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Pearsall et al.

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[45] **Sept. 18, 1973**

[54] **EMERGENCY STOP CONTROL SYSTEM FOR CLOTH SPREADING MACHINE**

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[73] Assignee: **Cutters Machine Company, Inc.**, Nashville, Tenn.

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[21] Appl. No.: **287,896**

[52] **U.S. Cl.** **318/282**, 318/369, 318/371, 318/461, 318/626

[51] **Int. Cl.** **H02h 7/00**

[58] **Field of Search** 318/282, 369, 371, 318/461, 465, 626, 627

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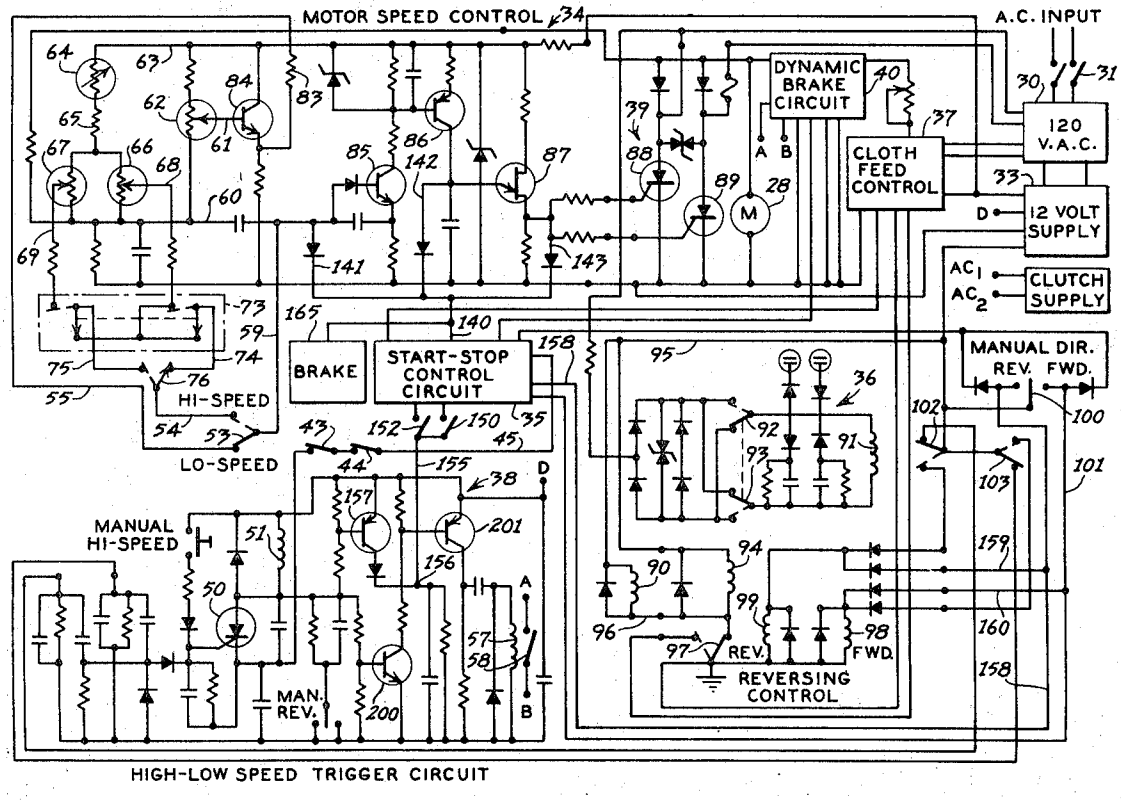
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Assistant Examiner—Thomas Langer
Attorney—Harrington A. Lackey

[57] **ABSTRACT**

An electrically driven and controlled cloth spreading machine including means for controlling the high and low speeds, the braking, and reversing of a machine, characterized by an emergency switch system for de-energizing the drive of the machine and actuating the reverse control means, when the switch for shifting the controls from the high speed to the low speed mode fails to function.

7 Claims, 4 Drawing Figures



DYNAMIC BRAKE CIRCUIT

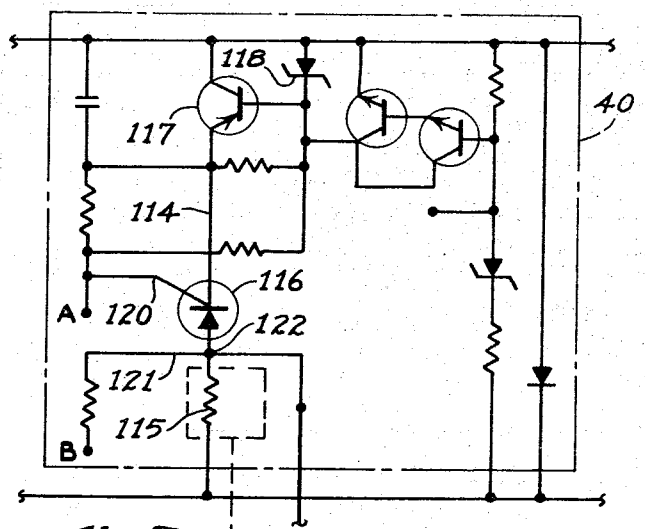


Fig. 3

START-STOP CONTROL CIRCUIT

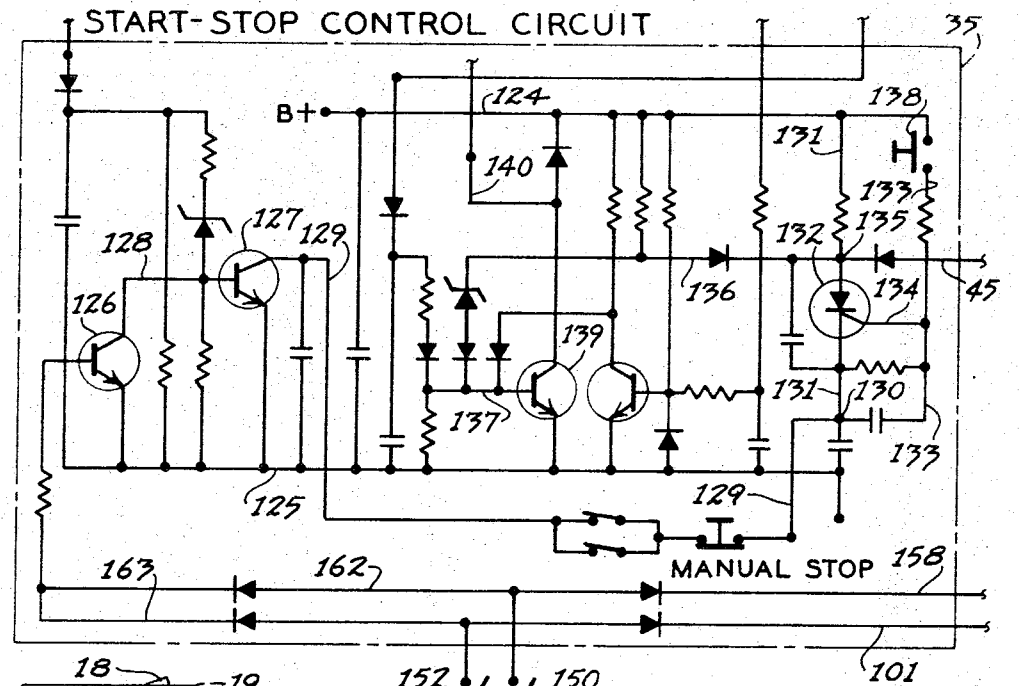


Fig. 4

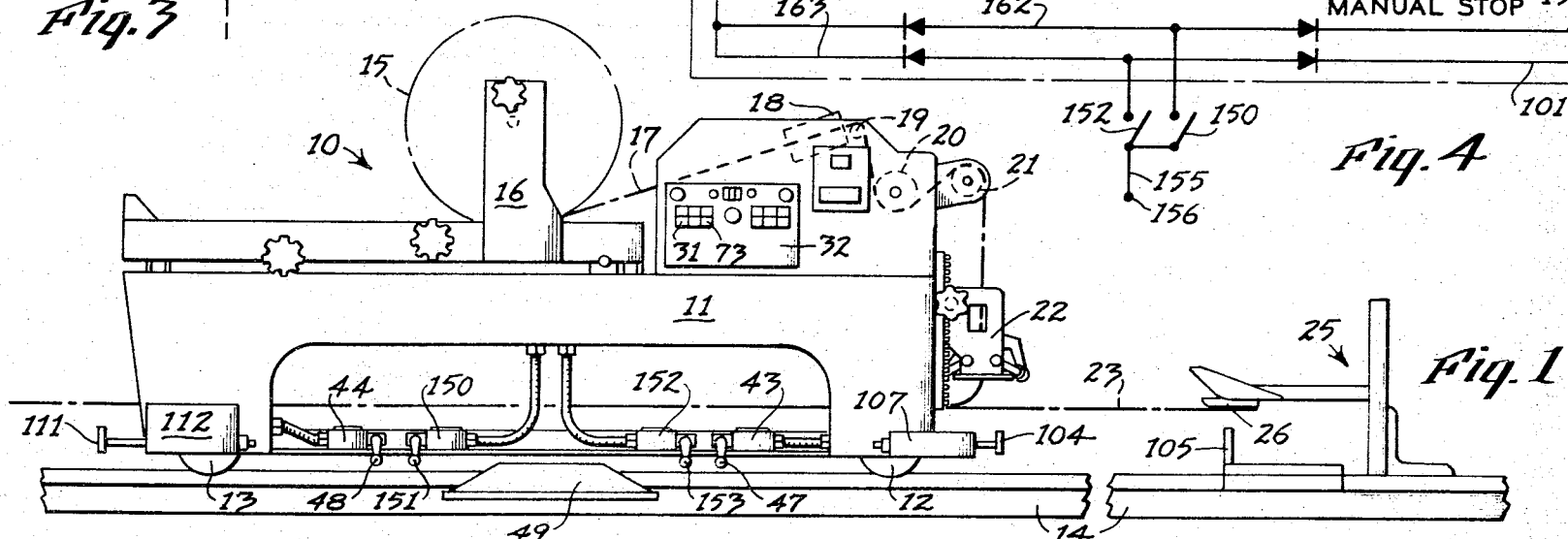


Fig. 1

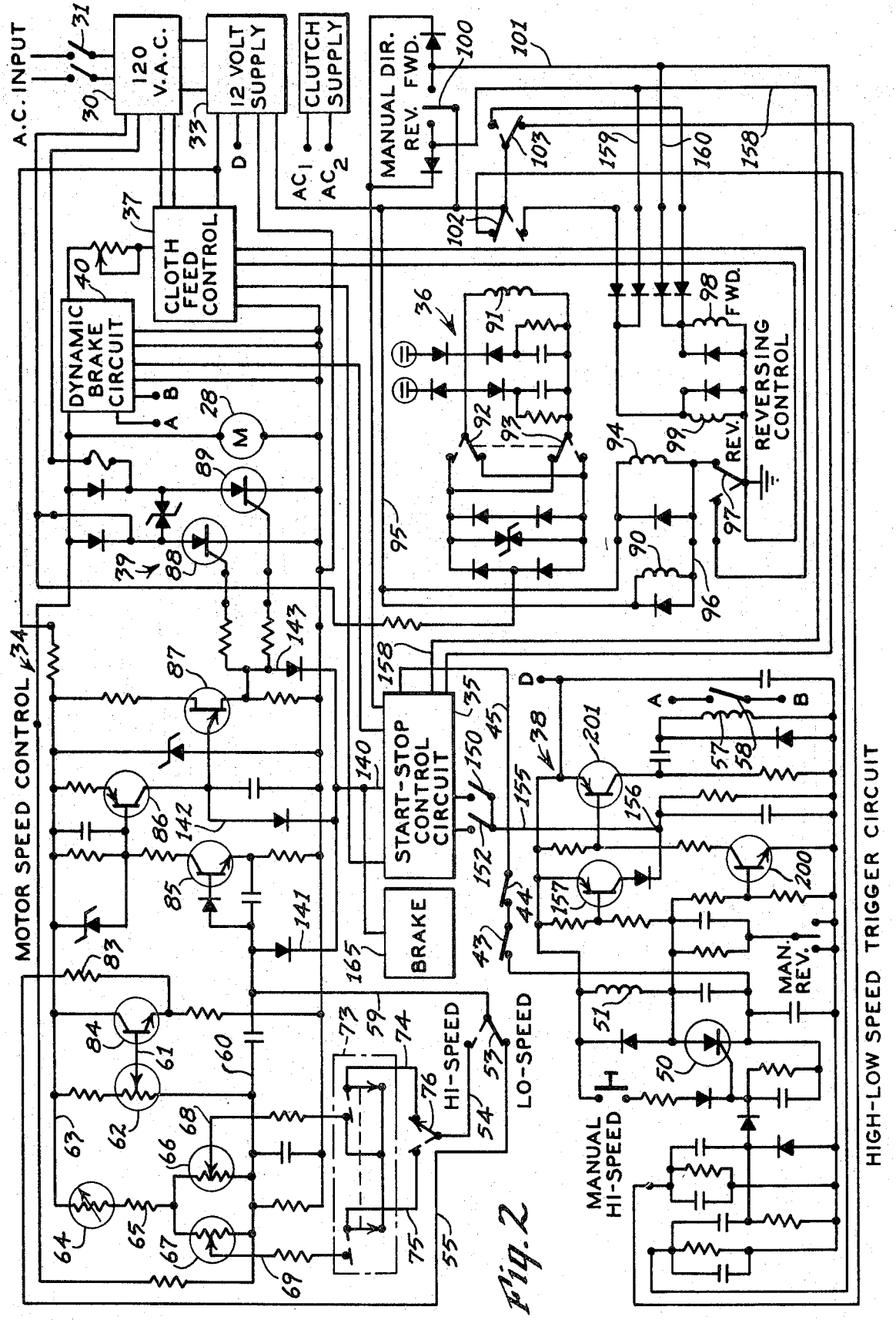

A.C. INPUT
120 V.A.C.
12 VOLT SUPPLY
CLUTCH SUPPLY
MANUAL DIR. REV. FWD.
CLOTH FEED CONTROL
DYNAMIC BRAKE CIRCUIT
REVERSING CONTROL
FWD.
REV.
START-STOP CONTROL CIRCUIT
BRAKE
HI-SPEED
LO-SPEED
MOTOR SPEED CONTROL
MANUAL HI-SPEED
MAN. REV.
HIGH-LOW SPEED TRIGGER CIRCUIT

Fig. 2

EMERGENCY STOP CONTROL SYSTEM FOR CLOTH SPREADING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to a cloth spreading machine, and more particularly to an electrically operated cloth spreading machine having an emergency stop switch system.

Cloth spreading machines have been developed, and are now in operation, which travel at high speed over the major portion of their reciprocal course between a pair of reversing stations, and in low speed adjacent each reversing station for cooperative engagement with the catcher mechanism to form folds in the ends of the layers of cloth. However, in order to minimize damage to the machine and cloth, and jerking and irregular folding of the cloth at each reversing station, various electrical switch controls have been adopted in order to reduce the speed of the machine just prior to its cooperation with the catcher mechanism.

As the demand continues for cloth spreading machines which travel faster and longer during their high-speed periods with a minimal of time spent in the low-speed modes, the possibilities of failure of the devices for switching the machine from high speed to low speed increases with a corresponding increase in the possible damage to equipment and injury to personnel.

An attempt to improve the safety of a cloth spreading machine has been made in the United States Benson Patent No. 3,663,006, issued May 16, 1972, owned by the assignee of this application. The Benson patent discloses a rather sophisticated electrically driven and controlled cloth spreading machine provided with various elements in the circuitry to cause the machine to fail safe into low speed upon the occurrence of certain operating and emergency conditions in the machine.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to overcome the above safety limitations on conventional cloth spreading machines and by providing a secondary or auxiliary emergency switch system for automatically stopping the cloth spreading machine upon failure of the primary speed switch to reduce the speed of the spreading machine.

In the preferred form of the invention, a second, emergency switch is located on the machine frame in longitudinal alignment with, but trailing, the low-speed switch of the machine, so that both the low-speed switch and the emergency switch may successively encounter the same tripping device fixed on the cutting table in the path of the switches as the machine approaches the catcher.

The emergency switch made in accordance with this invention is electrically connected in the drive and control circuit in such a manner that it will automatically disable the drive circuit, and actuate the reversing controls to automatically stop the movement of the machine, but only when the low-speed switch fails to function to switch the drive control circuit from the high-speed mode to the low-speed mode.

More specifically, the automatic emergency switch system is incorporated in an electrical drive and control circuitry for a cloth spreading machine including a solid-state drive circuit, a speed control circuit, a trigger circuit, a reversing circuit and a start-stop control circuit. The trigger circuit includes the low-speed switch which, when tripped as it approaches the catcher, causes the speed control circuit to shift from the high-speed mode to the low-speed mode and also to energize the dynamic braking switch, so that the drive circuit is disabled while the dynamic brake circuit is energized as the machine moves from high to low speed. However, when the machine decelerates to a predetermined low speed, the dynamic braking circuit is automatically de-energized and the drive circuit automatically re-energized to drive the motor at the low speed. As the machine engages the catcher, a reversing switch is actuated to energize the reversing circuit causing the machine to move in reverse in low speed for a predetermined time. Then, the speed control circuit is switched from its low-speed mode to its high-speed mode and continues to the opposite end of its travel.

The emergency switch in this system is so connected with the trigger circuit that the energency switch is only energized or actuated, after it is tripped, if the speed control is in its high-speed mode, that is if the low-speed switch fails to function to shift the speed control from high speed to low speed. If this emergency condition exists, then actuation of the emergency switch disables the drive circuit to de-energize the motor. The emergency switch means is also directly connected to the reversing circuit to automatically reverse the direction of current through the motor field coil which rapidly brings the machine to a halt, with the motor in a reverse mode, to avoid impact with the catcher.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a cloth spreading machine, made in accordance with this invention, in which the trip member is between the forward low-speed switch and the cooperating emergency switch, as the machine approaches the catcher mechanism at the forward end of the table;

FIG. 2 is a schematic circuit diagram of the electrical drive and control system for the machine;

FIG. 3 is an enlarged schematic diagram of the dynamic brake circuit; and

FIG. 4 is a schematic diagram of the start-stop control circuit, including the emergency switches.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, FIG. 1 discloses a cloth spreading machine **10** made in accordance with this invention, including a carrier frame **11** supported by wheels **12** and **13** for longitudinal movement along a spreading table or cutting table **14**. A cloth supply roll **15** is supported for rotary movement upon standard **16** mounted upon the frame **11** for unwinding and feeding a web of cloth **17**. In the machine **10**, the web **17** is threaded through the edge control device **18**, over guide bar **19** and under guide roller **20**, and then over a driven top feed roll **21**. The web **17** then depends through a cloth spreader frame or unit **22**, having tuck blades or spreader blades, not shown, for spreading the cloth web **17** in layers **23** upon the table **14**. A catcher mechanism **25** including a catcher bar **26** is stationed upon the spreading table **14** at one end (the front end of FIG. 1) of the travel or course of the carrier frame **11** to cooperate with the spreader unit **22** in a well-known manner to fold the end of each cloth layer **23**.

An electrical motor 28 (FIG. 2) mounted on the frame 11 is operatively connected to drive the rear wheels 13 by a suitable drive mechanism, not shown.

The top feed roll 21 is driven by a separate motor, not shown, within the cloth feed control system 37, in the same direction independently of the direction of movement of the frame 11.

Referring now to the electrical circuit diagram in FIG. 2, a power supply circuit 30 is connected to any suitable source of AC electricity, not shown, through the power switch 31, which is also disclosed in FIG. 1 upon the control panel 32 mounted on the side of the frame 11.

The low voltage supply circuit 33 supplies various voltages, including B+ supply voltage, to some of the other circuits of the system, such as the motor speed control circuit 34, the start-stop control circuit 35, the reversing control circuit 36, the cloth feed control circuit 37, and the high-low speed trigger circuit 38.

Connected in parallel with the drive motor 28 is an SCR motor drive circuit 39 and a dynamic braking circuit 40.

The trigger circuit 38 includes a pair of unidirectional, momentary, normally closed, low-speed switches 43 and 44 in series in the low-speed switch circuit 45. The low-speed switches 43 and 44 are mounted on the side of the frame 11 as disclosed in FIG. 1 so that each switch 43 and 44 is adapted to be opened by engagement of its corresponding lever 47 and 48 upon the trip ramp 49 fixed to the table 14.

The low-speed switch circuit 45 is connected in series with SCR 50 and high-low selector switch relay coil 51. When the relay coil 51 is energized, it moves selector switch 53 to its high-speed position indicated in dashed-lines in FIG. 2, to close the high speed circuit 54. When the relay coil 51 is de-energized, selector switch 53 is moved to its solid-line, low-speed position, as indicated in FIG. 2, to close the low-speed control circuit 55. When the low-speed switch circuit 45 is interrupted by opening one of the low-speed momentary switches 43 or 44, the dynamic braking relay coil 57 is energized to close the dynamic braking relay switch 58 to energize the dynamic braking circuit 40 when the speed of the machine 10 changes from high to low, as previously described in the common assignee's pending application of Robert G. Reed, Ser. No. 125,470.

The base of the selector switch 53 is connected by lead 59 into the base of transistor 85 through a diode, in the motor speed control circuit 34. The low-speed control line 55 is connected through the resistor 83 to the emitter of transistor 84, whose base is connected to wiper arm 61 of the low-speed potentiometer 62, which is connected between the common line 60 and the supply line 63 in the motor speed control circuit 34. The supply line 63 is also connected to maximum high-speed potentiometer 64, which, in turn, is connected through resistor 65 to a pair of adjustable high-speed potentiometers 66 and 67 connected in parallel, and whose respective wiper arms 68 and 69 are manually adjustable independently of each other in a manner taught in the co-pending application Ser. No. 254,272 of Johnny L. Fort et al., filed May 17, 1972, for "HIGH-SPEED CONTROL APPARATUS FOR CLOTH SPREADING MACHINE." Both adjustable high-speed potentiometers 66 and 67 are connected to the feed-back common line 60.

The wiper arms 68 and 69 are both connected to a manually operated, speed selector switch 73 also mounted on the control panel 32. A reverse lead 74 and forward lead 75 connect the speed selector switch 73 to the respective reverse and forward contacts of the speed directional switch 76 connected in the high-speed control circuit 54, as described in the above co-pending Fort et al application.

A voltage signal is generated between the supply line 63 and the base of transistor 85 through the speed selector line 59 and the respective wiper leads 61, 68 or 69 of the corresponding low-speed potentiometer 62, and the two high-speed potentiometers 66 or 67. The corresponding signal is transmitted through the successive transistors 85 and 86 and the unijunction 87 to fire the SCRs 88 and 89 in the drive circuit 39. The firing time of the SCRs 88 and 89 is a function of the signals generated by the respective speed potentiometers 62, 66 or 67.

The speed directional switch 76 is a relay switch controlled by its relay coil 90 in the reversing control circuit 36. The direction of rotation of the drive motor 28 is determined by the direction of current through the motor field coil 91 in the reversing control circuit 36, which in turn is determined by the position of the field directional relay switches 92 and 93 responsive to the relay coil 94. Relay coils 94 and 90 are connected in parallel between the B+ supply line 95 and the common line 96. The coils 90 and 94 are energized by grounding through the directional relay switch 97 when it is in its solid-line forward position, as disclosed in FIG. 2. The directional relay switch 97 is pulled into its solid-line forward position by energization of the forward coil 98. Energization of the reverse coil 99 moves the directional relay switch to its dashed-line position permitting the coils 90 and 94 to become de-energized, thereby holding their respective relay switches 92, 93 and 76 in their respective reverse, solid-line positions. The forward coil 98 is energized through line 101 when the manual switch 100 is in its forward position, or when the reversing switch 103 is in its dashed-line position. The reverse coil 99 is energized when the manual switch 100 is in its reverse position, or when the reversing switch 102 is shifted to its dashed-line position in FIG. 2, when the plunger 104 (FIG. 1) engages the stop 105 at the front catcher mechanism 25 to trip the switch arm, not shown, in the plunger box 107.

The dynamic brake circuit 40 is more specifically disclosed in FIG. 3, and includes in the main circuit 114 in series the brake resistor 115, SCR 116 and switch transistor 117. The switch transistor 117 is controlled by Zener diode 118 to produce a constant voltage, or constant counter-current, in opposition to the back EMF developed in the braking resistor 115 from the motor 28. One side of the brake relay switch 58 in trigger circuit 38 is connected through the contacts A to the gate lead 120 of the SCR 116, while the other side of the brake relay switch 58 is connected through the contacts B and resistive lead 121 to junction 122 in the main line 115 between the SCR 116 and the braking resistor 115.

In FIG. 4, the start-stop control circuit 35 is disclosed in more detail, and includes a B+ supply line 124 and a common line 125. The control circuit 35 also includes a normally-off switch transistor 126 and a normally-on switch transistor 127, the collector of the transistor 126 being connected to the base of the tran-

sistor 127 through the lead 128. The collector lead 129 of the transistor switch 127 is connected to junction 130 in line 131 including SCR 132. The junction 130 is also connected through by-pass line 133 to gate lead 134 of the SCR 132. The by-pass line 133 includes momentary manual start switch 138. SCR line 131 is connected at junction 135 to lead 136, which in turn is connected to the base lead 137 of the switch transistor 139. The collector of the switch transistor 139 is connected to the grounding or clamping line 140 coupled to the motor speed control circuit 34, through diode line 141 to the base of the switch transistor 85, through diode line 142 to the gate of the unijunction transistor 87, and through diode line 143 to the gates of the drive SCRs 88 and 89. Thus, when the switch transistor 139 is turned on, it disables the motor speed control circuit 34 by grounding the lines 141, 142 and 143 through clamping line 140.

In accordance with this invention, a rear emergency switch 150 having a lever arm 151 (FIG. 1) is mounted on the same side of the frame 11 as the low-speed switches 43 and 44. Moreover, the switch lever arm 151 is located in longitudinal alignment with the forward low-speed switch arm 47 so that the switch arm 151 will be tripped by the trip ramp 49 in the same manner as the switch lever 47.

When the frame 11 is moving in the reverse direction, that is toward the left of FIG. 1, the emergency switch 152 trails the low-speed switch 44, so that the emergency switch lever arm 153 is in longitudinal alignment with the switch arm 48.

If, for some reason, the low-speed switch 43 does not open the line 45, whether or not the arm 47 is tripped, then when the rear emergency switch lever 151 is tripped, the rear emergency switch 150 will be energized to initiate emergency procedures. These emergency procedures will not be initiated if the low-speed switch 43 is actuated to open the line 45.

The emergency switch 152 and switch arm 153 function in the same manner as emergency switch 150, but in relation to the low-speed switch 44 instead of low-speed switch 43.

Both of the emergency switches 150 and 152 (FIG. 2) are connected through signal lead 155 to junction 156 within the trigger circuit 38 and in parallel with the transistor 157. When the high-speed relay coil 51 is energized, the transistor 157 is turned on to produce a high voltage signal of a predetermined value at the junction 156. However, when either of the low-speed switches 43 or 44 is tripped to de-energize the coil 51, the transistor 157 is turned off to produce a low voltage at the junction 156, insufficient to transmit an emergency signal through either of the emergency switches 150 or 152 even when closed. On the other hand, when the low-speed switch is not tripped, the transistor 157 remains turned on to maintain the high voltage signal at junction 156 which is transmitted through the subsequently closed emergency switch 150. The emergency signal transmitted through the closed emergency switch 150 continues through line 158 and line 159 to energize the reverse coil 99, which reverses the current through the motor field coil 91, bringing the machine 10 to a rapid halt prior to impact with the catcher mechanism 25.

The emergency switch 152 is connected through the leads 101 and 160 to the forward reversing coil 98 for reversing the current through the field winding 91 to cause the machine 10 to stop at the opposite end of the table 14, and to place the reversing circuit 36 in a forward mode.

Emergency switches 150 and 152 are also connected through respective leads 162 and 163 to the base of the switch transistor 126, so that when either switch 150 and 152 is closed and received an energency signal through the signal line 155, switch transistor 126 is turned on to turn off the transistor 127. Accordingly, SCR 132 is turned off to turn on switch 139 in order to ground the lines 141, 142 and 143 through the clamping line 140, thereby disabling the motor speed control circuit 34.

Since, in the emergency situation, the voltage at junction 156 in trigger circuit 38 remains high, the dynamic brake relay coil 57 remains de-energized and the dynamic brake circuit 40 remains off or de-energized until the SCR 132 is turned off by the switch transistors 126 and 127, as described above. When SCR 132 is turned off, SCR 50 in trigger circuit 38 is also turned off to subsequently turn on transistors 200 and 201 to energize dynamic braking relay coil 57, thereby actuating the dynamic brake circuit 40. However, in order to hold the machine 10 stationary, an electro-mechanical brake 165 (FIG. 2), of any desired construction, may be provided. The electro-mechanical brake 165 is connected to the clamping circuit 140, so that when no voltage is at the emitter of unijunction 87 in line 142, the brake 165 is simultaneously turned on, until a voltage signal is present again.

In the operation of the machine 10, the frame 11 is moved by the motor 28, the top feed roll 21 is driven by the cloth feed control 37, and the spreading unit 22 cooperates with the catcher mechanism 25 at the forward extremity of travel of the frame 11.

Assuming that power switch 31 is closed, the momentary start switch 138 has been depressed to turn on the SCR 132, and all the remaining switches, except speed selector switch 53 and direction switch 76, are in their solid-line positions of FIG. 2, the machine 10 is moving forward at high speed along the table 14 and is spreading cloth. The high-low speed selector switch 53 is in its dashed-line, high-speed position and direction switch 76 is in its forward dashed-line position.

As the machine 10 approaches the catcher mechanism 25, the front switch lever arm 47 is normally tripped by the ramp 49 to momentarily open the low-speed switch 43. The relay coil 51 in the trigger circuit 38 is de-energized causing the high-low speed selector switch 53 to shift to its solid-line, low-speed position, thereby shifting the speed control circuit 34 to its low speed mode. Moreover, the opening of the momentary low-speed switch 43 energizes the dynamic brake relay coil 57 to close the relay switch 58 and thereby energize the dynamic brake circuit 40 to cause the machine 10 to dynamically brake from its high to its low speed. After the machine 10 attains its low-speed, the dynamic braking circuit 40 is de-energized as previously described, and proceeds at low speed into the catcher mechanism 25. As the plunger 104 is thrust rearward by the front stop 105, the reversing switch 102 (FIG. 2) is momentarily shifted to its dashed-line position, energizing the reversing circuit 36 causing the machine 10 to move in reverse away from the catcher mechanism 25. After a predetermined distance, the machine 10 accelerates into high speed. When the reversing switch 102 returns to its solid-line position, SCR 50 in

trigger circuit **38** is turned on to re-energize coil **51** and shift the selector switch **53** to its high-speed position.

The same procedure is carried out at the opposite end of the table **14** when the low speed switch actuator lever **48** is tripped by the ramp **49**.

However, in the event that either of the low-speed switches **43** or **44** fails to open the circuit **45**, even though low-speed switch actuator arms **47** or **48** are tripped, the speed control circuit **34** continues in its high speed mode. In this event, assuming the machine **10** is moving forward, the emergency switch actuator arm **151** is tripped by the ramp **49** to close emergency switch **150**. Immediately, the high voltage signal at junction **156** in trigger circuit **38** is transmitted through the switch **150** to initiate the emergency procedures previously described. Thus, when the emergency switch **150** is closed, the reversing circuit **36** is immediately energized by the signal transmitted through line **158** to reverse the direction of the current in the motor field coil **91** and stop the machine **10**. The speed control circuit **34**, including the drive circuit **39**, is disabled by turning on transistor **139** to ground the lines **141**, **142** and **143**, through the closed clamping line **140**.

By carrying out the emergency procedures simultaneously, the machine **10** will be stopped with the reversing circuit **36** in its reverse mode before the machine **10** can engage, much less impact against, the catcher mechanism **25**.

This same emergency procedure will be initiated and effected by actuation of the emergency switch **152** when its switch lever **153** engages the ramp at the opposite end of the table, not shown, to prevent the machine **10** from impacting or crashing into the catcher at the opposite end of the table, or to prevent the machine **10** from running off the end of the table, if no catcher is employed.

What is claimed is:

1. An emergency stop control apparatus for a cloth spreading machine having a frame supported for longitudinal movement over a cloth-laying surface between reversing stations, a spreader unit to spread cloth in layers, and means for supplying cloth to the spreader unit, comprising:

a. electrically energized motor drive means for moving said frame longitudinally of said surface,

b. electrical speed control means including selector switch means operable to switch said speed control means between a high-speed mode and a low-speed mode to energize said drive means to move said frame respectively at a high speed or a low speed,

c. a trigger circuit including a low-speed switch,

d. said trigger circuit being operably connected to said selector switch means to operate said speed control means in said low-speed mode upon actuation of said low-speed switch,

e. low-speed actuating means on said frame to actuate said low-speed switch,

f. trip means for operating said low-speed actuating means in accordance with a predetermined program, while said frame is moving toward a reversing station,

g. emergency switch means on said frame operably connected to said motor drive means and said trigger circuit,

h. emergency actuating means for actuating said emergency switch means only after said trip means has operated said low-speed actuating means,

i. said emergency switch means, when actuated, being adapted to de-energize said motor drive means only while said speed control means is in its high-speed mode.

2. The invention according to claim **1** in which said trip means is adapted to successively operate said low-speed actuating means and said emergency actuating means.

3. The invention according to claim **2** in which said trip means is fixed relative to said cloth laying surface, and said emergency actuating means is mounted on said frame a predetermined distance trailing said low speed actuating means in alignment with said trip means as said frame moves longitudinally of said surface.

4. The invention according to claim **1** in which said trigger circuit generates an emergency voltage signal when said speed control means is in its high-speed mode and generates no emergency voltage signal when said speed control means is in its low speed mode, said emergency switch means, when actuated, being responsive only to said emergency voltage signal to de-energize said motor drive means.

5. The invention according to claim **1** further comprising electrical means for stopping the frame, said emergency switch means being operably connected to said electrical stopping means so that when said emergency switch means is actuated and while said speed control means is in its high-speed mode, said stopping means is energized to stop said frame.

6. The invention according to claim **1** further comprising reversing switch means adapted to control said motor drive means to reverse the movement of said frame, when actuated, between forward and reverse directions, said emergency switch means being operably connected to said reversing switch means so that when said emergency switch means is actuated and said speed control means is in its high-speed mode, said reversing switch means is actuated to stop said machine frame and assume a reverse directional mode.

7. The invention according to claim **6** in which said reversing switch means includes a field coil for said motor drive means, said reversing switch means being adapted to reverse the current through said field coil upon each actuation of said reversing switch means.

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