T. E. BARNUM.

MOTOR CONTROLLING DEVICE.

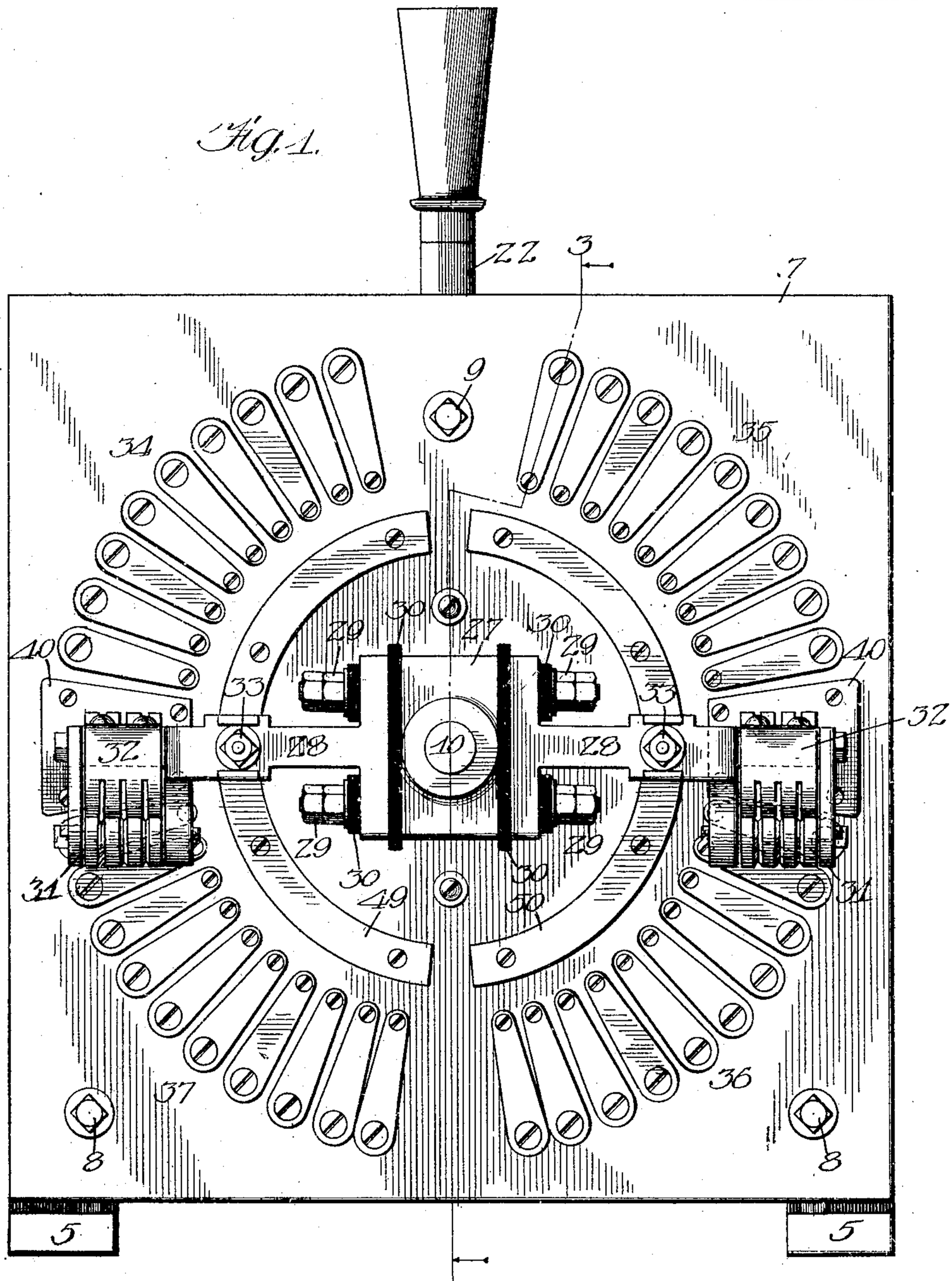
APPLICATION FILED MAY 9, 1907.

959,908.

Patented May 31, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



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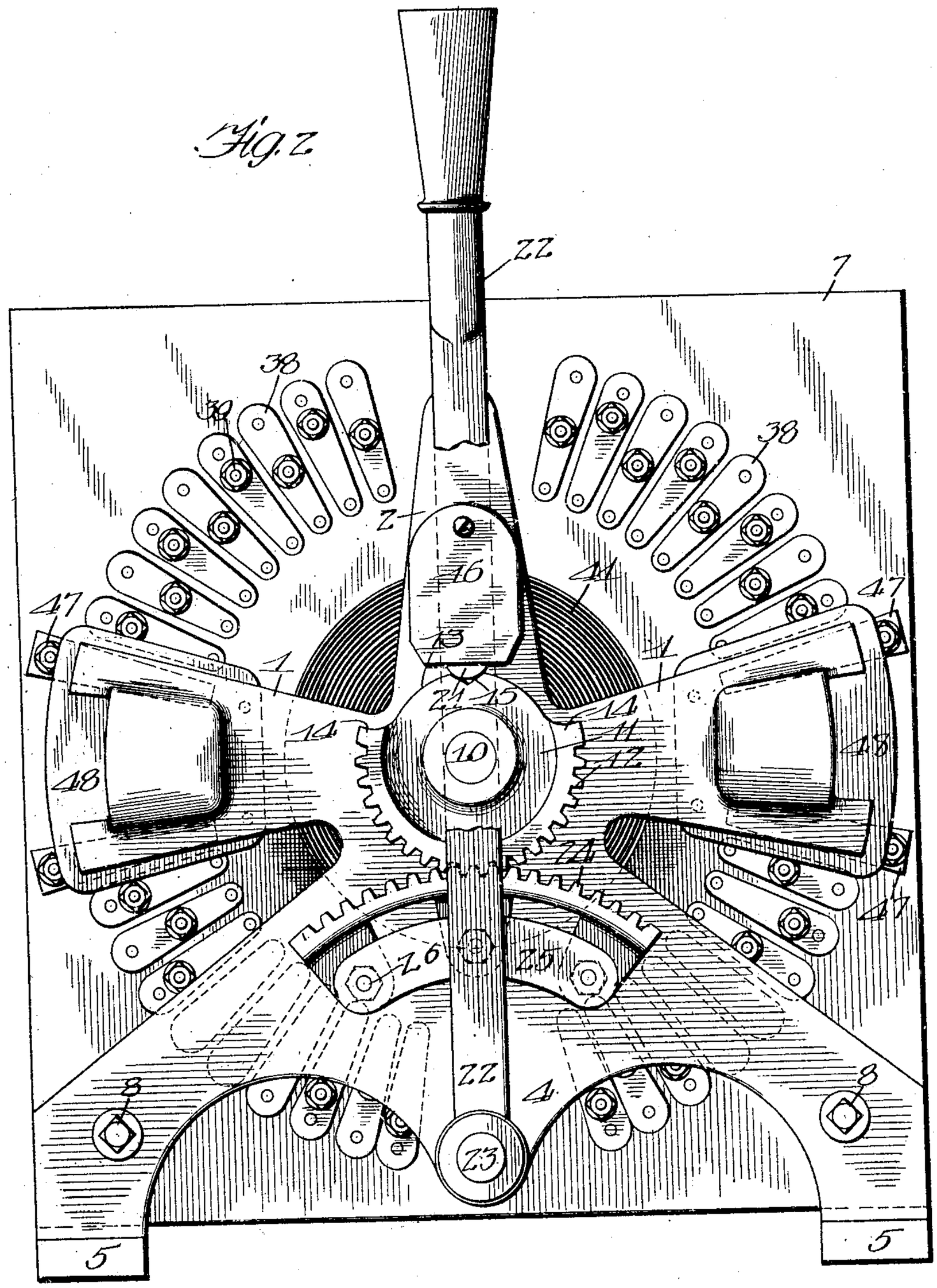
4 SHEETS—SHEET 2.

Fig. 2.



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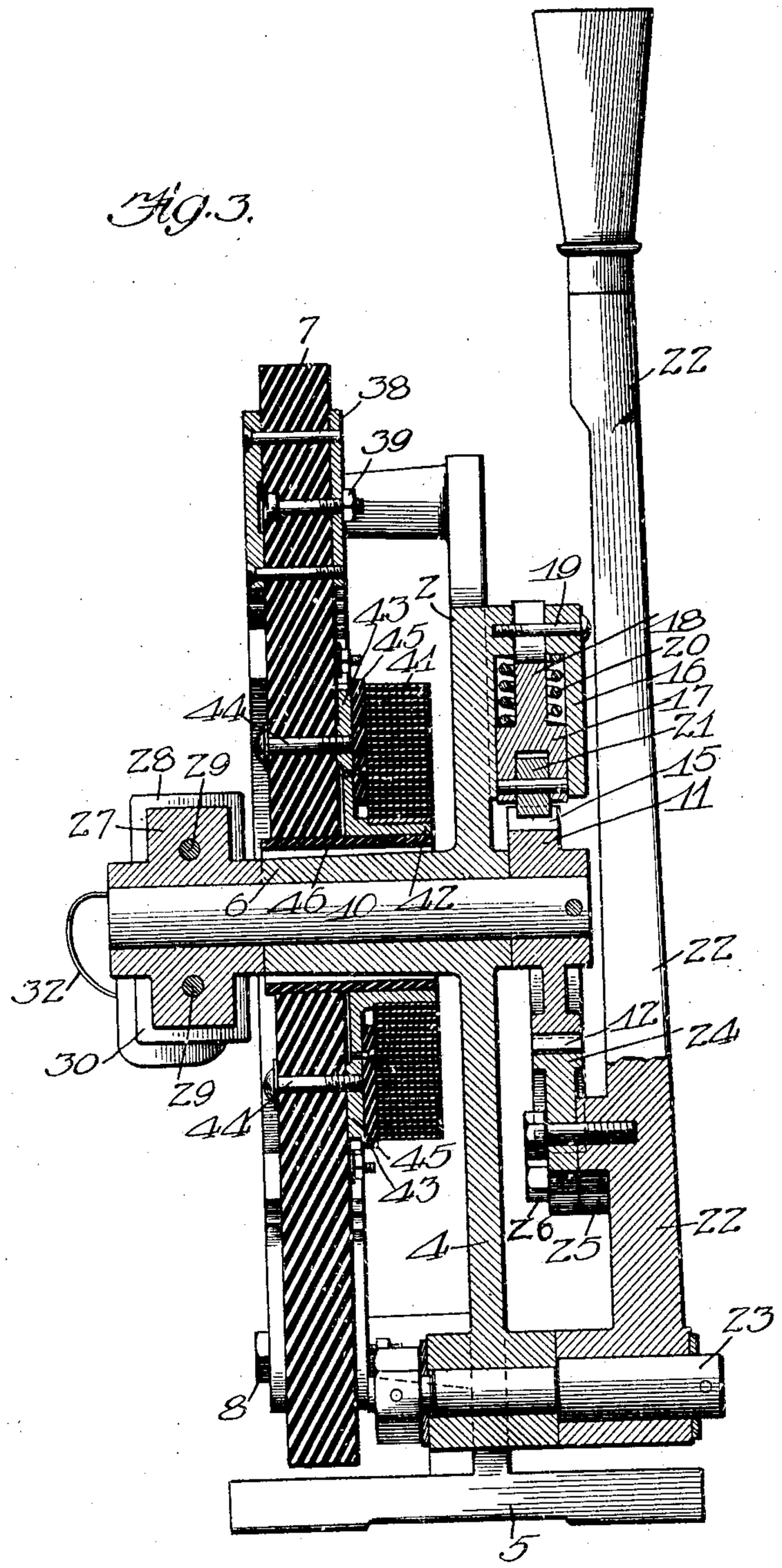
4 SHEETS—SHEET 3.

Fig. 3.



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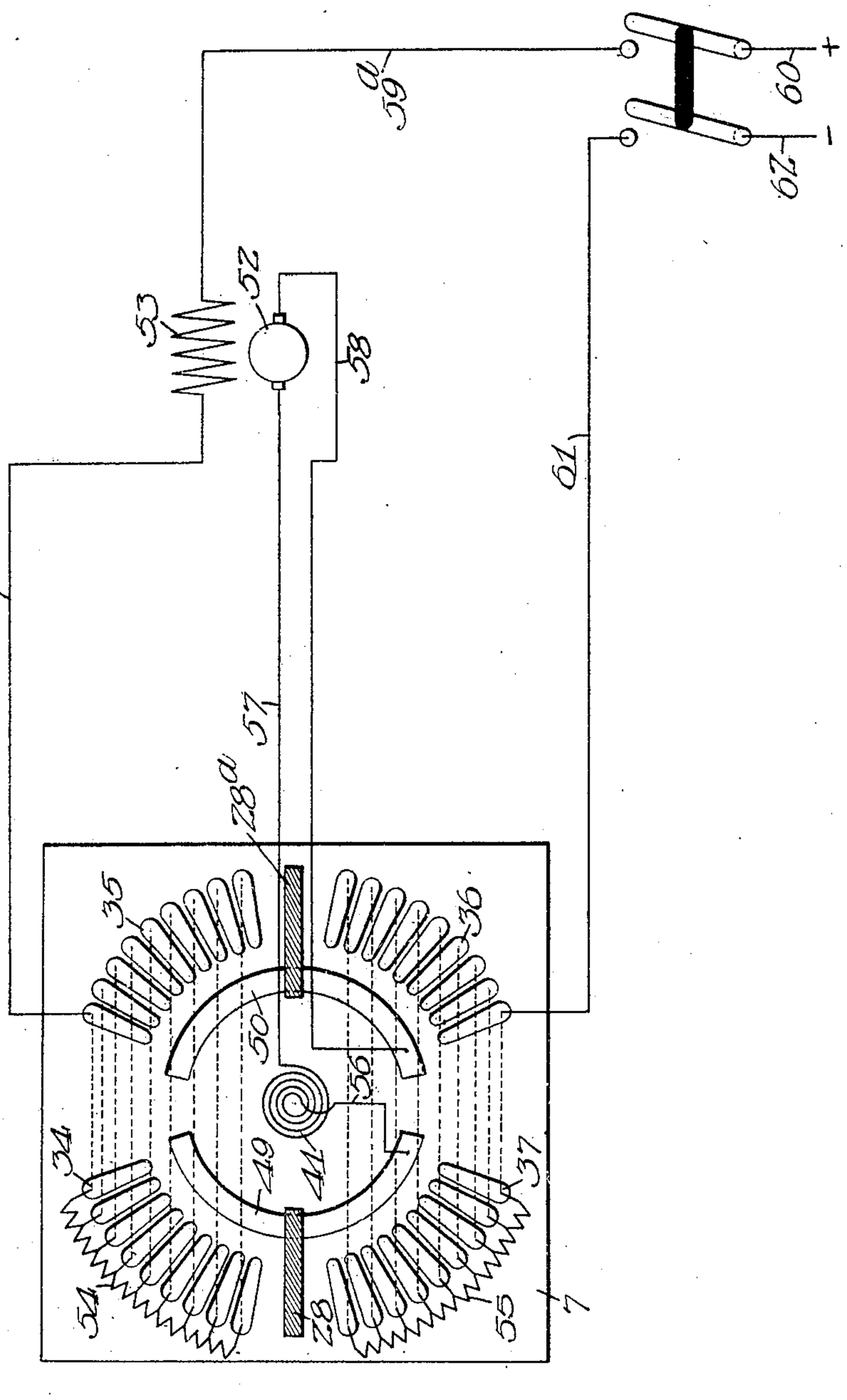
4 SHEETS—SHEET 4.

Fig. 4



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UNITED STATES PATENT OFFICE.

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MOTOR-CONTROLLING DEVICE.

959,908. Specification of Letters Patent. Patented May 31, 1910.

Application filed May 9, 1907. Serial No. 372,747.

To all whom it may concern:

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Motor-Controlling Devices, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in motor controllers and is preferably applicable to controllers which perform the function of both a rheostat and reversing switch.

One of the objects of my invention is to produce a controller of the character stated which shall produce better results with less wear and destruction to the parts than those heretofore devised.

My invention also contemplates certain electrical and mechanical relations between the parts, which reduce the number of points at which the circuit is broken, and at the same time prevent destructive arcs at the points where the circuit is opened.

For the purpose of disclosing my invention I have illustrated in the accompanying drawings one embodiment of the same. It will be understood, however, that other controllers embodying the same invention may be devised which, while departing from details of construction, do not depart from the spirit of my invention.

In the drawings: Figure 1 is a front view of the controller. Fig. 2 is a rear view thereof. Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1, and Fig. 4 is a diagram of the electrical connections and relations of the parts of my controller.

The controller is preferably provided with a supporting frame which preferably consists of an integral structure made of magnetic material, and comprising three radial arms, two of which 1 extend substantially horizontal and the third 2 extends substantially vertical, a base 4 having two feet 5 and a bearing sleeve 6. The arms extend radially from a common center and are all arranged in the same plane. The sleeve 6 is formed at the juncture of the arms and its axis extends transversely to the plane of the arms. The frame supports a face plate or base 7 formed of insulating or other suitable material, such as slate, soapstone or the like, which is preferably attached to the frame at the bottom by means of bolts 8, which extend through the base plate and the base, and at the top by a bolt 9 which extends through the base plate and the arm 2.

A shaft or spindle 10 extends through the bearing in the sleeve 6 and at its rear end is provided with a wheel 11 fastened thereto by a suitable means and bearing against the back of the frame to prevent axial displacement of the shaft. The wheel has formed thereon a segmental gear 12 and a cam 13. The ends of the gear 12 form stop lugs 14, one arranged at each end of the cam, which limit the arc through which the shaft may be turned to an arc corresponding to the distance between the lugs 14. The surface of the cam 13 is provided with a notch 15, which is located, midway between the lugs 14.

The arm 2 is provided with a projection 16 which is arranged in the path of the movement of the lugs 14 so that the lugs may strike against the same and limit movement of the shaft and when the shaft stands in its initial position, each lug is equidistant from said projection. Extending vertically through the projection 16 is a circular hole in which is arranged a slidable cylindrical block 17 having an upwardly extending tail rod 18. In the upper portion of the hole a ledge is formed and below the ledge the hole is of just sufficient diameter to admit the tail rod. A bearing is thus provided for the tail rod. The upper end of the tail rod is provided with a vertical slot through which passes a pin 19, to prevent the rod from turning. The cylindrical block 17 is pressed downward by a coiled spring 20 arranged between the bottom of the block and the ledge and surrounding the tail rod and the block carries a roller 21, which engages the edge of the cam 13.

When the parts of the controller are in the initial or "off" position the roller 21 is pressed into the notch 15 of the cam and thus holds the parts against accidental movement. A handle or lever 22 at its lower end is pivotally mounted upon a stud or shaft 23 extending rearwardly from the base 4, and is provided with a rack 24 secured to an arc shaped projection 25 integrally formed with the arm, by bolts 26. The rack 24 is adapted to mesh with the segmental gear 12 and as the handle is moved

to the right or left, rotates the gear thereby operating the spindle 10. The outer end of the shaft or spindle 10 carries a hub 27 from which extends two arms 28. The arms are fastened to the hub by means of suitable bolts 29 and insulating material 30 is placed between the arms, the hub and the bolts so as to electrically insulate one arm from the other. The outer end of each contact arm preferably carries pivoted fingers or contacts 31 made of copper or other suitable material adapted to engage certain stationary contacts that will be hereinafter described and these fingers are preferably pressed into engagement with the stationary contacts by a spring 32. In addition to the fingers or contacts 31 carried by each arm, each arm carries a second contact 33, which is adapted to engage other stationary contacts carried by the base 4, as will hereinafter be described. Of course the contacts on each arm may be electrically connected in any suitable way and may even be formed as a single contact.

The face plate carries four groups or sets of contacts 34, 35, 36, and 37 arranged concentrically with the axis of the shaft 10. These contacts are preferably what is known in the art as face plate or radial contacts, and the four groups of contacts are arranged, one group in each of four arcs of equal length and radius, the several arcs being equidistant apart and having a common center. Each contact is preferably held in position by means of screws, the heads of which are counter-sunk in the face of the contact. The screws pass through the face plate and are threaded into plates 38, upon the back thereof, which also preferably carry binding screws 39 by means of which electrical connection is made to the conductors and resistance as hereinafter set forth. In two of the spaces between the groups of contacts is preferably arranged an insulating block 40 upon which rests the brushes or fingers 31 of the controller arms when they are in the initial or "off" position.

A blowout coil 41 is provided, which preferably consists of a strip or band of conducting material wound in the form of a spiral and having suitable insulation wound therewith to insulate the convolutions from each other. This coil is preferably wound upon a tube or spool 42 made of brass or other nonmagnetic material and having a terminal extension 43 by which it is secured to the face plate by bolts 44. The extension 43 is preferably insulated from the blowout coil by a block of insulating material 45 interposed between the coil and the extension and the spool 42 is insulated from the sleeve 6 by an insulating tube 46. The inner end of the coil is attached to the spool and the outer end thereof is connected to a contact plate, which will be more fully described.

The contact arms 28 and the arms 1 of the frame form pole pieces for the blowout magnet. The two contact arms and the two arms of the frame form two pairs of poles, one pair at each point where arcs form on the opening of the circuit. The end contacts of each group of contacts where the circuit is broken is preferably larger than the intermediate contacts, as the circuit is opened and closed at that point, and the plate 47 to which the end contact is fastened is preferably made of magnetic material. The outer end of each arm of the arms 1 is preferably divided into two polar faces, one arranged back of each magnetic plate, and an insulating plate 48 is placed over the polar faces to shield the same from the adjacent plates 47.

When the contact arms are returned to the initial position an arc tends to form between each contact arm and the adjacent end contact of the set of stationary contacts over which said arm has been moved. This arc is extinguished by the magnetic flux that passes between the pole pieces formed by the contact arm and the corresponding arm of the frame. The circuit or path of the magnetic flux which is created by the blowout coil extends from the sleeve 6, through the radial arm 1 of the supporting frame, thence across the arc zone of one of the contact arms 28, and back through said arm and shaft 10 to the sleeve 6.

In addition to the sets of stationary contacts above described, within the circle described by the same, a pair of arc shaped contacts 49 and 50 are secured to the face plate by suitable bolts 51 and each plate is greater in length than the arc formed by two sets of stationary contacts, for instance, the length of the arc shaped contact 49 is greater than the arc formed by the sets 34 and 37 of contacts, and the arc shaped contact 50 is greater in length than the arc formed by the sets 35 and 36 of contacts. The point of separation of the arc shaped contacts 49 and 50 is opposite the "off" position of the arms 28, whereby the contacts 33 carried by the arms 28 are always in engagement with the contact plates 49 and 50. By this arrangement when the circuit through the motor is opened or the direction thereof through the motor changed, the number of points at which the circuit is broken is reduced to two, but due to the provision of the blowout magnet the arc is promptly disrupted at these two points.

In the structure shown in the drawing, as before stated, the circuit is broken at two points when the contact arms are returned to the initial position. The contact arms and the arms of the frame form pairs of poles for the blowout coil at each of these points and in consequence a magnetic flux is sent across each arc zone, thereby causing

the arc to be extinguished. Inasmuch as each contact arm forms a pole piece for the blowout magnet, the magnetic flux is distributed at the points where it will be most effective in extinguishing the arcs that occur upon the opening of the circuit.

The circuit relations of the parts of the controller are illustrated in Fig. 5 and referring to said figure I have illustrated the controller as being used for controlling a motor having armature 52 and a series field 53. It will be, of course, understood that my device may be used to control other forms of motors than that herein shown and described.

In order to distinguish certain parts of the controller from one another in describing the various circuits, I shall hereinafter use letters as exponents of the reference numerals which I have heretofore used. In each group of contacts each contact of the group on one side of the horizontal center of the controller is electrically connected to the corresponding contact of its opposite group. For example in the group of contacts 34, each of the contacts is connected with a corresponding contact in the group 35. The contacts of the groups 34 and 35 are thus electrically connected in pairs. Each group of contacts is connected to resistances 54 and 55 which are divided into sections or steps, the number of steps being equal to the number of pairs of contacts. The inner terminal of the blowout magnet 41 is connected through conductor 56 with the contact segment 49 and the outer terminal of the blowout magnet is connected by conductor 57 with one terminal of the armature 52. The opposite terminal of the armature 52 is connected by conductor 58, with the contact segment 50. The last of the set 35 of contacts is connected by conductor 59, with one terminal of the series winding 53, the opposite terminal of which is connected by a conductor 59ª, with one side 60 of the main line, and the last of the set of contacts 36 is connected by conductor 61 with the opposite side 62 of the main line.

In operation if the contact arms be moved clockwise the arm 28 will pass over the set of contacts 34 and the arm 28ª will pass over the set of contacts 36. When each contact arm comes into engagement with the first of the stationary contacts in the course of its travel, circuit will be closed from the main 60, by conductor 59ª, through the series field winding 53, by conductor 59, to the first of the contacts 35, thence through all of the resistance 54 connected therewith, to the last of the series 34 of contacts, thence across the arm 28 to the contact segment 49, by the way of conductor 56, through the blowout coil 41, by conductor 57, through the armature 52, by conductor 58, to the opposite segment 50, across the contact arm 28ª, to the first of the series of contacts 36, thence through all of the resistance 55, connected therewith, to the last of this series of contacts, and by conductor 61, to the opposite side 62 of the line, establishing the motor circuit. As the arms pass over the successive contacts, the resistance will be removed, step by step, and when the arms reach the last of the contacts, all of the resistance will have been removed from circuit and the motor will be running at full speed.

If the arms be moved in a counter clockwise direction from their "off" position, the arm 28ª will pass over the series of contacts 35, and the arm 28 will pass over the contacts 37. When the arm 28ª engages the first of the series 35 of contacts and the arm 28 engages the first of the series 37 of contacts, circuit will be closed from the main 60, by conductor 59ª, through the series field 53, thence by conductor 59, to the last of the series 35 of contacts, through all of the resistance 54 connected therewith to the first of the series 35 of contacts, across the arm 28ª, to the contact 50, and thence by conductor 58, through the armature 52 of the motor, by conductor 57, through the blowout coil 41, by conductor 56, to the contact segment 49. From the contact segment 49, the circuit will be closed across the arm 28, to the first of the series 37 of contacts, through all the resistance 55, connected therewith, to the last of the series of contacts, and thence by conductor 61 to the opposite side 62 of the line. As the arms pass over the contacts 35 and 37, the resistance will be removed from circuit, step by step, and when the arms reach the last of these contacts all of the resistance will be removed from circuit and the motor will be running at full speed in the reverse direction.

Inasmuch as the arms 28 and 28ª never pass off the contact segments 49 and 50, the circuit is only broken at two places when the arms are moved to their off position, but due to the provision of the blowout magnet, the arc formed at this point is immediately disrupted.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. The combination with arc shaped contacts, of a plurality of sets of circumferentially arranged contacts, a resistance connected to each set of circumferentially arranged contacts, and movable contacts connected in pairs arranged to pass off said contacts, one movable contact of each pair being arranged to always be in engagement with the arc shaped contacts.

2. The combination with a pair of continuous contacts, of a plurality of sets of circumferentially arranged contacts, a resistance connected to each set of circumfer-

entially arranged contacts, and a plurality of movable contacts arranged to pass over said contacts, the contacts passing over the continuous contacts, being arranged to be continuously in engagement therewith.

3. In a motor controller the combination with a plurality of sets of contacts circumferentially arranged, two of said sets having resistance sections connected thereto and being electrically connected to the terminals of the line, of a pair of continuous contacts connected to the terminals of the motor, and movable contacts arranged to pass over said contacts, the movable contacts engaging said continuous contacts being arranged to always remain in engagement therewith.

4. In a motor controller the combination with four sets of contacts circumferentially arranged, the sets of contacts being divided into pairs, and the contacts of each pair being electrically connected, of a resistance connected to each set, one set of each pair being electrically connected to the terminals of the line, a pair of continuous contacts electrically connected to the motor terminals, and four movable contacts electrically connected in pairs arranged to pass over said contacts, the movable contacts passing over the continuous contacts being arranged to continuously engage the same.

5. The combination with a plurality of circumferentially arranged sets of contacts, of a resistance connected to each set, a plurality of continuous contacts, a plurality of movable contacts arranged to pass over said contacts but adapted to open the circuit only on the contacts of the circumferentially arranged sets, and a blowout coil arranged to disrupt the arc formed at the contacts when the circuit is opened.

6. In a controller, the combination with a plurality of circumferentially arranged sets of contacts, of a plurality of continuous contacts, rotatable contact members arranged to engage said contacts, the circuit being arranged to be broken only at the contacts of the sets, and a blowout coil arranged substantially concentric with the axis of said movable members.

7. The combination with arc shaped contacts, of a plurality of sets of circumferentially arranged contacts, a resistance connected to each set of contacts, movable contacts arranged to pass over said contacts, the movable contacts engaging the arc shaped contacts being continuously in engagement therewith, and a blowout coil.

8. In a controller, the combination with a plurality of sets of circumferentially arranged contacts, two of said sets being electrically connected to the line terminals, of a resistance connected to each of said sets, a pair of contacts connected to the motor terminals, movable contacts arranged to pass over said contacts, the movable contacts for said motor terminal contacts being in continuous engagement therewith, and a blowout coil.

9. The combination with a plurality of circumferentially arranged contacts divided into electrically independent sets, a pivoted contact member adapted to sweep over said contacts and to be moved out of engagement therewith, and a plurality of continuous contacts arranged to be always engaged by said contact member.

10. In a motor controller, in combination, a plurality of circumferentially arranged resistance contacts divided into groups, a plurality of arc shaped contacts, and a pivoted contact member movable over said contacts to establish connections for operating the motor in either direction, said member being in continuous engagement with said arc shaped contacts and adapted to open the motor circuit upon being disengaged from said circumferentially arranged contacts.

It witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

THOMAS E. BARNUM.

Witnesses:

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OSCAR A. KELLER.