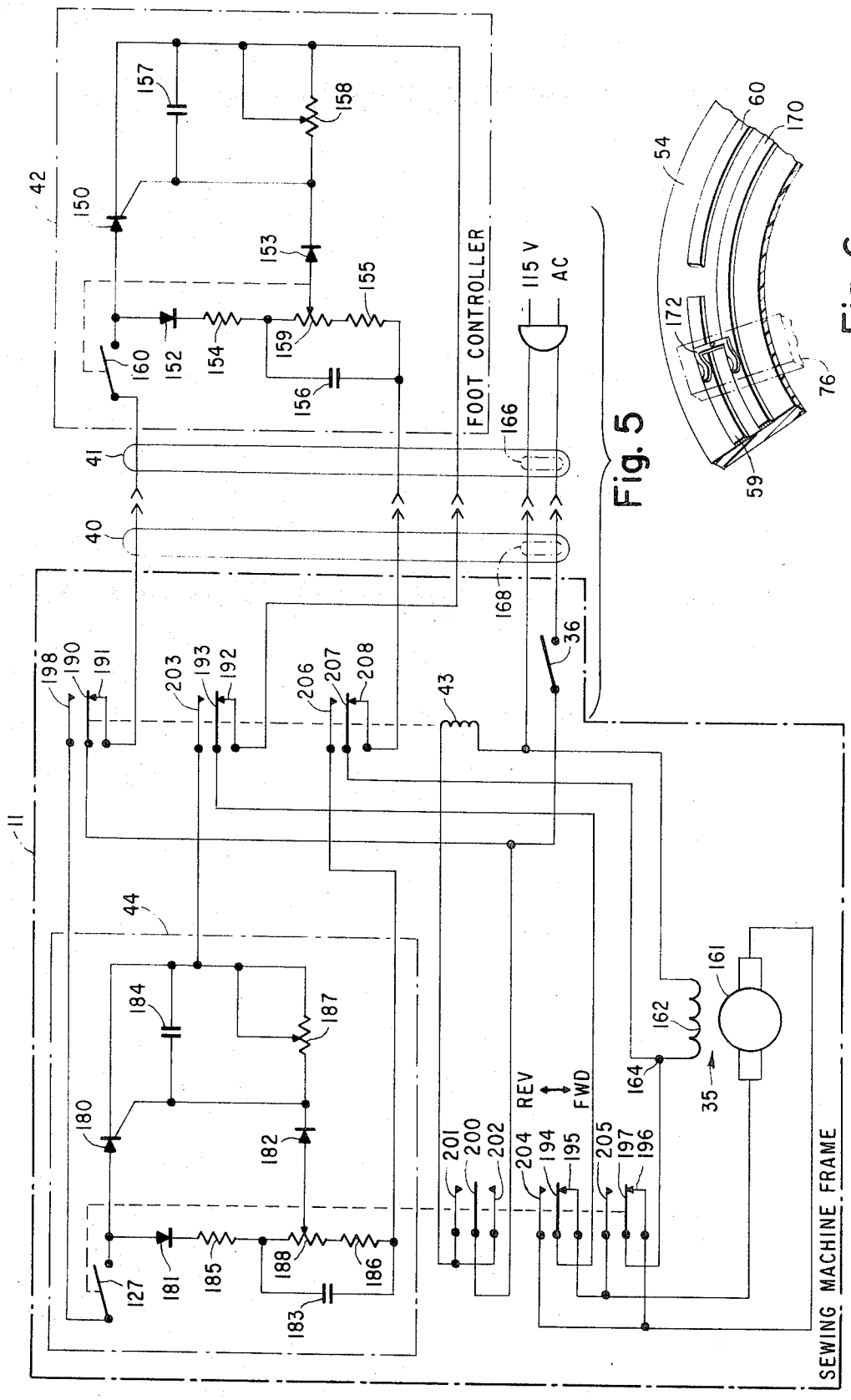

FOOT CONTROLLER
115 V AC
SEWING MACHINE FRAME
REV
FWD
42
44
43
41
40
11
35
36
59
60
76
127
150
152
153
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Fig. 5

Fig. 6

SEWING MACHINE WITH A PRINTED CIRCUIT SWITCH AND VARIABLE SPEED CONTROL MEANS

BACKGROUND OF THE INVENTION

The present invention relates to sewing machines, and in particular, to the elimination of the sewing machine handwheel and replacing it with a printed circuit switch and control arrangement without eliminating the ability of an operator to lower or raise slowly the needle of the sewing machine.

In the process of sewing various types of articles of clothing it becomes necessary to stop the sewing machine and change the orientation of the material without removing the needle from the work being sewn. Consequently, it is to the operators advantage to be able to maintain the sewing machine needle in the work piece while changing the orientation of the work. It also is an advantage, under certain circumstances, to be able to raise the needle out of the work once the machine has stopped so that the work may be removed from the machine.

Additionally, handicapped individuals, heretofore unable to operate a sewing machine that required a conventional foot controller, are now able to operate a sewing machine that is fabricated in accordance with the principles of the present invention.

SUMMARY OF THE INVENTION

An improved sewing machine, built in accordance with the principles of the present invention, has a frame including a bed and a hollow standard rising therefrom, stitch forming instrumentalities and work feeding mechanism, a main-shaft operatively connected to the stitch forming instrumentalities and the work feeding mechanism, an electric motor located within frame and operatively connected to the main-shaft, an operator-actuated foot controller for regulating the speed of operation of the motor, solid state circuit means coupled to the motor and controller and having terminals adapted to be connected to an external source of electrical energy, and variable speed switch means fixedly mounted within the sewing machine frame and coupled to the motor and the solid state circuit means for driving the motor in a forward and reverse direction.

DESCRIPTION OF THE DRAWING

FIG. 1 is a front view of a sewing machine in which the present invention is embodied;

FIG. 2 is an end view of a sewing machine incorporating the principles of the present invention with the end cover removed;

FIG. 3 is a partial cross sectional view in elevation, taken substantially along the line 3—3 of the sewing machine shown in FIG. 2;

FIG. 4 is an enlarged cross-sectional view taken substantially along the line 4—4 of FIG. 2;

FIG. 5 is a schematic circuit diagram of a preferred embodiment of the present invention; and

FIG. 6 is an enlarged pictorial representation of an alternate embodiment of a printed circuit switch.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIG. 1, there is shown a sewing machine 10. The sewing machine 10, in which the present invention is incorporated, comprises a frame 11 which has a substantially rectangular hollow base 12 having at its upper side a work supporting surface or bed 14 including therein a throat plate 16. Suitably secured upon the hollow base 12 is a vertically disposed hollow standard 18 which carries an overhead bracket-arm 20 terminating in a hollow head 22 in which is mounted a reciprocatory needle bar 24 carrying a needle 25. Also included in the hollow head 22 is a presser bar 26 which is terminated in a presser foot 28. Additionally included in the sewing machine 10 is a loop taker 30, a thread tension control 32 and a spindle 34 for retaining a spool of thread, and an electrical drive motor 35 which is coupled, via a geared coupling means 37, to a drive shaft 39. All of the items mentioned above are found on a conventional sewing machine as well as are stitch forming instrumentalities and work feeding mechanisms 45, all well known in the art.

In a preferred embodiment, in accordance with the principles of the present invention, the standard 18 of the sewing machine 10 is provided with an on-off power switch 36 and an actuating means 38 in the form of knob. The knob 38 is provided with an extension 33 for ease of operation.

The base 12 of the preferred embodiment is provided with a socket 40, which is adapted to be connected, via a cable and mating plug 41, to an operator actuated foot controller 42, shown in FIG. 5, and the AC energy source, not shown. The base 12 is also provided with a relay 43 and a solid state circuit means 44, which is substantially the same electrically as the solid state circuit means provided in the foot controller 42. The operation of the relay 43 and the circuit means 44 will be explained hereinafter.

An end view of a preferred embodiment of the sewing machine 10 is shown in FIG. 2 with the cover plate 46 removed. The cover plate 46 is mounted to the hollow standard 18, via screws 47 and 48, as shown in FIG. 3. With the cover plate 46 removed a printed circuit switch mechanism 50 and a control means 52 are exposed.

The printed circuit switch mechanism 50, in the preferred embodiment, includes an insulated board member 54, which is mounted to the frame of the sewing machine via two screws 56 and 58. A plurality of conductive strips or contacts 59 and 60 are provided on the insulated board member 54 in a conventional member, which forms a printed circuit as is well known in the art. The contacts 59 and 60 are arranged in accordance with the circuit requirements of the solid state circuit means 44 shown in FIG. 5, and are coupled thereto by wires 63.

The insulated board member 54 is provided with a hole 62 into which is mounted a collar 64 that contains a flange 66 which functions to rigidly support the insulated board member 54, thereby preventing it from flexing.

The collar 64 (FIG. 3) is provided with a hole 68 in which a shaft 70 is journaled. One end of shaft 70 has a gear 72 rigidly affixed thereto. The other end of shaft 70 is provided with threads upon which a metal arm 74 is threaded. In close juxaposition with the metal arm 74 is a contactor arm 76, which is made of a non-conducting material (insulator) and into which is fixedly mounted conductive spring finger contacts 78. The spring finger contacts are adapted to cooperate with the electrical conducting contacts 59 and 60 pro-

vided on the insulated board member **54.** The electrical contacts **50** and **60** are coupled to the electrical circuit means, via conducting wires **63.** The contactor arm **76** is attached to shaft **70** by means of a set screw **86** and is pinned to the metal arm **74** by a pin **88.** Contactor arm **76** is also provided with two wheels **90** and **92** which are rotatably retained within the contactor arm **76** by pins **94** and **96** respectively. Wheels **90** and **92** provide rolling contact with a rocker arm **98.**

Rocker arm **98** is provided with a protrusion **100** that is adapted to be slidably guided within slot **102** of a bracket **104** which is mounted by screws **106** and **108** to the sewing machine frame. Rocker arm **98** is attached by any suitable means to the extending portion or shaft **108** of the control means **52.**

The shaft **108** of the control means **52** is slidably mounted therein and has a spring **110** retained thereon by a pin **112.** The spring **110** functions to bias the control means **52** and the contactor arm **76** to their neutral position by exerting an equal pressure against the wheels **90** and **92** through the rocker arm **98.** The central portion of shaft **108** has an insulated block **114** affixed thereto by means of a rivet **113** as shown in FIG. **3.** An electrically conductive spring contact finger **115** is riveted by a rivet **116** to the insulated block **114** and functions to provide a conductive path between the carbon resistance element **118** and the electrically conductive bar **120** mounted within the control means **52** on an insulated board **122.** The bar **120** and resistance element **118** are provided with terminals **124, 125,** etc., (FIG. **3**) extending through to the underside of the insulated board **122,** which is utilized for mounting components such as, for example, a resistor **126.**

Additionally provided in the control means **52** is a switch **127** which is biased to the open position by the spring **110.** Switch **127** is held open by a protrusion **129,** on the insulated block **114** which functions to remove voltage from the circuit means **44,** as will be explained in conjunction with FIG. **5.** The control means **52** is fixedly mounted to the sewing machine frame by screws **128** and **130** inserted through holes provided in the flanges **132** and **134** of the control means case **133.**

In the preferred embodiment of the invention, the knob **38** has a gear **136** affixed thereto by means of a pin **135.** Gear **136** is adapted to mesh with gear **72.** Both the knob **38** and the gear **136** are affixed to the sewing machine frame by means of a shoulder screw **140** inserted through a hole **138** provided in the knob and gear which permits them to be journaled about the shoulder screw **140.**

In the preferred embodiment of the invention, the knob **38** is provided with a flat protruding portion **142** which is designed to interfere with a portion **144** of the sewing machine frame thereby limiting the travel of knob **38** in the upward direction. Movement of the knob **38** in the upward direction is designed to cause the motor **35** to reverse its direction and thereby, reverse the direction that the drive shaft **39** and the needle bar **24** were traveling. The downward movement of knob **38** is limited by a stop **46** which is mounted, via a screw **148,** to the bracket **104** and designed to interfere with contactor arm **76,** thereby limiting its travel. Movement of knob **38** in a downward direction is designed to cause the motor **35** to continue in the same direction that it was moving, which is the same direction as it would normally rotate when energized by the foot controller **42.**

Referring now to FIG. **5,** there is shown a schematic circuit diagram of a preferred embodiment of the present invention. The operator-actuated foot controller **42** which is adapted to be connected to the sewing machine base **12,** as noted earlier, contains solid state circuit means including a potentiometer **159,** a power control switch **160,** and an insulated board, not shown, upon which printed circuit wiring is deposited in a conventional manner. Mounting means, not shown, are also provided for a silicon controlled rectifier (SCR) **150;** diodes **152** and **153;** resistors **154** and **155;** capacitors **156** and **157;** and an adjustable resistor **158.** The cover of the foot controller, not shown, is coupled to the potentiometer **159** and controls the speed of the motor in a conventional manner. The control means of the foot controller **42** is similar to the control means **52** mounted within the sewing machine frame **11.**

The printed circuit conductors within the foot controller **42** are connected to provide a path for the AC power to be coupled, via the switch **160** and the SCR **150** to the armature **161** and field **162** windings of motor **35,** which are connected in series to the other side of the AC power source, not shown. A voltage divider is provided by the series connection of a diode **152,** a resistor **154,** a potentiometer **159** and a resistor **155** connected from the anode electrode of SCR **150** to the common connection **164** between the armature **161** and field **162** windings. Diode **152** rectifies the AC current in the voltage divider changing it to half wave DC, thereby reducing its power consumption. Capacitor **156** is connected in parallel with the series connection of potentiometer **159** and resistor **155** and filters the rectified AC voltage to provide a DC voltage, which is coupled via a diode **153,** to the gate electrode of SCR **150.** A capacitor **157** is coupled in parallel with the adjustable resistor **158** across the gate and cathode electrodes of SCR **150** to insure reliable firing of the SCR and, thereby, variable speed control in a conventional manner.

As noted earlier the operator-actuated foot controller **42** is coupled to the frame **11,** via a cable and plug **41** adapted to cooperate with the socket **40** on the sewing machine frame **11** and which also is coupled to the source of AC power. An alternate embodiment may provide a separate second plug and cable assembly **166** which has one end adapted to be connected to a source of AC energy or power, not shown, and may be connected on its other end to a socket **168** located on the sewing machine frame **11.**

It is to be noted that if two plugs and sockets are used, as in the alternate preferred embodiment described in FIG. **5,** removing the operator-actuated foot controller from the sewing machine permits the AC power to remain coupled to the sewing machine for operation by means of the hand-operated knob **38.**

In the preferred embodiment of the invention, the sewing machine motor **35,** the solid state circuit means **44,** the relay **43,** and the printed circuit switch mechanism **50** are mounted within the sewing machine frame **11** as noted earlier. The solid state circuit means **44** includes an SCR **180,** diodes **181** and **182,** capacitors **183** and **184,** resistors **185** and **186,** adjustable resistor **187** and potentiometer **188,** all of which correspond to the SCR **150,** diodes **152** and **153,** capacitor **156** and **157,** resistors **154** and **155,** adjustable resistor **158** and potentiometer **159,** of the operator-actuated foot controller and functions in the same manner as described ear-

lier to control the speed of the sewing machine motor **35.**

Potentiometer **188** is adapted to be controlled by the hand-actuated control knob **38** while the potentiometer **159** is controlled in a conventional manner by a foot-actuated housing cover, not shown. It is to be noted that actuation of the hand control knob **38,** in either a forward or reverse direction, will disable the operator-actuated foot controller **42,** so that if a slow speed is desired by the operator during the hand control of the knob **38,** the foot controller cannot inadvertently or accidentally increase the speed of the motor or change its direction. The hand control knob always controls the speed and the direction of the motor, regardless of the position of the foot controller. In addition, the energization of the voltage dividers is determined by the position of contacts **206, 207** and **208** of relay **43** which is controlled by control knob **38.**

In normal operation of the sewing machine by means of the foot controller **42,** the AC current is coupled from one side of the power source, not shown, to the sewing machine motor, via plug and cable **166,** normally open switch **36,** which must be closed by the operator to energize the circuitry, normally closed contacts **190** and **191** of relay **43,** socket **40,** plug **41,** normally open switch **160** which is closed when the foot controller cover is depressed, SCR **159,** normally closed contacts **192** and **193** and normally closed printed circuit contacts **194** and **195,** the armature winding **161,** normally closed printed circuit contacts **196** and **197,** the field winding **162,** to the other side of the AC power source, not shown, via the cable and plug **166.** Further depressing the foot controller by the operator increases the voltage coupled from the potentiometer **159,** via diode **153,** to the gate electrode of the SCR **150,** thereby increasing the motor speed in a conventional manner.

When the sewing machine is activated by the knob **38** in a downwardly direction, which is the normal or forward direction of motor drive, the power is coupled from one side of the AC line, via the normally open switch **36,** which must be moved to the closed position by the operator to energize the circuitry, normally open contacts **190** and **198,** which are now closed since the normally open printed circuit contacts **200** and **202** are now closed and provide voltage to energize the relay **43,** normally open switch **127** which is closed when the operator moves the knob **38, SCR 180,** normally open contacts **203** and **193** which are now closed because relay **43** is energized, printed circuit contacts **194** and **195,** armature field winding **161,** printed circuit contacts **205** and **197,** field winding **162,** plug and cable **166** to the other side of the AC line. Additional pressure in the downwardly direction increases the voltage coupled from the potentiometer **188,** via diode **182** to the gate electrode of SCR **180,** thereby firing the SCR earlier in the AC cycle and increasing the motor speed in a conventional manner.

When the sewing machine is activated by the knob **38** in an upwardly direction, which is the reverse direction of motor drive, the power is coupled from one side of the AC line, via the switch **36,** normally open contacts **190** and **198,** which are now closed since the normally open printed circuit contacts **200** and **201** are closed and provide voltage to energize the relay **43,** switch **127, SCR 180,** contacts **203** and **193,** printed circuit contacts **194** and **204,** armature winding **161,** printed circuit contacts **205** and **197,** field winding **162,** plug and cable **166,** to the other side of the AC line. Additional pressure in the upwardly direction increases the voltage coupled from the potentiometer **188,** via diode **182,** to the gate electrode of SCR **180,** thereby, firing the SCR earlier in the AC cycle and increasing the motor speed in a conventional manner.

Note that the preferred embodiment of the invention includes the use of a relay **43** in addition to the printed circuit switch mechanism **50.** Although the printed circuit switch mechanism is capable of providing all of the required circuit connections for operation by a conventional arrangement of the printed circuit switch contacts, for convenience, it may be desirable for some of the circuit connections to be accomplished by a conventional relay that is energized by the printed circuit switch mechanism, as shown in FIG. **5.** Also, note that an alternate type of printed circuit switch construction may be utilized. This construction is shown in FIG. **6.** The alternate printed circuit switch construction is similar to the construction used in the control means **52,** and is within the scope of this invention. The alternate type of construction provides for an additional printed circuit conductor **170** on the board member **54** for each pole of the switch. The contactor arm **76** is provided with shorting contacts **172** which complete an electrical connection from the additional printed circuit conductor **170** to the printed circuit conductors **59** or **60.** This allows all of the wires **63** to be connected to the printed circuit conductors on the board and none to the contactor arm **76,** thereby increasing reliability since none of the wires is required to be flexed.

Hereinbefore has been disclosed an improved sewing machine which utilizes a printed circuit switch and a solid state motor speed control means whereby the sewing machine mechanism may selectively be operated in a forward or reverse direction without the use of a convntional handwheel. The sewing machine may also be operated in both a forward or reverse direction without the use of the conventional operator-actuated foot controller.

Having thus set forth the nature of the invention what is claimed herein is:

1. A sewing machine having a frame including a bed and a hollow standard rising therefrom, stitch forming instrumentalities and work feeding mechanism, a mainshaft operatively connected to said stitch forming instrumentalities and said work feeding mechanism, an electric motor operatively connected to said mainshaft, an operator-actuated foot controller for regulating the speed of operation of said motor, solid state circuit means coupled to said motor and controller and having terminals adapted to be connected to an external source of electrical energy, and variable speed switch means fixedly mounted within said sewing machine frame and coupled to said motor and said solid state circuit means for driving said motor in a forward and reverse direction.

2. A sewing machine according to claim **1** wherein said variable speed switch means comprises:

a. an insulated board member fixedly mounted within said standard having a plurality of electrical switch contacts thereon, said contacts being adapted to be connected to said circuits means;

b. a contactor arm member rotatably mounted parallel to said board member bearing electrical switch contacts for cooperation with said board switch

contacts, the position of said contactor arm member determining which of said switch contacts are made or broken to effect the different operating conditions of said motor;

c. control means coupled to said solid state circuit means and having a slidably mounted extending portion adapted to cooperate with said contactor arm;

d. spring means adapted to cooperate with said extending portion and said contactor arm for biasing said extending portion and said contactor arm to a neutral position; and

e. actuating means coupled to said contactor arm, whereby urging said actuating means in a first direction effects the position of said switch contacts causing said motor to operate in a forward direction and urging said actuating means in a second direction effects the position of said switch contacts causing said motor to operate in a reverse direction.

3. A sewing machine according to claim **2** wherein said actuating means causes said control means to increase the speed of said motor proportional to the distance said actuating means is moved.

4. A sewing machine according to claim **2** wherein said actuating means causes said switch contacts to de-energize said operator actuated foot controller when moved from the neutral position.

5. A sewing machine according to claim **2** further including a second solid state circuit means, fixedly mounted within said sewing machine frame and coupled to said motor, said second circuit means including said control means and having terminals adapted to be connected to said external source of electrical energy and to said switch contacts and being energized when said actuating means and said contactor arm are moved from the neutral position.

6. A sewing machine according to claim **2** wherein said switch means further includes contacts for de-energizing said foot controller when said actuating means is urged in either said first or second direction.

7. A sewing machine according to claim **2** further including a relay means fixedly mounted upon said sewing machine frame, said relay means being energized by said switch contacts and having contacts adapted to energize and de-energize said foot controller.

8. A sewing machine according to claim **5** further including connector means for removing said foot controller and permitting an operator to operate said sewing machine by utilizing said actuating means.

9. In a sewing machine having a frame including a bed and a hollow standard rising therefrom, stitch forming instrumentalities and work feeding mechanism, a main shaft operatively connected to said stitch forming instrumentalities and said work feeding mechanism, an electric motor operatively connected to said main shaft, an operator actuated foot controller for regulating the speed of operation of said motor, and solid state circuit means coupled to said motor and controller and having terminals adapted to be connected to an external source of electrical energy, the improvement comprising:

a. an insulated board member fixedly mounted within said standard having a plurality of electrical switch contacts thereon, said contacts being adapted to be connected to said circuit means;

b. a contactor arm member rotatably mounted parallel to said board member bearing electrical switch contacts for cooperation with said board switch contacts, the position of said contactor arm member determining which of said switch contacts are made or broken to effect the different operating conditions of said motor;

c. control means coupled to said solid state circuit means and having a slidably mounted extending portion adapted to cooperate with said contactor arm;

d. spring means adapted to cooperate with said extending portion and said contactor arm for biasing said extending portion and said contactor arm to a neutral position; and

e. actuating means coupled to said contactor arm, whereby urging said actuating means in a first direction effects the position of said switch contacts causing said motor to operate in a forward direction and urging said actuating means in a second direction effects the position of said switch contacts causing said motor to operate in a reverse direction.

* * * * *