No. 897,713. PATENTED SEPT. 1, 1908.

A. J. BURNS.

MOTOR STARTER.

APPLICATION FILED AUG. 9, 1907.

5 SHEETS—SHEET 1.

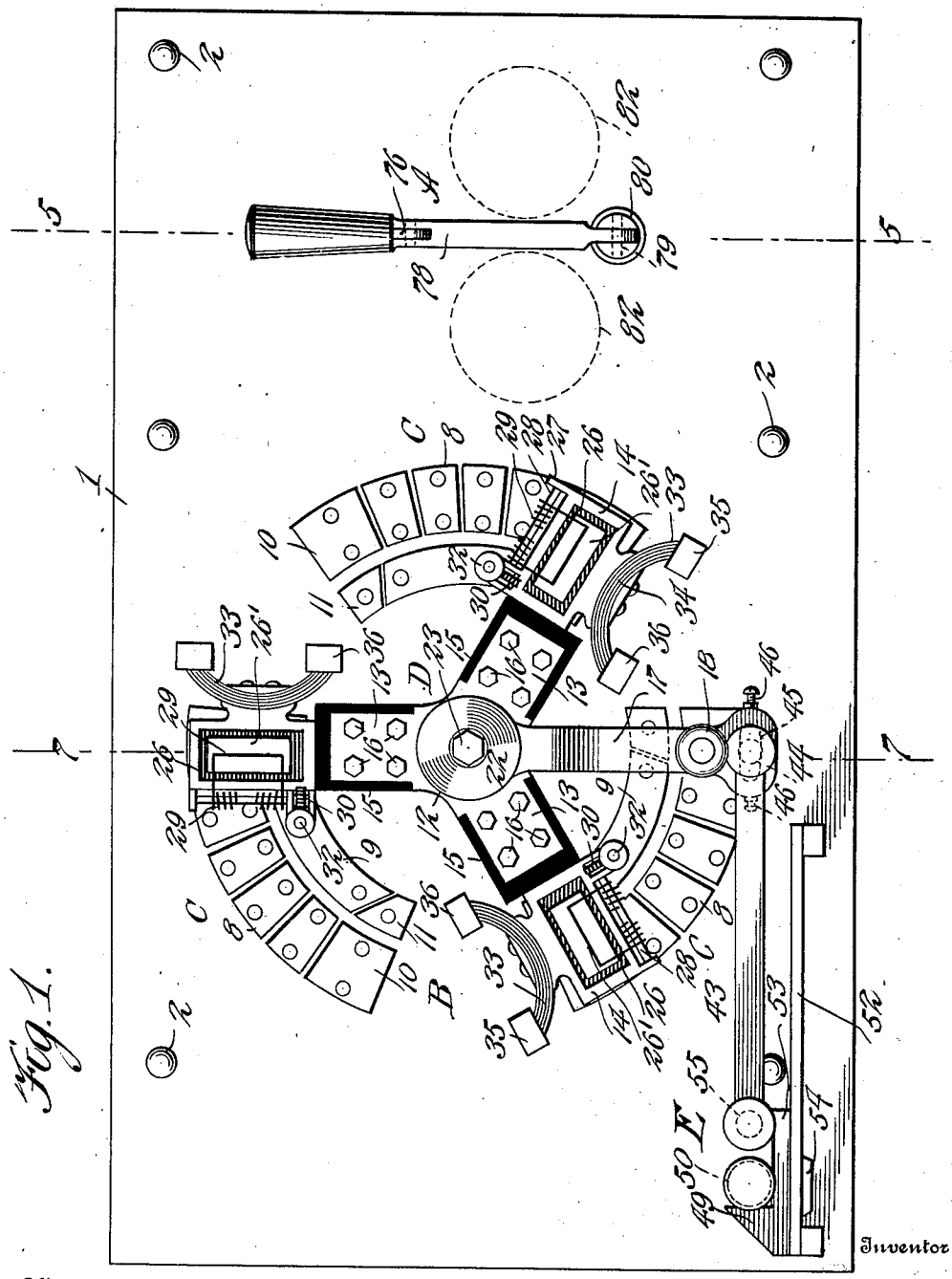

Fig. 1.

Witnesses

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5 SHEETS—SHEET 2.

Fig. 3.

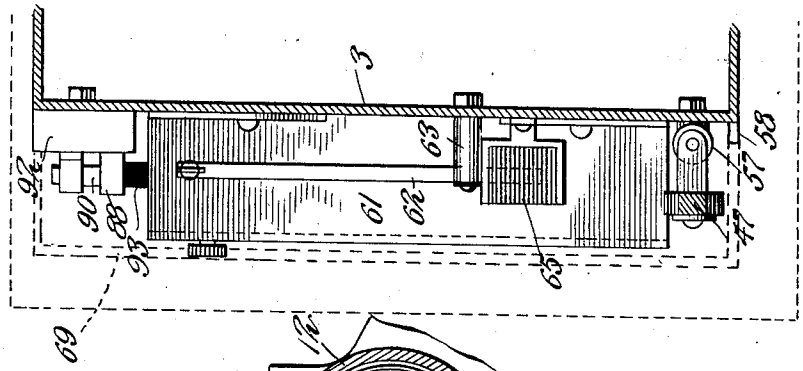


Fig. 4.

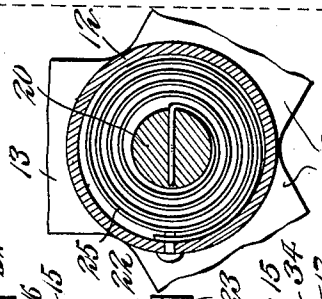
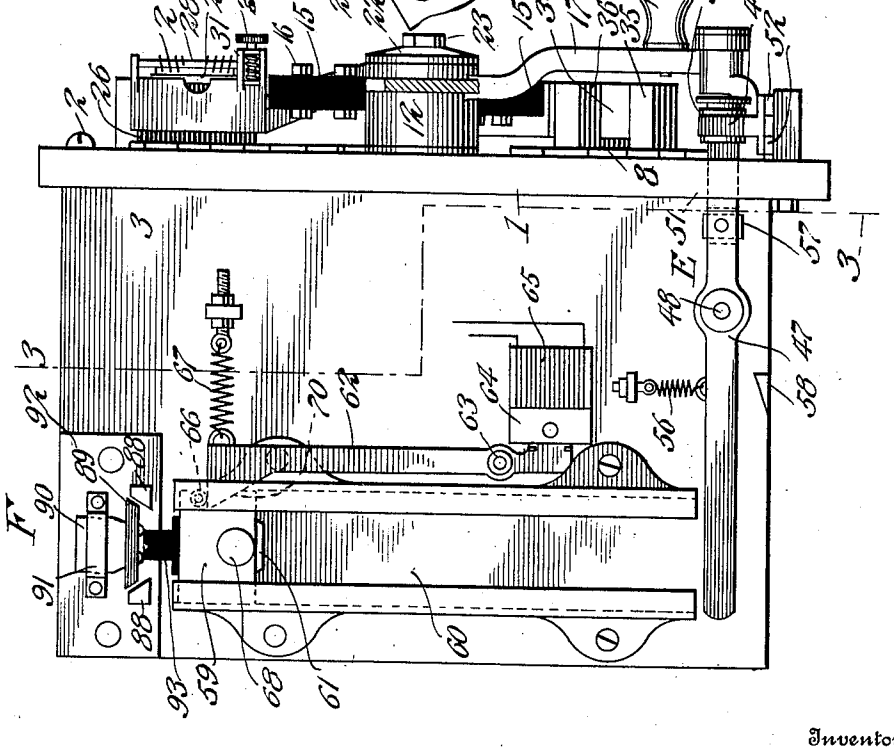


Fig. 2.



Witnesses

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5 SHEETS—SHEET 3.

Fig. 6.

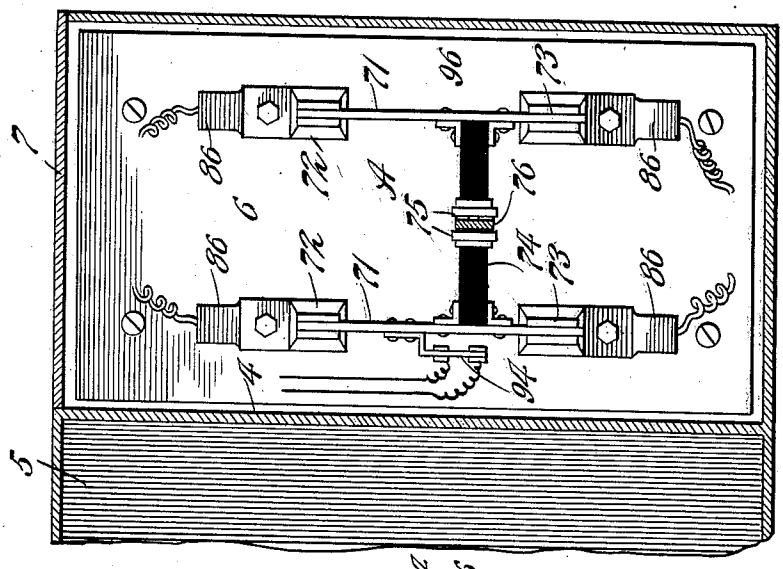
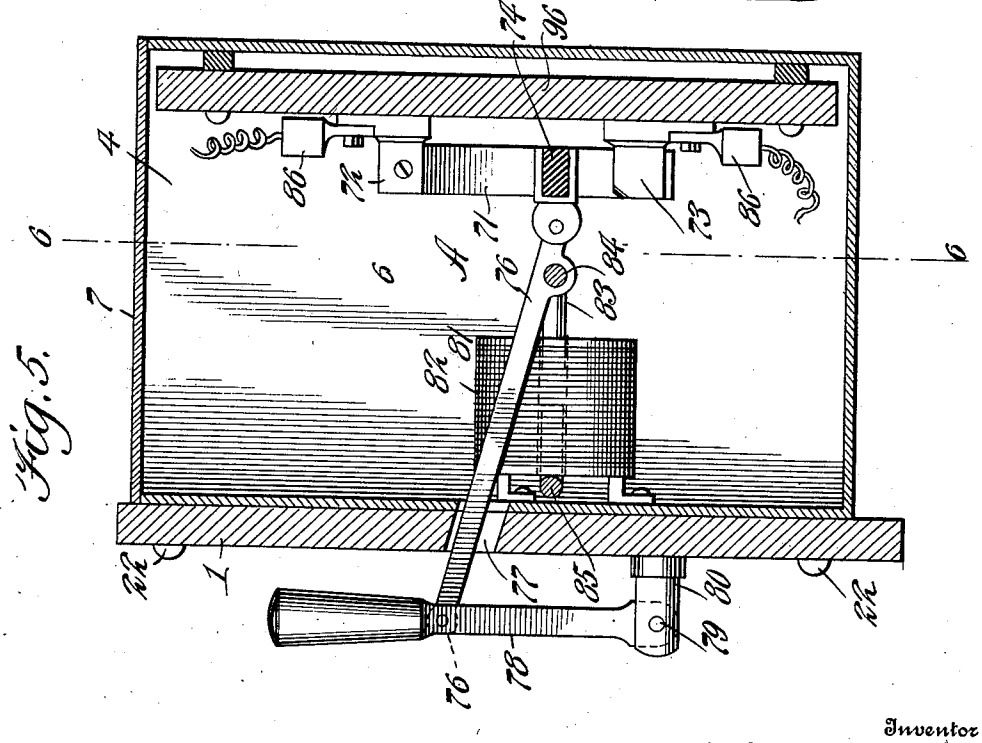


Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 9.

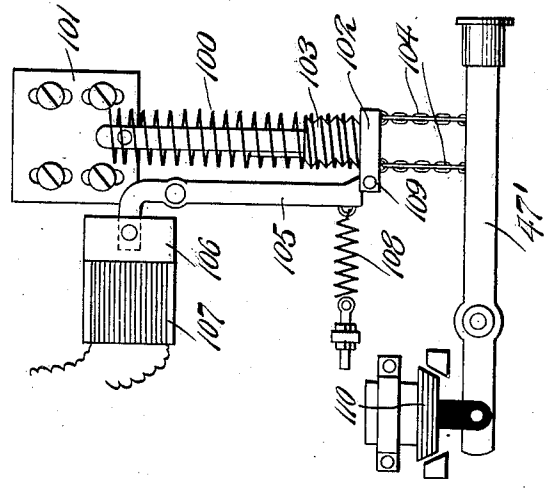
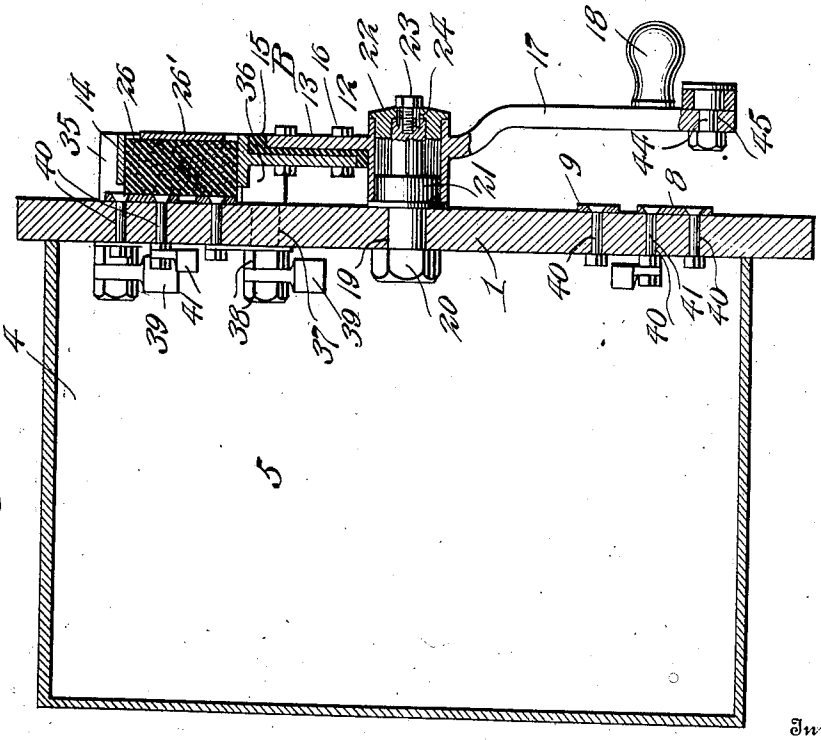


Fig. 7.



Witnesses

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5 SHEETS—SHEET 5.

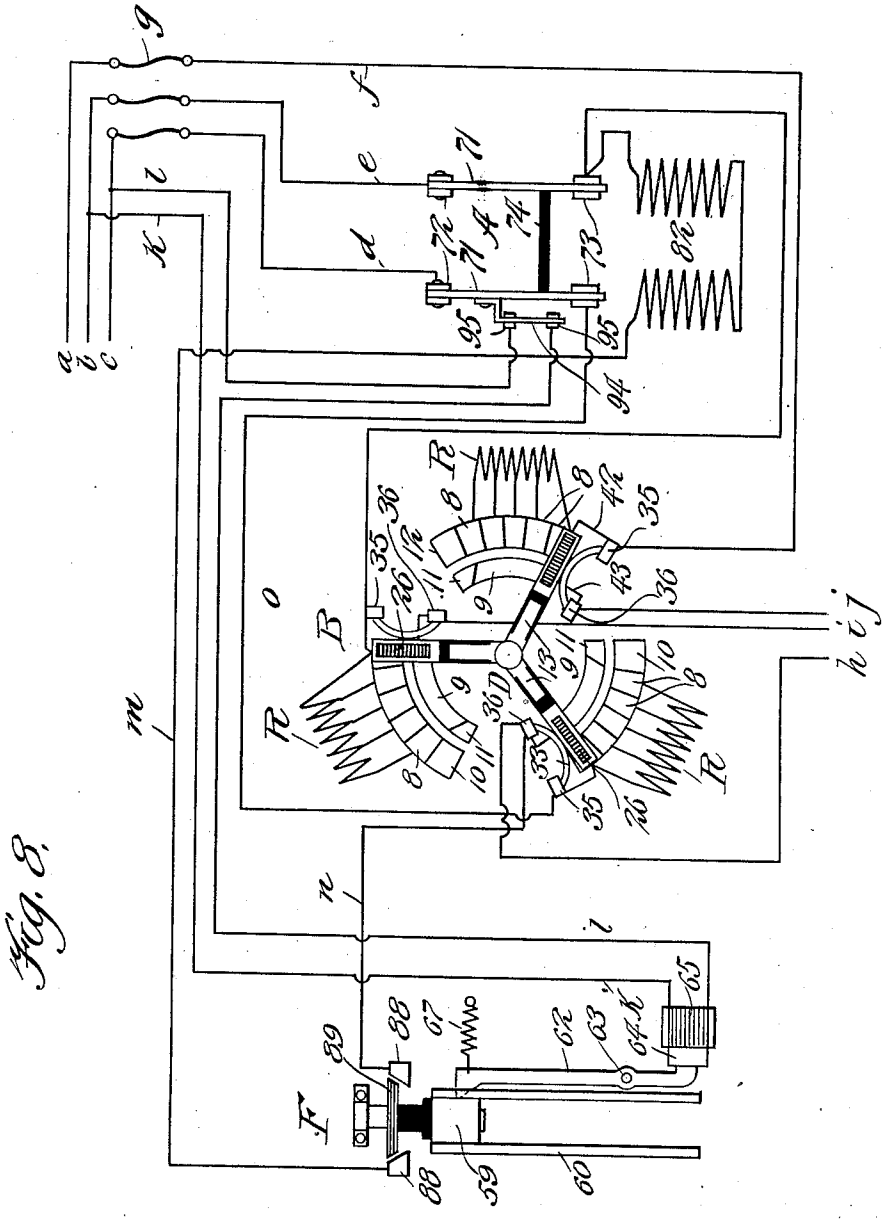

Fig. 8.

Witnesses

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UNITED STATES PATENT OFFICE.

ANTHONY J. BURNS, OF OSWEGO, NEW YORK.

MOTOR-STARTER.

No. 897,713. Specification of Letters Patent. Patented Sept. 1, 1908.

Application filed August 9, 1907. Serial No. 387,939.

To all whom it may concern:

Be it known that I, ANTHONY J. BURNS, a citizen of the United States, residing at Oswego, in the county of Oswego and State of New York, have invented new and useful Improvements in Motor-Starters, of which the following is a specification.

This invention relates to a motor starter of the automatic or no voltage release type designed primarily for alternating current motors of any phase, size or type, whereby the resistances in series with the motor can be gradually cut out of circuit during starting and the circuit automatically opened upon failure of current in the supply circuit so as to prevent a dangerous rush of current through the motor upon restoration of the voltage to normal.

The invention has for one of its objects to improve and simplify the construction and operation of apparatus of the character referred to so as to be comparatively easy and inexpensive to manufacture, thoroughly reliable and efficient in use, of substantial, durable and compact form, and designed to enable the circuit to be either automatically or manually opened.

A further object of the invention is the provision of a motor starting apparatus including an automatically released locking device for holding the starting switch in normal running position, in combination with an auxiliary means for opening the circuit between the mains and starting switch in case the latter should fail to return to the initial or open circuit position after the locking device has been released.

A still further object of the invention is to provide a motor starting apparatus comprising in a unitary structure, a starting switch tending constantly to return to normal position, an electro-magnetically actuated locking device which normally holds the starting switch in running position and is adapted to automatically release the switch when the current drops to a predetermined point, and an oil immersed switch which is electro-magnetically operated to open the circuit between the mains and starting switch.

With these general objects in view, and others as will appear as the description proceeds, the invention comprises the various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawings, which illustrate certain of the embodiments of the invention, Figure 1 is a front view of the apparatus. Fig. 2 is a view of the left hand end of the same. Fig. 3 is a section on line 3—3, Fig. 2. Fig. 4 is a detail sectional view of a hub of the movable element of the starting switch showing the returning spring therefor. Fig. 5 is a vertical section on line 5—5, Fig. 1. Fig. 6 is a vertical section on line 6—6, Fig. 5. Fig. 7 is a vertical transverse section on line 7—7, Fig. 1. Fig. 8 is a diagrammatic view of the circuits of the apparatus. Fig. 9 is a detail view of a modified form of an electro-magnetically released lock for the starting switch.

Similar reference characters are employed to designate corresponding parts throughout the several views.

Referring to the drawings, 1 designates a slab of marble or the like forming a supporting plate for the various parts of the apparatus, and secured to the rear side thereof by bolts 2 is a cast iron or other casing 3 which is divided by a vertical partition 4, Fig. 6, into a resistance-containing compartment 5 and a switch-containing compartment 6, the former compartment being open at its front and closed by the marble slab 1, and the latter compartment being open only at the top to contain a body of oil for preventing arcing between the blades and contacts of the cut-out switch designated generally by A, Figs. 5, 6 and 8, and the top of the compartment 6 is closed by a cover 7.

The motor-starting switch, designated generally by B, is mounted on the supporting plate 1 in front of the compartment 5. This switch comprises one or more groups of contacts or segments C suitably secured to the marble front plate, and a rotatable element D carrying means for engaging the contacts to complete the circuits between the source of supply and motor and vary the voltage impressed on the motor circuit during the starting operation. Each group of contacts C comprises a row of spaced copper blocks 8 or the like and a copper segment 9 arranged inwardly with respect to the blocks 8, there being dead contacts 10 and 11 at the end of the row and segment for the brushes to bear on when the switch is open. The rotatable element D of the switch is composed of a hub member 12 having one or more radial arms 13 for carrying the brush holders 14, there being interposed between each brush holder and ad-

jacent arm, a block of insulating fiber 15 or the like which is secured to the parts by bolts 16. Formed on the hub member is a crank arm 17 which is provided with a knob 18 that serves as a handle to permit the switch to be worked by hand, if desired. The supporting plate 1 has an opening 19 through which projects a bolt 20 that forms a pivot on which the element D rotates, there being a collar 21 on the front side of the bolt that has a working fit in the hub and which coöperates with a cap 22 fitted on the bolt and in the hub to provide a bearing on which the hub turns. The cap 22, as shown in Fig. 7, is secured in place by the screw bolt 23 and is prevented from turning by pins 24 extending through the cap and into the front end of the pivot 20. In the hub 12 is a coiled spring 25 which, as shown in Fig. 5, is anchored on a pivot bolt 20 at the inner end and secured to the hub at the outer end and the spring is so arranged that when the starting switch is in running position, there will be sufficient tension to return the rotatable element of the switch to initial position in the event of a failure of current in the supply system.

The brush-holders 14 are metal castings or the like of hollow rectangular form for receiving blocks of carbon 26 constituting brushes that engage the contact blocks 8 and segments 9 so as to convey current from the blocks to the adjacent segment, as the movable element of the switch is actuated for starting the motor, the blocks being connected with the mains of the supply system and the segments with the motor circuit. On each holder 14 are apertured lugs 27 which form bearings for a shaft 28 that carries a torsional spring 29. The spring 29 is U-shaped and has its ends coiled around the shaft 20 and secured thereto, the U-shaped portion of the spring bearing on a plate 26′ on the top of the brush. On the shaft 28 is a worm wheel 30 with which engages a worm 31, Fig. 2, so as to turn the shaft 28 for bearing the tension of the spring, the worm gearing serving as a lock for preventing the spring from unwinding after once being set. The worm-carrying shaft has a knurled head or enlargement 32 serving as a hand-hold whereby the worm can be actuated by hand. On each brush-holder is a bridging contact 33 composed of a plurality of metal laminæ 34 that are adapted to bear at their ends on the terminals 35 and 36 for the conductors leading from the supply mains and leading to the motor. As shown in Fig. 7, the terminals 35 and 36 have threaded studs 37 that extend through openings in the marble slab 1 and have nuts 38 for receiving the cable or conductor tips 39. The contact blocks and segments 8 and 9 are secured to the marble slab by through bolts 40, Fig. 7. The bolts of the contact blocks 8 are provided with coupling tips 41 of the inductive resistances of the motor starter, the resistances being of any approved construction, and designated by R in Fig. 8. Behind the plate 1 are connections between the terminals 35 and 36 and adjacent contact block 8 and segment 9, respectively, which connections are indicated at 42 and 43, Fig. 8.

In order to hold the motor starter in running position, as shown in Figs. 1 and 8, a locking device, designated generally by E, is provided. This device consists of a slide 43 disposed at the front of the supporting plate 1 and having one end connected by a pin 44 with the crank arm 17, which has a slot 45 for receiving said pin. On the arms 17 are oppositely arranged set screws 46 that extend into the slot 45 and engage the pin 44, so as to adjust the latter. The member 43 operates as a catch that engages a pivoted detent or lever 47 fulcrumed at 48 on one end of the casing 3, as shown in Fig. 2, and the catch 2 has a hooked-shaped extension 49 that engages over an anti-friction roller 50 secured on the front end of the member 47, which member projects through a slot 51 in the plate 1, so as to have vertical movement. On the supporting plate 1 is a horizontal guide 52 on which moves back and forth the outer section 53 of the member 43. The guide 52 is composed of spaced rails, as shown in Fig. 2, and the member 53 is held in sliding engagement by a headed screw 54 that has its shank disposed between the rail and its head engaging the under side of the latter. Between the inner and outer sections of the member 43 is a hinge joint 55. The detent 47 is held in locking position by means of an adjustable spring 56 which is connected with the detent and with the side of the casing 3. On the oscillating member or detent 47 is mounted an anti-friction roller 57 that is adapted to bear on the side of the casing and afford a support for the detent, and under the latter is arranged an abutment 58 on which the detent rests when the same is in unlocked position. Any suitable means may be employed for throwing the detent when the voltage of the supply system drops to a predetermined minimum. For this purpose, a weight or equivalent means may be employed and, as shown in Fig. 2, the rear end of the detent is located in the path of a weight 59 that is guided in a vertical way 60 secured to the outside of the casing 3. This weight has a rubber or other buffing device 61 secured to the bottom thereof so as to cushion the shock produced by the dropping of the weight on the detent. The weight is supported in raised position by a trip lever 62 fulcrumed at 63 and provided with an armature 64 associated with an electro-magnet 65. The upper end of the lever is arranged to engage under an anti-friction roller 66 carried by the weight 59. The lever is held in normal position by the electro-magnet 65 being en-

ergized, and the lever is moved out of engagement with the roller 66 by an adjustable spring 67 that is adapted to act when the electro-magnet becomes deënergized. The electro-magnet is connected in circuit at any suitable point so as to become deënergized when the voltage of the supply system becomes zero or any other predetermined minimum. As soon as the weight drops, the parts of the locking device are moved to unlocking position so as to permit the movable element of the starting switch to return to open circuit position under the tension of the spring 25. After the apparatus has been thrown out of commission, the weight has to be raised to the top of the guideway 60 and for this purpose, the weight has a hand-hold or knob 68 that projects out of the inclosing casing or housing 69 for the apparatus, as shown in Fig. 3. The lever 62 has a cam surface 70 with which the roller 66 engages when the weight is lifted, it being understood that the weight is lifted after the electro-magnet 65 is energized and the lever 62 is in its locking position.

The cut-out switch A, which is connected between the supply mains and the motor-starting switch, is, in the present instance, of the two-blade type, the blades 71 of which are pivoted at their upper ends on blocks 72, as shown in Figs. 5 and 6. The lower ends of the blades are adapted to engage the spring contacts or jaws 73. The two blades are rigidly connected together by a cross-bar 74 of insulation, there being a frame 75 on the center of the bar to which is pivoted a link 76. This link extends through a slot 77 in the front of the casing 3 and slab 1 and is connected with an operating lever. The lower end of the lever is pivoted at 79 on a bracket 80 extending forwardly from the front side of the slab 1, and by this construction the switch can be opened from the front of the apparatus. Disposed within the oil-containing compartment 5 is an electro-magnet 81 having its coils 82 supported on the front wall of the compartment 5 at a point directly in front of the switch A, and the armature 83 is connected with the link 76 so as to open the switch when the electro-magnet is energized. The armature 83 is preferably a bar that extends through an opening 84 in the link 76 and has its ends bent laterally to extend into the coils 82. The electro-magnet is provided with a core 85 which is also a bar of soft iron bent at its ends to extend into the hollow of the electro-magnet coils. The terminals 72 and 73 of the switch A are connected respectively with the supply mains and conductors leading to the motor, and the connections are made by means of the usual tips 86 that are bolted or otherwise secured to the switch terminals, as shown in Figs. 5 and 6. The electro-magnet 81 is connected across the terminals 73 of the switch and the energizing of the electro-magnet is controlled by means of a circuit-closer F which is clearly shown in Figs. 2 and 8. This circuit closer depends for its operation upon the dropping of the weight 59 and comprises spaced terminals 88 and a bridging contact 89. This contact is secured to the bottom of a weight 90 that is guided vertically in a guide 91, the parts of the circuit closer being mounted on a base-plate 92 of marble, slate or the like, so as to insulate the same from the cast iron casing 3. When the lock-releasing weight 59 is in raised position, the bridging contact 89 of the circuit-closer F is out of engagement with the terminals 88, this being accomplished by means of a block of insulation 93 mounted on the weight 59. As soon as the weight 59 drops, the circuit closer will close the circuit, including the electro-magnet that controls the oil-immersed switch so as to thereby open the latter. On one of blades 71 is a secondary blade 94, Figs. 6 and 8, that engages spring jaws 95 that are connected in circuit with the lock-releasing electro-magnet 65, so that upon the closing of the oil-immersed switch, the said electro-magnet will be immediately energized. In the compartment 6 is contained a body of oil or other suitable liquid which is employed for extinguishing the arcs produced by the opening of the switch A, especially when high voltages are employed. It is to be understood, however, that any other suitable quick brake or arc-extinguishing switch may be used, if required. The various parts of the oil-immersed cut-out switch are mounted on a supporting plate 96 of marble, slate or the like that is bolted or otherwise suitably secured to the back wall of the compartment 6.

Referring now to Fig. 8, the various circuits will be described in connection with the method of operation. In the present instance, an apparatus is shown designed for use in connection with a three-phase alternating current system, but it is to be understood that the apparatus can be used in other systems. *a*, *b* and *c* designate the mains of the supply system, and connected therewith are the lead wires *d*, *e* and *f*, there being suitable safety devices such as fuses *g* connected between the leads and mains so as to protect the motor and starting apparatus therefor. The leads *d*, *e* and *f* are each connected with the terminals 35 of the starter and the blades 71 of the oil-immersed switch are included in the leads *d* and *e*, and leading from the terminals 36 are the wires *h*, *i* and *j* that connect with the motor (not shown). Bridged across any two of the mains are the wires *k* and *l* that comprise the circuit including the lock-releasing electro-magnet 65, and in the conductor 12 is arranged the auxiliary cut-out switch 94. The coils 82 are connected with the terminal 73 of the right hand blade

of the switch A, and from the electro-magnet to the circuit-closer F extends a conductor *m*, the said conductor connecting with one of the terminals of the circuit closer. The opposite terminal 88 is connected by a conductor *n* with the terminal 36 of one of the sections of the motor starter. The circuit is completed through the bridging contact 33, terminal 35, and conductor *o* leading from the said terminal 35 to the terminal 73 for the left hand blade of the switch A.

When the parts of the apparatus are set, as shown in Figs. 1 and 8, the motor is operated under normal conditions. Current passes directly between the mains of the supply system to the motor through the leads *d*, *e* and *f*, terminals 35, brushes 26 and bridging contacts 34 in multiple, terminals 36, and conductors *h*, *i* and *j*. It will thus be seen that the inductive resistances R or other impedance devices are entirely cut out of circuit. The carbon brushes bear on the last contact blocks 8 and contact segments 9 and current passes through the brushes by way of connections 42 and 43. As long as the switch A is closed, current passes constantly through the electro-magnet that controls the releasing of the locking device, and the circuit includes the main C, conductor *l*, auxiliary cut-out switch 94, electro-magnet 65, conductor *k*, and main *b*. Since current is constantly passing through this electro-magnet, the device controlled thereby is so designed that comparatively little power is consumed in maintaining the electro-magnet energized. It will be observed that the circuit closer F is open while the motor starter is in running position and is ready to close as soon as the voltage of the mains drops to a sufficiently low point. When the rotatable element D of the motor starter is in the position shown, the returning spring 25 thereof is under tension and so held by the roller 50 of the detent 47, Figs. 1 and 2, engaging in front of the projection 49 of the catch 43. As soon as the voltage in the mains drops to a predetermined minimum, the electro-magnet 65 becomes deënergized so as to enable the retractile spring 67, Figs. 2 and 8, to draw the latch or lever 62 from under the roller 66 on the weight 59. The weight is thus permitted to drop so as to strike the detent or member 47 and throw the outer end thereof upwardly and out of the path of the projection 49, Fig. 1. This action releases the rotatable element of the motor starter so that it can be turned to initial or open circuit position under the action of the spring 25. Simultaneously with the dropping of the weight 59, the circuit closer F is actuated to complete the circuit that includes the electro-magnet 81, so as to cause the oil-immersed switch A to be automatically opened and thereby completely cut the motor starter out of circuit and protect the motor upon the restoration of voltage in the mains in the event of the rotatable element of the motor starter failing to return to open circuit position. When it is desired to cut the motor out of service, the operating lever 78 of the cut-out switch A is pulled forwardly so as to open the said switch, and by this operation, the auxiliary cut-out switch 94 is opened so as to deënergize the electro-magnet 65, with the result that the weight 95 releases the locking device E and permits the rotatable element of the motor starter to automatically return to normal position.

In starting the motor, the operating lever 78 of the cut-out switch A is first pushed backwardly so as to close the switch. This closes the circuit that contains the electro-magnet 65 so that the lever or catch 62 will be thrown to locking position by the electro-magnet, it being understood that the weight 59 is raised to its normal position after the switch A is closed so as to cause the circuit closer F to open before the current is thrown on the motor. The operator then turns the operating crank 17 in a clockwise direction so as to move the brushes 26 off the dead contacts 10 and 11, and as soon as the brushes reach the first contacts 8, current will flow to the motor through all of the sections of the inductive resistances R and as the movement is continued, the resistances are cut out step by step so as to gradually increase the voltage until the last contacts 8 are reached, when all of the resistances are cut out and full voltage impressed upon the motor. During the movement of the operating crank 17, the member 53 slides on the guide 52 and the inclined surface of the projection 49 engages the anti-friction roller 50 and causes the detent 47 to be raised against the tension of the spring 56. As soon as the projection 49 moves past the roller 50, the spring 56 will cause the said roller to engage behind the projection and automatically lock the rotatable element of the starting switch in running position.

In the modified form of locking device shown in Fig. 9, the parts are so designed as to dispense with the weight. The detent 47′ is fulcrumed on the side of the casing in the usual manner and the front arm is so proportioned that its own weight will maintain the detent in locking position. The detent is raised by means of a helical contractile spring 100 that has one end secured to an adjustable plate 101 and the other end secured to a member 102 in the form of a screw, the threads 103 of which serve to engage the convolutions of the spring for attaching the latter to the member. Between the member 102 and detent 47′ are flexible elements 104, which permit the front end of the detent to be raised by hand when it is desired to open the motor starting switch without throwing the cut-out switch A open. The spring 100 is held in stretched condition by a catch or

lever 105 that is fulcrumed on the side of the casing and carries an armature 106 associated with the electro-magnet 107. This electro-magnet is connected in circuit with the auxiliary switch in the manner previously described. The catch 105 is connected with a contractile spring 108 which draws it out of engagement with a roller 109 on the member 102 when the electro-magnet becomes de-energized. On the detent 47' normally rests the bridging contact 110 of the circuit closer F, which latter is connected in circuit with the electro-magnet of the oil-immersed switch, as will be readily understood. When the voltage in the mains falls, the catch 105 is permitted to fly back so as to allow the spring 100 to lift the front end of the detent 47 out of operative relation with the other parts of the locking device. At the same time, the circuit closer F will complete the circuit containing the electro-magnet that controls the cut-out switch. It is obvious that other modifications may be employed wherein the weight is dispensed with.

From the foregoing description, taken in connection with the accompanying drawings, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains, and which I have described the principle of operation of the invention, together with the apparatus which I now consider to be the best embodiment thereof, I desire to have it understood that the apparatus shown is merely illustrative and that such changes may be made when desired, as are within the scope of the claims.

Having thus described the invention, what I claim is:—

1. The combination of a motor starting switch including a movable contact member and means tending to hold the same at open circuit position, a locking device for holding the element in running position, an automatically actuated cut-out switch, an electro magnet normally in open circuit for opening the cut-out switch and means responsive to a drop in voltage for controlling the operation of the locking device and closing the circuit of the said electro magnet.

2. The combination of a motor starter including a biased contact-carrying arm, with an automatically actuated cut-out switch, a locking device for holding the arm in running position, a normal open circuit closer connected in circuit with the cut-out switch, and means responsive to changes in voltage for releasing the locking device to permit the arm to move to open circuit position and for closing the said circuit closer.

3. The combination of a no-voltage release motor starter, with an automatically-actuated cut-out switch, a normally open circuit closer for controlling the opening of the cut-out switch, and means responsive to no-voltage conditions for first closing the said closer and subsequently opening the motor starter.

4. The combination of a no-voltage release motor starter, with a cut-out switch disposed between the starter and source of current, a locking device for holding the movable element of the starter in running position, a normally open circuit closer connected in circuit with the cut-out switch, and an electro-magnetically controlled means sensitive to an abnormal drop in voltage for permitting the said circuit closer to close and the movable element of the starter to move to open circuit position.

5. The combination of a motor starter including a movable contact member adapted to automatically return to open circuit position, a locking device for holding the element in closed circuit position, a weight arranged to release the locking device, an electro-magnetically operated cut-out switch, and means sensitive to no-voltage conditions for permitting the weight to act and for closing the circuit including the electro-magnet of the cut-out switch.

6. The combination of a motor starter including a movable contact element adapted to automatically return to open circuit position, a locking device for holding the element in closed circuit position, a gravity-acting means for releasing the locking device, means sensitive to no-voltage conditions for permitting the said means to act, an automatic cut-out switch, and a second gravity-acting means depending upon the first for bringing the cut-out switch into operation.

7. The combination of a motor starter including a movable contact element adapted to automatically return to open circuit position, a locking device for holding the element in closed circuit position, a gravity-acting means for releasing the locking device, an electro-magnetically operated cut-out switch, a circuit closer normally open and adapted to close by gravity when the said means operates, and means sensitive to abnormal voltage conditions for permitting the gravity-acting means to operate.

8. The combination of a motor starter including a movable contact element adapted to automatically return to open circuit position, a locking device for holding the element in closed circuit position, a cut-out switch, an electro-magnet for opening the switch, a circuit closer normally open and adapted when closed to energize the electro-magnet, and electro-magnetically operated means for releasing the locking device, and a switch associated with the cut-out switch for opening the circuit of the electro-magnet of the lock-releasing means.

9. The combination of a motor starter including a movable contact element adapted to automatically return to open circuit position, a locking device for holding the element

in closed circuit position, a cut-out switch, means for automatically opening the switch, and a mechanism sensitive to voltage conditions for releasing the locking device and for bringing the said means into operation.

10. The combination of a no-voltage release motor starter, with an automatically operated cut-out switch adapted to operate under no-voltage conditions, an electro magnet normally in open circuit and arranged to open the switch, and means for closing the circuit of the electro magnet automatically.

11. The combination of a motor starter, with an oil-immersed cut-out switch associated therewith, and a lever for manually opening or closing the switch, a link between the lever and switch, and an electro magnet having its core connected with the link for opening the switch under no-voltage conditions.

12. The combination of a motor starter, with an oil-immersed cut-out switch associated therewith, an electro-magnet for opening the switch, a normally open circuit closer controlling the circuit of the electro-magnet, and means operated by a fall in voltage for permitting the circuit-closer to complete the circuit.

13. The combination of a motor starter, with an electro-magnetically operated cut-out switch, a normally energized electro-magnet, a switch carried by the cut-out switch for opening and closing the circuit of the electro-magnet, a circuit closer controlling the operation of the cut-out switch, and means under the control of the electro-magnet for permitting the circuit closer to complete the circuit when the electro-magnet becomes deënergized.

14. The combination of a no-voltage release motor starter, a cut-out switch, electrically operated means for opening the switch, a gravity acting circuit closer for said means, and a device responsive to a drop in voltage for permitting the said circuit closer to close.

15. The combination of a no-voltage release motor starter, a cut-out switch, an electro-magnetically operated means for opening the switch, a manual means for opening or closing the switch, and means responsive to a drop in voltage for operating the electro-magnetically operated switch opening means.

16. The combination of a motor starter including a rotary element, and means for returning the element to open circuit position, with a locking device for holding the element in closed circuit position, said device comprising a catch member, a detent for holding the catch member in normal operating position, and a suddenly acting motor normally separated from and arranged to strike a blow on the detent for moving the latter out of engagement with the catch, said detent being capable of being manually released for permitting the element to return to open circuit position.

17. The combination of a motor starter including a rotary element, and means for returning the element to open circuit position, with a locking device for holding the element in closed circuit position, said device comprising a member composed of hingedly connected parts, means for connecting one of the parts with the said element, a guide for the other part, a detent adapted to engage the member to prevent the element from moving to open circuit position, and means for operating the detent to release the same from the member.

18. The combination of a supporting structure containing a liquid holding compartment, a cut-out switch mounted in the said compartment, a motor starter mounted on the structure and including an arm, a fixed guide, a member slidably mounted on the guide, a connection between the member and arm, a spring tending to move the arm in a direction to open the motor starter, a locking device arranged to engage the said member for holding the starter in normal position, and means operated at a drop of voltage to a predetermined point for permitting the motor starter and cut-out switch to open.

19. The combination of a casing divided into separate compartments for containing resistance units and oil, a cut-out switch in the compartment containing the oil, stationary contacts, a movable contact element cooperating with the stationary contacts, a spring for moving the element in one direction, a locking device arranged outside the casing for holding the element in running position, and means for releasing the locking device and opening the switch.

20. The combination of a motor starter including a spring-actuated contact element, an arm connected therewith, a locking device for holding the element in closed circuit position, and an adjustable connection between the arm and locking device.

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

ANTHONY J. BURNS.

Witnesses:
WILLIAM SIPPEL,
LAWRENCE COX.