

Sept. 9, 1924.

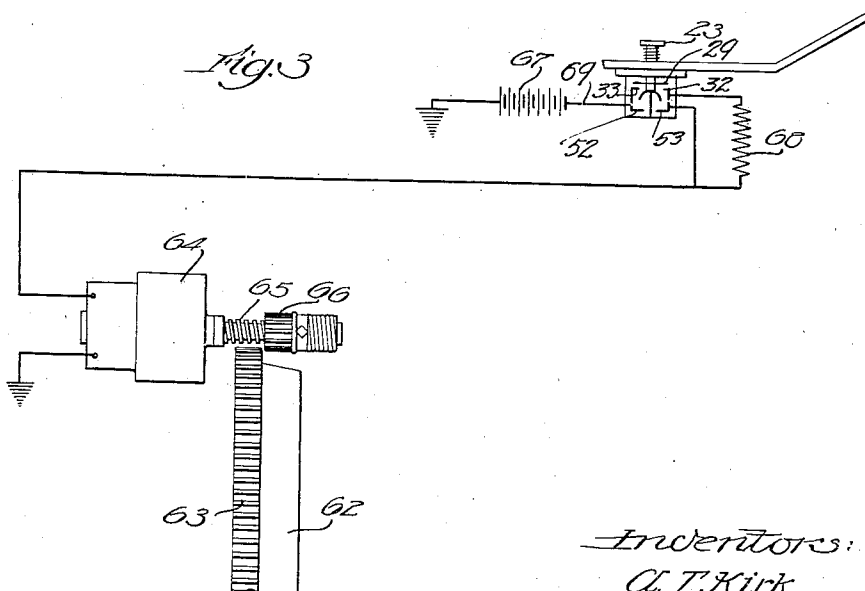
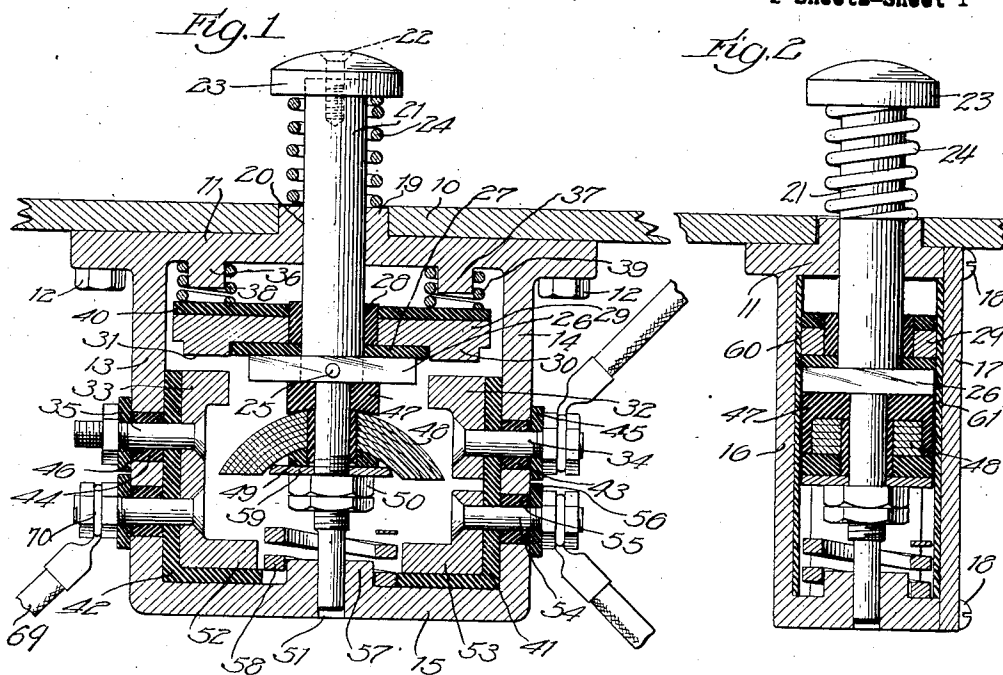
A. T. KIRK ET AL

1,507,741

STARTER MOTOR CONTROLLING MEANS

Filed Feb. 3, 1922

2 Sheets-Sheet 1



Inventors:

A. I. Kirk

W.T.Kirk

O.E. Barber

By William Bradbury O.E. Barber
McCulloch & Pierce attys.

Sept. 9, 1924.

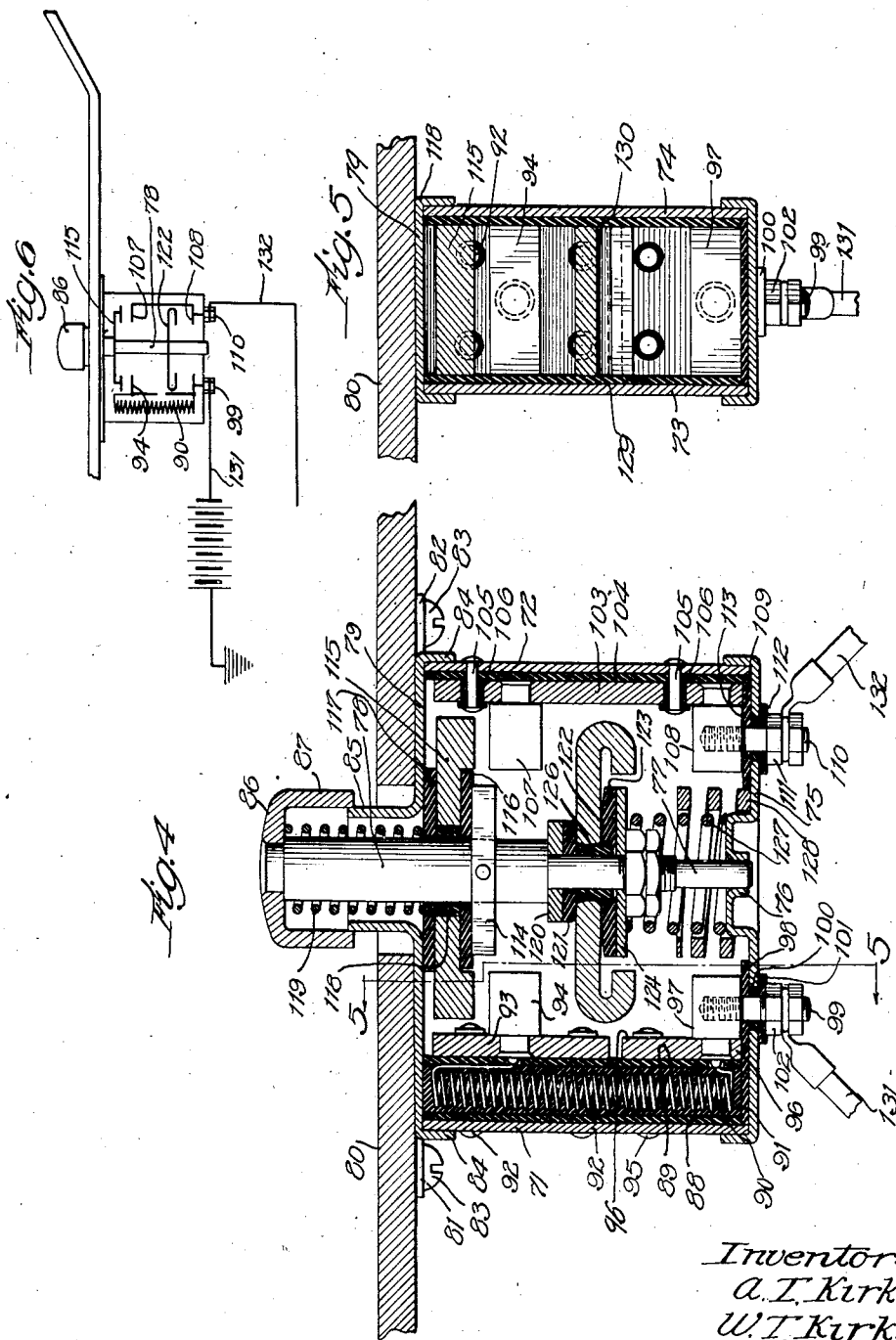
1,507,741

A. T. KIRK ET AL

STARTER MOTOR CONTROLLING MEANS

Filed Feb. 3, 1922

2 Sheets-Sheet 2



Inventors:

A. T. Kirk.

W. T. Kirk.

O. E. Barber.

Williams Readbury
McCauley & Pierce Attys.

UNITED STATES PATENT OFFICE.

ALLEN T. KIRK, WILLIAM T. KIRK, AND ORREN E. BARBER, OF CHICAGO, ILLINOIS.

STARTER-MOTOR-CONTROLLING MEANS.

Application filed February 3, 1922. Serial No. 533,849.

To all whom it may concern:

Be it known that we, ALLEN T. KIRK, WILLIAM T. KIRK, and ORREN E. BARBER, citizens of the United States, and residents of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Starter-Motor-Controlling Means, 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.

This invention relates to an improved circuit for a starting motor for an automobile, and also to the circuit controlling apparatus for carrying out the functions of the circuit. In starting motors of the type in which the driving gear is caused to mesh with the driven gear, due to the initial rotary movement of the starter motor shaft, it has been found that when the circuit is closed through the motor winding, the shaft starts to rotate with such velocity and power that when the gears are brought into mesh, due to the rotary movement of the shaft, the teeth of the gears are oftentimes broken, thus making necessary undesirable delays and expensive replacements.

The object of the present invention is to provide a circuit controlling device and a circuit for starter motors of this type which will avoid the undesirable features above noted.

One of the features of the present invention is the provision of a circuit and controlling means therefor, which will cause a limited supply of electrical energy to be furnished to the starting motor during its initial or gear meshing operation, and upon a subsequent movement of the circuit controlling device will cause the full energy of the battery to be supplied to the motor to cause the motor to turn the engine over.

Another feature of the invention is the provision of means in the circuit controlling device which will tend to cause a pause between the initial operation of the circuit controlling device or switch, and the subsequent operation by means of which the full current of the battery is supplied to the starter winding.

A still further feature of the invention is

the provision of means which tend to prevent excessive sparking of the switch contacts carrying the full current from the battery at the time the contacts are opened.

Other features and advantages of the invention will appear from time to time as the description of the invention progresses.

In the drawings—

Figure 1 shows a transverse section through the floor board or toe board of an automobile, and applicants' circuit controlling device, or switch attached thereto.

Figure 2 is a section through the switch substantially at right angles to Figure 1;

Figure 3 is a circuit diagram schematically indicating the circuit connections for the starter and switch;

Figure 4 is a transverse section through the toe board of an automobile, and a modified form of controlling device;

Figure 5 is a section on the line 5—5 of Figure 4, and

Figure 6 is a circuit diagram indicating the circuit connections for the modification of Figures 4 and 5.

Referring now to the drawings, 10 indicates the floor or toe board of the automobile, to which is secured the framework or housing of the switch. This housing is a box-like structure comprising the plate 11 arranged to be secured to the floor board 10 by means of the bolts or screws 12, the end plates 13, 14, the bottom plate 15, and the side plate 16, all integral with the plate 11, and the removable side cover plate 17, adapted to be secured in position by means of the screws 18.

The plate 11 is provided with an upwardly extending boss 19 which is received in an opening in the floor board. Extending through the boss 19 and the adjacent portion of the plate 11 is a bearing 20, through which the operating plunger 21 of the switch is longitudinally movable. Secured to the upper end of the plunger 21 by means of a screw 22, or any other desired manner, is the plate 23 adapted to be engaged by the foot of the user in the operation of the switch. Surrounding the plunger 21, and positioned between the boss 19 and the plate 23 is a spiral spring 24, which normally tends to maintain the plunger in

its raised position as shown in Figures 1 and 2.

Secured to the plunger 21 about midway of its length, as by the pin or set screw 25, is a collar or washer 26. Mounted about the plunger 21, above the collar 26 is a washer 27 and collar 28, both of any suitable insulating material. Mounted about the collar 28 is the conducting element 29 provided with the contacts 30 and 31, arranged to engage the fixed contacts 32 and 33 respectively, which are secured to the end walls 14 and 13 respectively by means of the bolts 34 and 35.

The plate 11 is provided with downwardly extending lugs 36 and 37 about which are positioned the coil springs 38 and 39, which normally tend to force the contacts 30 and 31 into engagement with the fixed contacts 32 and 33. A strip 40 of insulating material is provided between the switching element 29 and the ends of the springs 38 and 39.

While the springs 38 and 39 normally tend to force the contacts 30 and 31 downwardly, this downward movement, when the switch is at rest, is opposed by the stronger spring 24, and the switch elements are normally retained in a position such as indicated in Figure 1, in which all the contacts are open. The fixed contacts 32 and 33 are insulated from the end plates 14 and 13 respectively by the L-shaped strips 41 and 42 of insulating material. The clamping bolts 34 and 35 are also insulated from the end plates 14 and 13 by means of the insulating collars 43 and 44, and the insulating washers 45 and 46.

The plunger 21 below the washer 26 is reduced in diameter, and positioned thereabout is the insulating block 47. Positioned about the inner portion of the block 47 is the central portion of the curved strips 48 of conducting material. The strips 48 are maintained in position by being clamped between the block 47 and the insulating washer 49 by means of the nut 50 screw-threaded on the plunger. The end of the plunger 21 remote from the toe plate 23 is slidably received by the opening or bearing 51 in the bottom plate 15.

Arranged in a position to be simultaneously engaged by the opposite ends of the conducting strips 48 are the fixed contacts 52 and 53. The contact 52 is formed integral with the contact 33. Contact 53, however, is electrically separated from the contact 32 and is secured to the end plate 14 by means of the bolt 54, which is insulated from the end plate by means of the collar 55, and washer 56 both of insulating material.

Positioned about the boss 57 which forms part of the bearing 51 is a relatively heavy coiled spring 58. This spring preferably is

made rectangular in cross-section as is the material of a lock washer. The spring 58 is of such a length that when the plunger 21 is moved downwardly the spring will be engaged by the washer 59 fixed on the plunger between the nut 50 and the insulating collar 49, just before the conducting strips 48 engage the contacts 52 and 53.

Thus, in the operation of the device, the user will place his foot upon the plate 23 and press downwardly, causing the contacts 30 and 31 to engage the fixed contacts 32 and 33 respectively. This first movement of the plunger will be brought about by a comparatively light pressure upon the plate 23. However, after the contacts 30 and 31 are brought into engagement with the contacts 32 and 33, but before the strips 48 become effective, to bridge contacts 52 and 53, the washer 59 will come into engagement with the end of spring 58, thus tending to stop the downward movement of the plunger, which may be brought about by a relatively light pressure and necessitating a comparatively heavy pressure on the plate 23 to cause the strips 48 to engage the contacts 52 and 53. Between the plates 16 and 17 and the operating members of the switch are the sheets 60 and 61 which operate to prevent the electrical engagement of any of the movable switching elements with the housing.

Referring now to Figure 3, 62 indicates a flywheel or other movable part of the motor, attached to which is the starting gear wheel 63. At 64 is indicated a starting motor, having the shaft 65 formed with spiral grooves or threads external to the motor upon which is mounted the motor gear wheel 66 adapted to mesh with the gear 63 upon the initial rotation of the shaft 61, as is usual with starting apparatus of this character. The illustration of the starting motor and adjacent engine parts is purely schematic, the only feature to be noted being that applicants' invention is adapted to be applied to a starting mechanism in which the initial rotation of the starter shaft causes the driving gear on the starter shaft to be brought into mesh with the driven gear.

At 67 is indicated the usual storage battery employed in starting and lighting systems. One pole of the battery is grounded or connected to the frame of the machine. The other pole is connected to contacts 33 and 52, by means of conductor 69 and binding post 70. One end of the starter motor winding is grounded, the other end of the winding being connected directly to contact 53, and to contact 32 through the resistance 68.

When the operating plunger 21 is depressed by the user, contacts 30 and 31 will engage contacts 32 and 33, thus complet-

ing the circuit from grounded battery through the contacts in series with resistance 68 and the winding of the starting motor back to ground, or the frame of the machine. Shortly after the contacts 30 and 31 have been brought into engagement with contacts 32 and 33, the washer 59 is caused to engage the end of the heavy spring 58. This will ordinarily cause a sufficient pause in the downward movement of the plunger to permit the relatively light current flowing through the resistance 68 to rotate the starting motor shaft sufficiently to cause engagement of the driving gear 66, with the driven gear 63. Due to the resistance 68 in this preliminary circuit, the shaft 65 will not be rotated with enough force to cause damage to the gear teeth when they are brought into engagement.

The user noting the increased resistance on the plunger 21 will now press downwardly with increased force, and cause the strips 48 to bridge the contacts 52 and 53, thus permitting the full voltage of the battery to flow to the starting motor winding. During the time the contacts 52 and 53 are bridged by the strips 48, contacts 30 and 31 will still be in engagement with contacts 32 and 33, but practically no current will flow through contacts 30 and 31, at this time, as the resistance in series with them is short circuited by the practically no-resistance path, including contacts 52 and 53.

Upon removal of pressure from the plate 23, the engagement of strips 48 with the contacts 52 and 53 is first broken. Excessive arcing at these contacts is prevented by the fact that they are in parallel with the circuit through contacts 30 and 31 in series with resistance 68. An instant later, the circuit through the contacts 30 and 31 is interrupted, but due to the relatively small amount of current flowing through the contacts 30 and 31, no detrimental spark will occur, due to breaking this circuit.

In the form of the device shown in Figures 1 to 3, the resistance 68 may be located at any convenient point as on the instrument board of the machine. The form shown in Figures 4, 5 and 6 has exactly the same function as the arrangement of Figures 1, 2 and 3, but differs therefrom in certain details of construction, and further in the fact that the resistance has been mounted within the switch housing, thus necessitating only two binding posts or connection terminals on the outside of the switch. Due to this arrangement, there is no danger of the switch being improperly connected to the circuit. All that is necessary is to connect one of the binding posts to the ungrounded pole of the battery, and the other binding post to the ungrounded side of the starting motor winding.

In Figures 4 and 5, 71 and 72 represent

the end walls, and 73 and 74 the side walls of a portion of the housing. Parts 71 to 74 inclusive are in the form of a rectangular tube open at both ends. The lower end of the housing tube is closed by means of the cover plate 75 provided with the boss 76 having a perforation therein through which extends the reduced end 77 of the plunger member 78. The upper end of the housing is closed by the cover plate 79 which is held in position by being clamped against the toe board 80. The end members 71 and 72 are provided at the upper ends thereof with right angularly extending flanges 81 and 82 adapted to receive the screws or bolts 83, by means of which the switch may be secured to the toe board 80. The flanges 81 and 82, it will be understood, project through portions cut away from the downwardly extending flanges 84 of the cover member 79.

The cover plate 79 is provided with the annular flange 85 which extends upwardly through an opening in the toe board 80. The plunger 78 at the upper end thereof is provided with the cup-shaped plate 86 having the downwardly extending flange 87 adapted to engage the outer surface of flange 85. In engagement with the end member 71 is an insulating strip 88, and spaced therefrom is a second insulating strip 89. Between the strips 88 and 89 is positioned the resistance coil 90. The space about coil 90 is preferably filled in by insulating material 91 which may be poured in in a molten condition.

Secured to the inner side of the insulating strip 89, by means of the bolts or rivets 92, is a metallic strip 93, to which is secured, in any desired manner, a contact terminal 94. One end of the resistance coil 90 is conductively connected to the contact 94. Also secured to the inner surface of the strip 89, by means of the bolts or rivets 95, is a metal strip 96 to which is secured the contact member 97. Projecting from the lower side of the contact 97 and through aligned openings in the insulating strip 98 and the cover member 75 is a screw threaded lug 99. On the lug 99 is an insulating collar 100 and an insulating washer 101 which is engaged by the clamping nut 102, thus serving to assist in maintaining the cover plate 75 in position.

Secured to the end 72 of the housing is a conducting strip 103. Between the strip 103 and the end member 72 is an insulating strip 104, the whole being secured together by means of the bolts or rivets 105 which are insulated from the metallic strip 103 by means of the collars 106. Secured to the strip 103, in any desired manner, are the contacts 107 and 108. Projecting downwardly from the contact 108 through aligned openings in the insulating strip 109 and

the cover plate 75, is a screw threaded lug 110, the cover plate 75 being clamped in position by means of the nut 111. Lug 110 and nut 111 are insulated from the housing by means of the insulating washer 112 and the insulating collar 113.

Fixed to the plunger 78, in any desired manner, is a collar 114. Loosely mounted on the plunger 78 above the collar 114 is the contact bridging member 115, upon opposite sides of which are insulating washers 116 and 117, respectively. A collar 118 of insulating material is provided between the plunger 78 and the contact bridging member 115. Positioned about the plunger 78 and between the washer 117 and the plate 86 is a coil spring 119. Upon depression of the plunger 78, as hereinafter described, the contact bridging member 115 is adapted to engage and conductively join contacts 94 and 107.

Positioned about the reduced portion of the plunger 78 is a metallic washer 120 and a washer 121 of insulating material. Also mounted about the reduced portion of the plunger 78 is a contact bridging member 122, an insulating washer 123, and a metallic washer 124, the parts 120 to 124 inclusive being firmly secured to the plunger by means of the nuts 125. The contact bridging member 122 is spaced from the plunger by means of the insulating collar 126.

About the reduced portion 77 of the plunger is a compression coil spring 127 which has one end in engagement with the washer 124, and the other in engagement with the end member 75. This spring tends to normally maintain the switching parts in their upper or normal position. Positioned above the boss 76 is a coil spring 128. Spring 128 is of heavy construction in cross section, such as a lock washer. The side walls 73 and 74 of the housing are lined with the insulating strips 129 and 130, respectively.

The operation of the modification of Figures 4 and 5, as before stated, is substantially the same as that of Figures 1 and 2. On the plunger being depressed by the foot of the operator against the tension of the spring 127, the contact bridging member 115 is forced downwardly by spring 119, causing it to engage contacts 94 and 107, thus completing a circuit from conductor 131, through the binding post lug 99, contact 97, resistance coil 90, which is secured to plate 96, strip 98, contact 94, bridging contact member 115, contact 107, strip 103, contact 108, binding post lug 110, to conductor 132.

As above stated, it is immaterial which of conductors 131 or 132 is connected to the ungrounded pole of the battery so long as the other one is connected to the ungrounded side of the motor winding.

Further depression of the plunger 78 is

resisted to a slight extent by the spring 119 which acts to maintain the bridging member 115 firmly in engagement with contacts 94 and 97. As the downward movement of the plunger continues, washer 124 engages the upper end of the stiff spring 128 just before bridging member 122 engages contacts 97 and 108. This engagement with the spring 128 tends to momentarily retard the downward movement of the plunger, thus giving the motor time to rotate sufficiently to cause the driving gear to mesh with the driven gear. The operator will now exert a harder pressure on plate 86, causing the member 122 to bridge the contacts 97 and 108, thus permitting the entire battery potential to be supplied to the starter motor winding.

While in the above description and in the drawings certain definite embodiments of the invention have been disclosed, it is obvious that many modifications in the structure of the circuit controlling device would suggest themselves to one skilled in the art, also in the circuit arrangement controlled thereby. For instance, instead of having the first set of contacts close a circuit including a resistance in series with the winding, an obvious but less desirable manner would be to have these contacts close a circuit from some middle point in the battery and arrange the strips 48 to close a circuit, including the entire battery, the first set of contacts, of course, being opened at the instant the second set are closed to avoid short circuiting a portion of the battery. Other modifications and variations will suggest themselves to those skilled in the art.

The essential feature of this invention, however, is the arrangement which, upon the initial movement of the controlling device, closes a circuit to supply to the starter motor winding current of less potential than is supplied to the starter winding when the second set of contacts are closed, and means which will indicate to the user in some manner or other when the first set have been closed and prior to the closure of the second set. This indicating means will preferably be in the form of an increased resistance, which will cause a momentary pause in the downward or inward movement of the circuit controlling plunger. It is to be understood, therefore, that the invention is to be limited merely by the scope of the appended claims.

What I claim is new and desire to secure by Letters Patent of the United States is:

1. In a circuit controlling device, an operating member, a set of contacts, a second set of contacts, the contacts of said sets respectively being arranged to be brought successively into engagement upon continuous movement of said member, and means made operative after the contacts of the first set are in engagement and prior

to the engagement of the contacts of the second set for indicating to the operator that the first set of contacts are in engagement.

2. In a circuit controlling device, an operating member, a set of contacts, a second set of contacts, the contacts of said sets respectively being arranged to be brought successively into engagement upon continuous movement of said member, and means made operative after the contacts of the first set are in engagement tending to delay the engagement of the second set of contacts.

3. In a circuit controlling device, an operating member, a set of contacts, a second set of contacts, the contacts of said sets respectively being arranged to be brought successively into engagement upon continued movement of said member, and resilient means made operative after the engagement of the contacts of the first set and before the engagement of the contacts of the second set for resisting the further movement of said operating member.

4. In a circuit controlling device, an operating member, a set of contacts, a second set of contacts, the contacts of said sets respectively being arranged to be brought into engagement successively upon continued movement of said member, and a spring arranged to be engaged by said operating member after the engagement of the contacts of said first set, but before the engagement of the contacts of the second set, for resisting the further movement of said operating member.

5. In a circuit controlling device, a longitudinally movable operating member, a pair of fixed contacts, a movable contact member adapted to electrically connect said fixed contacts, resilient means normally tending to force said movable contact member toward said fixed contacts, and resilient means engaging said operating member normally maintaining said contact member out of engagement with said fixed contacts.

6. In a circuit controlling device, a longitudinally movable operating member, a pair of fixed contacts, a movable contact member adapted to electrically connect said fixed contacts, resilient means normally tending to force said movable contact member toward said fixed contact, resilient means engaging said operating member normally maintaining said contact member out of engagement with said fixed contacts, a second set of contacts, a contact member adapted to electrically join the contacts of said second set, and a spring arranged to be engaged by said operating member just prior to the engagement of said second mentioned contact member with the second pair of fixed contacts.

7. In a circuit controlling device, an op-

erating member, a pair of independent fixed contacts, a pair of movable contact members adapted to electrically engage said fixed contacts respectively, resilient means normally tending to force one of said movable contact members into engagement with its respective fixed contact, and resilient means engaging said operating members for normally maintaining said contact member out of engagement with said fixed contacts.

8. In a circuit controlling device, a movable contact operating member, a fixed contact, a movable contact member adapted to electrically engage said fixed contact, resilient means normally tending to force said movable contact member toward said fixed contact, resilient means engaging said operating member for normally maintaining said contact member out of engagement with said fixed contact, a second fixed contact, a second movable contact member adapted to engage said second fixed contact, and a spring arranged to be engaged by said operating member just prior to the engagement of said second-mentioned contact member with the second fixed contact.

9. In a circuit controlling mechanism, a housing, a pair of terminal or binding posts on said housing, a pair of stationary contacts, a pair of movable contacts and a resistance all within said housing, one of the stationary contacts being joined direct to one of said binding posts and the other fixed contact being joined to the said binding post through said resistance, an actuating member arranged to bring the said movable contacts successively into engagement with said fixed contacts respectively, and means for joining said movable contacts to said other binding post.

10. In a circuit controlling mechanism, an operating member, a set of contacts, a second set of contacts, the contacts of said sets being arranged to be brought respectively into engagement upon continued movement of said member, a source of electrical energy, an outgoing circuit, a resistance, said first set of contacts being arranged to close a series circuit from said source through said resistance to said circuit, said second set being arranged to short-circuit said resistance, and resilient means made operative subsequent to the closure of the circuit through said resistance, but prior to the closure of the second set of contacts, for resisting the closure of the second set of contacts.

11. In a circuit controlling mechanism, an operating member, a set of contacts, a second set of contacts, the contacts of said sets being arranged to be brought respectively into engagement upon continued movement of said member, a source of electrical energy, an outgoing circuit, a resistance, said first set of contacts being arranged to close a series cir-

6
5
cuit from said source through said resistance to said circuit, said second set being arranged to short-circuit said resistance, and a spring arranged to be engaged by said operating member after the engagement of the contacts of the first set, and prior to the engagement of the contacts of the second set, for resisting further movement of the said member.

In witness whereof, we hereunto subscribe 10
our names, this 18th day of January, 1922.

ALLEN T. KIRK.
WILLIAM T. KIRK.
ORREN E. BARBER.

Witnesses:

EMILE J. BOURGEOIS,
DAGMAR PETERSON.