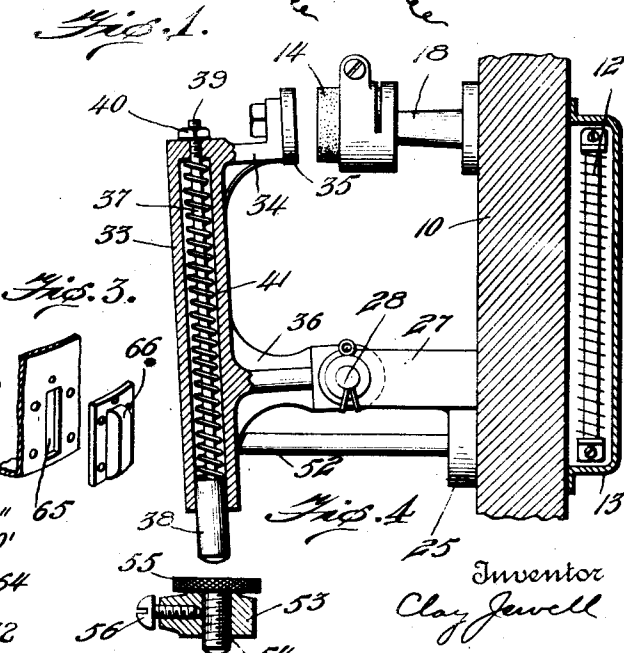
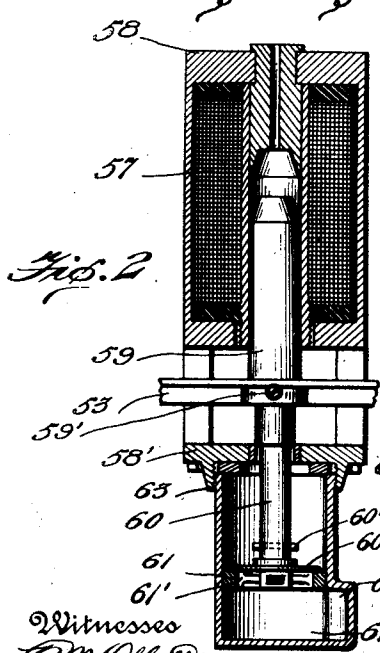
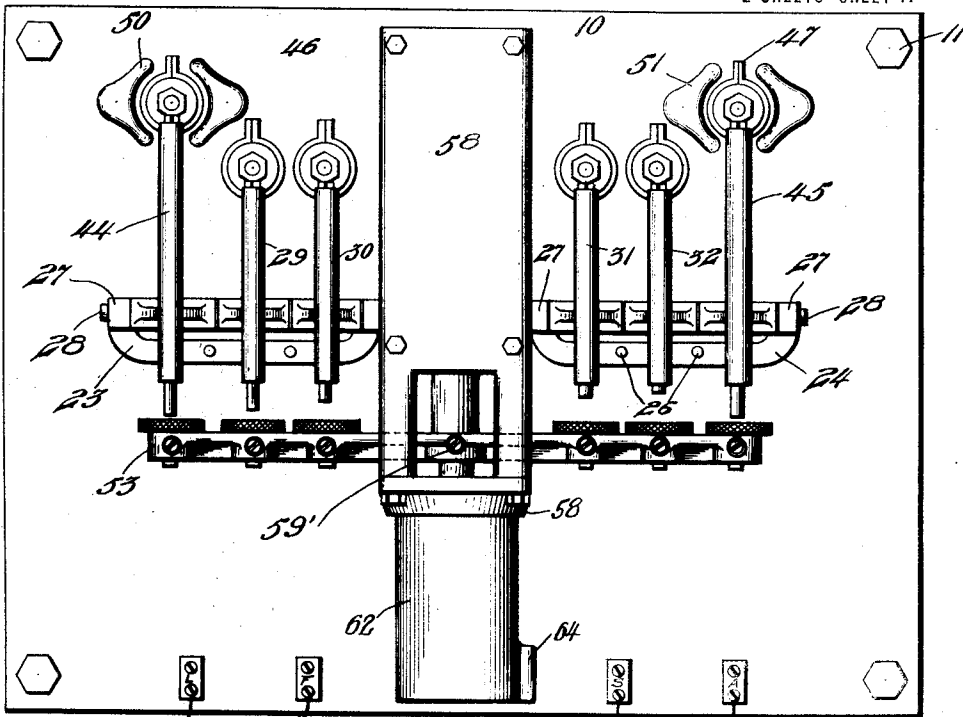


1,207,923.

Patented Dec. 12, 1916.

2 SHEETS—SHEET 1.



Witnesses
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2 SHEETS—SHEET 2.

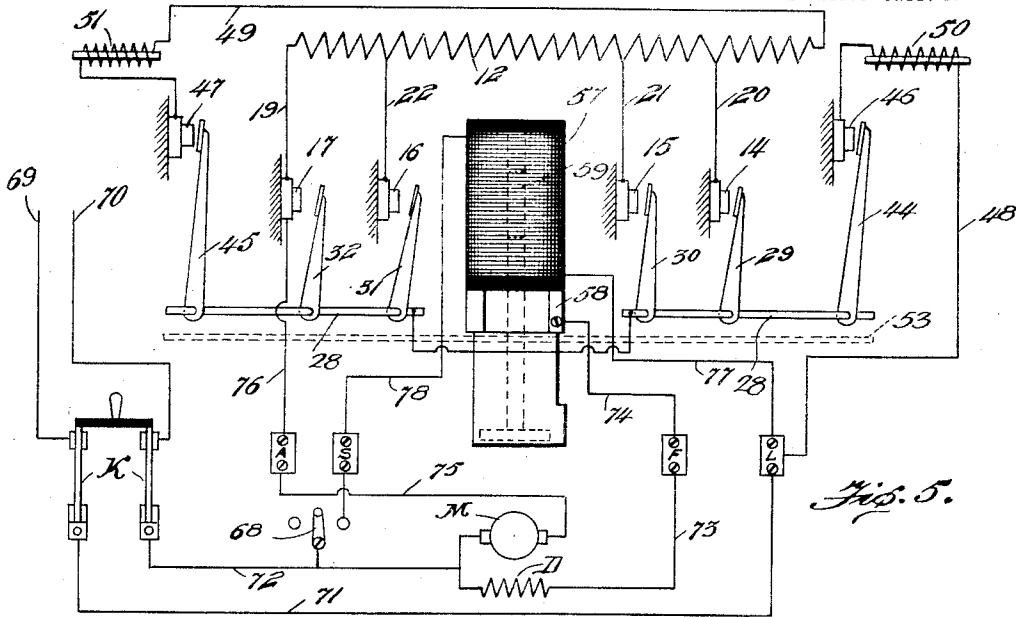


Fig. 5.

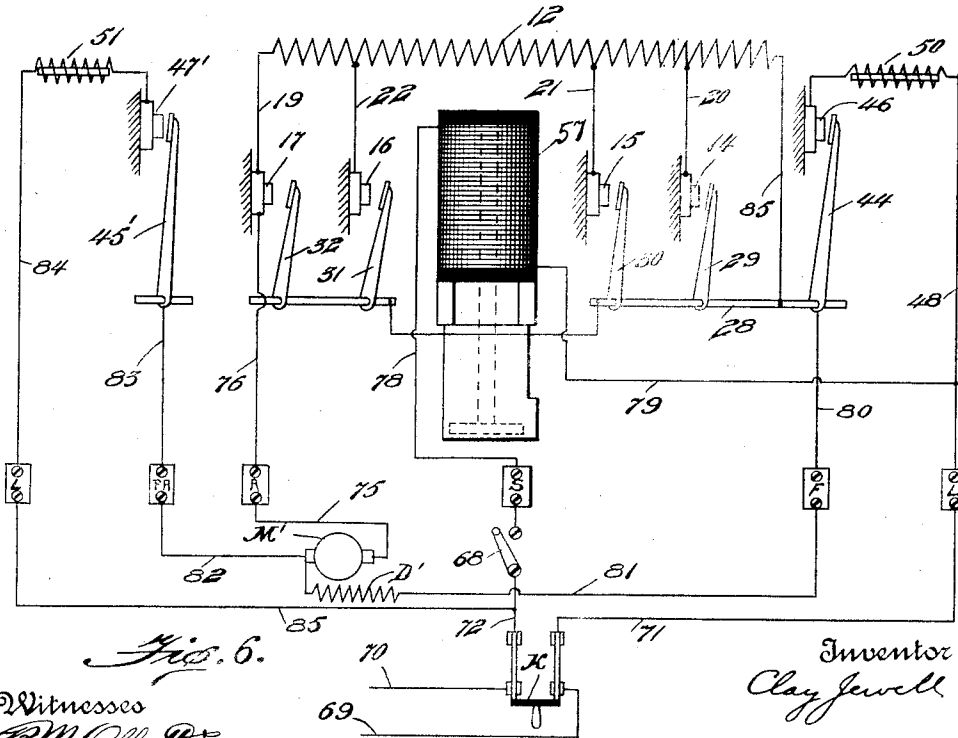


Fig. 6.

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UNITED STATES PATENT OFFICE.

CLAY JEWELL, OF BALTIMORE, MARYLAND.

MOTOR-STARTER.

1,207,923.

Specification of Letters Patent.

Patented Dec. 12, 1916.

Application filed March 1, 1913. Serial No. 751,628.

To all whom it may concern:

Be it known that I, CLAY JEWELL, a citizen of the United States, residing at Baltimore city, Maryland, have invented certain new and useful Improvements in Motor-Starters, of which the following is a specification.

This invention relates to electric motor controlling devices and more particularly to an automatic circuit closer and starter for direct current motors, but it is to be understood that certain features of the mechanism are adapted for use in controlling devices for alternating current motors.

One of the objects of this invention is to provide an efficient and simple arrangement whereby the completion of an electrical circuit serves to set in operation parts which almost instantaneously close the field circuit and simultaneously closing the armature circuit through a resistance in series therewith to start the motor. A further operation of said parts serves to gradually cut out and finally short-circuit the resistance, which is in series with the armature circuit at starting.

Another object is to prevent excessive arcing at the contacts by opening and closing the circuits quickly. A novel arrangement of the dash-pot, which includes a by-pass, affords a quick initial movement of the operating parts on starting and a final quick movement of said parts on stopping, and intermediate the starting and stopping the movement of said parts is retarded.

A further object of the invention is to provide a controlling device in which the circuit, which includes the motor armature, may be opened at one point or at two points, also to provide for operation of the starter so that the same may be controlled from a distance and to provide for the automatic closing and opening of the main circuit and restoration of the resistance in series with the armature circuit.

Further objects and the novel features of the invention will be apparent from the following description taken in connection with the drawing, in which:

Figure 1 is a front elevation of the starter mounted on a suitable switchboard panel. Fig. 2 is a longitudinal sectional view of the solenoid and the dash-pot with a by-pass constructed according to this invention. Fig. 3 is a fragmentary perspective view of a modification of the by-pass in the dash-

pot construction. Fig. 4 is a sectional view showing in detail the construction of one of the pivoted contactors and the cooperating parts including a section of the bar for operating the contactor. Fig. 5 is a diagrammatic illustration of the electrical circuits and connections to the motor and starting device, the same showing the arrangement for a main line single pole switch. Fig. 6 is a diagrammatic illustration in most respects similar to Fig. 5 except that the circuits are arranged for a main line double pole switch.

Referring to the drawing, the numeral 10 designates a slate, marble or other insulating panel upon which the starter is mounted and which may be secured to a support by means of the bolts 11 located at the four corners of the panel. A starting resistance 12 is mounted in a suitable inclosing casing 13 on the rear of the panel 10 and is connected to a series of renewable carbon contact faces 14, 15, 16 and 17, which are supported on stands 18 secured to the front of the panel and on opposite sides of the center thereof. In the arrangement indicated in both Figs. 5 and 6 one end of the resistance 12 is permanently connected to the contact 17 by means of the conductor 19 and the contacts 14, 15 and 16 are connected at points intermediate the ends of the resistance by the conductors 20, 21 and 22 so that as each contact is engaged by its cooperating contactor elements, the resistance will be successively cut out, and when the contact 17 is engaged the entire resistance will be short-circuited.

On opposite sides of the center of the panel and extending horizontally across the same there are two yokes 23 and 24 of suitable conducting material. The bases 25 thereof lie flush with the panel and each is secured to said panel by means of bolts 26 which extend through said parts 25. At the opposite ends of the bases 25 there are upstanding ears 27 pierced to receive the spindles 28, upon which the short-circuiting members or contactors 29, 30, 31 and 32 are pivotally mounted.

As shown in Fig. 4 each short-circuiting member is of the clapper type and comprises a tubular portion 33 having at its upper end an angular extension or foot 34, to which a contacting face 35 is secured, the said face cooperating with the carbon block 14. Near its other end each contactor

has a lateral extension 36 parallel to the extension 34, the part 36 being enlarged laterally and bored to receive the spindle 28. The tubular portion and the spindle 5 upon which it is mounted are of suitable metal and, as indicated in Fig. 1, the yokes and their spindles therefore electrically connect the short-circuiting members mounted thereon. Arranged in the tubular portion 10 33 there is a thrust pin comprising a shank 37, one end of which extends through an opening near the part 34 smaller than the inner diameter of the tubular member and at its lower end the shank has a head 38 15 slidably fitting in the tube and projecting therefrom. The upper end of the shank is threaded at 39 to receive the nut 40 seated on the exterior of the tubular member and whereby the thrust pin may be adjusted. 20 A spiral spring 41 seats at one end against the inner end of the head 38 and at its opposite end against the end 42 on the interior of the tubular member. The spring tends to keep the pin in an extended position and 25 provides a cushion and a yielding part, against which the operating element may engage, and also allows the said operating element to make a complete stroke to close all circuits in the proper order. The 30 threaded end 39 and nut 40 on the exterior also afford a means for adjusting the position of the head 38 so that the same shall project out of the tube downward a distance sufficient for proper operation of the device. 35

The circuit closing contactors 44 and 45, which are similar in construction to the short-circuiting members shown in Fig. 4, are pivoted on the spindles 28 at the outer 40 ends of the brackets or yokes 23 and 24, respectively, and are therefore electrically connected with the short-circuiting members and with each other. The contact blocks 46 and 47 and their supports, with 45 which the pivoted switch members 44 and 45 cooperate, are similar in construction to the contact blocks 14 and their supporting means 18, which are clearly shown in Fig. 4. The contact 46 is permanently connected 50 to one branch of the electric supply mains by means of the conductor 48 and the contact 47 is permanently connected to one end of the resistance 12 by means of the conductor 49, as shown in Fig. 5.

The clappers 44 and 45 with their associated contacts 46 and 47 and connections constitute a single pole line switch arranged to open the main line connected to the armature circuit in two places which minimizes 60 any injurious arcing on make and break. However, to further reduce the arcing each contact is equipped with a magnetic blow-out 50 and 51. All of the pivoted members are so supported that the upper end thereof 65 projects beyond a vertical plane through

the pivots 28 so that they are overbalanced and the contact parts 35 thereof will automatically move outwardly and away from the contact 14 and the lower ends thereof 70 engage against abutments 52 on the brackets and maintain the pivot members in position to be engaged by the operating means. As shown in Figs. 1, 5 and 6 the heads of the pivoting members 44 and 45 project 75 from the tube an equal distance and the heads of the members 29, 30, 31 and 32 project from the tubular portion unequal distances so that when the operating member reciprocates the short-circuiting members 80 controlling the resistance the latter members will be successively operated.

To operate the clappers a bar 53 is provided which has threaded openings 54 arranged to receive the threaded shanks of the bearing plates 55 which underlie the 85 heads 38 of the clappers. The shanks of the plates 55 are secured in their adjusted positions by means of set screws 56. The number of plates on the bar 53 corresponds 90 to the number of pivoted members on the yokes 23 and 24 and the said plates are disposed immediately below the said pivoted members so that as the bar reciprocates the plates may engage the heads of said pivoted 95 members.

The means for reciprocating the bar 53 comprises a solenoid 57 located in a suitable inclosing casing 58 secured to the panel 10 between the brackets 23 and 24. The solenoid is provided with a movable core 100 59, to which the bar 53 is rigidly secured by means of a screw 59' or other suitable device, the lower part of the casing having a transverse opening therethrough to receive 105 a continuous bar and having a removable bottom 58' for disassembling the structure. Rigidly secured to the core 59 and extending beneath the bar 53 there is a rod 60 which has a piston 61 at its lower end working 110 in a dash-pot 62 secured to the removable bottom 58' of the casing by means of the threaded connection 63.

The dash-pot is arranged to retard the action of the solenoid and bar when actuating the pivoted members to cut out the resistance. 115 However, it is important that the circuit through the armature and the resistance in series therewith as well as the field circuit be quickly closed when starting the motor. To accomplish quick initial movement 120 of the bar 53 a by-pass 64 is provided at the lower end of the dash-pot which will allow the oil or other fluid in the dash-pot to flow past the piston while the core and bar connected thereto move a sufficient distance 125 to close the circuit by operating the clappers 44 and 45. The piston head 61 has ports 61' therethrough which are covered on the upward movement of the core 59 and piston rod 60 by a disk valve 60' which is 130

loosely mounted on the rod 60. The movement of the disk valve along the rod 60 is limited by the piston head 61 and by the pin 60'' secured to the piston rod 60. On the release of the core of the solenoid the piston and parts connected thereto move down of their own weight and the disk 60' is raised by the pressure of the fluid which has escaped to the lower side of the piston head. As a consequence the plunger and parts connected therewith descend rapidly and the resistance is more rapidly inserted than cut out and near the end of the stroke the movement of the piston, bar and parts is even more rapid so that the end clappers will be very quickly released. When the solenoid circuit is opened and the resistance is again inserted in the circuit, as the piston 61 approaches the end of its movement, the by-pass 64 and the ports 61' in the piston head will permit the quick return of the fluid to the other side of the piston, whereby the main circuit will be rapidly opened and injurious arcing avoided. The by-pass 64 may be made or cast integral with the cylinder, as shown in Fig. 2, and constitutes merely an elongated cup in the side wall of the cylinder 62, or the same may be constructed as shown in Fig. 3, by cutting a slot 65 in the cylinder wall and near the bottom thereof and riveting and soldering a flanged cupped member 66 over the slot. A dash-pot constructed as described will afford a rapid movement of the clapper actuating parts so that there will be no destructive arcing at the contacts when the circuit is made and broken.

As shown in Figs. 1 and 5 terminals are located at the lower edge of the switchboard panel, to which one side of the line, one side of the field, the motor armature and a contact of a switch 68 controlling the solenoid circuit may be connected. The main line comprising conductors 69 and 70 supplies current to the starter and motor controlled thereby, the double pole knife switch K controlling the supply circuit. The conductors 71 and 72 lead from the knife switch K, the conductor 71 being connected to the terminal L and through the conductor 48 and blow-out coil 50 to the contact 46. The conductor 72 leads from the switch K to the single pole knife switch 68 which controls the solenoid and which may be located on an elevator or any other suitable or remote place from the starter and serves to control the starter and operate the motor after the knife switch K is closed. The conductor 72 is also connected to one lead of the motor M and to one terminal of the field D. The other terminal of the field D is connected to the terminal block F, through the conductor 73 and from there is permanently connected to the casing 58 by a conductor 74, and to the bar 53 which is electrically connected through the metal-

lic parts connecting the plunger 59 of the solenoid to the casing 58 and to the bar 53 and when the latter operates connection is effected with the opposite side of the circuit through the clapper 44 contacting with the block 46. The other lead of the motor is connected through the conductors 75 and 76 to one end of the resistance through the terminal block 17 and conductor 19.

The operation of the starter will be briefly explained.

When the switch K has been closed, the single pole switch 68 when closed will complete the circuit through the solenoid 57 and energize the same by the following path:— conductor 71, conductor 77, solenoid 57, conductor 78, switch 68 to the opposite side of the line, through conductor 72 and switch K. The solenoid when energized will raise the core 59 and bar 53 connected therewith and almost instantaneously close the field circuit by the following path: conductors 71 and 48, contact 46, clapper 44, bar 53, casing 58, conductors 74 and 73, field D to the opposite side of the line through conductor 72. At the same time the circuit through the armature will be completed by the following path: conductors 71 and 48, contact 46, clapper 44, brackets 23 and 24, clapper 45, contact 47, conductor 49, resistance 12, conductor 17, conductors 76 and 75, motor 19, contact 17, conductors 76 and 75, motor M to the opposite side of the line through conductor 72. The sudden initial movement thus closes the field and armature circuit through the same clapper 44 and almost immediately after the switch 68 is closed. After the piston passes the by-pass the retardation of the movement of the bar 53 will be effected and the resistance 12 will be gradually cut out by the operation of the clappers 29, 30, 31 and 32 in the order indicated, the clapper 32 finally short-circuiting all of the resistance.

In the modification shown in Fig. 6 the arrangement is shown as adapted to a double pole main line switch wherein there is a clapper in each side of the line. In this arrangement the clapper 45' is pivoted on an independent bracket or on a sleeve insulated from the other parts so that there will be no short-circuit of the line. The closing of the switch 68 which leads to the solenoid from the conductor 72 through the conductor 78 to the opposite side of the line through conductor 79 energizes the solenoid and the operation of the latter immediately operates the clappers 44 and 45', whereby the field circuit and the circuit through the armature is closed by the following path: conductors 71 and 48 to contact 46, clapper 44, spindle 28, conductors 80, 81, field D', conductors 82, 83, clapper 45', terminal block 47', conductor 84 to the opposite side of the line, through conductor 85. It will be observed that the contact between the bar 53 and the

clapper 45' will be an insulated contact, that is, one of the parts is so constructed or supported as to be electrically insulated from the other so that current cannot flow from the bar to the clapper or vice versa and consequently there will be no short-circuiting of the connections. The closing of the armature circuit will take place according to the following path: conductors 71 and 48, contact 46, clapper 44, spindle 28, conductor 85, resistance 12, conductor 19, contact 17, conductors 76 and 75, motor M', conductors 82 and 83, clapper 45', contact block 47' and to the opposite side of the line through conductors 84, 85 and 72. The subsequent movement of the bar 53 will successively engage the clappers 29, 30, 31 and 32 in the order indicated and cut out the resistance in such order so that the resistance will finally be cut out when the clapper 32 engages the contact block 17.

When the switch 68 is opened the solenoid will be deenergized and the resistance will be quickly reinserted into the circuit with the armature and as the piston in the dash-pot gets to the end of its stroke the by-pass will permit a very rapid movement thereof, whereby the end clappers will be quickly released to prevent arcing.

It will be seen that the contacts and clappers which cooperate therewith are symmetrically arranged with respect to the centrally located actuating device. The bar which rocks the clappers when first operated simultaneously engages the two outside clappers. These clappers are at substantially equal distances from the vertically movable magnet plunger which is attached at the center of the bar, and the weight on the bar is thus substantially equalized and the binding tendency of the parts is lessened.

It will be understood that numerous changes may be made in the motor starter shown without departing from the spirit of the invention, and it is therefore intended that the invention shall not be limited to the exact details as shown and described.

Having thus described the invention what is claimed as new is:

1. In a motor starter, the combination with a starting resistance, of a current supply main, circuit closers for connecting the current supply main to the resistance and subsequently gradually short-circuiting the resistance, means for actuating two of said circuit closers simultaneously, on starting, and the other circuit closers afterward, means for starting and releasing said actuating means, and means whereby said actuating means, when started, operates with a quick initial movement to quickly connect the supply main to the resistance and thereafter operates with a retarded movement until the entire resistance is cut out, and whereby said actuating means when released

has a return movement at first more rapid than said retarded movement to reinsert the resistance in circuit, said return movement being finally more rapid than said quick initial movement to suddenly break the connection between said resistance and said current supply means.

2. In a motor starter, the combination with a starting resistance, of a current supply main, a plurality of independently movable circuit closers for connecting the current supply main to the resistance and subsequently gradually short-circuiting the resistance, means for actuating said circuit closers comprising a horizontally disposed vertically reciprocable bar adapted to move each of the aforesaid circuit closers, means for starting and releasing said actuating means, and means whereby said actuating means when starting operates with a quick initial movement to quickly operate the circuit closers which connect the supply main to the resistance, and whereby said actuating means thereafter operates with a retarded movement until the entire resistance is cut out, and whereby said actuating means when released has a return movement at first more rapid than said retarded movement to reinsert the resistance in circuit, said return movement being finally more rapid than said quick initial movement to suddenly break the connection between said resistance and said current supply main.

3. In a motor starter, the combination of a panel or support, a starting resistance, contacts on the front of the panel connected to points in said resistance, another contact on the front of said panel adapted to be connected directly to a current supply main, a plurality of members cooperating with the contacts, a reciprocable bar having means for engaging all of said members to actuate them, an electro-magnet having a plunger connected substantially midway between the ends of the bar whereby the latter is balanced with respect to the plunger, and means whereby said bar is operated to cause said members to first quickly close the circuit and connect the resistance to the current supply main and thereafter to gradually cut out said resistance.

4. In a device of the class described, the combination of a starting resistance, contacts connected with different points in said resistance, current supply mains, an armature circuit having a lead directly connected with one of said supply mains and a lead directly connected with said resistance, a series of electrically connected members cooperating with said contacts, one of said members being arranged when operated to connect the other supply main to said resistance and other members arranged when successively operated to gradually short-circuit said resistance, a horizontally disposed re-

reciprocable bar having means for engaging and operating all of said members, and an electro-magnet for reciprocating said bar.

5 In a motor starter, the combination of a panel, a vertically arranged electro-magnet on said panel, a starting resistance, a set of contacts on said panel connected to different points of said starting resistance and symmetrically arranged on opposite sides of
10 said electro-magnet, two other contacts on opposite sides of the electro-magnet and at equal distances therefrom, a plurality of independently movable contacting members cooperating with all of said contacts and
15 also arranged symmetrically with respect to the electro-magnet, a vertically reciprocable

plunger operable by said electro-magnet, a horizontal bar carried by said plunger and capable of causing the operation of said members, said bar first simultaneously engaging the contacting members which co-
20 operate with said two other contacts and thereafter successively engaging the contacting members which cooperate with said set of contacts.
25

In testimony whereof I affix my signature in presence of two witnesses.

CLAY JEWELL.

Witnesses:

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THOMAS S. MOONEY.