

W. M. SCOTT.
CONTROL APPARATUS.
APPLICATION FILED AUG. 4, 1913.

1,100,786.

Patented June 23, 1914.

3 SHEETS—SHEET 1.

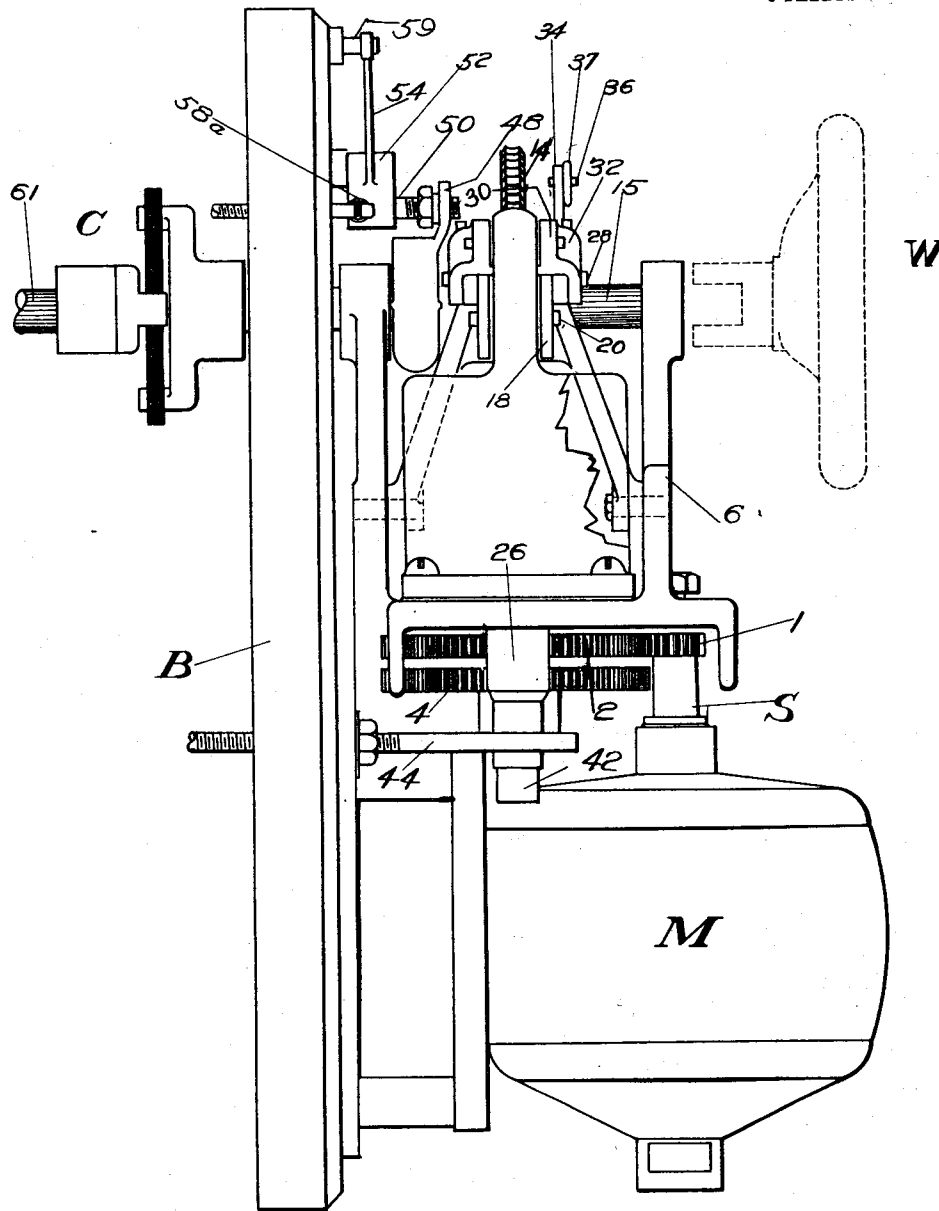


Fig. 1.

Witnesses

Raymond H. MacLean
James H. Wyatt

By

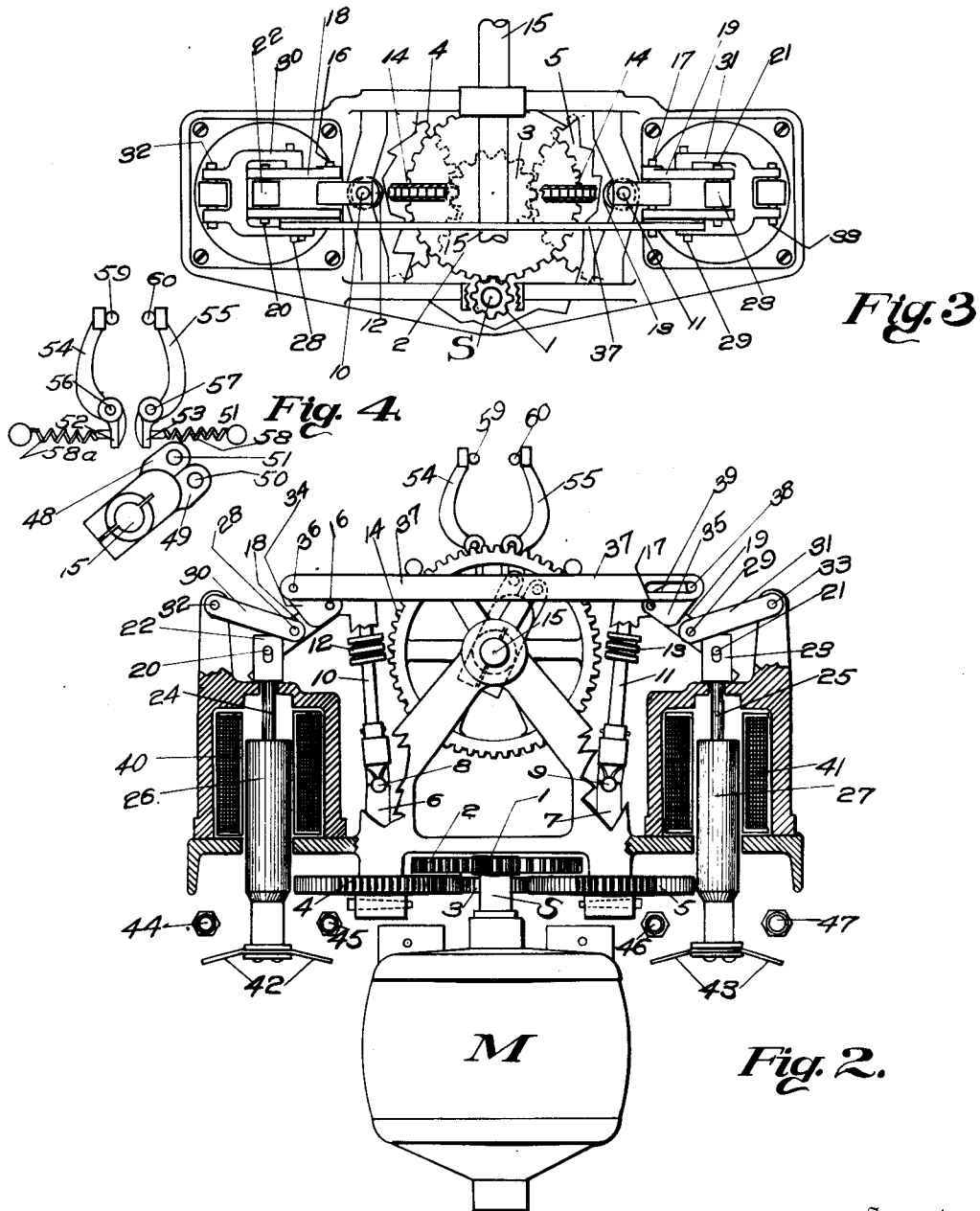
William M. Scott
Cornelius S. Ebert
his Attorney

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3 SHEETS—SHEET 3.

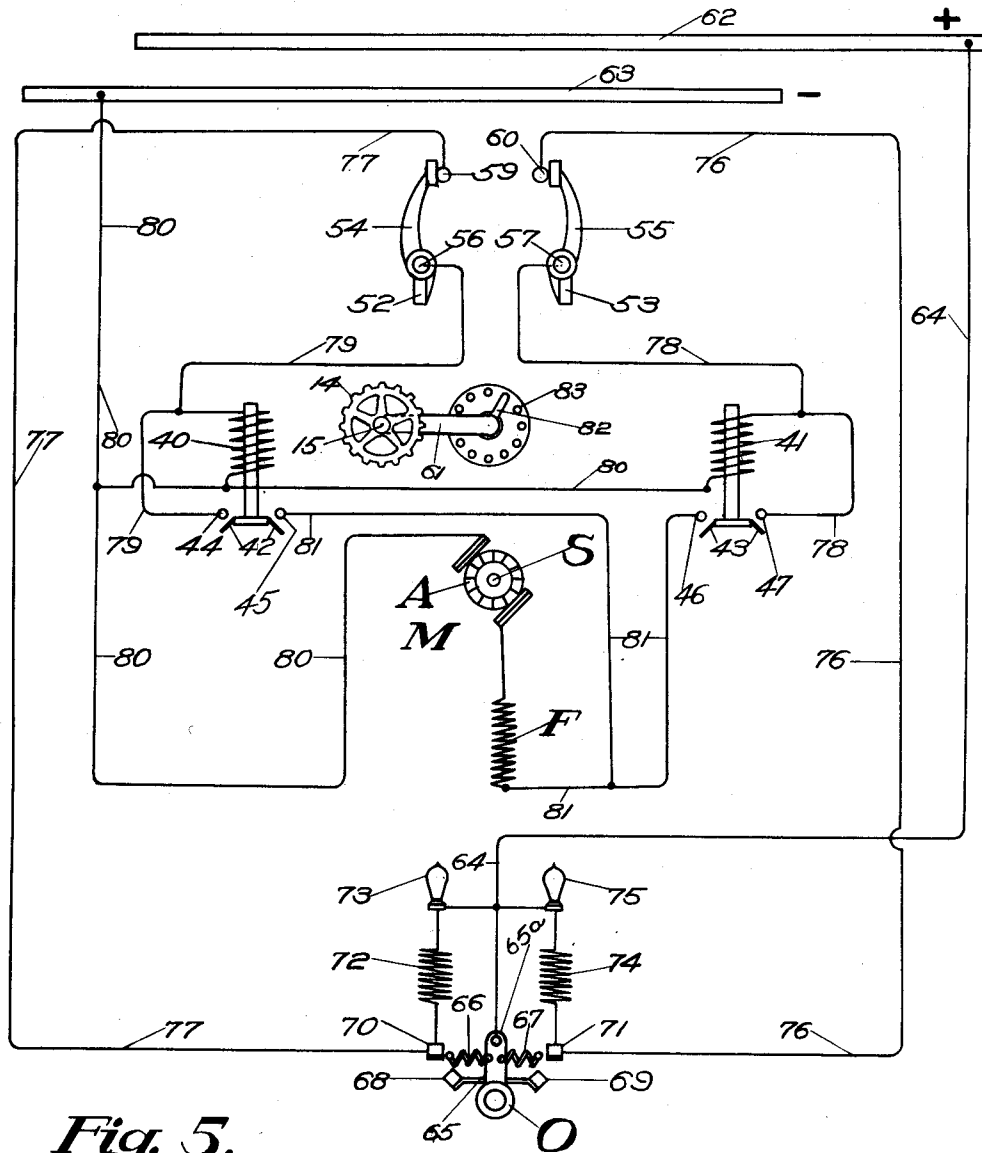


Fig. 5.

Witnesses

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UNITED STATES PATENT OFFICE.

WILLIAM M. SCOTT, OF RADNOR, PENNSYLVANIA.

CONTROL APPARATUS.

1,100,786.

Specification of Letters Patent.

Patented June 23, 1914.

Application filed August 4, 1913. Serial No. 782,798.

To all whom it may concern:

Be it known that I, WILLIAM M. SCOTT, a citizen of the United States, residing at Radnor, county of Delaware, State of Pennsylvania, have invented certain new and useful Improvements in Control Apparatus, of which the following is a specification.

My invention relates to electrical control apparatus whereby any suitable device, such as an electric switch, traveling contact arm of a rheostat, or the like, may be driven or operated by an electric motor which may be controlled from any point more or less remote.

It is the object of my invention to provide means for the purpose above referred to in which an electric motor, rotating always in the same direction, may drive the switch or other device in either direction depending upon the control exercised upon the means for connecting the motor with the device to be driven thereby.

To these and other ends I have provided the apparatus of the character hereinafter described.

My invention resides in the features of construction and control hereinafter described and claimed.

For an illustration of one of the forms my invention may take reference is to be had to the accompanying drawings, in which:

Figure 1 is a side elevational view of the motor driving mechanism. Fig. 2 is a front elevational view, some parts in section, on smaller scale, showing the motor driving mechanism. Fig. 3 is a top plan view of apparatus shown in Fig. 2. Fig. 4 is a detailed view illustrating means for operating the limit switches. Fig. 5 is a diagrammatic view illustrating the circuits of the apparatus and its control system.

Referring to the drawings, B is a base or switch board upon which the apparatus may be mounted.

M is an electric motor, of any suitable type, here shown with its shaft S disposed vertically. Upon the upper end of the shaft S is secured the pinion 1 meshing with the gear 2 to which is secured the pinion 3 meshing with the gears 4 and 5. Driven by the gears 4 and 5, respectively, are the shafts 6 and 7 connected through universal joints 8 and 9 with the shafts 10 and 11 carrying the worms 12 and 13, respectively, these worms adapted to mesh with the gear wheel

14 secured upon the shaft 15 to drive the same in opposite directions. Pivoted to the shafts 10 and 11 at 16 and 17, respectively, are the toggle links 18 and 19 having the pin slot connections 20 and 21 with the blocks 22 and 23 secured upon the rods 24 and 25 carried by the solenoid cores 26 and 27. Pivoted to the links 18 and 19 at 28 and 29 are the toggle links 30 and 31 pivoted at 32 and 33 to stationary brackets. The links 18 and 19 carry the members 34 and 35, of which 34 is pivoted at 36 to the bar 37 while member 35 carries pin 38 movable in the slot 39 in the bar 37. Associated with the solenoid cores 26 and 27 are their respective windings 40 and 41. Carried by but insulated from the solenoid cores 26 and 27 are the contacts 42 and 43, the former adapted to bridge and connect stationary contacts 44 and 45 while the latter is adapted to engage and bridge the stationary contacts 46 and 47. Adapted to be clamped at any suitable angular position to the shaft 15 are the dogs 48 and 49 carrying pins 50 and 51 adapted to engage, respectively, the lower ends 52 and 53 of contact levers or limit switches 54 and 55 pivoted at 56 and 57 and normally drawn toward each other by spring 58 and 58' against the stationary contacts 59 and 60. The driven shaft 15 is provided with an insulating coupling C, Fig. 1, through which it drives the shaft 61 which may operate or drive any suitable device, such as the movable element of an electric switch, the movable contact arm of a rheostat, or any other similar device. As indicated at W, Fig. 1 a hand wheel may be attached to the shaft 15 for rotating the same independently of the motor M.

Referring now to Fig. 5, 62 and 63 represent bus bars or conductors of any electric supply circuit. This circuit may deliver either direct or alternating current, and for facility of description of connections, the conductor 62 will be assumed a positive conductor while conductor 63 is negative. From the conductor 62 extends a conductor 64 connected with the switch lever 65 of the operator's or control switch O. This lever is biased toward its central position illustrated by springs 66 and 67. The lever 65 carries the contacts 68 and 69 both in electrical communication with the conductor 64. Contact 68 is adapted to engage contact 70 and contact 69 is adapted to engage contact

71. Between the contact 70 and conductor 64 are connected the resistance 72 and incandescent lamp 73; and similarly between contact 71 and conductor 64 are connected the resistance 74 and incandescent lamp 75. From contact 71 a conductor 76 extends to contact 60 while a conductor 77 extends from contact 70 to contact 59. From contact lever 55 extends a conductor 78 connecting with one terminal of the solenoid winding 41 and also with the contact 47; similarly from contact lever 54 extends a conductor 79 connecting with one terminal of solenoid winding 40 and also with contact 44. The remaining terminals of solenoid windings 40 and 41 connect through conductor 80 with the conductor 63. Contacts 45 and 46 are connected together through conductor 81 which also connects with one terminal of the field winding F of the motor M, such field winding F, in the example illustrated, is connected in series with the motor armature A whose other terminal is connected through conductor 80 with the conductor 63. A movable contact arm 82 of a rheostat 83 is here shown connected to the shaft 61 driven through coupling C from shaft 15, the purpose of the apparatus, as illustrated in Fig. 5 being to rotate the arm in either direction across the contacts of the rheostat 83 which may be connected in any suitable circuit whose resistance is to be varied. For example the rheostat 83 may be connected in the circuit of the field winding by a generator for adjusting the voltage or pressure delivered by the generator; or it may be connected in any other relation. And it is to be understood that the shaft 61 may drive any other suitable device, instead of the contact arm 82, as for example a movable element of any electrical switching mechanism.

The operation is as follows: Normally the parts occupy the positions indicated in the various figures of the drawings. If the operator desires to rotate the rheostat arm 82 in one direction, he will move the switch arm 65 upon its pivot 65* to bring contact 69 into engagement with contact 71 whereupon current will flow from conductor 62, through conductor 64, contact 69, contact 71, conductor 76, contact 60, contact lever 55, conductor 78, through solenoid winding 41 to conductor 80, to conductor 63. This causes energization of solenoid winding 41 whereupon solenoid core 27 is attracted upwardly, extending the toggle 19, 31 to shift the shaft 11 toward the left, Fig. 2, to bring worm 13 into mesh with the worm wheel 14. During this extension of the toggle 19, 31, the pin 38 moves to the left in slot 39 without however communicating longitudinal motion to bar 37. About the time toggle 19, 31 has been extended sufficiently to bring the worm 13 into mesh with wheel 14 the contact 43 engages and connects contacts 46

and 47, whereby current passes from conductor 78 through contact 47, contact 43, contact 46, through the motor M, to conductor 80, to conductor 63, this current starting the motor M. When shafts 15 and 61 have been rotated a predetermined distance, pin 51 on dog 49 engages contact lever 55 at 53, rotating the same in opposition to spring 58 away from contact 60, thus breaking the circuit of both motor M and solenoid coil 41, with the result that core 27 falls, collapsing toggle 19, 31, withdrawing worm 13 from mesh with wheel 14 and thereafter carrying contact 43 away from contacts 46, 47, and leaving shafts 15 and 61 in the position to which they had been rotated. Or, at the will of the operator, the rotation of the shaft 15 in the direction instituted as above described, may be determined by the operator releasing his switch O to the control of the centering springs, in which case the contacts 69 and 71 are separated with resultant breaking of the circuit of solenoid 41 of motor M, the deenergization of the solenoid 41 causing the operation above described. If, now, the operator wishes to rotate the rheostat arm 82 in opposite direction he swings his switch O in opposite direction bringing contacts 68 and 70 into engagement with each other whereupon current flows from conductor 62, through conductor 64, contacts 68 and 70, conductor 77, contact 59, limit switch 54, conductor 79, through solenoid winding 40, conductor 80, to negative conductor 63. The solenoid 40 being now energized its core 26 is attracted upwardly, whereby the toggle 18, 30 is extended and the motor M started because of closure of its circuit at contacts 42, 44, and 45. The now rotating worm 12 is brought into mesh with the wheel 14 and the shaft 15 rotated in opposite direction from that previously described, though the motor M is rotating in the same direction. And after predetermined extent of rotation of shaft 15 the pin 50 on dog 48 engages limit switch 54 at 52 carrying contact lever 54 away from contact 59 in opposition to spring 58, breaking the circuit of both the solenoid 40 and the motor M, causing stoppage of the motor and withdrawal of worm 12 from mesh with wheel 14, leaving the shaft 15 in the position to which it had been rotated. In other words, the movement of the operator's switch O toward the left produces the same effects as upon its rotation toward the right, except that the shaft 15 is rotated in opposite direction. Where the extent of rotation of shaft 15 is not sufficient to call the limit switches into action the operator may move the rheostat arm 82 backward and forward at will through any extent of movement short of that calling into action the limit switches, by simply moving his switch O to the right and left. When the operator's switch O is in

normal position indicated, the lamp 73 and resistance 72 are in series with the solenoid winding 40 and the lamp 73 glows to indicate that the circuit through the winding 40 is intact and in readiness to respond to actuation of the operator's switch toward the left. Similarly lamp 75 and resistance 74 are in series with the solenoid winding 41, the lamp 75 glowing to give a similar indication as to solenoid 41. In both cases the lamps and resistances prevent sufficient current flowing through the solenoid windings to cause the attraction of their cores. The movement of the operator's switch to either of the positions heretofore described short circuits the lamp and its resistance thus increasing the current flow through the corresponding solenoid, such increased current being sufficient to attract the core as above described.

It will be understood that should worm 12 for any reason stick in mesh with the wheel 14, subsequent energization of solenoid 41 would extend the toggle 19, 31 to cause the pin 38 to travel toward the left in slot 39, Fig. 2, and engage the left end of said slot and push the rod 37 toward the left to positively collapse the toggle 18, 30 and positively disengage the worm 12 from wheel 14. And similarly should worm 13 stick in mesh with the wheel 14, subsequent energization of solenoid 40 would move the bar 37 toward the right and collapse the toggle 19, 31 and positively disengage worm 13 from wheel 14. By this construction it is impossible for both worms to be simultaneously in mesh with the wheel 14, a condition of affairs which, if allowed to occur, would stall the motor, prevent rotation of shaft and device driven thereby, and prevent desired operation of the system. It will be noted also that the solenoids 40 and 41, when brought into circuit, are thrown across the line 62, 63 independently of the motor. In consequence the closure of the circuit of either of them will cause the desired operation of the device without influence upon the current in the solenoid winding by the rotating motor. This is of advantage in various relations, and particularly in the case of a generator which is just being started or which is just "picking up" for in such case the solenoids 40 and 41 will, even on relatively low voltage, operate their respective worms to control the rheostat 83 which may be connected in the field circuit of the generator. It is within my invention however to otherwise connect solenoids 40 and 41, as for example in parallel with the motor M.

What I claim is:

1. The combination with an electric motor, of a driven shaft, a plurality of disengageable mechanical connections for connecting said shaft with said motor, one of said connections adapted to drive said shaft

in one direction and the other in the other direction, means preventing simultaneous operation of said connections, solenoids controlling said disengageable connections, an operator's switch controlling said solenoids, and a switch controlling said motor controlled by one of said solenoids.

2. The combination with a driven shaft, of a worm wheel secured thereto, a motor rotating always in the same direction, worms driven by said motor and adapted to drive said gear in opposite directions, electromagnetic means for bringing a worm into mesh with said gear, and means preventing simultaneous engagement of another of said worms with said gear.

3. The combination with a worm gear, of worms adapted to engage the same for driving the same in opposite directions, a solenoid and its core for controlling each worm, mechanical means preventing simultaneous engagement of said worms with said gear, and a switch controlling energization of said solenoids one at a time.

4. The combination with a worm gear, of worms adapted to engage the same for driving the same in opposite directions, a solenoid and its core for each worm, a toggle connection between each worm and its solenoid core, a bar pivoted to a link of one of said toggles, and a pin and slot connection between said bar and one of said toggles, whereby said worms cannot simultaneously engage said gear.

5. The combination with an electric motor and switching mechanism to be driven thereby, of a disengageable connection between said motor and said mechanism, a solenoid for establishing connection between said motor and said mechanism, an operator's switch controlling said solenoid, and a normally open motor control switch closed by said solenoid to start said motor when said solenoid is energized through said operator's switch.

6. The combination with an electric motor and switching mechanism to be driven thereby, of a disengageable connection between said motor and said mechanism, a solenoid for establishing connection between said motor and said mechanism, an operator's switch controlling said solenoid, a normally open motor control switch closed by said solenoid to start said motor when said solenoid is energized through said operator's switch, and a limit switch operated after predetermined movement of said mechanism for breaking the circuit of said solenoid.

7. The combination with an electric motor and switching mechanism to be driven thereby, of a disengageable connection between said motor and said mechanism, a solenoid for establishing connection between said motor and said mechanism, an operator's switch controlling said solenoid, a normally

open motor control switch closed by said solenoid to start said motor when said solenoid is energized through said operator's switch, and a limit switch operated after predetermined movement of said mechanism for breaking the circuit of said motor.

8. The combination with an electric motor and switching mechanism to be driven thereby, of a disengageable connection between said motor and said mechanism, a solenoid for establishing connection between said motor and said mechanism, an operator's switch controlling said solenoid, a normally open motor control switch closed by said solenoid to start said motor when said solenoid is energized through said operator's switch, and a limit switch operated after predetermined movement of said mechanism for breaking the circuit of said solenoid and said motor.

9. The combination with an electric motor, of a driven member, a plurality of disengageable mechanical connections for connecting said motor with said member to drive the same in different directions, means preventing simultaneous operation of said connections, electro-magnetic means controlling said disengageable connections, and an operator's switch having a plurality of contacts controlling said disengageable connections through said electro-magnetic means, the circuit of said motor being controlled by said operator's switch in each of its positions.

10. The combination with an electric motor, of a driven member, a plurality of disengageable mechanical connections for connecting said motor with said member to drive the same in different directions, electro-magnetic means controlling said disengageable connections, and an operator's switch having a plurality of contacts controlling said disengageable connections through said electro-magnetic means, the circuit of said motor being controlled by said operator's switch in each of its positions.

11. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, and an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids.

12. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections,

and an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids.

13. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, and a motor control switch controlled by each of said solenoids.

14. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, and a motor control switch controlled by each of said solenoids.

15. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, and limit switching mechanism operated after predetermined movement of said driven member for breaking the circuit of said motor.

16. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, and limit switching mechanism operated after predetermined movement of said driven member for breaking the circuit of said motor.

17. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, an operator's switch controlling

member for breaking the circuit of said motor, and a motor control switch controlled by each of said solenoids.

22. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, limit switching mechanism operated after predetermined movement of said driven member for breaking the circuit of said motor, and a motor control switch controlled by each of said solenoids.

23. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, a limit switch for each of said solenoids operated after predetermined movement of said driven member for breaking the circuit of its associated solenoid, and a motor control switch controlled by each of said solenoids.

24. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, a limit switch for each of said solenoids operated after predetermined movement of said driven member for breaking the circuit of its associated solenoid, and a motor control switch controlled by each of said solenoids.

25. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to drive said member in different directions, a solenoid controlling each of said disengageable connections, an operator's switch controlling said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, limit switching mechanism operated after predetermined movement of said driven

member for breaking the circuit of said solenoids and said motor, and a motor control switch controlled by each of said solenoids.

5 26. The combination with an electric motor, of a member driven thereby, a plurality of disengageable mechanical connections between said motor and said member to
10 drive said member in different directions, means preventing simultaneous operation of said disengageable connections, a solenoid controlling each of said disengageable connections, an operator's switch controlling
15 said solenoids dis-simultaneously and controlling the circuit of said motor simultaneously with each of said solenoids, limit switching mechanism operated after predetermined movement of said driven member
20 for breaking the circuit of said solenoids and said motor, and a motor control switch controlled by each of said solenoids.

27. The combination with a driven member, of a plurality of disengageable members adapted to drive the same in opposite
25 directions, a toggle for each of said disengageable members, electro-magnetic means for controlling said toggles, and a member connecting said toggles to prevent simultaneous engagement of said disengageable
30 members with said driven member.

28. The combination with a driven member, of a plurality of disengageable members adapted to drive the same in opposite
35 directions, a toggle for each of said disengageable members, electro-magnetic means for controlling said toggles, and a member connecting said toggles to prevent simultaneous

engagement of said disengageable members with said driven member, said toggle connecting member having a lost motion
40 connection with one of said toggles.

29. The combination with a driven member, of a plurality of disengageable members adapted to drive the same in opposite
45 directions, a toggle for each of said disengageable members, electro-magnetic means for controlling said toggles, and a member connecting said toggles to prevent simultaneous engagement of said disengageable
50 members with said driven member, said toggle connecting member pivoted to a toggle link at a distance from the toggle link pivot.

30. The combination with a driven member, of a plurality of disengageable members adapted to drive the same in opposite
55 directions, a toggle for each of said disengageable members, electro-magnetic means for controlling said toggles, and a member connecting said toggles to prevent simultaneous engagement of said disengageable
60 members with said driven member, said toggle connecting member pivoted to the link of one toggle at a distance from the pivot of said link and having a lost motion connection with a link of another of said toggles
65 at a distance from the pivot of said link.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

WILLIAM M. SCOTT.

Witnesses:

EDWARD C. SEMPLE,
ALBERT KUNZ.