T. E. BARNUM.

CRANE CONTROLLER.

APPLICATION FILED AUG. 27, 1907.

959,909.

Patented May 31, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

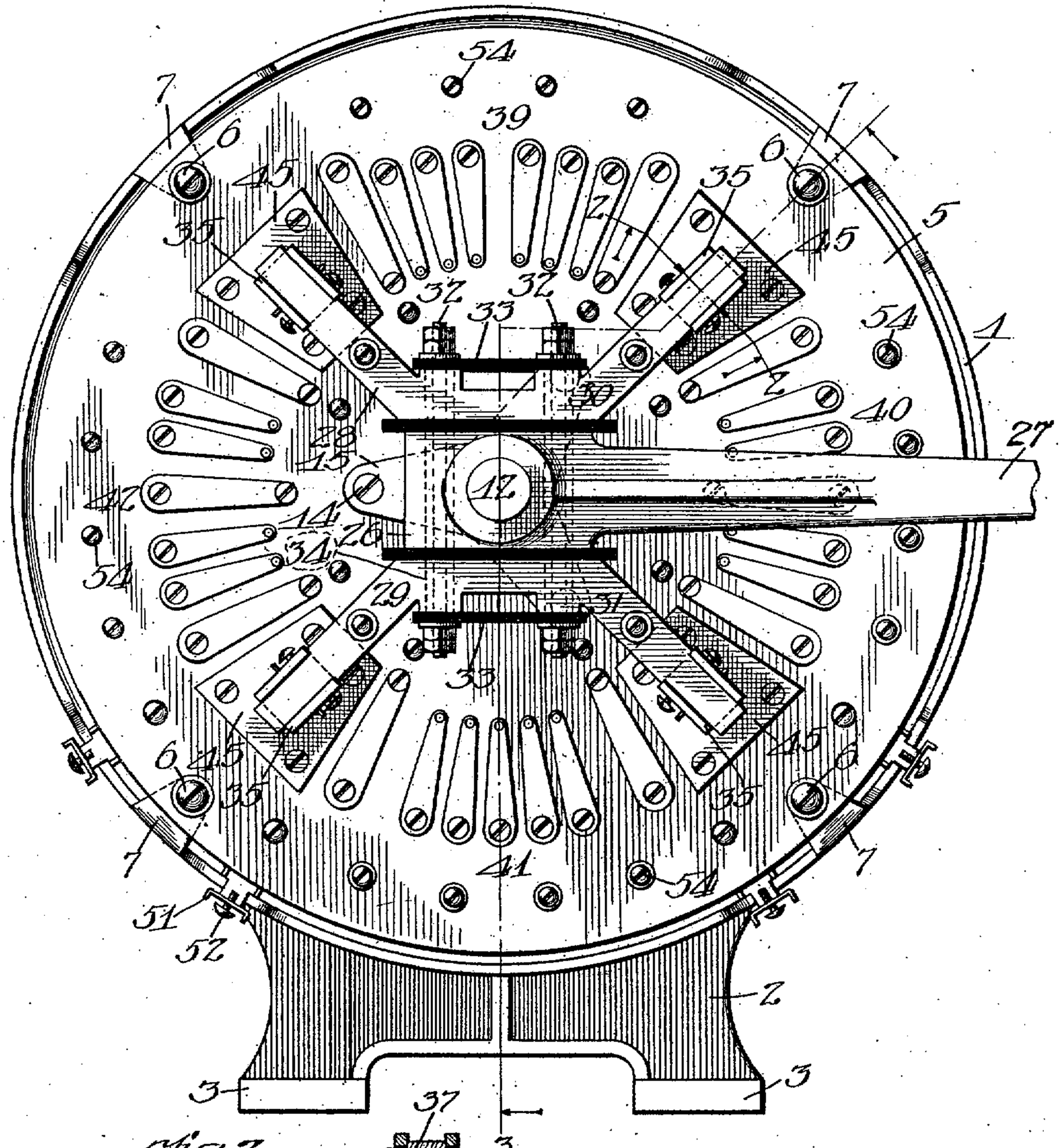

Fig. 2.

WITNESSES:

Robert A. Weir

W. Perry Haley

INVENTOR

Thomas E. Barnum

BY

Edwin B. H. Towers, Jr.

HIS ATTORNEY

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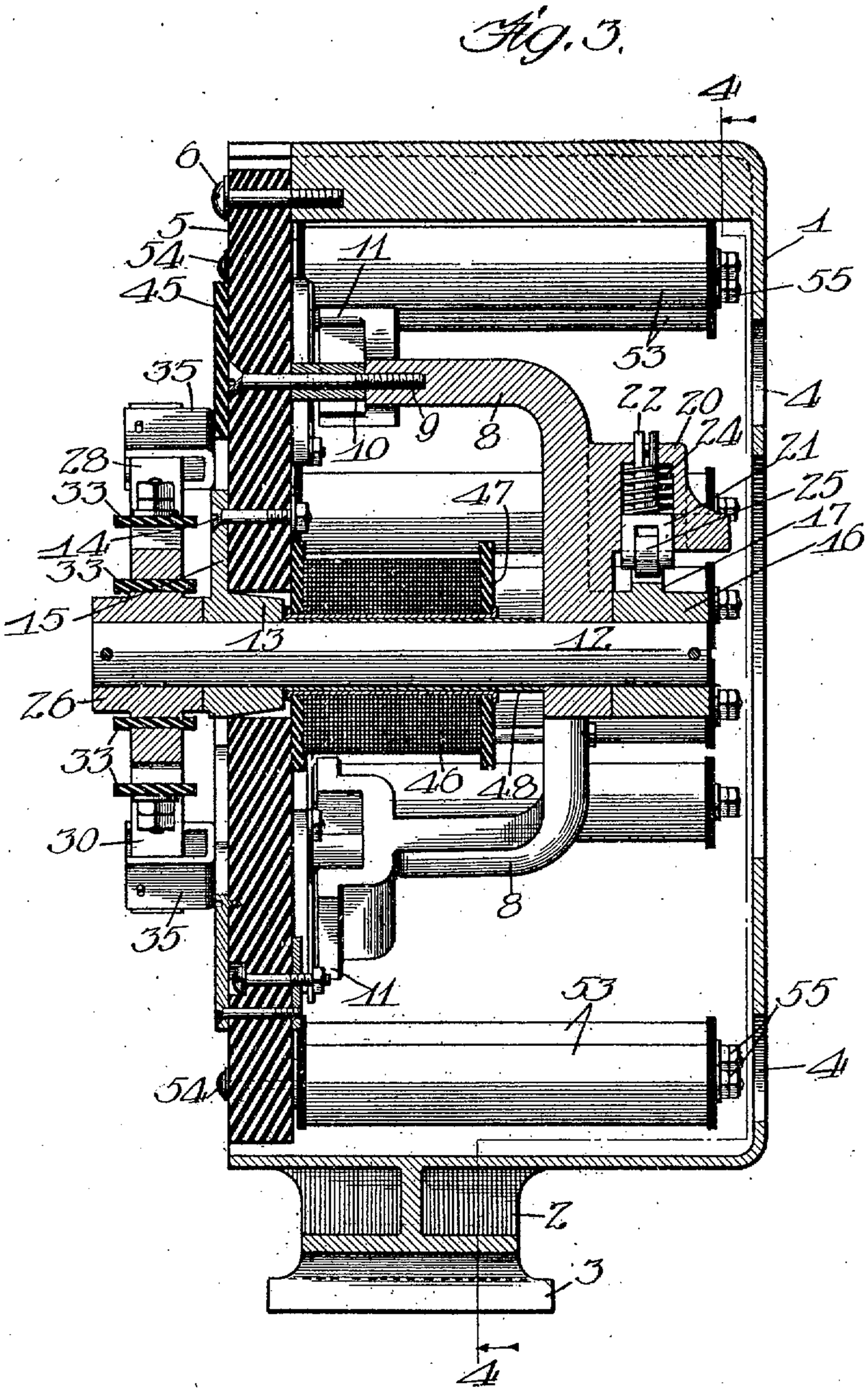
4 SHEETS—SHEET 2.

Fig. 3.



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ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

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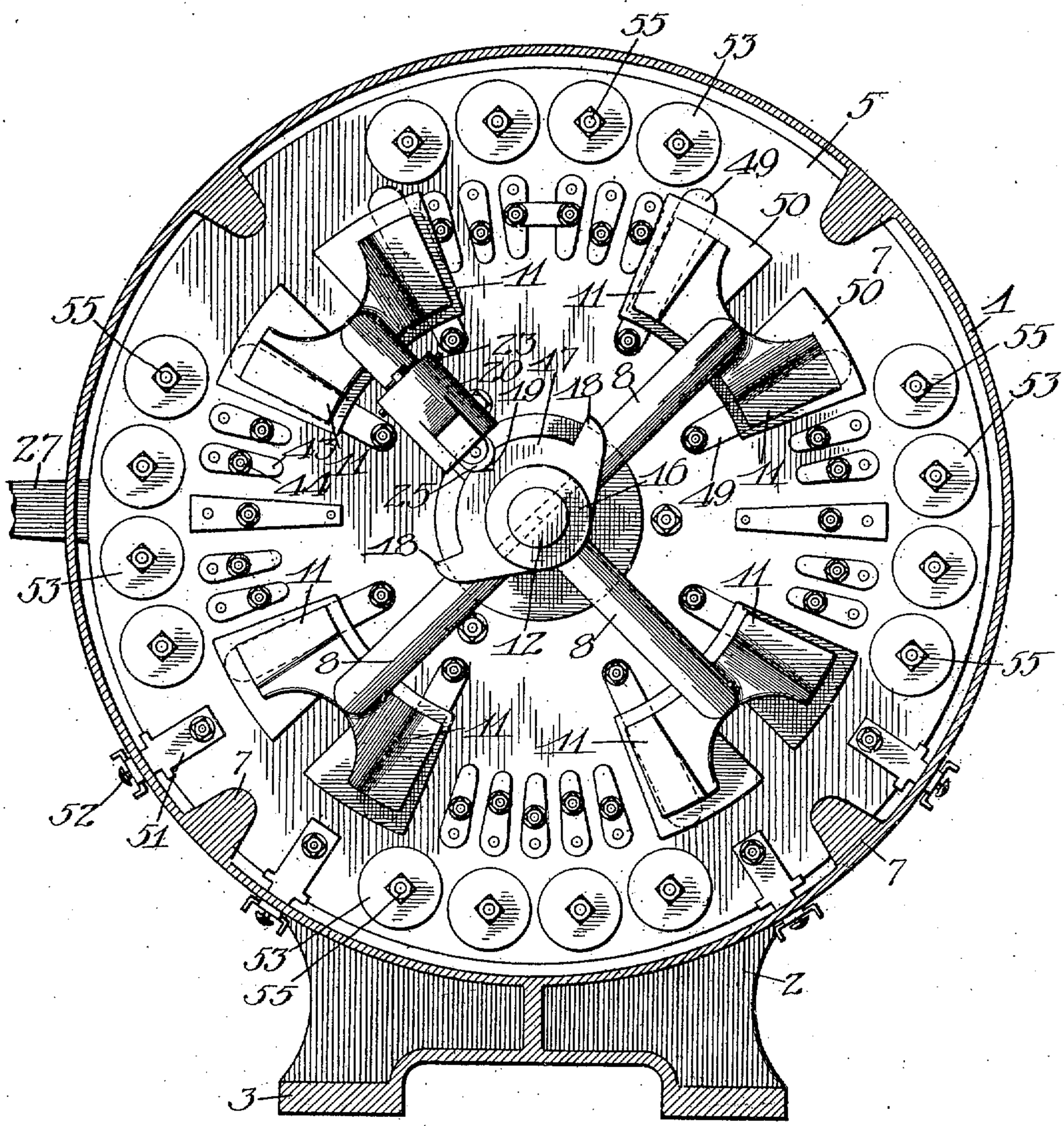
4 SHEETS—SHEET 3.

Fig. 4



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W. Perry Hahn

INVENTOR

Thomas E. Barnum

BY

Edwin B. H. Jones, Jr.

his ATTORNEY

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

T. E. BARNUM.

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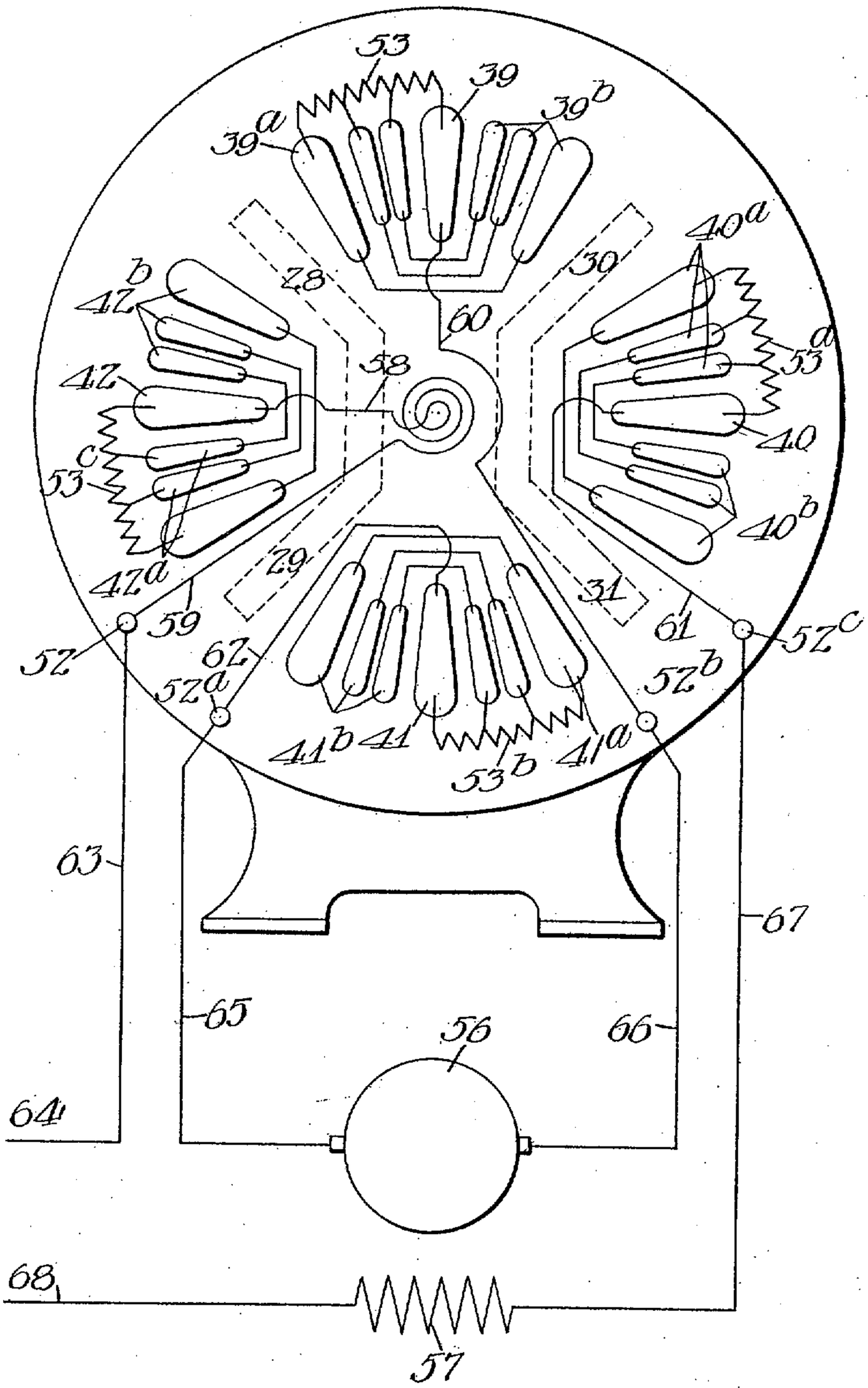
4 SHEETS—SHEET 4.

Fig. 5.



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W. Perry Haley

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BY

Edwin B. H. Towers Jr.

his ATTORNEY

UNITED STATES PATENT OFFICE.

THOMAS E. BARNUM, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

CRANE-CONTROLLER.

959,909. Specification of Letters Patent. **Patented May 31, 1910.**

Application filed August 27, 1907. Serial No. 390,305.

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 Crane-Controllers, 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 particularly applicable to controllers which perform the functions of a rheostat and reversing switch.

One of the objects of my invention is to provide a controller of the above character which will produce better results in practice than those heretofore devised, and in which the parts are simplified and may be all mounted upon a single supporting member.

For the purpose of disclosing my invention, I have illustrated in the accompanying drawings one embodiment thereof.

In said drawings: Figure 1 is a front elevation of a controller embodying my invention. Fig. 2 is a sectional view taken on the lines 2—2 of Fig. 1. Fig. 3 is a transverse sectional view of the controller taken on the lines 3—3 of Fig. 1. Fig. 4 is a rear view of the controller, the casing being in section and taken on the lines 4—4 of Fig. 3, and Fig. 5 is a diagrammatic view showing the circuit connection thereof.

For supporting the controller and inclosing various parts thereof, I provide an inclosed casing 1 preferably cylindrical in form and having a base 2, provided with legs, 3. Suitable openings are formed in the back of the casing to permit a free circulation of air about the resistance to dissipate the heat.

All of the parts of the controller are mounted upon a suitable base or face plate 5, which preferably takes the form of a circular disk formed of insulating material, such as soapstone or the like, and which is adapted to fit within the casing and be secured in position by bolts or screws 6 which pass through the face plate, and are adapted to be screwed into inwardly extending lugs 7 formed integrally with the casing 1.

Secured upon the rear of the face plate 5 is a frame which preferably consists of an integral structure made up of magnetic material and comprising four arms 8, which extend radially from a common center. These arms are equi-distant apart and at their ends extend forwardly to the face plate, screws 9 passing through the face plate and into the ends of the arms secure the frame in position on the face plate. A sleeve 10 of nonconducting material, surrounding each screw 9, is interposed between the ends of the arms and the rear of the face plate to properly space the arms face from the plate. The end of each of the arms is provided with a pair of pole pieces 11 which are preferably integrally formed on the ends of the arm.

A bearing is formed at the junctions of the arms 8 in which is supported one end of shaft 12, the opposite end of which shaft is supported in bearing or sleeve 13, which fits in a central opening in the face plate 1, and is secured in position by screws 14 that pass through radial arms 15 integral with the sleeve, and through the face plate 5. The rear end of the shaft 12 is provided with a collar 16 fastened thereto by any suitable means and bearing against the back of the frame to prevent axial displacement of the shaft. A cam 17 is preferably formed upon the collar and is provided with two stop lugs 18, one arranged at each end of an arc concentric with the axis of the shaft. The shaft may be turned through an arc corresponding to the distance to the lugs 18. The surface of the cam between the stops is provided with a notch 19 which is located midway between the stops 18. One of the arms 8 of the frame is provided with a projection 20 which is arranged in the path of the movement of the lugs 18 so that the same may strike against the projection to limit the arc through which the shaft may be turned. When the shaft stands in its initial position, each lug is equi-distant from the projection. Extending vertically through the projection 20 is a circular hole in which is arranged a slidable cylindrical block 21, having an upwardly extending tail-rod 22. In the upper portion of the circular hole a ledge is formed and above the ledge the diameter of the hole is just sufficient 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 23 to prevent the rod from turning. The cylindrical block is pressed downward by a

spring 24 surrounding the tail rod and arranged between the top of the block and the ledge. The block carries a roller 25 which engages the edge of the cam 17. When the parts of the controller are in the initial or "off" position, the roller 25 is pressed into the notch 19 in the cam and thus holds the parts against accidental movement.

The outer end of the shaft 12 carries a hub 26 from which extends a handle or lever 27 for operating the controller. The hub carries two pairs of contact arms, one pair having arms 28 and 29, and the other, arms 30 and 31. These arms extend radially and are equi-distant apart. The arms of each pair are preferably integral and are preferably made of cast iron which is adapted to serve as both an electrical and magnetic conductor. The two pair of arms are fastened to the hub by means of suitable bolts 32 and insulating material 33 is placed between arms, the hubs and the bolts, and insulating sleeves 34 surround the bolts so as to electrically insulate one pair of arms from the other. The outer ends of each of the arms preferably carry contacts which may take the form of U shaped members 35, the legs of the U being adapted to fit upon either side of the arms, and provided with slots 36 through which extend pins 37 for preventing the contacts from coming off the arms. The slots in the contacts permit a slight movement of the contacts on the arms, and springs 38 interposed between the arms and the contacts serve to maintain the contacts in close electrical engagement with the contact plates.

The face plate 5 carries four groups or sets of contacts 39, 40, 41 and 42 arranged concentrically with the axis of the shaft 12. These contacts are preferably what is known in the art as face plate or radial contacts. The four groups of contacts are arranged, one group in each of four arcs of equal length and equal radius, the several arcs being equi-distant apart and having a common center. Each contact is preferably held in place 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 43 upon the back thereof, and which preferably carry binding screws 44 by means of which electrical connection is made to the conductors and the resistance hereinafter set forth.

Each group of contacts preferably comprises a center contact and several contacts on each side of said center contact, the several contacts on each side of the center contact preferably being equal in number. In some instances, however, the center contact may comprise several electrically connected contact plates as in the group 39.

In each of the spaces between the four groups of contacts is preferably arranged an insulating block 45 upon which the contacts of the four arms are adapted to rest when the arms are in the initial or "off" position.

A blowout coil 46 is preferably mounted upon the spider or shaft 12 and takes the form of a magnetic winding, which may be wound upon a tube of brass or other non-conducting material and between end pieces 47 of insulating material. A sleeve 48 is interposed between the coil 46 and the spindle 12, whereby the spindle may turn without causing the blowout coil to turn with it.

The contact arms 28, 29, 30 and 31, and the arms 8 of the frame form pole pieces for the blowout magnets. The four contact arms and the four arms of the frame form four pairs of poles, one pair at each point where an arc forms, opening the circuit. The contact at each end of each end of contacts is preferably larger than the intermediate contacts as the circuit is opened and closed on that contact. The plate 49 to which the end contact is fastened is preferably made of magnetic material, and as before described, the outer end of each of the arms 8 is divided into two polar faces 11 one arranged back of the two magnetic plates 49. An insulating plate 50 is preferably placed over the polar faces to insulate the same from the adjacent plates 49.

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 the contact arm has been moved. This arc is extinguished by the magnetic flux that passes between the pole pieces formed by the contact arm and a corresponding arm of the frame. The circuit or path of the magnetic flux that is created by the blowout coil extends from the shaft 13, through the radial arms 8 of the frame, thence across the arc zone, to one of the contact arms, 28 for instance, and back through said arm to the shaft 6.

In the structure shown in the drawing the circuit is broken at four points when the contact arms are returned to initial position. The contact arms and the radial arms of the frame form pairs of poles for the blowout coil at each of these points. 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 magnetic flux the flux is distributed at points where it will be most effective in extinguishing arcs that occur upon the opening of the circuit.

A plurality of plates 51 are secured upon the face plate, carrying binding screws 52 by which the controller is connected to the motor and to a source of electrical energy.

Mounted upon the rear of the faceplate

are a plurality of resistance units 53 which may take most any desired form, but the preferable form that I use comprises a tube or spindle of porcelain upon which the resistance wires are wound, and a suitable inclosing casing. The resistance units are secured upon the rear of the face plate by means of bolts or screws 54 which extend through the face plate and through the units, suitable nuts 55 being provided upon the ends of the bolts for holding the units in position. These resistance units may be arranged upon the face plate in any desired manner, but I have illustrated them in the present form, as being arranged in groups of three or four, each group being placed in an arc concentric with the arcs of the groups of contacts. By this arrangement the resistance units are placed where they take up minimum amount of space.

The circuit relations of the parts of my controller are illustrated in Fig. 5, and I shall now describe the same. The controller may be used for controlling a suitable motor having an armature 56 and a series field 57. It will of course be understood that my device is adaptable to control other forms of motors as well as the form herein. In order to distinguish certain parts of the controller from one another in describing the various circuits, I shall use letters as exponents of the reference numerals that I have heretofore used.

In each group of contacts 39, 40, 41 and 42, each contact on one side of the center contact is electrically connected to the corresponding contact on the other side of the center contact by a cross connector. For example in the group of contacts 39 each contact 39^a is electrically connected with its corresponding contact 39^b. The contacts 39^a and 39^b are thus electrically connected in pairs. Each group of contacts is connected to a resistance which is divided in sections or steps, the number of steps being equal to the number of pairs of contacts. One end of the resistance is connected to the center contacts and the other end to the outer or end pair of contacts, intervening sections of resistance being connected to the intermediate pair of contacts. The second section is connected between the second pair of contacts and the third pair of contacts and so on until the last section is connected between the fourth pair of contacts and the center contact. It will be noted that each group of contacts is electrically independent of the other groups. The center contact 42 is connected by a conductor 58 to the outer terminal of the blowout coil 46. The inner terminal of the coil is connected through conductor 59 to the binding post 52. The center contact 39 is connected by a conductor 60 to the binding post 52^b. The center contact 40 is connected by the conductor 61 of the binding post 52^c and the center contact 41 is connected by conductor 62, with the binding post 52^a. The binding post 52 is connected by conductor 63 with the positive side 64 of the line. One terminal of the armature 56 is connected by conductor 65 with the binding post 52^a, and the other terminal of the armature is connected by conductor 66 with the binding post 52^b. One terminal of the field 57 is connected by conductor 67 to the binding post 52^c, and the other terminal of the field winding is connected with the negative side 68 of the line.

As previously stated the contact arms are divided into two pairs, each pair being electrically insulated from the other, and the arms of each pair being preferably made integral so as to electrically connect the contacts carried at the ends thereof. It will be noted that four movable contacts electrically connected in two pairs are thus provided, and that these contacts are adapted to pass one over each group of stationary contacts. Of course, it will be understood that I may electrically connect the four movable contacts in two pairs in a different way than that which I have shown.

If the contact arms be moved clock-wise, the arm 28 will move over the contacts 39^a and arm 29 will move over the contacts 42^a. The arm 30 will move over the contacts 40^a and the arm 31 will move over the contacts 41^a. 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 positive line 64 by conductors 63 and 59, through the blowout coil 46 by conductor 58, center contact 42, resistance 53^c, first contact 42^a, arm 29, arm 28, first contact 39^a, resistance 53, center contact 39, conductors 60 and 66, armature 56, conductors 65 and 62, center contact 41, resistance 53^b, first contact 41^a, arm 31, arm 30, first contact 40^a, resistance 53^a, center contact 40, conductors 61 and 67, through the field winding 57 and thence to the negative side 68 of the line. As the arms pass over the successive contacts, the resistances will be removed from circuit, step by step, and when the arms reach the center contacts, all of the resistance will have been removed from circuit, and the motor will be running at full speed.

If the arms be turned in a counter clockwise direction, the arm 28 will pass over contacts 42^b, the arm 29 over contacts 41^b, the arm 30 over contacts 39^b, and the arm 31 over contacts 40^b. When each arm engages the first contact, circuit will be closed from the positive line 64, by conductors 63 and 59, through the blowout coil 46, conductor 58, center contact 42, resistance 53^c, end contact 42^b, arm 38, arm 29, end contact 41^b, resistance 53^b, center contact 41 conductors 62 and 65, through the armature 56, conduc-

tors 55 and 60, center contact 39, resistance 53, end contact 39^b, arm 30, arm 31, end contact 40^b, resistance 53^a, center contact 40, conductors 61 and 67, through the field winding 57, and thence to the negative side 68 of the line. Accordingly current will flow through the armature in an opposite direction to that which it would when the arms were moved clock-wise, and therefore the motor will be started in a reverse direction. As the arms pass over the contacts 42^b, 41^b, 40^b and 39^b, the resistance will be removed from circuit, step by step, and when the arms have reached the center contacts all of the resistance will have been removed from circuit and the motor will be running at full speed in reverse direction.

Inasmuch as contacts 42 and 40 are positive and negative respectively, as the contacts 39 and 41 are connected to the opposite terminals of the armature, and as the contacts 41 and 40 may be connected by the arms 30 and 31 and contacts 39 and 42 by arms 28 and 29 or the contacts 39 and 40 may be connected by the contacts 30 and 31 and contacts 41 and 42 by contacts 28 and 29, the controller is enabled to perform the function of a reversing switch as well as that of a controller.

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

1. In a controller, the combination with a face plate, of a plurality of sets of circumferentially arranged contacts, the contacts of each set being electrically connected in pairs, and each set of contacts being electrically independent of the other sets of contacts, a resistance mounted on said face plate and connected to each set of contacts, said resistance being divided into sections and each section being electrically connected to a pair of contacts, and movable contacts mounted on said face plate, and arranged to pass over said sets of contacts.

2. In a controller, the combination with a casing, of a face plate set therein, a plurality of sets of circumferentially arranged contacts mounted on said face plate, the contacts of each set being electrically connected in pairs, and each set of contacts being electrically independent of the other sets of contacts, a resistance mounted on said face plate and within said casing connected to each set of contacts, said resistance being divided into sections and each section being electrically connected to a pair of contacts, and movable contacts mounted on said face plate arranged to pass over said sets of contacts.

3. In a motor controller, in combination, a face plate, four sets of face plate contacts arranged thereon, said contacts being arranged one in each of four arcs equi-distant apart on the same circumference, two diametrically opposite sets being electrically connected to the terminals of the line, and the other two diametrically opposite sets being electrically connected to the terminals of the motor, cross connections connecting the contacts of each set in pairs, each set of contacts being electrically independent of the other sets of contacts, a resistance mounted on said face plate and connected to each set of contacts, and four contact arms forming two pairs of arms mounted on said face plate the arms of each pair being integral, and said arms being adapted to pass one over each set of contacts.

4. In a controller, in combination, a face plate, a plurality of sets of circumferentially arranged contacts, the contacts of each set being electrically independent of the other sets of contacts, a plurality of resistance units mounted upon said face plate and connected to each set of contacts, and movable contacts carried on said face plate arranged to pass over said sets of contacts.

5. In a motor controller, in combination, a face plate, four sets of face plate contacts arranged thereon, said sets of contacts being arranged one in each of four arcs equidistant apart upon the same circumference, two diametrically opposite sets being electrically connected to the terminals of the line, and the other two diametrically opposits sets being electrically connected to the terminals of the motor, cross connections connecting the contacts of each set in pairs, each set of contacts being electrically independent of the other sets of contacts, a plurality of resistance units for each set of contacts mounted upon said face plate, and four contact arms forming two pairs of arms mounted on said face plate, the arms of each pair being integral and said arms being adapted to pass over each set of contacts.

6. In a motor controller, in combination, a face plate, a plurality of sets of contacts mounted on one side thereof, a rotatable contact member having a plurality of radial arms for engaging said set of contacts, a blowout coil arranged on the opposite side of said face plate substantially concentric with the axis of said rotatable contact member, and a frame carried by said face plate on the same side with said blowout coil, said frame having a plurality of radial arms forming pole pieces for said blowout coil, the arms of said frame corresponding in number to said sets of contacts and having their extremities disposed opposite to the contacts at which circuit is broken.

7. In a motor controller, in combination, a face plate, a plurality of sets of stationary contacts mounted on one side of said face plate, a magnetic frame mounted on the opposite side of said face plate and having a plurality of radially disposed arms, each of said arms having its extremity disposed

opposite to the end contacts of two adjacent sets of contacts, a rotatable contact member having radial arms for engaging said sets of contacts, said member being movable in opposite directions to cause said arms to engage different sets of contacts and a blowout coil arranged between said face plate and said frame and substantially concentric with the axis of said contact member and said frame.

8. In a controller, in combination, a face plate, a frame having four radial arms arranged in the rear of and carried by said face plate, four radial contact arms arranged on the front of said face plate and journaled on a suitable bearing carried by said face plate, four sets of stationary contacts mounted upon said face plate and arranged one in each of four arcs equi-distant apart on the same circumference and concentric with the axis of said contact arm, and a blowout coil arranged substantially concentric with the axis of said contact arms, said contact arms and the arms of said frame forming pole pieces of said blowout coil.

9. In a controller, in combination, a casing, a face plate arranged to fit within said casing, a frame having four radial arms arranged in the rear of and carried by said face plate, four radial contact arms arranged in front of said plate and journaled in suitable bearings carried by said plate, four sets of stationary contacts arranged one in each of four arcs equi-distant apart on the same circumference and concentric with the axis of said contact arms, and a blowout coil arranged substantially concentric with the axis of said contact arms and within said casing, said contact arms and the arms of said frame forming pole pieces of said blowout coil.

10. In a motor controller, a combination, a face plate, four sets of face plate contacts arranged thereon, said sets of contacts being arranged one in each of four arcs equi-distant apart on the same circumference, two diametrically opposite sets being electrically connected to the terminals of the line and the other two diametrically opposite sets being connected to the terminals of the motor, cross connections connecting the contacts of each set in pairs, each set of contacts being electrically independent of the other sets of contacts, a plurality of resistance units for each set of contacts mounted upon the rear of said face plate, four contact arms forming two pairs of arms, the arms of each pair being integral and said arms being adapted to pass over each set of contacts, a frame having four radial arms mounted upon the rear of said face plate, and a blowout coil arranged substantially concentric with the axis of said contact arms, said contact arms and the arms of said frame forming pole pieces of said blowout coil.

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

THOMAS E. BARNUM.

Witnesses:

WALTER E. SARGENT,

OSCAR A. KELLER.