

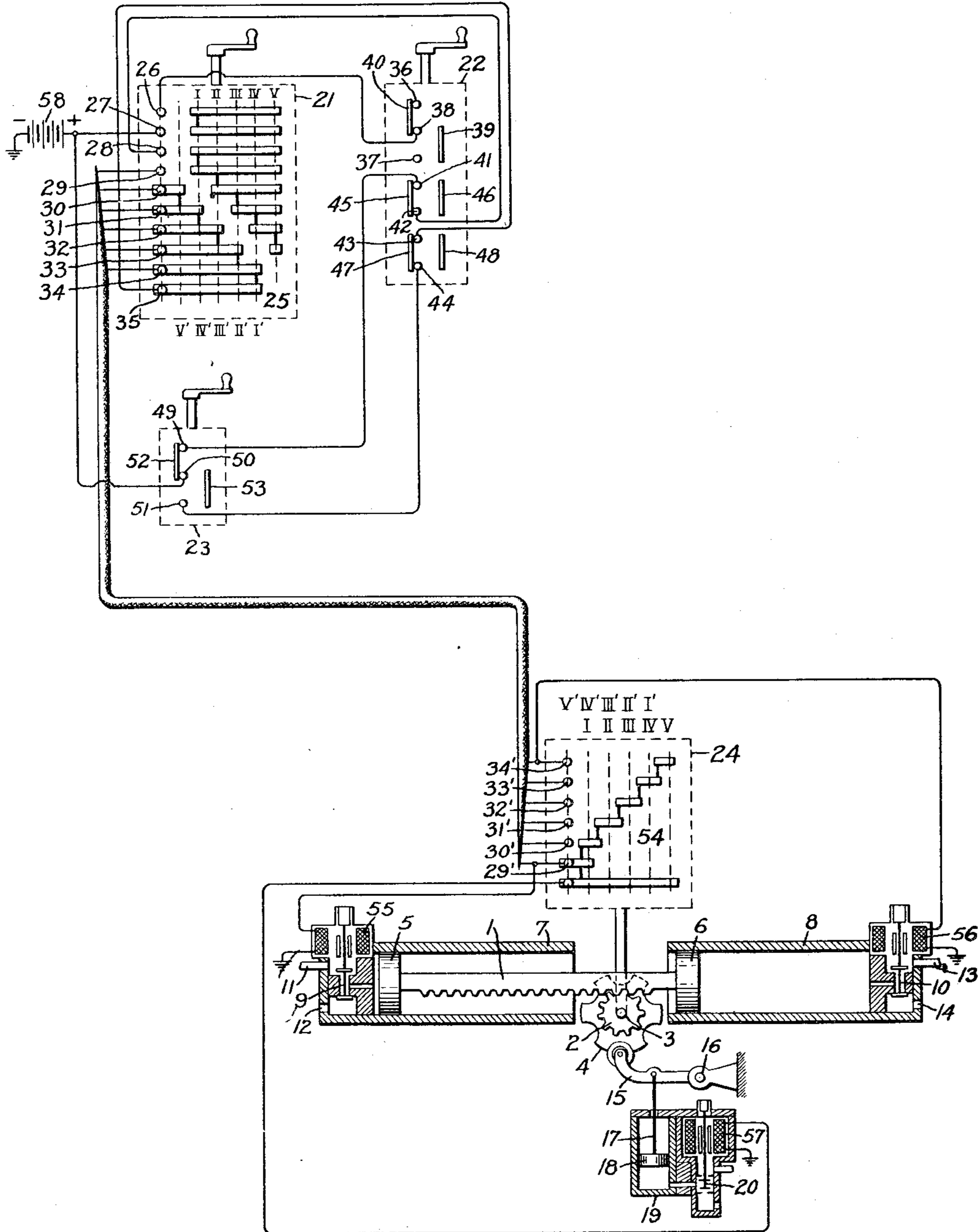
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E. FALCKE ET AL

SYSTEM OF CONTROL

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SYSTEM OF CONTROL.

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Our invention relates to systems of control and especially to pneumatically operated means for controlling the switching operations in a system of control for electric
5 motors.

In the operation of pneumatically operated controllers of the type in which a step-by-step movement is utilized to control the motor connections, difficulty has been encountered in securing a positive and definite
10 stop because of the tendency to over-travel which results in trouble at the controller contacts. In the usual type of pneumatic engine, for example, a piston within a cylinder is moved forward an increment for
15 each step or position of the controller, and it is difficult to insure that the piston shall move only the predetermined distance since, owing to the inertia of the moving parts,
20 there is a decided tendency to over-travel. In order to prevent over-travel various devices have been utilized, among which may be mentioned means for admitting operating
25 fluid under pressure to the trailing cylinder near the end of each piston movement, and means for controlling the rate at which the operating fluid is permitted to escape from the trailing cylinder. While such means are
30 effective in securing a positive and definite stopping of the switch controlling mechanism, they are not entirely satisfactory because they tend to reduce the operating speed.

In order to prevent injurious arcing it is
35 desirable that the switch contacts be separated at a comparatively high rate of speed and it therefore becomes important to provide means arranged both to secure a positive stop in any desired switching position
40 and to permit rapid movement between the different positions. In accordance with our invention the trailing piston is arranged to move freely thereby permitting rapid movement of the switching mechanism, and pneumatically operated means are utilized for
45 operating a pawl by which the mechanism is locked in a position determined by the position of the main controller.

An object of our invention is to provide
50 an improved means by which electric motors may be started, stopped and generally controlled in a simple, reliable and efficient manner.

A further object is to provide means by
55 which rapid movement of the switch con-

tacts may be effected and by which the switch operating mechanism may be positively and definitely stopped in any predetermined position.

A further object is to provide pneumati-
60 cally controlled means for stopping the operating mechanism in any desired position.

Our invention will be better understood from the following description taken in connection with the accompanying drawing and
65 its scope will be pointed out in the appended claims.

Referring now to the drawing, the single figure shows a switch operating engine in which our invention has been embodied, together with an electric system through which
70 the engine may be controlled to perform certain predetermined switching operations.

As illustrated in the drawing the switch operating engine has a piston rod 1 made in
75 the form of a rack and arranged to cooperate with a pinion 2 mounted upon the cam shaft 3 upon which is also mounted the star-wheel 4. Mounted upon the cam shaft 3 are the cams (not shown) which determine
80 the sequence in which the various switches are closed and opened. Since switches of this type are well known to those skilled in the art neither the switches nor the cams by which they are operated have been shown.
85 Arranged to cooperate with the pistons 5 and 6 are the cylinders 7 and 8 provided with magnetically controlled valves 9 and 10 respectively. The valve 9, in its upper position, is arranged to admit operating fluid
90 under pressure to the cylinder 7 from a suitable source of supply through the opening 11 and in its lower position is arranged to permit the discharge of operating fluid through the orifice 12. The valve 10 is likewise
95 arranged to allow the supply of operating fluid to the cylinder 8 through the opening 13 and to permit its egress through the discharge orifice 14. For the purpose of positively stopping the cam shaft 3 in any
100 predetermined position a pawl 15 pivoted at 16 and arranged to cooperate with the star-wheel 4 is provided. The pawl 15 is pneumatically controlled through a rod 17 attached to a piston 18 arranged to reciprocate in a cylinder 19. For the purpose of
105 controlling movement of the pawl 15 there is provided a magnetically controlled valve 20 constructed to admit operating fluid under pressure to the cylinder 19 in its lower
110

position when its operating coil is deenergized and to permit the discharge of operating fluid from the cylinder 19 in its upper position when said coil is energized.

For the purpose of controlling the movement of the cam shaft 3 through which the various switching movements are effected by the cams mounted on it there is provided, a main controller 21, a reverser controller 22, a trailing controller 23 and a pawl controller 24. The main controller 21 is provided with a contact cylinder 25 the segments of which in the various controller positions are arranged to cooperate with the contact fingers 26 to 35 inclusive. The reverser controller 22 is provided with contact fingers 36, 37 and 38 arranged to cooperate with the segments 39 and 40 for the purpose of changing the connection of a reverser which may be utilized to control the motor fields in a manner well known to those skilled in the art. The reverser controller 22 is also provided with contact fingers 41 to 44 inclusive arranged to cooperate with the segments 45 to 48 for the purpose of opening the main controller connections when the connections to the reverser are altered. The trailing controller is provided with contact fingers 49, 50 and 51 arranged to cooperate with the segments 52 and 53 for the purpose of adapting the main controller for operation from either end of the engine shown in Fig. 1. The pawl controller 24 is provided with a cylinder 54 arranged to cooperate with contact fingers 29' to 34', which are interconnected with the contacts 29 to 34, respectively, through the agency of the control cable illustrated as the cam shaft 3 is moved through its various positions. A battery 58 is provided for energizing the operating coils 55 and 56 of the valves 9 and 10 respectively as may be desired and for supplying current to the operating coil 57 of the valve 20 in accordance with the position of the main controller.

Assuming the various controllers to be in the positions indicated in the drawing, movement of the main controller to the position I closes a circuit to the reverser, energizes the operating coil 55 of the valve 9 and energizes the operating coil 57 of the valve 20. In this position of the main controller a circuit is established from the plus side of the battery 58 to the reverser through contact 27, a segment of the main controller drum, contacts 26 and 38 segment 40 of the reverser controller and contact 36. At the same time a circuit is established from the plus side of the battery 58 to the operating coil 55 of valve 9 through contact 50, segment 52 of the trailing controller, contacts 49 and 41, segment 45 of the reverser controller, contacts 42 and 28, a segment of the main controller drum, and contact 29. The

coil 55 is thus energized to maintain the valve 9 in its upper position for positions I to V inclusive of the main controller. Upon connection of the contact 29 to the battery 58, a circuit is also established from the battery to the operating coil 57 of the valve 20 through contact 29' and a segment of the pawl controller drum, and the valve 20 is thereupon operated to disengage the pawl 15 from the star-wheel and permit rotation of the cam shaft 3 until the contact 29' has moved off the corresponding segment of the pawl controller drum when the coil 57 is deenergized and the pawl is forced into contact with the star-wheel to prevent further rotation of the cam shaft. Upon movement of the main controller successively to the other positions II to V the sequence of operation of controller 24 to its corresponding positions II to V is similar to that described in connection with position I. The energizing circuit for the operating coil 55 of the valve 9 of the pneumatic engine is maintained established through the contacts 26 and 27 of the main controller 25. The energizing circuit for the operating coil 57 of the auxiliary pneumatic engine is successively established and interrupted through the several pairs of cooperating contacts 30—30', 31—31', 32—32', 33—33', respectively, in substantially the same manner as through the contacts 29—29' described in connection with the operation of the controller to position I.

To operate the controller 24 in the reverse direction, trailing controller 23 is operated to move the segment 52 so as to interrupt the circuit between the contacts 50 and 49 and move the segment 53 so as to establish a circuit between the contacts 50 and 51. Thereupon movement of the main controller 25 in the reverse direction successively through the positions I' to V' results in energization of the operating winding 56 of the valve 10. In this way pressure is admitted to the cylinder 8 from the pressure line 13 to move the piston rod 1 in the reverse direction. In this case the pairs of contacts 33—33' to 29—29' are successively utilized to control the energization and deenergization of the operating winding 57 of the auxiliary pawl controlling pneumatic engine in the reverse order but in the same manner as previously described. The reversing controller 22 is operated in the usual manner to control a reversing switch not shown in the drawing and not essential to the present invention. The cam shaft 3 may thus be moved to and positively stopped in any predetermined position merely by movement of the main controller to a corresponding position.

What we claim as new and desire to secure by Letters Patent of the United States is:—

1. A control system for a switch mechanism comprising a reciprocating element, means for reciprocating the same between predetermined limits, and electrically controlled means for stopping and locking said reciprocating member in any selected one of a plurality of definite intermediate positions comprising a position-selective controller, a star-wheel operable in accordance with the movement of said member between said positions; a member operable into and out of locking engagement with said star-wheel, and fluid pressure means having electroresponsive valve mechanism energized jointly in accordance with the positions of said selective controller and said reciprocating member for releasing and maintaining said locking member released until after movement of the reciprocating element to a selected one of said intermediate positions.

2. A control system for a switch mechanism comprising a reciprocating member, a fluid pressure engine for reciprocating said member each way between a plurality of positions, a fluid pressure operated means independent of said engine for stopping and locking the said reciprocating member in each of a plurality of said positions and having electroresponsive valve mechanism for controlling the operation thereof, a controller, and circuit-controlling means dependent upon the position of said reciprocating member and cooperating with said controller for selectively controlling the energization of the valve mechanism of said independent pneumatic means to release said reciprocating member and automatically stop and lock the same after operation thereof between predetermined positions.

3. A control system for a switch mechanism comprising an electrically controlled reciprocating member, a fluid pressure engine provided with a pair of pistons each for reciprocating said member in a different direction between fixed limits, electrically controlled fluid pressure operated means independent of said pistons for stopping and locking said member in each of a plurality of intermediate positions, a controller selectively operable to any one of a plurality of positions corresponding to said intermediate positions, a cooperating controller connected to be operated in accordance with the position of said reciprocating member, and connections jointly controlled by said controllers for selectively controlling said independent pneumatic means to release said reciprocating member and automatically stop and lock the same upon operation there-

of to a selected one of said intermediate positions determined by operation of said selectively operable controller.

4. A control system for a switch mechanism comprising a reciprocating member, a fluid pressure engine having electrically controlled valves for reciprocating said member each way between a plurality of positions, an independent fluid pressure engine having an electrically controlled valve for stopping and locking said member in each of said positions, a switch member operable in accordance with the movement of said reciprocating member between said positions, and a selective controller for controlling the energization of the valves of said first engine and for cooperating with said switch member to control the energization of the valve of said independent pneumatic engine to release said reciprocating member and automatically stop and lock the same upon operation thereof to any one of a plurality of positions selected by operation of said controller.

5. A control system for a switch mechanism comprising a reciprocating member, a fluid pressure engine provided with a pair of pistons each for reciprocating said member in a different direction between predetermined limits under the control of an electroresponsive valve, a second fluid pressure engine provided with a piston operable under the control of an electroresponsive valve to stop and lock said reciprocating member in each of a plurality of intermediate positions, a controller for selectively energizing the electroresponsive valves of said first engine to operate the reciprocating member in each direction, a second controller cooperating therewith and having a plurality of operative positions corresponding to the intermediate positions of said reciprocating member, and a circuit controlling device arranged to be operated in accordance with the position of said reciprocating member and connected to cooperate with said selective controller upon operation thereof from one of its operative positions to another position to control the energization of the electroresponsive valve of said second engine to effect the release of said reciprocating member and automatically stop and lock the same upon operation thereof to the position corresponding to the operative position to which said second controller is operated.

In witness whereof, we have hereunto set our hands this 4th day of May, 1923.

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