Feb. 28, 1939. C. W. WYMAN 2,148,474

ELECTRICAL CONTROLLING APPARATUS

Filed Jan. 2, 1936 3 Sheets-Sheet 1

Fig. 1

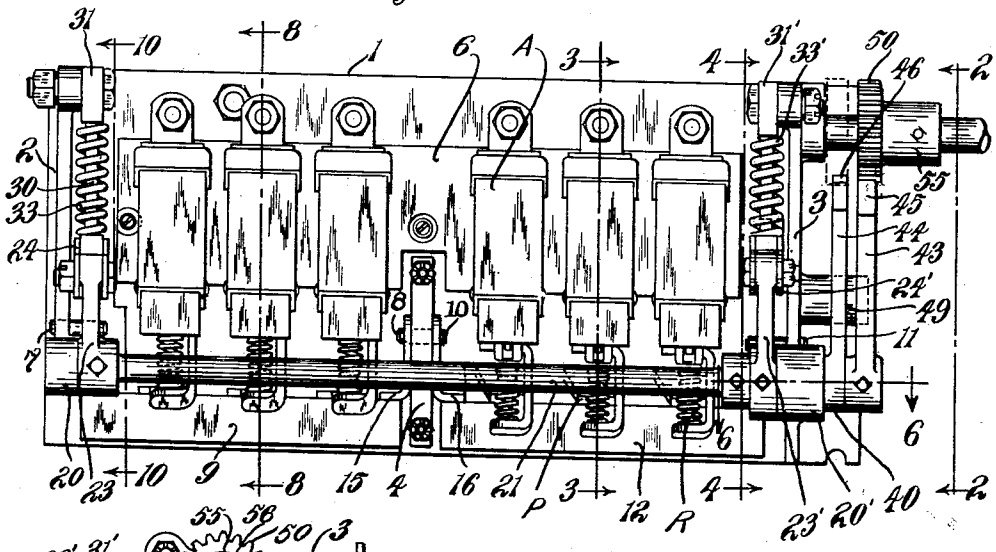

Fig. 2

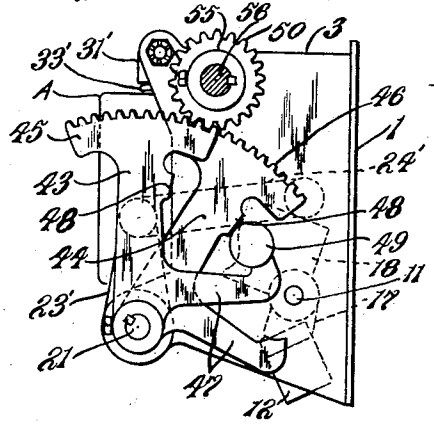

Fig. 3

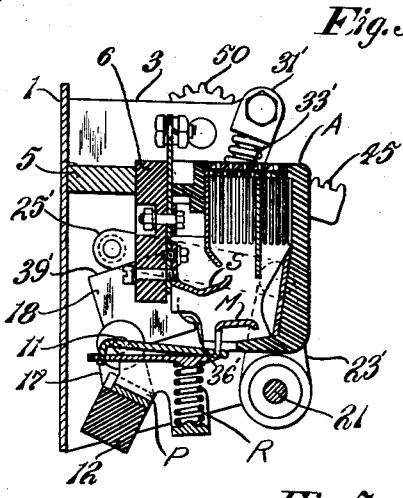

Fig. 4

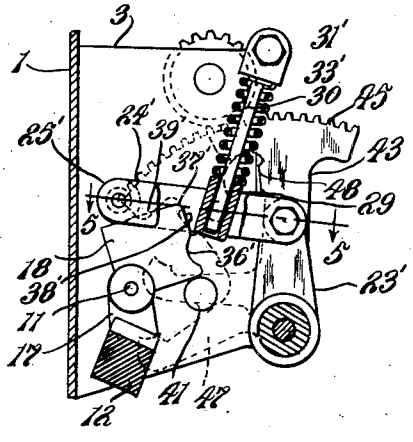

Fig. 5

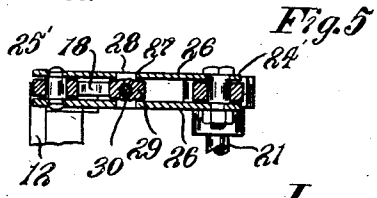

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Fig. 6

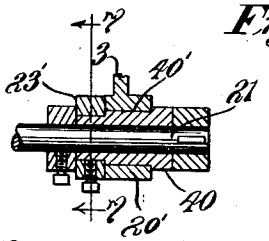

Fig. 7

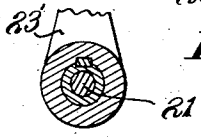

Fig. 8

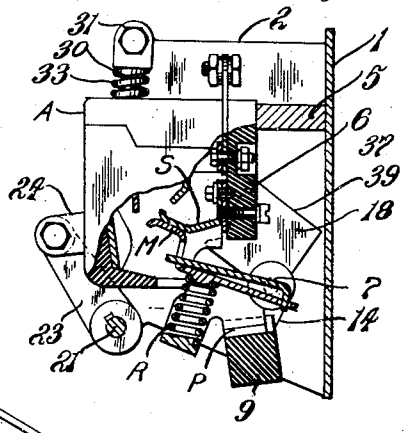

Fig. 9

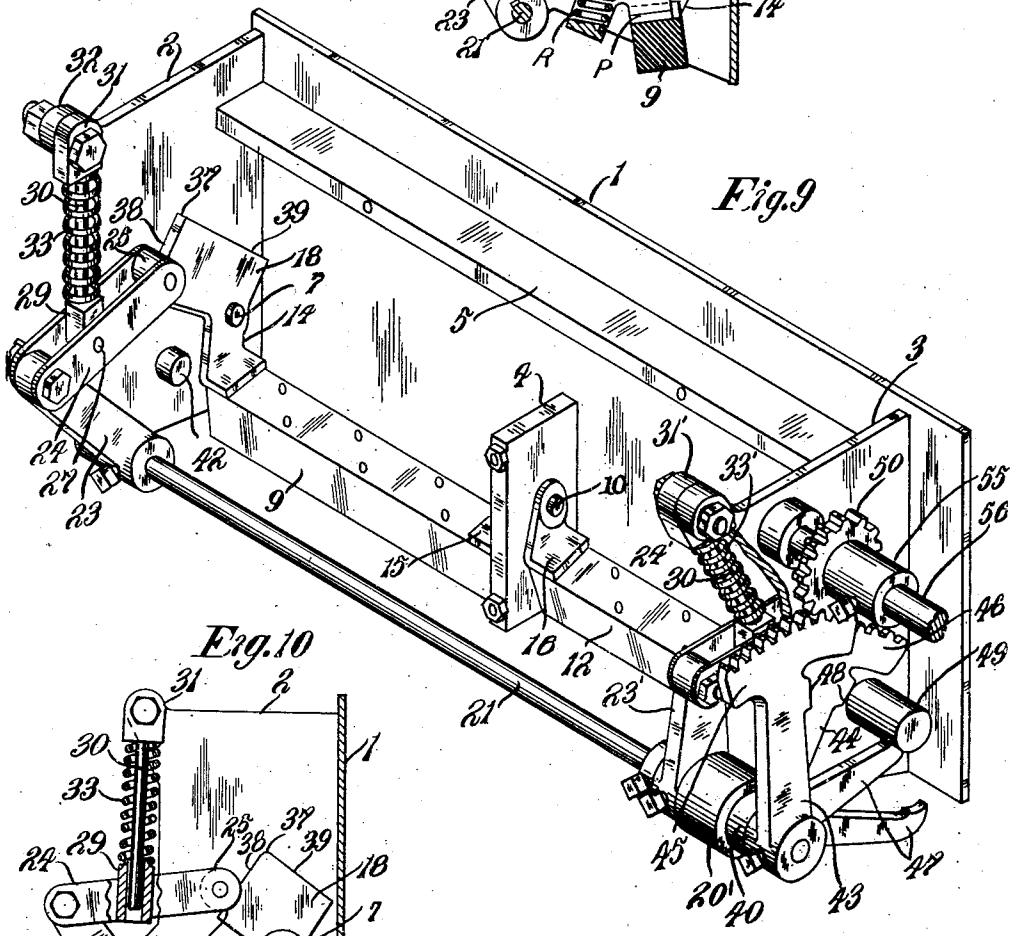

Fig. 10

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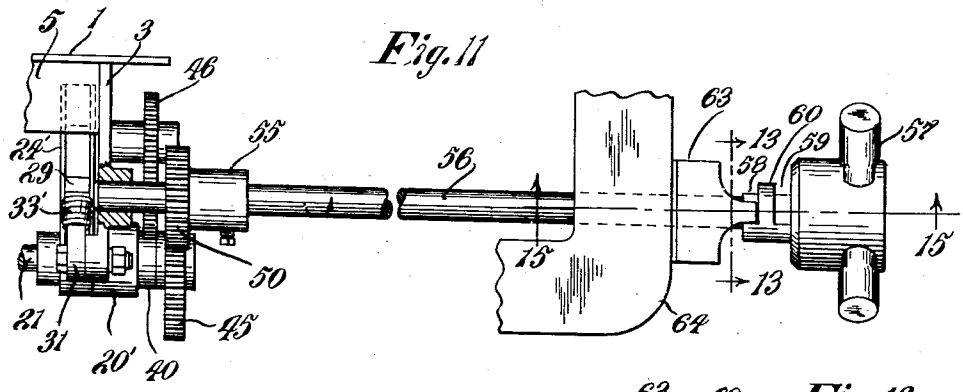
Fig. 11



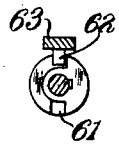


Fig. 13

Fig. 12

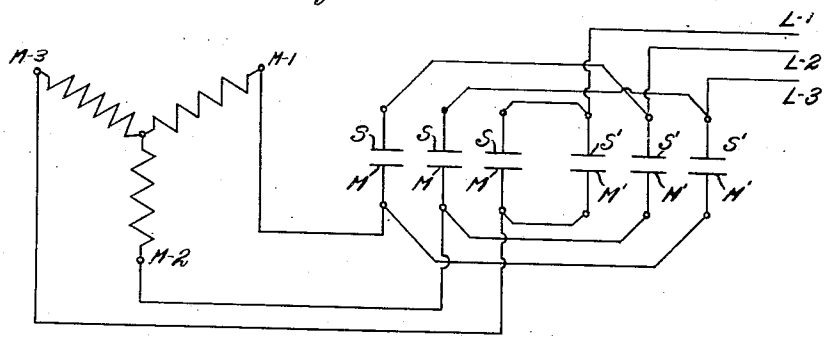


Fig. 14

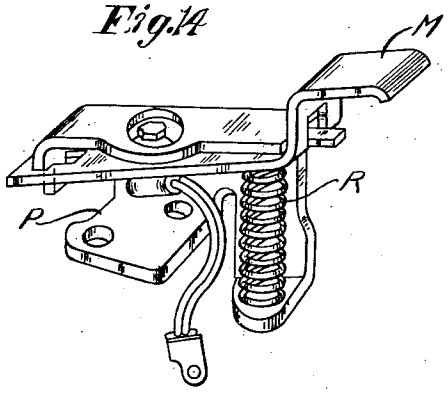
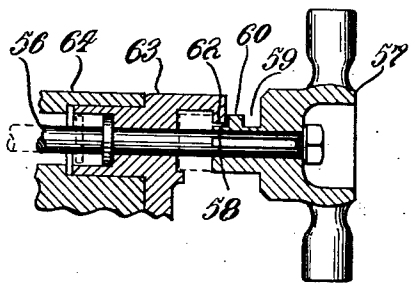


Fig. 15



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Patented Feb. 28, 1939 2,148,474

UNITED STATES PATENT OFFICE

2,148,474

ELECTRICAL CONTROLLING APPARATUS

Charles W. Wyman, Claremont, N. H., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application January 2, 1936, Serial No. 57,137

6 Claims. (Cl. 200—18)

My invention relates to electrical controlling apparatus, and more particularly to reverse switch mechanism.

An object of my invention is to provide an improved electrical controlling apparatus. Another object of my invention is to provide an improved reverse switch mechanism. A further object of my invention is to provide an improved reverse switch mechanism which shall be operative with a snap action, and which shall very effectively prevent harmful arcing. A still further object of my invention is to provide a reverse switch whose mode of operation may be predetermined, and which cannot be operated in a manner to make a reverse connection of the motor windings with the lines without a certain time interval and without the deliberate manipulation of operating means to make possible the reverse connection of the motor with the lines. Yet another object of my invention is to provide an improved reverse switch mechanism comprising distinct switch elements for effecting motor operation in one direction and distinct switch elements for effecting motor operation in the other direction, and means for selectively rendering one or the other set of switch elements operative while precluding the concurrent rendering of both of them operative at the same time. Still another object of my invention is to provide improved snap actuating mechanism comprising a plurality of snap operating devices having a common primary operating element selectively, but not concurrently adapted to effect operation of both of them. Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawings, in which one illustrative embodiment of the invention is shown for purposes of illustration—

Fig. 1 is a front view of a reverse switch in which the illustrative embodiment of my invention is incorporated.

Fig. 2 is an end view on the plane of the line 2—2 of Fig. 1.

Fig. 3 is a transverse section on the plane corresponding to the line 3—3 of Fig. 1, the view being taken in an opposite direction to that of Fig. 2.

Fig. 4 is a vertical transverse section on the plane of the line 4—4 of Fig. 1, the view being taken in the same direction as Fig. 3.

Fig. 5 is an approximately horizontal sectional view on the plane of the line 5—5 of Fig. 4, showing a detail of construction.

Fig. 6 is a fragmentary horizontal sectional view taken on the plane of the line 6—6 of Fig. 1.

Fig. 7 is a fragmentary detail sectional view taken on the plane of the line 7—7 of Fig. 6.

Fig. 8 is a vertical transverse sectional view taken on the plane of the line 8—8 of Fig. 1, this view being taken looking in the direction opposite that of Figs. 3 and 4.

Fig. 9 is a perspective view of the operating mechanism for the reverse switch, the electrical portions thereof being omitted, together with certain cover parts.

Fig. 10 is a vertical section on the plane of the line 10—10 of Fig. 1.

Fig. 11 is a fragmentary plan view of a portion of the reverse switch operating mechanism, showing the manual controlling means therefor.

Fig. 12 is a diagram showing electrical connections.

Fig. 13 is a fragmentary section on the plane of the line 13—13 of Fig. 11.

Fig. 14 is a perspective view of one of the moving contacts.

Fig. 15 is a vertical section through the operating means for the reverse switch, the view being taken on the plane of line 15—15 of Fig. 11.

An understanding of my invention will be more readily obtained if certain of the electrical features be first considered and explained, and thereafter the mechanical features of the operating and interlock mechanism be explained.

In the illustrative embodiment of the invention, the same is shown in the form of a reverse switch mechanism for a three-phase A. C. motor, and the mechanism illustrated is adapted to effect selectively, at the will of the operator, a connection of the windings of the motor in a direction for running in one direction or the other, as may be elected, with the main lines L1, L2 and L3. For the purpose of effecting the connection of the motor for operation in one direction with the power lines, three contact devices, each connecting one power line to a given point in the motor windings, are employed; while for the purpose of connecting the motor for operation in the other direction with the power lines, three other contact devices, each operative to connect one power line with a given point in the motor windings, are use. Each of these contact devices includes a stationary contact element S and a movable contact element M. Each of the movable contact elements M is yieldably supported, as shown in Fig. 14, upon a mounting plate P by means of a spring R. Each of the contact devices is provided with its own arc box A; and the several contact devices and their arc boxes, as shown in the drawings, are of a well known com-

mercial construction, so that further detailed description is unnecessary, it being understood that any suitable contact devices, adaptable to my improved actuating mechanism, may be employed, as desired.

Now, taking up the mechanical structure, so to speak, of the reverse switch mechanism, it will be observed that a main mounting plate 1 is provided adjacent its opposite ends with supporting plates or brackets 2 and 3, respectively; that it has intermediate its ends a division plate 4; and that it has, extending longitudinally thereof and resting upon the division plate 4 and extending between the plates 2 and 3 and abutting against the plate 1, a further plate member 5. A suitable panel plate 6, removed for clarity of disclosure in Fig. 9, supports the several stationary contacts S and arc boxes A. Suitable pivot pins 7 and 8, carried respectively by the end plate 2 and the intermediate plate 4, provide a support for a contact mounting bar 9, and alined pivot pins 10 and 11 support another contact mounting bar 12. The contact mounting bars 9 and 12 are respectively supported by their supporting pins for bodily rotary movement about the axes of their pin supports, being supported by bracket devices 14, 15, 16 and 17, so that the contact mounting bars lie materially below the axes about which they move. The brackets 14 and 17 each have secured to them cam plates 18 which will be described in more detail shortly.

Forwardly projecting ears 20 and 20' carried by the plates 2 and 3 respectively provide bearings for an operating shaft 21 which extends longitudinally of the reverse switch. The operating shaft carries, adjacent the ear 20 of the plate 2, an operating arm 23 which pivotally supports, at its outer end, a swingably-mounted, built-up operating lever 24 which carries at its free end a roller 25 which is adapted to cooperate with the cam plate 18, herein shown as formed integral with the bracket 14. The lever 24 comprises suitably spaced side members 26, 26 providing journals at 27 for bearing pins 28 on a perforated block 29 through which a rod 30, pivotally supported at 31 upon an ear 32 carried by the plate 2, extends. A spring 33 surrounding the rod 30 constantly tends to press the free end of the lever 24 downwardly and to maintain it in firm contact with the cam plate 18. The strength of the spring 33 is sufficient to impart a pressure to the cam plate adequate to effect the necessary operating movements of the contact mounting bar 9.

The form of the cam plate 18 may now be briefly described. It will be noted that it is generally rectangular in shape but provided with a notch 36, and it will be observed that from its point 37, at a maximum distance from the pivot pin 7, the cam slopes sharply, as at 38, toward the notch 36, and also, in a direction about at right angles to the surface 38, slopes, as at 39.

Now, clearly, with the parts in the position shown in Fig. 10, the pressure of the spring 33 tends constantly to turn the bracket 14 clockwise, as viewed in Fig. 10, and since Fig. 10 shows the position of the parts with the contacts carried by the contact mounting bar 9 in closed position, the action of the spring 33 is to maintain the contacts firmly in closed position. It will be noted that in this relative position of the parts the roller 25 engages in the notch 36.

The plate 3 caries an ear 20', corresponding to the ear 20 but having a larger opening therethrough at 40', in which a lever-carrying sleeve 40, in which the shaft 21 is journaled, is rotatably supported. To the sleeve 40 an arm 23' is secured, this arm corresponding to the arm 23. The arm 23' carries an operating lever 24' carrying a roller 25' adapted to cooperate with the cam plate 18 mounted upon the bracket 17. Yielding pressure means for normally forcing the free end of the lever 24' downward is provided, substantially identical with the construction at the left-hand end of Fig. 9, and corresponding parts bear corresponding numbers, with primes. The cam 18 associated with the bracket 17 has a notch 36', a high point 37', and surfaces 38' and 39' corresponding to the similarly numbered parts of the cam 18 associated with the bracket 14. It will be noted that in the relative position of the parts shown in Fig. 4, the action of the spring 33' is to force the cam plate 18 as far in a clockwise direction as possible, which is the direction in which the contact mounting bar moves to open the contacts, and the distance which the cam 18 fixed to the bracket 17 may move in the direction mentioned, is limited by its engagement with a stop pin 41 carried by the plate 3. A stop pin 42, for a similar purpose, is mounted on the plate 2 to limit the movement of the cam plate 18, rigid with the bracket 14, in a contact opening direction.

Now, to take up the operating devices for the operating shaft 21 and for the operating sleeve 40. It will be noted that the sleeve 40 and the outer end of the operating shaft 21 each carry a gear-segment-supporting arm member, that mounted directly upon the shaft 21 being numbered 43, and that mounted upon the sleeve 40 being numbered 44. The gear segments 45 and 46, respectively carried by the arms 43 and 44, are of equal arcuate extent and bear similar relations to their respective supporting arms. Each of these gear segments may be moved into a position to bring its supporting arm vertical, as is shown by the position of the arm 43 in Fig. 9, or to an inclined position, as shown by the position of the arm 44 in Fig. 9. Each arm 43 and 44 has connected with it, and at approximately right angles to it, a motion-limiting arm 47, and each arm 43 and 44 has formed integral with it a motion-limiting lug 48. These arms and lugs are adapted to cooperate with a projecting boss or pin-like member 49 carried by the plate 3, to limit the opposite angular movements of the arms 43 and 44. For the purpose of moving the arms 43 and 44 alternatively, I have provided improved means including a pinion 50 which may be selectively engaged with the gear segments 45 and 46. At this point, before describing the operating mechanism for the pinion 50, it should be noted that irrespective of the application of any holding force through the pinion 50 to the gear segment 45, and so to the operating shaft 21, the arm 23 will be held firmly in the position shown in Fig. 9, for the spring 33 acting through the lever 24 not only maintains the contacts closed, but also forces the arm 23 as far outwardly as is permitted by the engagement of the arm 47 with the stop member 49. Correspondingly, the spring 33' acting upon lever 24' continuously tends to pull the arm 23 as far over toward the plate 1 as the engagement of the lug 48 on the arm 44 permits. Therefore, whether the contacts on either contact mounting bar be in open position or in closed position, the parts are held firmly in the position to which they have been adjusted.

Now, to take up the operating mechanism of

the pinion once more, it will be observed that this pinion must be movable longitudinally, that is, axially, to effect its selective engagement with the gear segments 45 and 46, and that it must be rotatable through a certain arc to effect the necessary rocking motions of the shaft 21 and of the sleeve 40. These motions are provided for by the mechanism shown in Figs. 11, 13 and 15. It will be noted that the pinion is mounted through a suitable supporting sleeve 55 upon a longitudinally slidable shaft 56 which has an operating handle 57 at its outer end. The handle 57 is provided with a pair of approximately semi-circular grooves 58 and 59 separated by an arcuate wall 60, said grooves being connected at one end—the lower end in Fig. 13—by a groove 61. A finger 62 carried by a bracket 63 mounted upon a suitable frame part 64, for example, a part of the frame or housing of a mining machine, is mounted in adjacency to the grooved portion of the handle 57, and by appropriate movement of the handle either the semi-circular groove 58 or the semi-circular groove 59 may be moved into such relation to the finger 62 that rotation of the handle with either of these grooves receiving the finger, may be possible. In the position of the parts 180° from that shown in Fig. 13, a shifting of the grooves relative to the finger 62 may be effected, for the notch 61 would then be opposite the finger. It may be noted that the size of the pinion relative to the size of the arcuate gear segments 45 and 46 is such that a half-revolution of the pinion will be just sufficient to provide the desired movements of the arms 43 and 44.

Now, it is believed that the mode of operation of the entire apparatus may be understood without difficulty. A detailed description of the changes in electrical connections seems scarcely requisite in view of the clarity of the diagram of Fig. 12. It may be noted, however, that this figure shows at its left-hand side three stationary contacts S, S, S and three moving contacts M, M, M, by means of which circuits to effect the running of the motor in one direction may be established by movement of the bar 9. In like manner, three stationary contacts S', S', S' and three moving contacts M', M', M' are provided, and upon movement of the contact supporting bar 12 in a proper manner, these contacts may be caused to cooperate to establish circuits for effecting the opposite running of the motor.

Now, let it be assumed that it is desired by the operator to cause the motor to start and operate in the direction in which it will run with the contacts carried by the bar 9 closed. The operator, starting with the lug 48 on the arm 43 in contact with the stud 49 and with the pinion 50 in engagement with the gear segment 45, will simply rotate the handle 57 through approximately 180° in the direction of the arrow in Fig. 11, thereby bringing the parts to the position shown in Figs. 9 and 11, and effecting closing of the contacts carried by the contact mounting bar 9, while leaving the contacts carried by the contact mounting bar 12 unmoved.

Now, if the operator wishes to effect interruption of operation of the motor, he must turn the handle 57 180° in a direction opposite that of the arrow shown in Fig. 11, which will move the arm 43 down again to bring its lug 48 into engagement with the stud 49. This will move the arm 23 clockwise in Fig. 9 and cause the roller 25 to pass over the point 37 on the cam 18 which is fixed with respect to the bracket 14. As soon as the high point in the cam is passed, the action of the spring 33 will cause the roller to force the cam 18 counter-clockwise in Fig. 9, and move the bar 9 in a direction to open the switch devices of the parts which it supports. The movement imparted to the cam 18 will be limited by its engagement with the stop pin 42, and the action of the spring 33 will hold the arm 23, and through it the arm 43, in open-circuit contact position.

Now, if the operator wishes to close the switch devices whose movable elements are carried by the contact mounting bar 12, he will move the handle 57 and with it the shaft 56, longitudinally to the left in Fig. 11, a thing which will be possible with both switches in open position, due to the fact that the notch 61 will be opposite the finger 62. When engagement between the pinion 50 and the gear segment 46 has been established, the handle 57 may be turned in the direction of the arrow thereon, because the finger 62 will then lie within the groove 59, and the gear segment 46 may then be moved forwardly in Fig. 9, moving with it the arm 44 and swinging the arm 23' in a direction to cause the roller 25' carried thereon to pass forwardly over the peak, so to speak, 37' of the cam 18 carried by the bracket 17, whereupon a snap closing of the switch devices controlled by the contact mounting bar 12 will take place.

Now, when it is desired to re-open the circuits established by the operation last described and to stop the motor, the handle 57 will simply be turned in a direction opposite that indicated by the arrow in Fig. 11, through 180°, and the gear segment 46 will be restored to the full-line position shown in Fig. 9; and during this process the roller 25' will again pass over the hump 37', so to speak, of the cam 18 carried by the bracket 17, and so the movable switch elements carried by the bar 12 will be brought sharply to open position. With the handle 57 in a position such that the pinion 50 engages both gear segments 45 and 46, rotation of the handle is impossible, because the finger 62 then lies in the notch 61, which blocks rotation of the handle.

From the foregoing description, it will be evident that I have provided an improved electrical controlling apparatus, herein an electrical reverse switch, in which a single operating handle may alternatively effect the movement of contact supporting means to establish forward or reverse motor operating circuits. It will be noted that it is impossible to establish these circuits simultaneously. It will be noted that the same operating device is selectively brought into operative relation with the operating mechanism for each of the different series of contacts. It will still further be noted that the contacts are always opened and closed with a snap action. It will still further be noted that they are firmly but yieldingly held in either position to which they may be moved. It will likewise be noted that their moving devices are in like manner firmly held in the position to which they may have been moved by the operator in effecting the desired circuit connections. It will be observed that the apparatus is very rugged, simple in construction, capable of using many standard commercial parts, and is practically "fool-proof" in operation.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form is shown for purposes of illustration, and that the invention may be modified and em-

bodied in various other forms without departing from its spirit or the scope of the appended claims.

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

1. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, and means for alternatively effecting closure of said contact means including separate snap actuating means for said contact means respectively and a common rotatable operating element oppositely axially reciprocable from a neutral position to select different directions of motor operation and thereafter oppositely rotatable to effect and interrupt motor operation and having a hub provided with grooves conforming in curvature to arcs struck from its axis of rotation and means cooperating with said grooves for controlling the direction of rotation after initial positioning of said rotatable operating element.

2. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, and means for selectively moving either of said contact means while the other remains stationary including contact-moving means including operating segments, a pinion selectively engageable with said segments and operative to move the same, means for moving said pinion from one segment to the other when said pinion and segments are in but one position, and means for preventing pinion rotation while said pinion is in transit between said different segments.

3. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, said contact means arranged generally in alined, end to end relation, snap actuating means for rendering one of said contact means operative arranged at one end of one of said contact means, snap actuating means for rendering the other of said contact means operative arranged at the relatively opposite end of the other of said contact means, and operating means for actuating said snap actuating means alternatively, arranged at one end of said alined contact means and including a primary operating element rotatable to effect actuation of said snap actuating means, and means engaging said operating element for holding said operating element against rotation except in positions in which but one of said snap actuating means is actuatable thereby.

4. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, said contact means arranged generally in alined, end to end relation, snap actuating means for rendering one of said contact means operative arranged at one end of one of said contact means, snap actuating means for rendering the other of said contact means operative arranged at the relatively opposite end of the other of said contact means, said snap actuating means arranged at the extreme opposite ends of said alined contact means, and operating means for actuating said snap actuating means alternatively, arranged at one end of said alined contact means and including gear sectors rotatable on a common axis and respectively individual to said snap actuating means and a shiftable pinion selectively engageable with said sectors and held against rotation except when in engagement with but one of said sectors at a time.

5. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, and means for selectively moving either of said contact means while the other remains stationary including snap action devices individual thereto each including a cam and a shiftable device for applying pressure to different points of said cam, and a common primary operating element for selectively moving either of said shiftable devices relative to its respective cam, said operating element movable to positions to effect operation of one or the other of said shiftable devices, and means including means carried by said operating element for controlling movement of said operating element to its respective operating positions.

6. In a motor reverse switch, contact means operative to effect one direction of motor operation, contact means operative to effect motor operation in the opposite direction, and means for selectively moving either of said contact means while the other remains stationary including snap action devices individual thereto each including a cam and a bodily movable spring-pressed cam-throwing element, a common primary operating element positionable selectively to move either of said throwing elements only when both of said contact means are in open-circuit-causing position, and means including means carried by said operating element and means cooperating with said last mentioned means for controlling the positioning and operation of said operating element.

CHARLES W. WYMAN.