

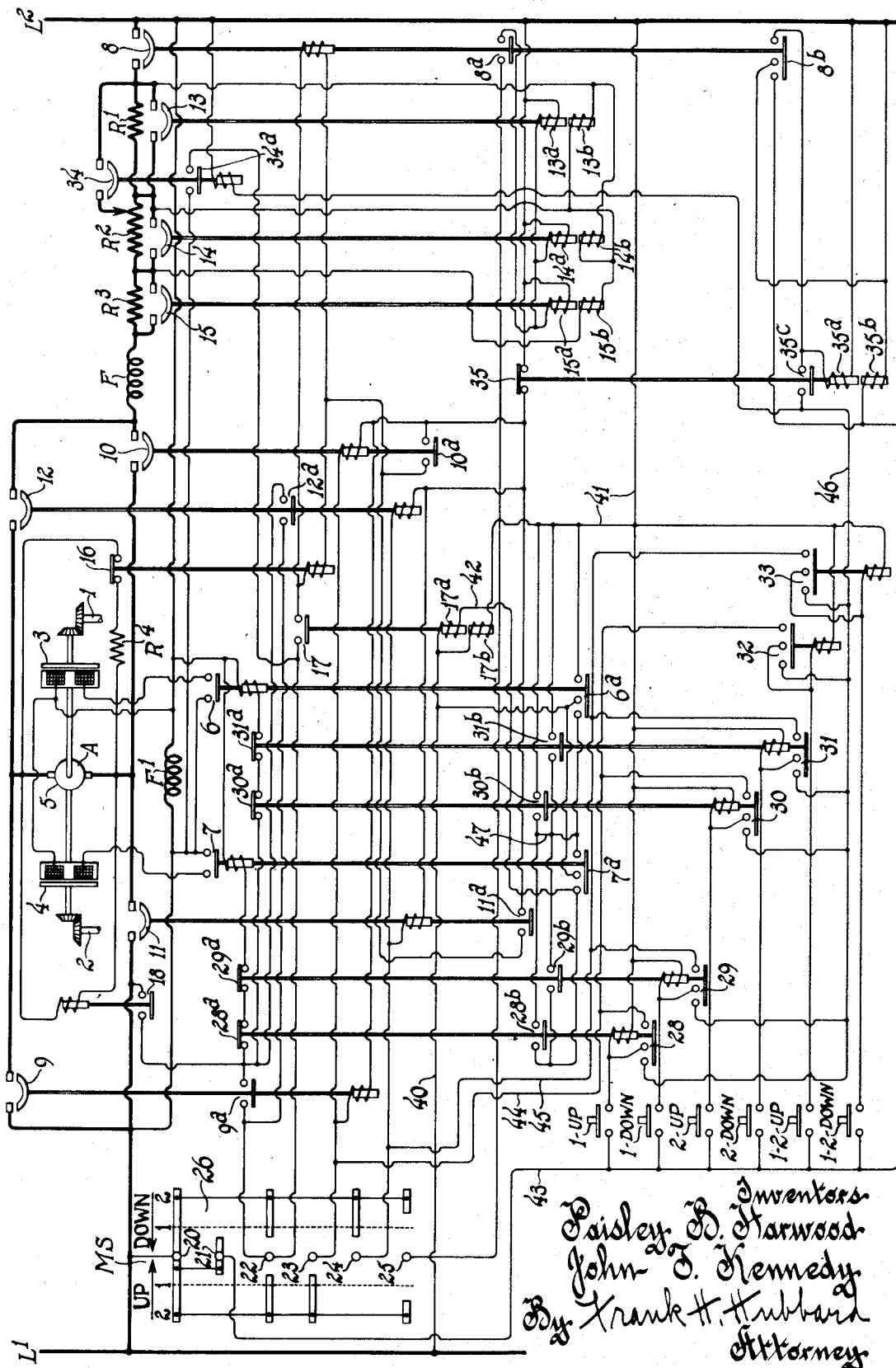
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ELECTRICAL CONTROL SYSTEM

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ELECTRICAL CONTROL SYSTEM

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This invention relates to electrical control systems for motor driven apparatus.

The invention relates more particularly to controllers for rolling mill screw downs employing a single driving motor and a plurality of electromagnetic clutches for establishing driving connections between the motor and a plurality of screw downs.

The invention has among its objects to provide an improved controller for motor driven screw downs of the aforesaid character which provides for control of the driving motor and the clutches to effect continuous operation of the screw downs in opposite directions selectively and which also provides for separate or simultaneous jogging of the screw downs in either direction.

Another object is to provide a controller of the aforesaid character which insures establishment of selected driving connections by the clutches prior to starting of the driving motor, and which insures against interruption of such driving connections by the clutches until stopping of the driving motor.

Another object is to provide a controller of the aforesaid character which acts during jogging of the screw downs to effect quick starting of the driving motor and to also effect automatic stopping of the driving motor upon operation thereof for a predetermined relatively short interval.

Various other objects and advantages of the invention will hereinafter appear.

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

Referring to the drawing, the same illustrates screw downs 1 and 2 arranged to be driven through the medium of electromagnetic clutches 3 and 4, respectively, by a motor 5. The driving motor illustrated is of a direct current type to be supplied with current from a supply circuit indicated by lines L¹-L², and as shown the same is provided with an armature A, a series field winding F, and a shunt field winding F¹ which is permanently connected across said supply circuit.

The clutches 3 and 4 are respectively controlled by normally open electromagnetic switches 6 and 7 and the control means for motor 5 includes a normally open electromagnetic main switch 8, two pairs of normally open electromagnetic reversing switches 9-10 and 11-12, and a plurality of normally open accelerating switches 13, 14 and 15 for shunting series starting resistances

R¹, R² and R³, respectively. Each of said accelerating switches is provided with an operating winding a and a restraining winding b, and as hereinafter set forth said restraining windings act during starting of the motor in either direction and also upon plugging thereof to delay operation of their associated switches. The control means for motor 5 also includes an electromagnetic dynamic braking switch 16 which is normally closed to connect a braking resistance R⁴ across the terminals of the motor armature A.

A master switch MS is provided for controlling the aforementioned switches to provide for operation of motor 5 in its up or down direction at high or low speed, and to effect plugging of said motor during reversals and dynamic braking thereof during stopping. The master switch MS also provides for control of the clutch control switches 6 and 7, and as hereinafter set forth an electromagnetic relay 17 having an operating winding a and a restraining winding b associated therewith prevents starting of motor 5 in either direction by said master switch except upon energization of both of the clutches 3 and 4, and a normally open counter voltage relay 18 insures against de-energization of either of said clutches except upon stopping of said motor. The master switch MS is provided with a plurality of stationary contacts 20 to 25, inclusive, and a cooperating drum 26 which is movable from an intermediate off position in up or down directions as indicated by arrows in the drawing to control the energizing circuits for the aforementioned control switches in a manner which will be hereinafter described.

Means is also provided for controlling the aforementioned control switches for motor 5 and clutches 3 and 4 to effect individual or simultaneous jogging operations of the screw downs 3 and 4 in up or down directions selectively. The jogging control means includes a plurality of normally open jog push buttons designated as 1-up, 1-down, 2-up, 2-down, 1-2-up and 1-2-down, and a plurality of relays 28 to 33, inclusive, each of which is associated with one of said push buttons. As hereinafter set forth said push buttons are adapted to act through the medium of their associated relays to selectively control the two sets of reversing switches 9-10 and 11-12, and to also effect control of the clutch control switches 6 and 7. The jogging control means also includes a normally open electromagnetic resistance controlling switch 34 and a jogging relay 35 having an operating winding a and a restraining winding b associated therewith. Switch 34 is under the control of the aforementioned jogging push buttons and

their associated relays, and as hereinafter set forth said switch provides for shunting a variable portion of the starting resistance during jogging operations and also provides for control of main switch 8 and the clutch control switches 6 and 7. Also as hereinafter set forth upon starting of motor 5 by any one of the aforementioned jogging push buttons the jogging relay 35 operates after a given period of delay to effect stopping of said motor.

The operation of the aforescribed controller and also the circuit connections therefor will now be more fully described.

To effect simultaneous operation of both of the screw downs 1 and 2 upwardly, the drum of the master switch MS is moved in its up direction and in its first position the same bridges stationary contacts 20, 22 and 23. Circuit is then established from line L¹ to stationary contact 23 of the master switch, through the operating windings of reversing switches 9 and 10 and through the jogging relay 35 to line L². Reversing switches 9 and 10 then respond and immediately upon response thereof the operating windings of the clutch control switches 6 and 7 are connected in parallel across lines L¹—L², the former winding being connected across said lines through the medium of master switch contacts 20 and 22, auxiliary contacts 9^a associated with reversing switch 9 and normally closed auxiliary contacts 30^a—31^a associated with relays 30 and 31 and the latter winding being connected across said lines through the medium of said master switch contacts, said auxiliary reversing switch contacts and auxiliary contacts 28^a and 29^a associated with relays 28 and 29. The clutch control switches 6 and 7 thus respond immediately upon response of reversing switches 9 and 10, and as is apparent from the drawing switch 6 in responding connects the operating winding of clutch 3 across lines L¹—L² to establish a driving connection between motor 5 and screw down 1 and switch 7 in responding connects the operating winding of clutch 4 across said lines to establish a driving connection between said motor and screw down 2.

Upon response of the clutch control switches 6 and 7 relay 17 operates in a manner which will now be described, to effect starting of the driving motor 5 but only after a delay which is sufficient to insure engagement of both of the clutches 3 and 4. As hereinbefore stated, relay 17 is provided with a restraining winding b, and as is apparent from the drawing this winding is normally energized since one terminal thereof is permanently connected to line L¹ by conductor 40 and the other terminal thereof is permanently connected to line L² by conductor 41. Upon response of the clutch control switches 6 and 7 the operating winding 17^a of relay 17 is energized by a circuit extending from line L¹ by conductor 40 to and through said operating winding, by conductor 42 through auxiliary contacts 7^a associated with clutch control switch 7 and auxiliary contacts 6^a associated with clutch control switch 6 and by conductor 41 to line L². Also upon response of clutch control switch 6 the auxiliary contacts 6^a thereof shunt the restraining winding 17^b of relay 17. Restraining winding 17^b then acts by self-induction to hold relay 17 in open position against the action of its operating winding 17^a but after a given interval said restraining winding becomes ineffective and relay 17 then responds under the action of its operating winding. Upon response of relay 17 main switch 8 and dynamic braking switch 16 are

energized by a circuit extending from line L¹ through contacts 20 and 22 of the master switch, through relay 17, through the operating windings of main switch 8 and dynamic braking switch 16, through auxiliary contacts 10^a associated with reversing switch 10 and through the jogging relay 35 to line L². Main switch 8 then closes, and as is apparent from the drawing the armature circuit of the motor is then completed through starting resistances R¹, R² and R³. Both of the screw downs 1 and 2 are then driven by motor 5 through the medium of clutches 3 and 4 at slow speed in up direction.

To effect simultaneous operation of both of the screw downs 1 and 2 downwardly the drum of the master switch is moved towards the left and the controller then operates in a manner similar to that hereinbefore described except that the set of reversing switches 11 and 12 is energized through the medium of contacts 20 and 24 of the master switch and the jogging relay. Also the aforescribed energizing circuits for the clutch control switches 6 and 7 are established through auxiliary contacts 12^a associated with reversing switch 12 and the aforescribed energizing circuit for the dynamic braking switch 16 and main switch 8 is established through the medium of auxiliary contacts 11^a associated with reversing switch 11.

When the drum of the master switch MS is moved into either of its second speed positions contacts 20 and 25 are bridged to connect the operating windings a of accelerating switches 13, 14 and 15 in parallel across lines L¹—L² through the medium of auxiliary contacts 8^a associated with main switch 8. It will be noted that the restraining windings b of accelerating switches 13 and 14 are both permanently connected across resistance R¹ while the restraining winding 15^b of accelerating switch 15 is permanently connected across resistance R². Said restraining windings are therefore energized immediately upon completion of the armature circuit for the motor and tend to hold their associated switches in open position. However, when the motor is started from rest the restraining action of winding 13^b is such as to permit immediate response of resistance switch 13 upon energization of its operating winding 13^a. On the other hand, if the master switch is operated to effect plugging of the motor, restraining winding 13^b will prevent response of its associated switch until the current in the motor circuit drops to a value corresponding to normal starting current. Prior to response of accelerating switch 13 the restraining winding 14^b prevents response of its associated switch but upon response of switch 13 said winding is shunted and the same then acts by self-induction to delay response of accelerating switch 14. Prior to response of accelerating switch 14 the restraining winding 15^b prevents response of its associated switch but upon closure of accelerating switch 14 said restraining winding is short-circuited and the same then acts by self-induction to delay response of its associated switch 15.

The counter voltage relay 18 has its operating winding connected across the terminals of armature A and upon starting of the motor in either direction said relay responds to establish a maintaining circuit for the clutch control switch 6 extending through auxiliary contacts 30^a and 31^a of relays 30 and 31 and to also establish a maintaining circuit for the clutch control switch 7 extending through auxiliary contacts 28^a and 29^a

of relays 28 and 29. Upon stopping of the motor, relay 18 drops out to interrupt said maintaining circuits.

sections between the motor 5 and both of the screw downs 1 and 2.

From the foregoing it is apparent that provision is made for preventing starting of the motor by the master switch except upon engagement of both of the clutches 3 and 4 and to also insure against deenergization of said clutches except upon stopping of the motor.

The function and operation of the jogging control means will now be more fully described. When the master switch is in off position circuit is established from line L¹ through stationary contacts 20 and 21 to conductor 43, and as is apparent from the drawing each of the jog push buttons is then adapted when depressed to establish an energizing circuit for its associated jog relay extending from conductor 43 to line L². The 1-up, 2-up and 1-2-up jog push buttons provide for operation of motor 5 in its up direction, it being noted that upon depression of any one of these push buttons circuit is established from conductor 43 through its associated relay to conductor 44 through the operating windings of reversing switches 9 and 10 and through the jogging relay 35 to line L². The 1-down, 2-down and 1-2-down jog push buttons provide for operation of motor 5 in its down direction, and upon depression of any one of these push buttons circuit is established from conductor 43 through the relay associated therewith to conductor 45 through the operating windings of reversing switches 11 and 12, and through the jogging relay 35 to line L².

Also upon depression of any one of the jog push buttons circuit is established from conductor 43 through the depressed push button and its associated relay to conductor 46 and thence through the operating winding of resistance controlling switch 34 to line L². Resistance controlling switch 34 thus responds immediately upon depression of any one of the push buttons and in responding the same shunts a portion of the starting resistance to insure quick starting of the motor during jogging operations. Also upon closure of switch 34 the auxiliary contacts 34^a thereof establish circuit from line L¹ to stationary contact 22 of the master switch and as is apparent the clutch control switch 6 is then adapted to be energized through the medium of the auxiliary contacts 30^a and 31^a of relays 30 and 31 while the clutch control switch 7 is then adapted to be energized through the medium of the auxiliary contacts 28^a and 29^a of relays 28 and 29. However, since relay 28 responds upon depression of the 1-up push button and relay 29 responds upon depression of the 1-down push button it is apparent that upon depression of either of these push buttons, clutch control switch 7 remains deenergized and clutch control switch 6 is energized to effect engagement of clutch 3 for establishment of the driving connection between motor 5 and screwdown 1. Also since relays 30 and 31 respond upon depression of the 2-up and 2-down push buttons it is apparent that upon depression of either of these push buttons clutch control switch 6 remains deenergized and clutch control switch 7 is energized to effect engagement of clutch 4 for establishment of the driving connection between motor 5 and screw down 2. On the other hand, it should be noted that upon depression of either the 1-2-up or 1-2-down push buttons, relays 28, 29, 30 and 31 are in normal position and thus both of the clutch control switches 6 and 7 are energized to effect engagement of both of the clutches 3 and 4 for establishment of driving con-

Upon depression of any one of the jog push buttons relay 17 operates after a given delay to establish an energizing circuit for main switch 8 and dynamic braking switch 16 extending from line L¹ through auxiliary contacts 34^a of resistance switch 34 through said relay, through the operating windings of said main switch and said dynamic braking switch, through auxiliary contacts 10^a or 11^a, as the case may be, and through jogging relay 35 to line L². Upon depression of either the 1-2-up or 1-2-down push buttons the clutch control switches 6 and 7 are both energized as hereinbefore set forth and the operating winding 17^a of relay 17 is energized through the medium of auxiliary contacts 6^a and 7^a associated with said switches and the restraining winding 17^b of said relay is shunted by auxiliary contacts 6^a. When the 1-up relay 28 or the 1-down relay 29 is held in its attracted position by its associated push button, clutch control switch 6 is energized as hereinbefore set forth and upon response thereof the operating winding 17^a of relay 17 is energized by a circuit extending from line L¹ to and through said winding, through auxiliary contacts 28^b or 29^b, as the case may be, to conductor 47, through auxiliary contacts 6^a associated with clutch control switch 6 and by conductor 41 to line L² and the restraining winding 17^b of relay 17 is shunted by the auxiliary contacts 6^a. When the 2-up relay 30 or the 2-down relay 31 is held in its attracted position by its associated push button, clutch control switch 7 is energized as hereinbefore set forth and upon response thereof the operating winding 17^a of relay 17 is energized by a circuit extending from line L¹ by conductor 40 through said operating winding, through contacts 7^a of clutch control switch 7 to conductor 47, through auxiliary contacts 30^b or 31^b, as the case may be, and by conductor 41 to line L². Also the restraining winding 17^b is then shunted by a circuit extending from the lower terminal thereof through auxiliary contacts 30^b and 31^b, as the case may be, to conductor 47 through auxiliary contacts 7^a of clutch control switch 7 to the upper terminal of said restraining winding. As hereinbefore set forth, upon energization of the operating winding of relay 17 and shunting of the restraining winding thereof said relay responds after a given interval determined by the self-inductance of said restraining winding. Thus during jogging operation relay 17 functions to prevent starting of the motor for an interval which is sufficient to permit establishment of selected driving connections by the clutches.

During jogging operations relay 35 acts in a manner which will now be set forth, to interrupt the motor circuit upon operation of the motor for a predetermined interval. It will be noted that the restraining winding 35^b of relay 35 is normally energized since the same is permanently connected between conductor 43 and line L². However, upon response of main switch 8 restraining winding 35^b of relay 35 is shunted by auxiliary contacts 8^b associated with main switch 8 and said auxiliary contacts also connect the operating winding 35^a of said relay between conductor 43 and line L². Restraining winding 35^b then acts by self-induction to hold relay 35 in normal position, but after a given interval said restraining winding becomes ineffective and relay 35 then responds under the action of its operating winding 35^a. Response of relay 35 interrupts the aforedescribed energizing circuits for

the reversing switches 9—10 or 11—12, main switch 8 and dynamic braking switch 16. The motor circuit is thus interrupted and dynamic braking switch 16 in closing effects braking of the motor to effect quick stopping thereof. Also during stopping of the motor relay 18 acts in the manner hereinbefore described to provide a maintaining circuit for the clutch control switches 6 and 7 until the motor is brought to rest. Upon response of jogging relay 35 the operating winding 35^a thereof is maintained energized by a circuit extending from line L¹ through the depressed jog push button and its associated relay to conductor 46, through auxiliary contacts 35^c of said jogging relay and through the operating winding thereof to line L². The jogging relay 35 is thus maintained in open position to prevent restarting of the motor except upon release of the jog push buttons.

20 What we claim as new and desire to secure by Letters Patent is:

1. In a controller for motor driven adjusting mechanisms, in combination, means for controlling said motor to effect starting thereof in opposite directions selectively, and a switch associated with said means for automatically stopping said motor after a given period of operation thereof, said switch having an operating winding associated therewith to be energized upon starting of said motor and also having a normally energized restraining winding associated therewith to be shunted upon starting of said motor.

2. The combination with an adjustment device, of a driving motor therefor, an electromagnetic clutch responsive to establish a driving connection between said motor and said device, and control means for said motor and said clutch including means for energizing said clutch and for thereafter effecting starting said motor, means acting upon starting of said motor for automatically stopping the same after a given period of operation thereof, and means for preventing deenergization of said clutch except upon stopping of said driving motor.

3. The combination with a pair of adjustment devices and a driving motor therefor, of an electromagnetic clutch associated with each of said devices for establishing a driving connection between the same and said motor, control means for said motor and said clutches, including means for effecting operation of said motor in opposite directions selectively and for effecting energization of either or both of said clutches selectively, said control means providing for energization of said clutches for a given interval prior to starting of said motor.

4. The combination with an adjustment device, of a driving motor therefor, an electromagnetic clutch responsive to establish a driving connection between said motor and said device, means for starting said motor in opposite directions selectively and for controlling energization of said clutch, said means including means for preventing starting of said motor except upon energization of said clutch, and for preventing deenergization of said clutch except upon stopping of said motor.

5. The combination with a plurality of adjusting mechanisms and a driving motor therefor, of an electromagnetic clutch associated with each of said mechanisms for establishing a driving connection between the same and said motor, and means for controlling said motor and said

clutches, including means for preventing starting of said motor except upon engagement of said clutches and for insuring against disengagement of said clutches except upon stopping of said driving motor.

6. The combination with an adjustment device, of a driving motor therefor and an electromagnetic clutch responsive to establish a driving connection between said motor and said device, of means for controlling said motor and said clutch including a switch responsive upon energization of said clutch to effect starting of said motor, said switch having an operating winding to be energized upon establishment of an energizing circuit for said clutch and having a normally energized restraining winding associated therewith to be shunted upon energization of said clutch, the latter winding acting by self-induction upon shunting thereof to delay operation of its associated switch.

7. The combination with a plurality of adjusting mechanisms, a driving motor therefor and an electromagnetic clutch associated with each of said mechanisms for establishing a driving connection between the same and said motor, control means for said clutches and said motor including means for energizing said clutches and for thereafter effecting starting of said motor in opposite directions selectively, and a counter voltage relay associated with said motor for maintaining said clutches energized pending stopping of said motor.

8. The combination with a plurality of adjusting mechanisms, a driving motor therefor and an electromagnetic clutch associated with each of said mechanisms for establishing a driving connection between the same and said motor, control means for said motor and said clutches, including a plurality of normally open push buttons, certain of said push buttons being operable to effect starting of said motor in one direction, and certain of the same being operable to effect starting of said motor in an opposite direction, means associated with said push buttons for controlling energization of said clutches to selectively provide for separate and also simultaneous operation of said adjusting mechanisms by said motor, and means for effecting a delay in the starting of said motor upon depression of any one of said push buttons.

9. The combination with a plurality of adjusting mechanisms, a driving motor therefor and an electromagnetic clutch associated with each of said mechanisms for establishing a driving connection between the same and said motor, control means for said motor and said clutches including a plurality of normally open push buttons, certain of said push buttons being operable to effect starting of said motor in one direction and certain of the same being operable to effect starting of said motor in an opposite direction, means associated with said push buttons for controlling energization of said clutches to selectively provide for separate and also simultaneous operation of said adjusting mechanisms by said motor, and means for insuring delayed starting of said motor upon depression of any one of said push buttons, and for preventing interruption of the driving connections by said clutches except upon stopping of said motor.

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