No. 751,547. PATENTED FEB. 9, 1904.

F. V. NICHOLLS.

MOTOR CONTROLLER.

APPLICATION FILED JUNE 13, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

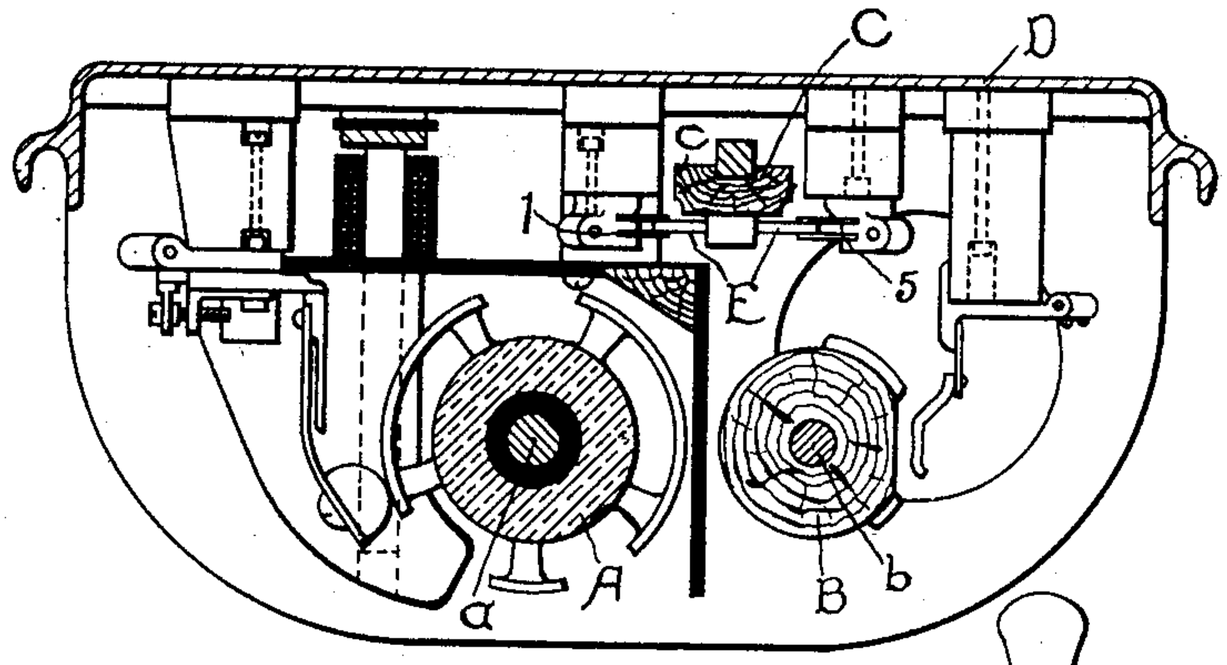

Fig. 1.

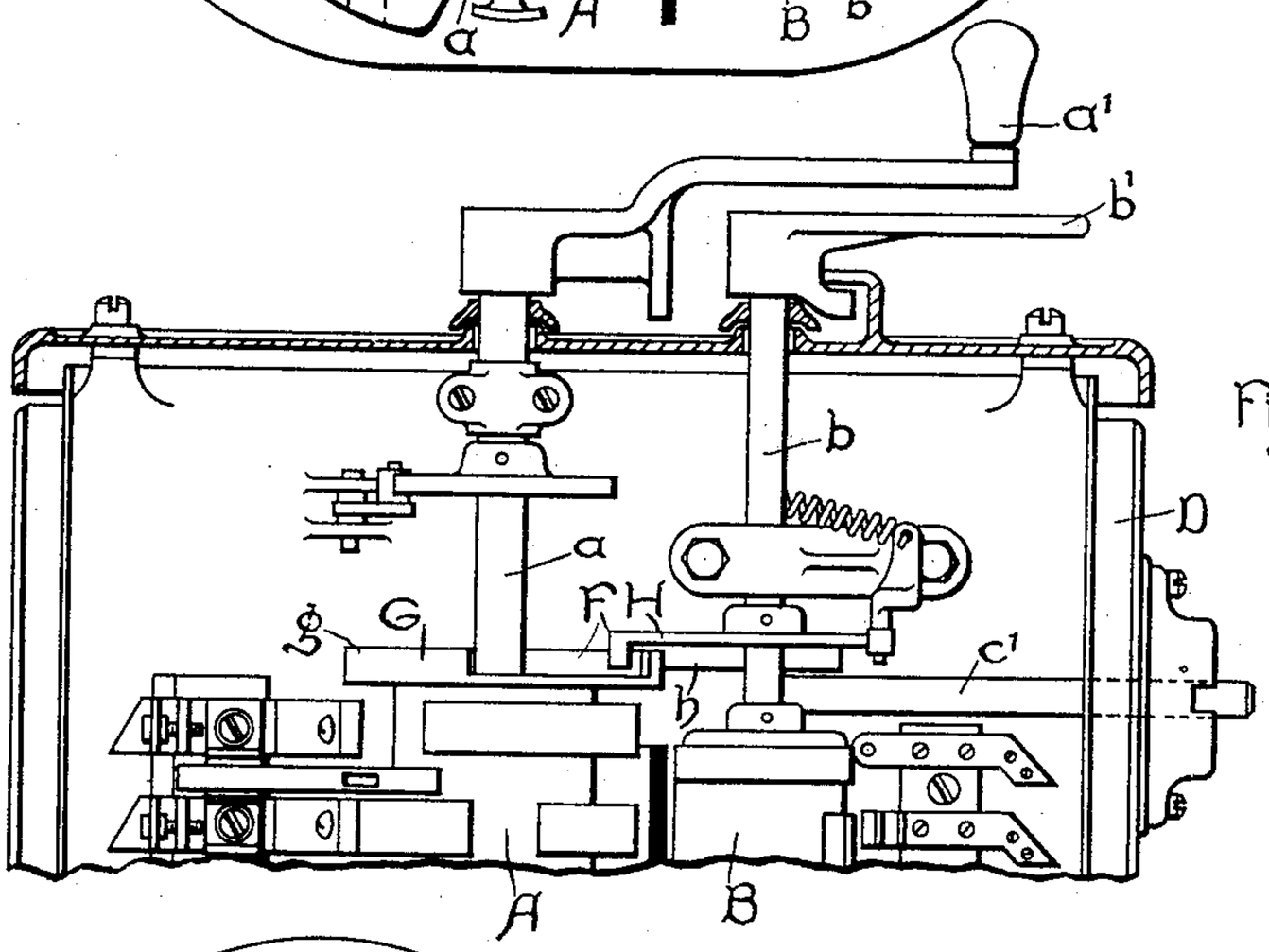

Fig. 2.

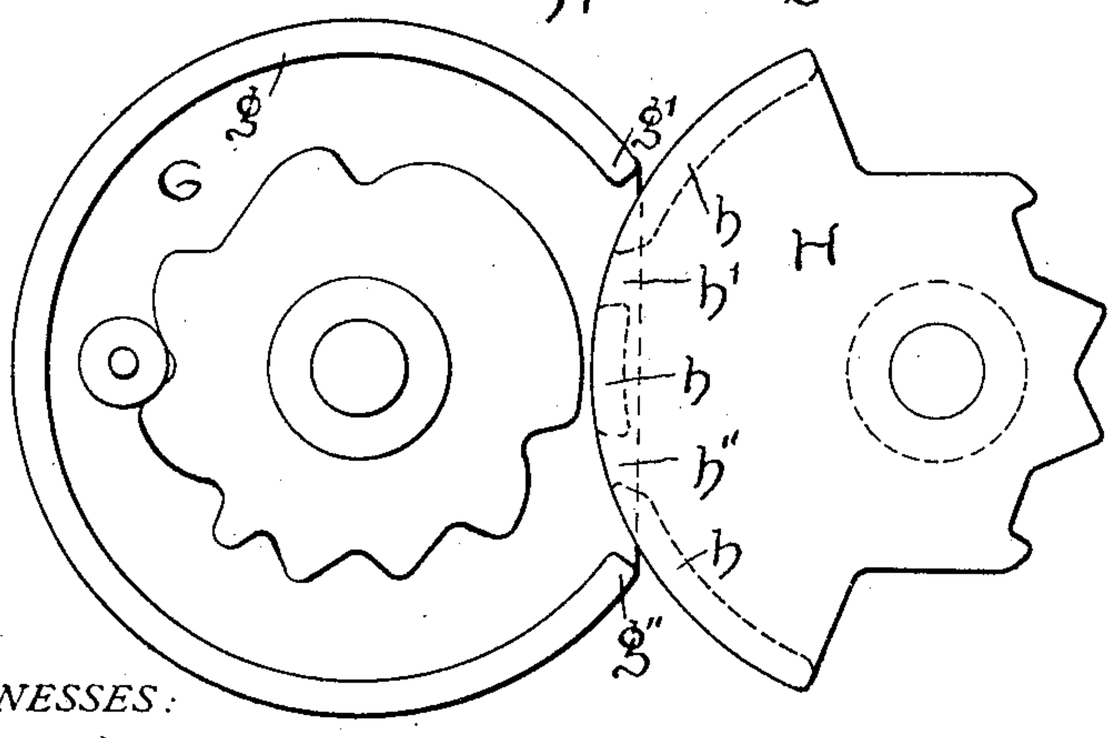

Fig. 3.

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NO MODEL. 2 SHEETS—SHEET 2.

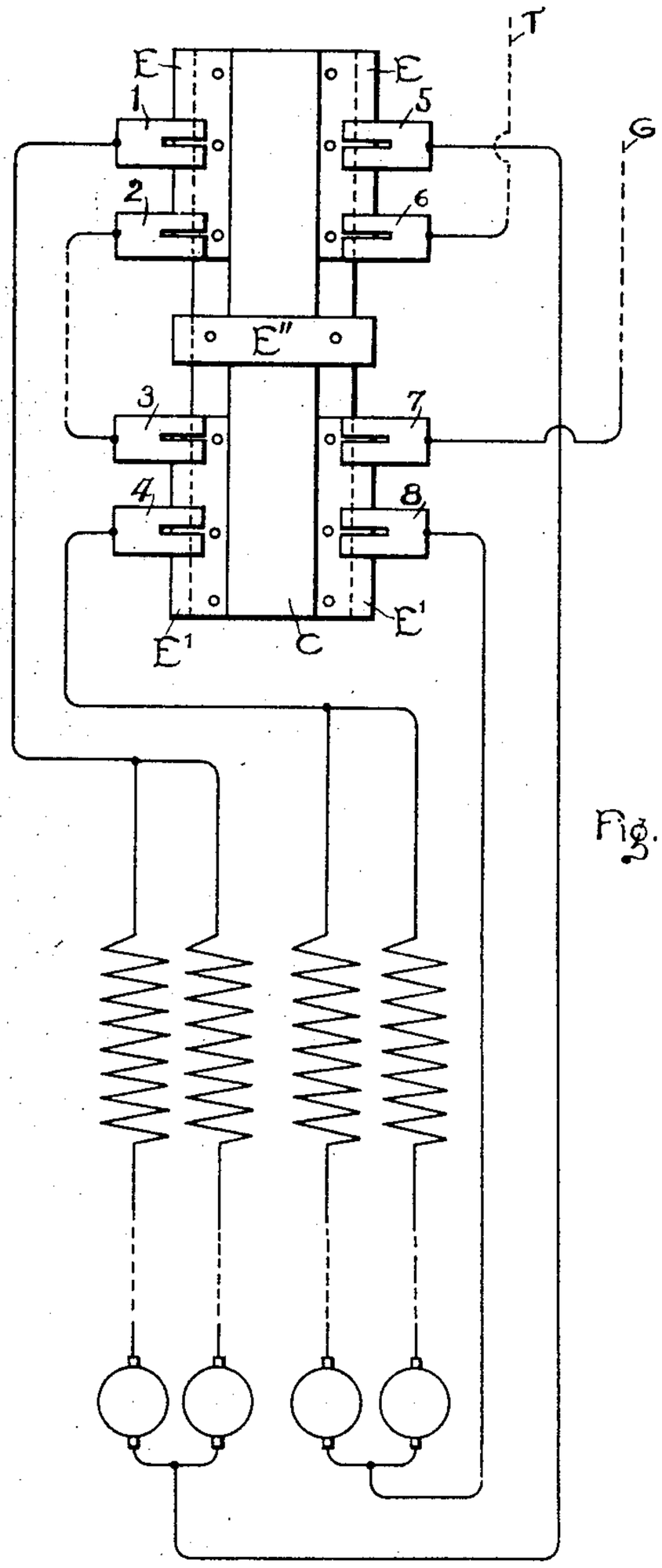

Fig. 4.

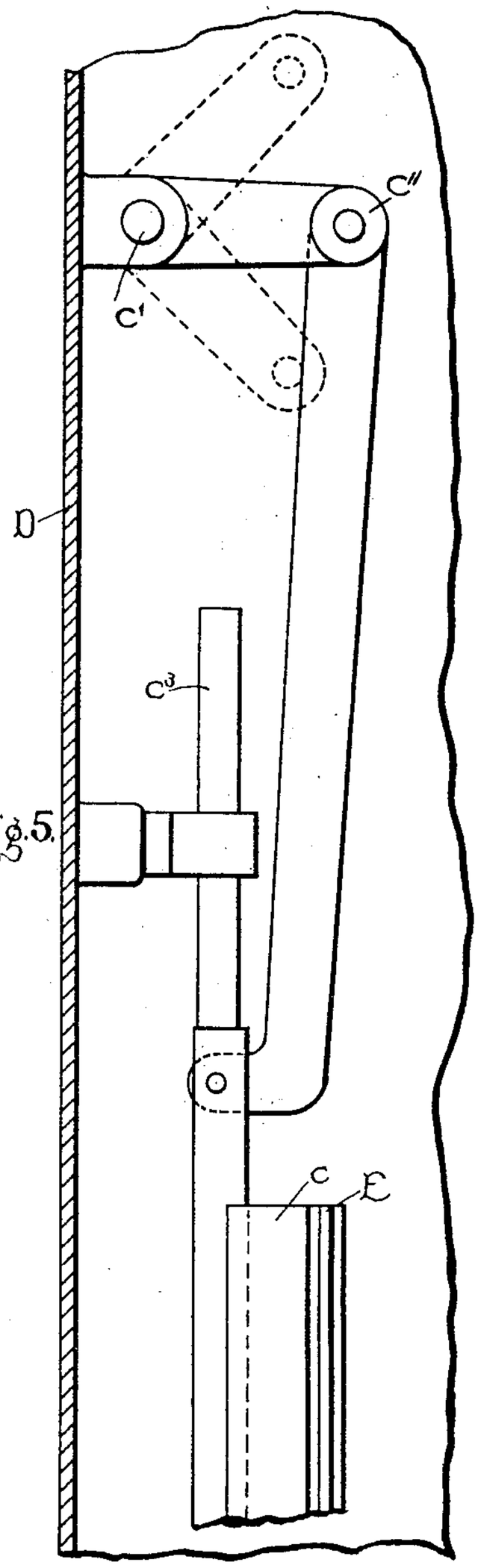

Fig. 5.

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UNITED STATES PATENT OFFICE.

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MOTOR-CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 751,547, dated February 9, 1904.

Application filed June 13, 1903. Serial No. 161,266. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS V. NICHOLLS, a citizen of the United States, and a resident of Pittsfield, Massachusetts, have invented certain new and useful Improvements in Motor-Controllers, of which the following is a specification.

My invention relates to controllers for electric motors, and is especially applicable to the type commonly employed for electric railways.

The object of my invention is to provide a structure of this type in which the parts are so arranged as to be readily accessible and easy to operate, but which shall permit a controller of much smaller size to be used than has been possible with former arrangements.

Another object of my invention is to provide a form of cut-out switch which shall be both simple and economical and which shall enable a motor when disabled to be immediately cut out without interfering with the proper operation of the controller.

A further object of my invention is to provide means for interlocking the various parts of the controller which shall be both simple and efficient and which shall prevent the movement of any switch in the controller unless all other switches are in the proper position.

Referring to the drawings, Figure 1 is a plan view in cross-section of a structure embodying my invention. Fig. 2 is a front elevation of the same with casing removed and the lower part of the controller broken away. Fig. 3 is a plan view in detail of my interlocking device. Fig. 4 shows a detail view of a form of cut-out switch embodying my invention together with a diagrammatic representation of the circuit connections. Fig. 5 shows the operating mechanism for the cut-out switch.

Referring to Figs. 1 and 2, A represents the controller-drum mounted on the vertical shaft *a* and properly insulated therefrom. *a'* is the operating-handle for the controller-drum. B is the drum of the reversing-switch mounted on the vertical shaft *b* with operating-handle *b'*. C represents the cut-out switch mounted on the back of the casing D. The switch consists, essentially, of two rows of contacts 1 to 8, (shown in Fig. 4,) there being four of these contacts in a row. A moving member *c*, preferably of insulating material, carries four contacts E and E', which contacts when both motors are in series connect the fixed contacts in four groups, as clearly indicated in the diagrammatic representation of the circuits. The moving member also carries a contact E'', which is essentially disposed as compared with the contacts E and E', so that as the moving member *c* is raised, disengaging contacts E from fixed contacts 2 and 6, said centrally-disposed contact E'' will connect the opposite contacts of the different rows 2 and 6 together. Likewise downward movement of the vertical member *c* will cause the centrally-disposed strip E'' to connect the fixed contacts 3 and 7, which were previously connected by contacts E'. This movement of the member *c* is effected by the rocking of the transverse shaft *c'*, which has a suitable bearing in the side of casing D and projects therethrough, as shown in Fig. 2. This shaft preferably has an end adapted to receive the handle *b'* of the reversing-switch when it is necessary to operate the cut-out switch. The movement of the shaft *c'* is transmitted to the moving member by the bell-crank *c''* and the bar c^3 connected therewith.

In the diagram of connections of Fig. 4 the connections to the controlling and reversing switches are omitted for the sake of simplicity, since they are not necessary to the understanding of the present invention, and since many methods of connection to those switches are well known in the art four motors in two sets of two each are illustrated; but it is evident that the cut-out switch is not limited to this particular number. The fixed contacts of the cut-out switch are connected as follows: The two top contacts 1 and 5 are connected either directly or through the reversing-switch to the terminals of the first group of motors, while the lower contacts 4 and 8 of the two rows are connected in the same way to

the terminals of the second group of motors. The four intermediate contacts of the two rows 2, 3, 6, and 7 are connected to the proper fingers of the controlling-switch, so that when the motors are in the series position two contacts in the same row, as 2 and 3, are connected together, while the other two contacts, as 6 and 7, are connected to trolley and ground, respectively. It is evident that when the member *c* of the cut-out switch is in its normal or mid-position each terminal of each group of motors is properly connected to the controlling-switch. If, however, either group of motors is disabled and should be cut out, this may readily be done by moving the switch up or down, as necessary, so as to disconnect the motor-terminals at the end of the row from the next contacts which are connected to the controlling-switch, which contacts are then connected together by the contact E″, which is common to the two rows. Thus a movement up will disconnect the terminals of the first group of motors from the controlling-switch, and therefore from any part of the working circuit, but will leave the terminals of the second group of motors 4 and 8 in connection with the controlling-switch, while the contact *e″*, projecting across the controlling-switch terminals 2 and 6, will complete that part of the working circuit ordinarily occupied by the first group of motors. This switch enables me with a very few contacts and with a small and compact arrangement to satisfactorily provide for the ordinary functions of such a switch, and as the operative mechanism thereof projects to the outside of the controller at the side thereof it can be operated without opening the controller-casing, but at the same time it is not in a position to encumber the top of the controller, where there is comparatively little room. Furthermore, by adapting the cut-out-switch mechanism to be operated only by the handle of the reversing-switch I insure that the cut-out switch shall not be operated except when both the controlling and reversing switches are on the off position, since only in that position can the handle of the reversing-switch be removed to operate the cut-out switch.

The interlocking device between the controlling-switch and reversing-switch is shown at F in Fig. 2 and in detail in Fig. 3. On the shaft of the controlling-switch is a disk G, having an upwardly-extending flange *g*, and on the reversing-switch shaft is a disk H, having a downwardly-extending flange *h*. Each of these flanges is made non-continuous, the flange *g* being in the present instance cut away from *g′* to *g″*, while the flange *h* extends only over a short part of the circumference of the disk H and is cut away at two places *h′* and *h″*. In Fig. 3 the disks are shown in the position they occupy when both the reversing-switch and controlling-switch are at the off position. It will be seen that in this position the controlling-switch cannot be moved, since the upwardly-extending flange *g* would engage the downwardly-extending flange *h*. When, however, the reversing-switch is moved, the position of flange *g* allows such movement that one of the openings *h′* may be brought opposite to one end of the flange *g*, while the end of the flange *h* will be brought to the interior of the flange *g*. Under these circumstances the controlling-switch can be moved freely, since the flange *g* can pass through the opening *h′* and around the outside of the flange *h*. A movement of the reversing-switch in the other direction brings the other opening *h″* in front of the end of the flange *g* and produces a like result. On the other hand, when the controlling-switch has once been moved, with the flange *g* passing through one of the openings *h′*, it is obvious that it is impossible to move the reversing-switch. By this means, therefore, without any cams, springs, or pawls I am enabled to lock the controlling-switch when the reversing-switch is at the off position, and I am also enabled to lock the reversing-switch when the controlling-switch is at the operative position, the purpose of which is old and well-known to the art.

I do not desire to limit myself to the particular construction and arrangement of parts herein shown, since changes therein which do not depart from the spirit of my invention and which are within the scope of the appended claims will be obvious to those skilled in the art.

Having thus fully described my invention, what I claim, and desire to protect by Letters Patent, is—

1. In a controller device for electric motors, a controlling-cylinder, a reverse-cylinder, and interlocking means for said cylinders, comprising disk-like members, or segments, movable with said cylinders adjacent to one another, and coöperating apertured projecting rings on said members, rotation of each member being restrained while the ring of the opposite member lies in the gates or apertures of its own ring, substantially as described.

2. In combination with the controlling and reverse cylinders of a controller for electric motors, an interlocking mechanism to prevent the movement of either cylinder except when the other cylinder is at a predetermined position, said mechanism comprising two overlapping disks, or such segments of the same as are suitable for the purpose, one mounted on the controlling-cylinder and the other on the reverse-cylinder, each disk having a peripheral guard ring or flange the arcs of which lie in a common plane so that said arcs intersect, said rings each having gates corresponding to the arc of intersection of the rings respecively, so that if one guard-ring is set with its gates registering with the arc of the other ring the latter may pass freely through these gates and

the corresponding cylinder may rotate freely, but during such passage the first ring and its cylinder are locked by the second except when the second cylinder and its ring are in one of the predetermined positions when its gates register with the arc of the first ring.

3. An interlocking mechanism comprising two disks or rings rotatable in adjacent parallel planes and having projections in the form of arcs lying in a common plane, said arcs being so disposed as to permit the free rotation of one ring only when the second ring is in a fixed position and to permit the free rotation of the second ring when the first ring is in one of two fixed positions.

4. In a controller for a plurality of electric motors, the combination with controlling and reverse switches, of a cut-out switch comprising jaws and a movable connecting device to slide between said jaws, said device having contact members acting in various positions of said device to connect all the motors into circuit, and to cut out one or the other of said motors or groups of motors, the circuit being always maintained by a contact member thrown across the circuit to replace the motor or group of motors thus cut out, substantially as described.

5. The combination with two electric motors of a controlling-switch, a cut-out switch comprising two rows of fixed contacts connected one half to the motor-terminals and one half to the controlling-switch, a set of movable contacts comprising contacts adapted to connect the said fixed contacts in pairs, each pair comprising a motor-terminal contact and a controlling-switch contact and a contact out of engagement with said fixed contacts when said fixed contacts are all connected in pairs but engaging and connecting any controlling-switch contacts that are disconnected from their motor-terminal contact when said switch is moved to cut out one or the other motor.

6. In an electric controller for two motors, a controlling-switch, a switch for cutting out either of the motors having two rows of fixed contacts end contacts of each row being connected to motor-terminals and centrally-disposed contacts of each row being connected to the controlling-switch, movable contacts adapted to connect said end contacts to said centrally-disposed contacts, and a central movable contact common to both rows and arranged to connect together whichever two of the centrally-disposed contacts that are disconnected by the movement of the switch from the adjacent end contacts.

7. The combination of two electric motors, a controlling-switch therefor, a cut-out switch having two rows of fixed contacts connected to the motor-terminals and to the controlling-switch, and having a rectilinearly-moving contact member comprising two corresponding rows of contacts and one contact common to the two rows.

8. In combination with two electric motors and a controlling-switch therefor, a cut-out switch having two rows of contacts, the end contacts thereof being connected to motor-terminals and the corresponding end terminals of the two rows being connected to the two terminals of the same motor, connections from the central contacts of each row to the controlling-switch, and having a set of movable contacts comprising a central contact common to both rows and upper and lower contacts for each row adapted to connect the fixed contacts in pairs.

9. In a controller device for electric motors, a controlling-cylinder, a reverse-cylinder, and interlocking means for said cylinders, comprising disk-like members, or segments, movable with said cylinders adjacent to one another, and coöperating apertured projecting rings on said members so disposed as to permit free rotation of one cylinder only when the second cylinder is in one of two fixed positions and to permit the free rotation of the second cylinder only when the first cylinder is in one fixed position.

10. The combination of a controlling-switch, a disk rotatable therewith, a reversing-switch, a disk rotatable therewith, an upwardly-projecting flange on the controlling-switch disk, a downwardly-projecting flange on the reversing-switch disk, said flanges having openings, said disks being in such proximity that either of them is locked by the other except when the openings are in predetermined positions.

11. In an electric controller, the combination of a casing, a pair of rotatable shafts carried thereby and projecting through the top of the same, operating-handles therefor, a controlling-switch member carried by one shaft a reversing-switch member carried by the other shaft, a rectilinearly-movable cut-out switch carried by the back of the casing, and operating mechanism therefor extending through the side of the casing.

Signed at Pittsfield, Massachusetts, this 2d day of June, 1903.

FRANCIS V. NICHOLLS.

Witnesses:
L. A. HAWKINS,
R. E. HAYNES.