

April 1, 1947.

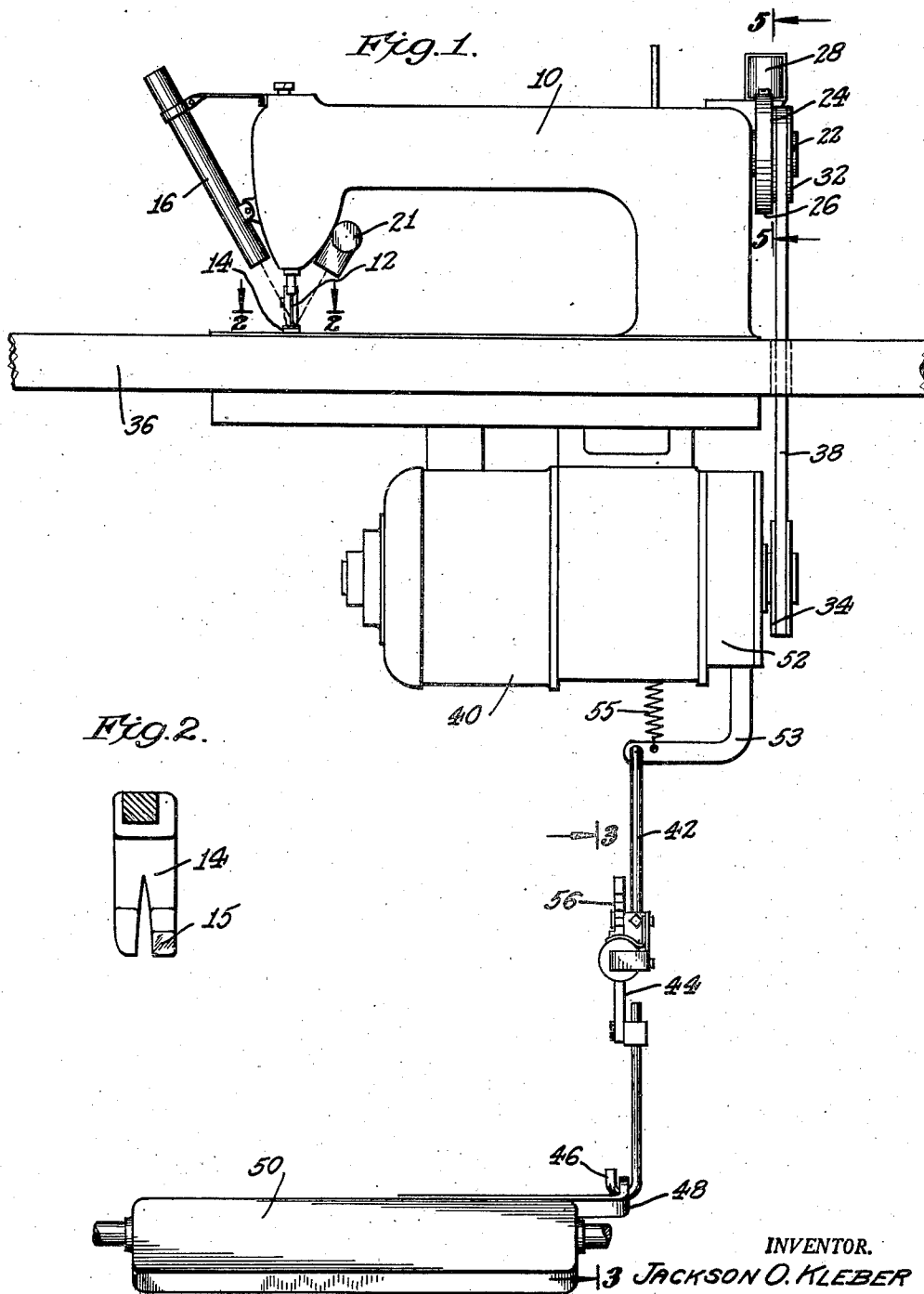
J. O. KLEBER

2,418,356

SAFETY CONTROL DEVICE FOR ELECTRICALLY OPERATED MACHINES

Filed July 1, 1944

2 Sheets-Sheet 1



INVENTOR.

JACKSON O. KLEBER

BY Frederick Griswold, Jr.

ATTORNEY

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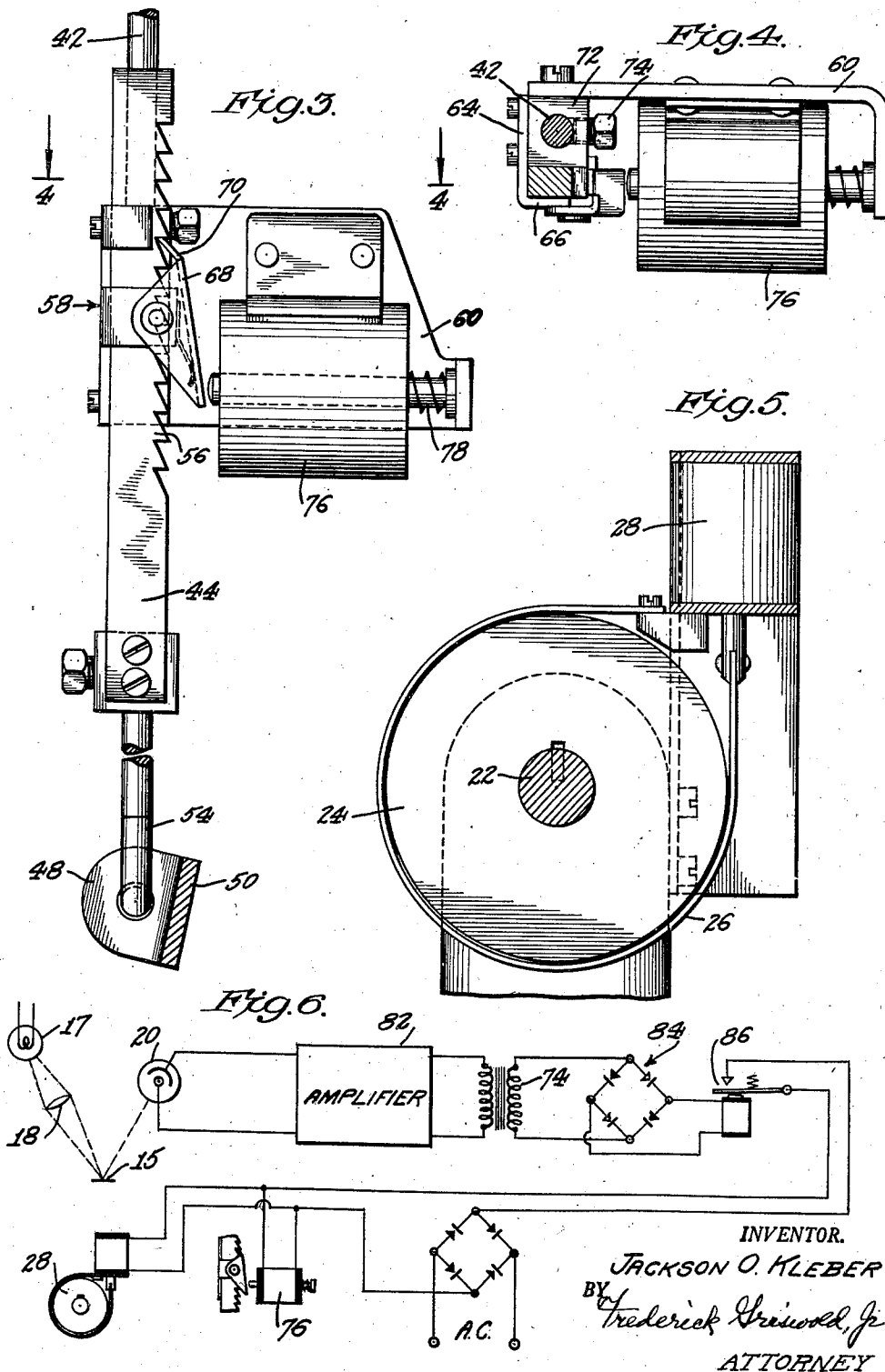
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UNITED STATES PATENT OFFICE

2,418,356

SAFETY CONTROL DEVICE FOR ELECTRICALLY OPERATED MACHINES

Jackson O. Kleber, Long Island City, N. Y.

Application July 1, 1944, Serial No. 543,127

3 Claims. (Cl. 112-219)

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This invention relates to a safety control device for electric sewing machines.

The primary object of the invention is to provide a safety device adapted to protect the fingers of sightless persons or others when operating electric sewing machines.

It is also an object of the invention to bring the sewing machine to a complete and sudden stop whenever the fingers of an operator come dangerously close to the needle.

In accordance with the invention, a beam of light is directed down towards the region in front of the sewing machine needle and this light is reflected upwardly onto a photoelectric cell. The photoelectric cell is connected with suitable control equipment for immediately stopping the sewing machine responsive to interruptions of the reflected light, as when an operator's finger enters the region dangerously close to the needle.

While I am aware that photoelectric cell equipment has heretofore been used for the control of various types of machines, the use of such equipment for insuring the safety of the operators of the sewing machines involves a number of special problems which so far as I am aware, have not been heretofore encountered or solved. It should first be noted that for the automatic stopping of a sewing machine, the equipment must be so arranged that the operator may normally bring his fingers up to the presser foot and be able to feed the cloth, or other material to be sewed, along beneath the pressor foot without causing the machine to be automatically stopped. That is, the operator should be free to move his hands and fingers up to the presser foot, and also around the sides and to the rear thereof to properly guide the work without stopping the machine. Also, of course, the work should be free to travel through its normal path under and around the presser foot without being liable to interrupt the light and automatically stopping the machine. However, the instant that the operator brings his fingers accidentally over the area of the upper surface of the presser foot, then to be effective, the automatic equipment must stop the machine at once and before there is opportunity for the needle to take even one additional downward stroke.

The immediate stopping of an electric sewing machine involves not only the difficulty of overcoming the inertia of the rapidly moving mechanism in the sewing machine itself, but also the substantial inertia of the rapidly rotating drive motor must also be taken into consideration.

In accordance with the present invention, the

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above noted difficulties have been overcome by directing the beam of light downwardly, preferably at a sharp angle from the side, onto the presser foot which is formed or provided with a reflective surface in such a position that the beam is reflected upwardly, preferably at a sharp angle onto the photoelectric cell.

With the original light beam and the reflected beam located in these positions, the above described normal manipulations of the work and of the operator's hands and fingers, may be carried out without interrupting the light beam. However, immediately upon the operator's fingers moving into a position over the presser foot in front of the needle, the reflected light is interrupted for actuating the stop mechanism.

In order to have the stop mechanism operate substantially instantaneously and positively, the photoelectric cell is preferably connected with an improved amplifier and circuit arrangement for immediately and positively operating a relay the moment the light beam is interrupted. This relay in turn, is preferably arranged to control a quick acting solenoid brake which acts to at once stop the sewing machine *per se*. At the same time, the relay is preferably connected to actuate a quick acting solenoid controlled clutch for disconnecting the motor so that its inertia will not tend to cause the machine to further move the sewing needle.

These and other objects and features of the invention and the means for their attainment will be clearly apparent from the following detailed description, taken in connection with the accompanying drawings illustrating one embodiment by which the invention may be realized and in which:

Fig. 1 is a view in front elevation showing a sewing machine in which the improvements of this invention have been incorporated;

Fig. 2 is a view, in plan, showing the presser foot;

Fig. 3 is a detail view showing the sectional clutch rod and the devices enabling the sections to be automatically released;

Fig. 4 is a transverse sectional view taken in the plane indicated by the line 4-4 of Fig. 3 and looking in the direction of the arrows;

Fig. 5 is a vertical sectional view taken in the plane indicated by the line 5-5 of Fig. 1, looking in the direction of the arrows and showing the brake means to halt the sewing machine; and

Fig. 6 shows the circuit diagram by which the electrically actuated devices of this invention are controlled,

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Referring first to Fig. 1, there is there shown a conventional sewing machine indicated as a whole at 10, having the reciprocating needle 12 and presser foot 14. An upper surface 15 of the presser foot 14, Fig. 2, is polished or otherwise provided with a surface that reflects light rays. On the end of the sewing machine proximate the needle 12 is a tubular casing 16 containing a light source and so disposed that light from the light source 17, Fig. 6, is directed to and through a lens 18 onto the upper reflecting surface 15 of the presser foot 14, and from such mirrored upper surface 15 it is directed to fall on a photoelectric cell 20 in a casing 21 carried on the sewing machine on the opposite side of the needle 12 from the source of light 17.

The operating shaft 22, Figs. 1 and 5, extending outwardly through the right hand side, as viewed, of the sewing machine, is provided with a brake drum 24 about which a strap 26 extends to a solenoid 28, whereby, when the solenoid is energized, the brake strap is drawn upwardly and binds on the drum and serves to promptly stop rotation of the brake drum and thereby the rotation of the shaft 22, which in turn results in immediate cessation of the needle movement.

Also carried on the shaft 22 is a pulley 32 which is driven by means of belt 38 from a driving pulley 34 rotated by the motor 40 carried beneath the bed 36 of the machine. Extending from the motor 40 is a control rod comprising an upper section 42 and a lower section 44, which is provided with a hook 46 at its lower end for connection with an arm 48 on the pivoted foot treadle 50. The upper end of the rod 42, 44 is connected with a clutch in the casing 52 on the motor. Pressure on the foot treadle 50 clutches the motor 40 to the sewing machine drive through the control rod 42, 44 and simultaneously releases the brake 26 acting on the machine in a manner hereinafter described in connection with the electrical circuits operating this instrumentality.

As shown in Figs. 1 and 3, the control rod 42, 44 is provided with a hook member 46, 54 at its lower end whereby the rod is removably connected with an arm 48 on the foot treadle 50, and the upper section 42 is connected with the clutch 52 of the motor.

It is contemplated in accordance with this invention, for purposes of safety, that pressure on the foot treadle 50 will clutch the motor 40 to the machine. On the other hand, when pressure on the treadle is released, or what is equivalent thereto, should the rod break or its sections 42, 44 separate, the motor is disconnected and the brake applied to the machine. To this end, the lower section 44 is formed with a plurality of upwardly facing teeth 56 and the upper end of section 44 enters a frame 58 on a solenoid bracket 60 carrying instrumentalities by which the rod section 42 and the rod section 44 are connected to move as a unit. As shown (Fig. 4), the rear wall 60 of the bracket is provided at one extremity, the left (as viewed), with side wall 64, and having integral therewith a front wall 66. On the front wall section 66 is pivotally mounted a pawl 68, the tooth 70 of which is adapted to enter one of the spaces between the teeth 56 to retain the lower rod section 44 within the frame 58. At its upper end, the connecting plate is shown as formed with a socket 72 in which the lower end of the upper rod section 42 extends and is held by a set screw 74. The upper rod section is connected to the clutch 52 by the arm 53 and is

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normally urged in an upward direction by spring 55. Mounted on the front face, as viewed, of the bracket 60 is a solenoid 76, the core 78 of which, upon energization of the solenoid, is moved to trip the detent 68 and rock the detent out of engagement with the teeth on the lower control rod 44 thereby disconnecting the rod sections.

Pressure of the foot on the foot treadle draws the rod 42, 44 downwardly thereby actuating the clutch to thereby connect the motor 40 with the driving shaft of pulley 34, to operate the sewing machine. Conversely, relieving the foot pressure disengages the clutch. Similarly, disconnection of the control rod sections interrupts the downward pull on the clutch and thereby also releases the clutch.

Referring now to Fig. 6 wherein are shown the various elements of the electrical circuits and other electrically actuated devices controlling the apparatus hereinbefore described, light source 17 is of a variable intensity (in this case it is merely lit by an alternating current). Other methods of varying its intensity such as a rotating shutter or vibrating reed might be used.

The light from light source 17 is focused by lens 18 to fall upon the reflecting surface 15 and then be reflected to the photoelectric cell 20. The output of this photoelectric cell is then amplified by amplifier 32 and hence appears on the primary side of transformer 74 as direct current impulses. (This same condition will be true regardless of how the light intensity of light source 17 is varied.) In passing through transformer 74, these direct current impulses are again changed to alternating current through the action of the transformer 74.

Rectifier 84 then changes this alternating current back to direct current which is used to control relay 86. The operation is as follows:

As long as a varying light falls on the photoelectric cell 20, a varying or impulse direct current appears on the primary of transformer 74 and an alternating current appears on the secondary of transformer 74. This current is then rectified to direct current by rectifier 84 and holds relay 86 in operation as shown in Fig. 6.

The instant the light falling on photoelectric cell 20 is interrupted, the current in the primary of transformer 74 becomes steady (the steady direct current of the output stage of amplifier 82). As a result of this no voltage appears on the secondary of transformer 74 and relay 86 becomes de-energized, thus closing its contacts (normally held open) and causes the treadle to effect disconnection of the rod by electromagnet 76 and brake solenoid 28 to function and to instantaneously stop the machine.

A novel feature of this operation, unlike other photoelectric devices, is that the current in relay 86 goes from maximum (while the light is uninterrupted) to zero (when light is interrupted), and this results in rapid operation of relay 86.

In other photoelectric control circuits, the current in the control relay 86 would decrease from a higher to a lower level rather than from a higher to zero level as in this invention.

Various modifications will occur to those skilled in the art in the disposition and configuration of the component elements going to make up the invention as a whole as well as in its entirety, and no limitation is intended by the phraseology of the foregoing description or illustrations in the accompanying drawings except as indicated in the appended claims.

What is claimed is:

1. Safety apparatus for immediately stopping electrically driven sewing machines when the operator's fingers approach the needle, said apparatus being adapted for machines of the type having a vertically reciprocating needle and accompanying presser foot beneath which the work is fed, said apparatus comprising means for directing a beam of light downwardly onto the upper surface of the presser foot in front of the needle and in a position for reflection at a relatively sharp angle from said surface upwardly, a photoelectric cell positioned substantially above the presser foot to receive the reflected beam, an electromagnetically operated brake for stopping the main shaft of the machine, an electromagnetically operated clutch for disconnecting the drive motor, and electric circuit and relay means operative under the control of said photoelectric cell to immediately operate said brake and clutch responsive to obstruction of said reflected light beam.

2. Safety apparatus for immediately stopping electrically driven sewing machines when the operator's fingers approach the needle, said apparatus being adapted for machines of the type having a vertically reciprocating needle and accompanying presser foot beneath which the work is fed, said apparatus comprising means for directing a beam of light downwardly from one side onto a surface area on the upper side of the presser foot in front of the needle and in a position for reflection at a relatively sharp angle from said surface upwardly at the other side of the presser foot, a photoelectric cell positioned substantially above the presser foot to receive the reflected beam, an electromagnetically operated

brake for stopping the machine, an electric circuit means operative under the control of said photoelectric cell to immediately operate said brake responsive to obstruction of said reflected light beam.

3. Safety apparatus for immediately stopping electrically driven sewing machines when the operator's fingers approach the needle, said apparatus being adapted for machines of the type having a vertically reciprocating needle and accompanying presser foot beneath which the work is fed, said apparatus comprising means for directing a beam of light downwardly onto the upper surface of the presser foot in front of the needle and in a position for reflection from said surface upwardly, a photoelectric cell positioned to receive the reflected beam, and electromagnetically operated means for stopping the machine, and electric circuit means operative under the control of said photoelectric cell to immediately operate said stopping means responsive to obstruction of said reflected light beam.

JACKSON O. KLEBER.

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