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R. B. HUNTER

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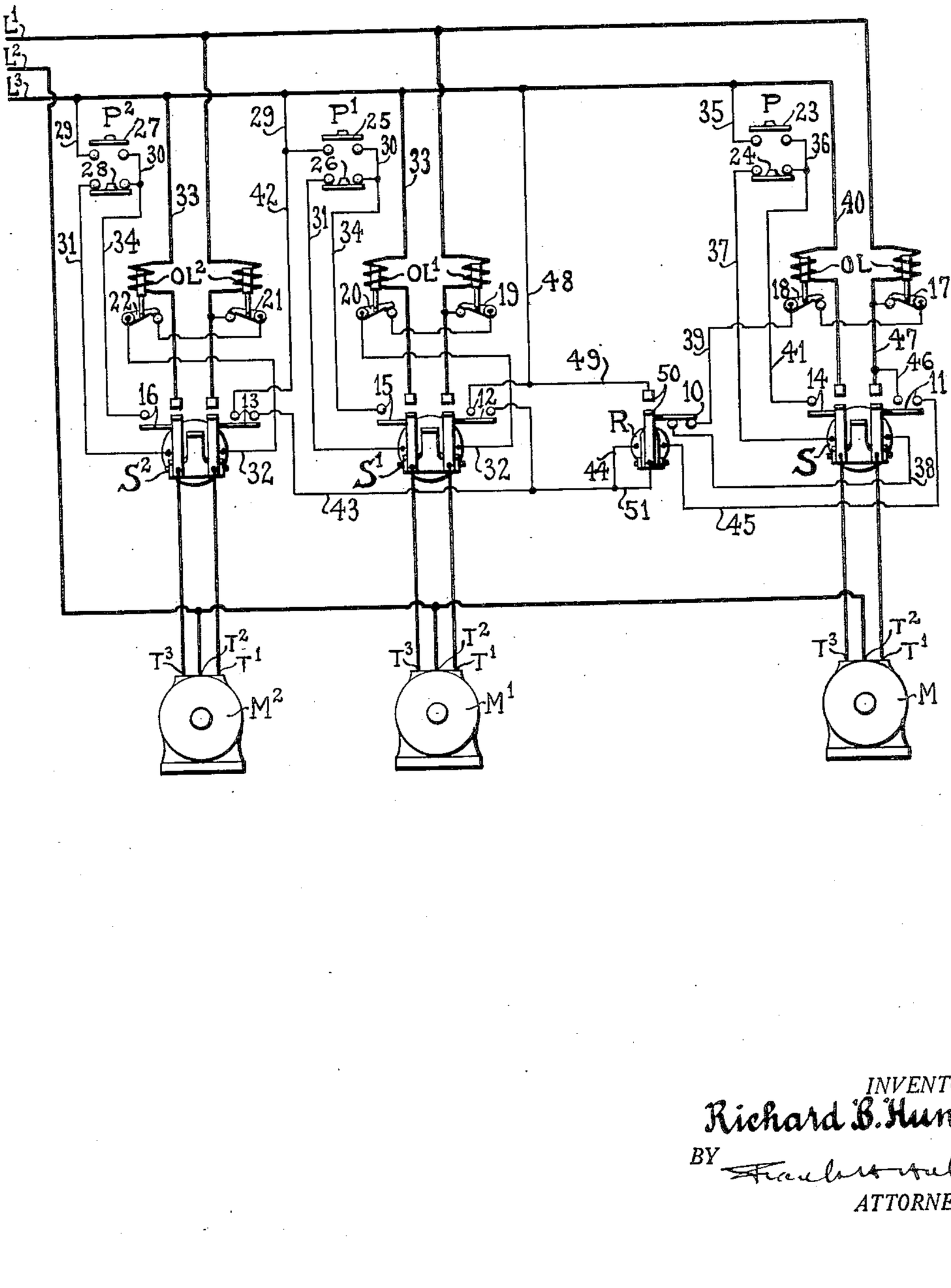

INVENTOR.
Richard B. Hunter
BY Fauchs & Hubbard
ATTORNEY

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RICHARD B. HUNTER, OF SHOREWOOD, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

CONTROLLER FOR ELECTRIC MOTORS.

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This invention relates to controllers for electric motors, and more particularly to controllers for motor operated woodworking machines and the like.

Woodworking machines for tenoning or mortising ordinarily comprise a plurality of cutter motors, each cutter being adapted to perform an operation upon a piece of wood simultaneously with the other cutters; and a common feed motor which pushes the wood past the several cutters. If a cutter breaks or fails to cut due to a knot or other obstacle in the wood, it is highly desirable that the cutter motor affected and the feed motor be stopped as quickly as possible.

An object of the invention is to provide simple and efficient means for accomplishment of the aforementioned desirable result, among others.

Another object is to provide means for insuring against operation of the feed motor during starting of one or more of the cutter motors.

Another object is to provide automatic electrical control means for effecting stopping of the feed motor jointly with one or more of the cutter motors under predetermined conditions.

Another object is to provide manual control means for effecting starting or stopping of the several motors jointly or individually, but subject to control by suitable electrical interlocks.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates an embodiment of the invention which will now be described, it being understood that the embodiment illustrated is susceptible of various modifications without departing from the spirit and scope of my invention as defined in the appended claims.

In the drawing, M designates a feed motor adapted to effect passage of a piece of wood through a woodworking machine (not shown), and M^1 and M^2 designate the cutter motors. It is to be understood that the number of cutter motors included in the control system may be increased or decreased if desired. Said motors are adapted to be supplied with energy from a suitable source, as indicated at lines L^1, L^2 and L^3; line L^2 being directly connected to terminals T^2, respectively, whereas connection of lines L^1 and L^3 with terminals T^1 and T^3 of the respective motors is controlled by electroresponsive switches S, S^1 and S^2. Individual push-button stations P, P^1 and P^2 are provided for control of the energizing circuits of the respective electroresponsive switches S, S^1 and S^2, said energizing circuits being also subject to control by suitable overload relays OL, OL^1 and OL^2, which may be of the delayed action type. Relays OL controlling the energizing circuit of switch S may be omitted if desired.

The energizing circuit of switch S is also subject to control by normally closed auxiliary contacts 10 of an electroresponsive relay R; whereas the energizing circuit of relay R is subject to control by normally open auxiliary contacts 11 of switch S in conjunction with auxiliary contacts 12 or 13 of switches S^1 and S^2, respectively. Contacts 12 and 13 are of the transient closing type; that is to say, they are normally open in the opened or closed positions of switches S^1 and S^2, respectively, but are adapted to be temporarily closed during opening or closing of the latter.

Switches S, S^1 and S^2 are also provided with normally open auxiliary contacts 14, 15 and 16 adapted when closed to provide maintaining circuits for said switches, respectively. Normally closed overload relay contacts 17, 18 are included in the energizing circuit of switch S, as aforedescribed; whereas normally closed overload relay contacts 19, 20 and 21, 22 are included in the energizing circuits of switches S^1 and S^2, respectively. Push-button station P comprises normally open contacts 23 adapted when closed to effect starting of motor M, and normally closed contacts 24 adapted when opened to effect stopping of said motor. Push-button stations P^1 and P^2 similarly comprise normally open contacts 25 and 27 and normally closed contacts 26 and 28 for effecting starting and stopping of motors M^1 and M^2, respectively.

The operation of the control system will now be described. Upon closure of push-button switch 27 an energizing circuit is completed for switch S^2, said circuit extending from line L^3 by conductor 29 through said switch 27, by conductor 30 through the normally closed contacts of push-button switch 28, by conductor 31 through the winding of switch S^2, by conductor 32 through the normally closed contacts 22 and

21 of overload relays OL^2, and thence through the right-hand overload relay coil to line L^1. Switch S^2 thereupon closes to complete the line connections for motor M^2, said line connections being obvious. During closure of switch S^2 auxiliary contacts 13 are temporarily closed for a purpose hereinafter described. Also upon closure of switch S^2 auxiliary contacts 16 thereof are adapted to provide a maintaining circuit therefor, said circuit extending from line L^3 by conductor 33 through the left-hand overload relay coil, through the left-hand main contacts of switch S^2, through auxiliary contacts 16, by conductor 34 through push-button switch 28, and thence to line L^1 as previously traced. The power and control circuits for motor M^1 and any other cutter motor which might be included in the system are exactly like those described with reference to motor M^2, and hence further discussion thereof is deemed unnecessary.

With switches S^2 and S^1 closed in the manner aforedescribed, closure of switch S may be effected by closure of push-button switch 23, which completes an energizing circuit extending from line L^3 by conductor 35 through said switch 23, by conductor 36 through normally closed push-button switch 24, by conductor 37 through the winding of switch S, by conductor 38 through normally closed auxiliary contacts 10 of relay R, by conductor 39 through normally closed contacts 18 and 17 of overload relays OL, and thence through the right-hand overload relay coil to line L^1. Switch S thereupon closes to complete the line connections for motor M. Switch S upon closure of its auxiliary contacts 14 provides a maintaining circuit for itself, said circuit extending from line L^3 by conductor 40 through the left-hand overload relay coil, through the left-hand main contacts of switch S and auxiliary contacts 14, by conductor 41 through push button switch 24, and thence to line L^1 as previously traced.

Switch S is also provided with normally open auxiliary contacts 11 which are adapted upon closure thereof to preset the energizing circuit of relay R for completion upon temporary closure of either or both sets of auxiliary contacts 12 and 13 of switches S^1 and S^2, respectively. Thus upon the occurrence of an overload upon motor M^2, one or both of the overload relay contacts 21 and 22 will be opened, thus interrupting the aforedescribed maintaining circuit of switch S^2; whereas the latter in opening will effect transient engagement of its auxiliary contacts 13 to complete the energizing circuit of relay R. Said circuit may be traced from line L^3 by conductors 29 and 42 through said contacts 13, by conductors 43 and 44 through the winding of relay R, by conductor 45 through auxiliary contacts 11 of switch S, by conductors 46 and 47 through the right-hand overload relay coil, and thence to line L^1. Relay R immediately closes and provides a maintaining circuit for itself, said maintaining circuit extending from line L^3 by conductors 48 and 49 through the main contacts 50 of said relay, by conductors 51 and 44 through the winding of relay R, and thence to line L^1 as previously traced. Relay R in closing effects opening of its normally closed auxiliary contacts 10 thereby interrupting the aforedescribed maintaining circuit of switch S, whereby the latter is opened to effect stopping of motor M. Moreover, switch S in opening effects opening of its auxiliary contacts 11 thereby interrupting the aforedescribed maintaining circuit of relay R which thereupon assumes its normally open position.

Obviously, if motors M, M^1 and M^2 are in operation an overload upon motor M^1 will effect interruption of the maintaining circuits of switches S^1 and S for simultaneous stopping of motors M^1 and M, as aforedescribed in connection with motors M^2 and M. If either of the cutter motors M^2 or M^1 is stopped due to an overload the other cutter motor will be left running, but no harm will result because the feed motor M will likewise have been stopped. The last-mentioned cutter motor may thereupon be stopped by depressing the stop push-button switch 28 or 26, as the case may be, thereby interrupting the maintaining circuit of switch S^2 or S^1, respectively.

It is to be understood that any of the motors M, M^1 or M^2 may be stopped at will by depressing the respective push-button switches 24, 26 or 28, whereas the means aforedescribed will operate to insure stopping of the feed motor M upon stopping of one or more of the cutter motors.

In the normal operation of the system by the manual control means, all of the cutter motors will be started by closing the respective push-button switches 27, 25; and thereafter the feed motor will be started by closing the push-button switch 23. However, if the feed motor should be intentionally or inadvertently started prior to starting of any or all of the cutter motors, the former will be automatically stopped during closure of switches S^1 or S^2, through temporary closure of auxiliary contacts 12 or 13, respectively. Such closure of auxiliary contacts 12 or 13 completes the energizing circuit of relay R, whereas the latter in closing effects opening of its auxiliary contacts 10 to interrupt the energizing circuit of switch S with consequent stopping of motor M as aforedescribed. Moreover, in stopping the system as a whole the motor M is preferably first stopped by depressing the push-

button 24, whereupon the motors M^1 and M^2 are stopped by depressing the respective push-button switches 26 and 28. On the other hand if either or both of the push-buttons 26 and 28 are depressed while motor M is still in operation the means heretofore described acts automatically to effect stopping of the latter.

It will be noted that relays OL in the circuit of motor M provide an additional safety feature, inasmuch as the same will act to interrupt the energizing circuit of switch S in the event of an overload upon said motor, such as might occur if relay R failed to operate properly upon stopping of one or both of the cutter motors.

The control switches and relays employed may be of simple and standard construction, as will be obvious.

What I claim and desire to secure by Letters Patent of the United States is:

1. The combination with an electromagnetically operable switch, of an energizing circuit therefor, and means for completing said energizing circuit, said means comprising a second electromagnetically operable switch having auxiliary contacts which are open in the opened and closed position of said last-mentioned switch but adapted to be temporarily closed during closing or opening of the latter.

2. The combination with an electromagnetically operable switch, of an energizing circuit therefor, means for completing said energizing circuit, said means comprising a second electromagnetically operable switch having auxiliary contacts which are open in the opened and closed position of said last-mentioned switch but adapted to be temporarily closed during closing or opening of the latter, and means adapted upon closure of said first-mentioned switch to provide a maintaining circuit therefor.

3. The combination with a plurality of separately operable driving motors, of electroresponsive switches for respectively controlling the energizing circuits of said motors, means for interrupting the energizing circuit of one of said motors upon interruption of the energizing circuit of another of the same, said means comprising an electroresponsive relay adapted upon operation thereof to interrupt the energizing circuit of one of said switches, and auxiliary contacts carried by another of said switches and adapted upon opening of the latter to effect operating energization of said relay.

4. The combination with a plurality of motors, of individually operable electroresponsive control switches therefor, means for rendering one of said switches subject to control by another of the same under given conditions, said means comprising an electroresponsive relay and auxiliary contacts on said switches adapted when simultaneously closed to effect operating energization of said relay, and normally closed auxiliary contacts on said relay adapted when opened to effect interruption of the energizing circuit of one of said switches.

5. The combination with a plurality of motors, of individually operable electroresponsive control switches therefor, means for rendering one of said switches subject to control by another of the same under given conditions, said means comprising an electroresponsive relay and auxiliary contacts on said switches adapted when simultaneously closed to effect operating energization of said relay, all of said auxiliary contacts being normally open but certain of the same being adapted for temporary closure during opening of their respective switches, and normally closed auxiliary contacts on said relay adapted when opened to effect interruption of the energizing circuit of one of said switches.

6. The combination with a plurality of electric motors, of individually operable electroresponsive control switches therefor, and means for insuring against operation of one of said motors during starting of other of the same, said means comprising an electroresponsive relay controlling the energizing circuit of one of said switches, and auxiliary contacts on a plurality of said switches adapted to control the energizing circuit of said relay.

7. The combination with a plurality of electric motors adapted to be operated jointly, of means for insuring against operation of one of said motors during starting of other of the same and for effecting stopping of said one of said motors upon stopping of other of the same, said means comprising a plurality of electroresponsive switches for individually controlling said motors, an electroresponsive relay having normally closed contacts controlling the energizing circuit of one of said switches, and normally open auxiliary contacts on other of said switches adapted to be temporarily closed during opening or closing of the latter to thereby control the energizing circuit of said relay.

8. The combination with a plurality of electric motors, of control means therefor comprising individually operable electroresponsive control switches for the respective motors and overload relays having normally closed contacts included in the energizing circuits of the respective switches, manually operable means for completing the energizing circuits of said switches respectively, and means for insuring against energization of one of said switches during initial energization of other of the same, said means comprising an electroresponsive relay having normally closed contacts included in the energizing circuit of one of said switches,

and normally open contacts carried by a plurality of said switches and adapted when jointly closed to complete the energizing circuit of said relay.

9. The combination with a plurality of electric motors, of control means therefor comprising individually operable electroresponsive control switches for the respective motors and overload relays having normally closed contacts included in the energizing circuits of the respective switches, manually operable means for completing the energizing circuits of said switches respectively, and means for insuring against energization of one of said switches during initial energization of other of the same, said means comprising an electroresponsive relay having normally closed contacts included in the energizing circuit of one of said switches, and normally open contacts carried by a plurality of said switches and adapted when jointly closed to complete the energizing circuit of said relay, certain of said auxiliary contacts being normally open in the opened or closed position of their respective switch but adapted for temporary closure during closing or opening of the latter.

10. The combination with a plurality of electric motors, of control means therefor comprising individually operable electroresponsive switches for the respective motors and overload relays having normally closed contacts included in the energizing circuits of the respective switches, manually operable means for controlling the energizing circuits of said switches respectively, and means for effecting interruption of the energizing circuit of one of said switches upon interruption of the energizing circuit of other of the same, said means comprising an electroresponsive relay having normally closed auxiliary contacts adapted to be included in the energizing circuit of one of said switches, normally open auxiliary contacts carried by said last-mentioned switch, and auxiliary contacts carried by other of said switches and adapted for temporary closure during opening of the latter, said auxiliary contacts of said switches when jointly closed being adapted to complete the energizing circuit of said relay to effect opening of the auxiliary contacts of the latter.

11. In a controller for woodworking machines and the like, the combination with a plurality of electric motors, electroresponsive switches for controlling the circuits of said motors respectively, manually operable means for effecting energization and de-energization of said switches individually at will, means for insuring against energization of one of said switches during initial energization of other of the same and for effecting de-energization of said one of said switches upon de-energization of other of the same, said means comprising an electroresponsive relay having normally closed contacts included in the energizing circuit of one of said switches, and normally open auxiliary contacts on said last-mentioned switch and on other of said switches and adapted when jointly closed to complete the energizing circuit of said relay.

12. In a controller for woodworking machines and the like, the combination with a plurality of electric motors, electroresponsive switches for controlling the circuits of said motors respectively, manually operable means for effecting energization and de-energization of said switches individually at will, means for insuring against energization of one of said switches during initial energization of other of the same and for effecting de-energization of said one of said switches upon de-energization of other of the same, said means comprising an electroresponsive relay having normally closed contacts included in the energizing circuit of one of said switches, normally open auxiliary contacts on said last-mentioned switch and on other of said switches and adapted when jointly closed to complete the energizing circuit of said relay, and overload relays having normally closed contacts included in the energizing circuits of certain of said switches and adapted under given conditions to automatically interrupt said circuits.

In witness whereof, I have hereunto subscribed my name.

RICHARD B. HUNTER.