

Dec. 11, 1923.

E. E. TAEUBERT

1,476,777

STARTING SWITCH FOR ELECTRIC MOTORS

Filed March 30, 1920

5 Sheets-Sheet 1

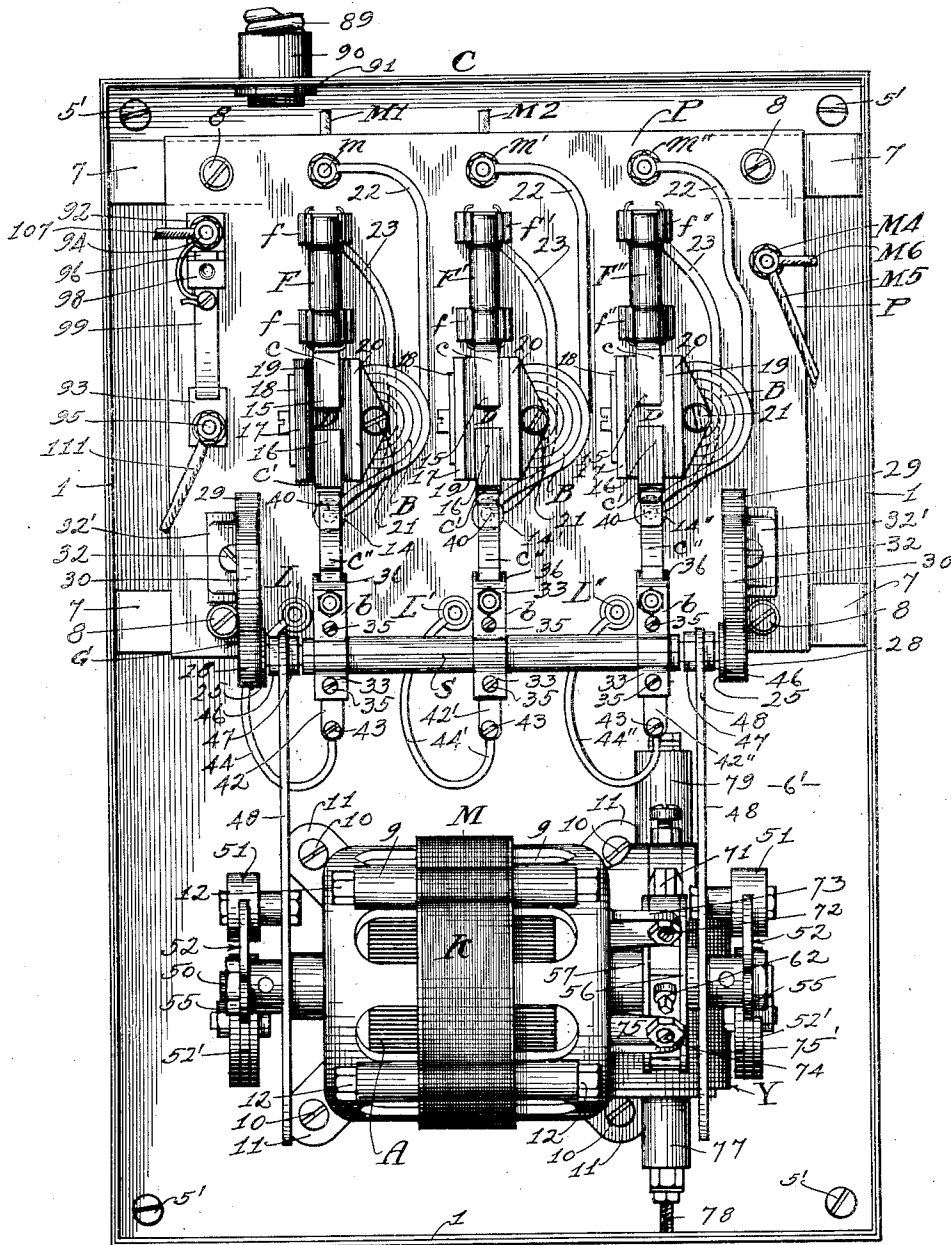


Fig. 1

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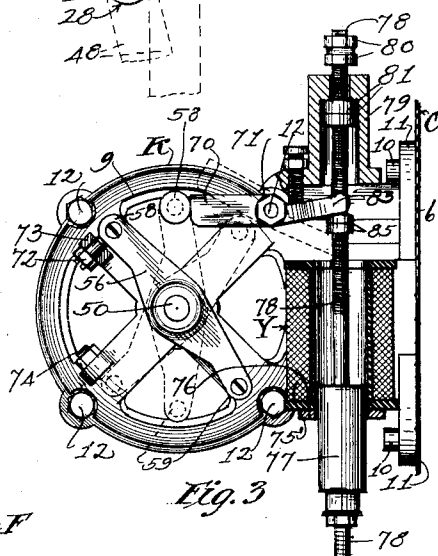
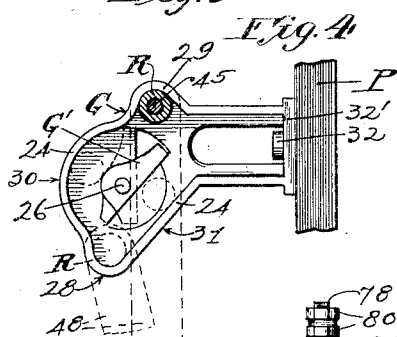
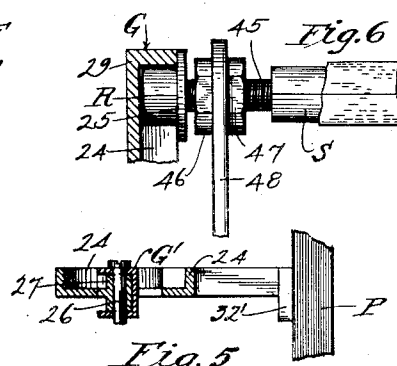
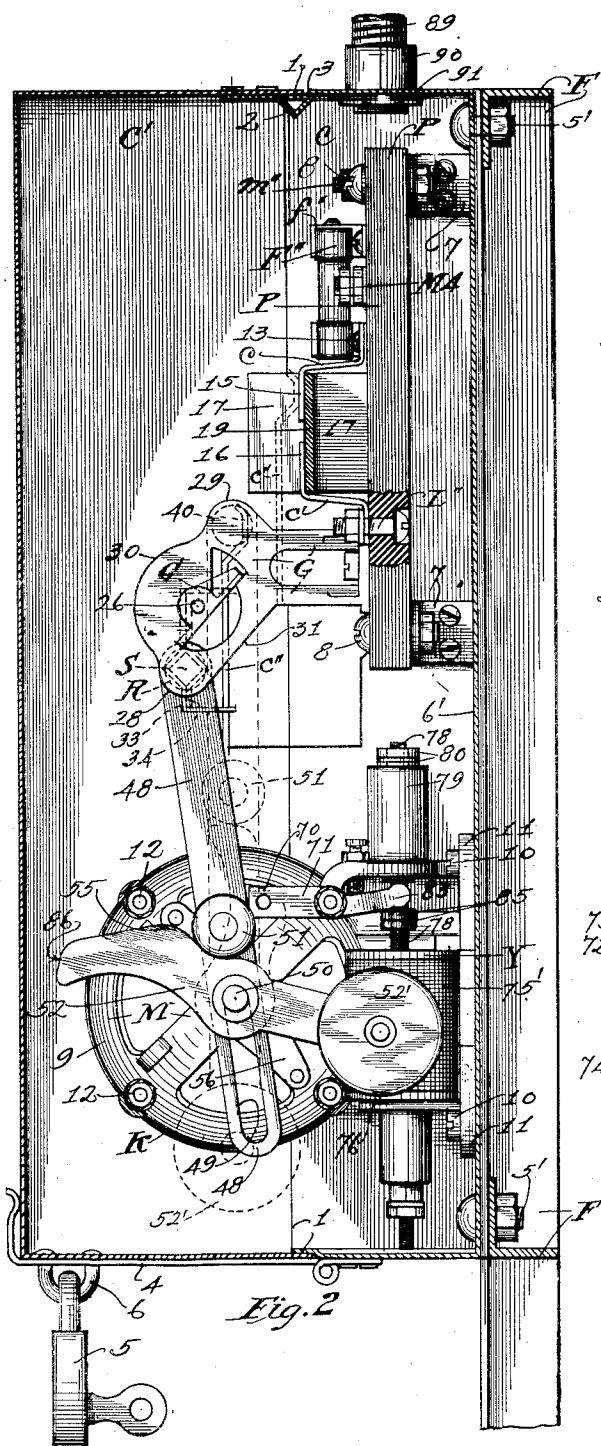
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STARTING SWITCH FOR ELECTRIC MOTORS

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5 Sheets-Sheet 2



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STARTING SWITCH FOR ELECTRIC MOTORS

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5 Sheets-Sheet 3

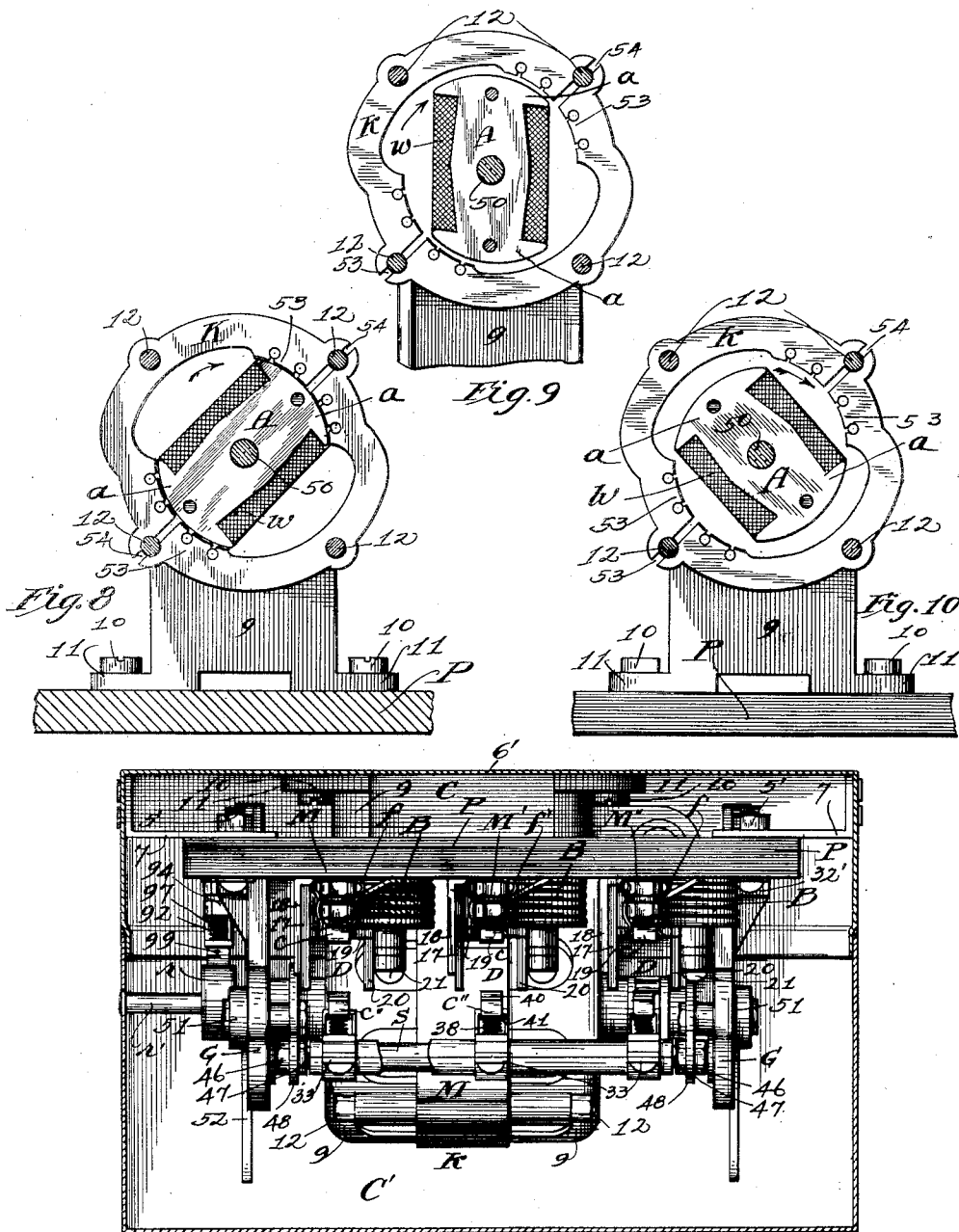


Fig. 7

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STARTING SWITCH FOR ELECTRIC MOTORS

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5 Sheets-Sheet 4

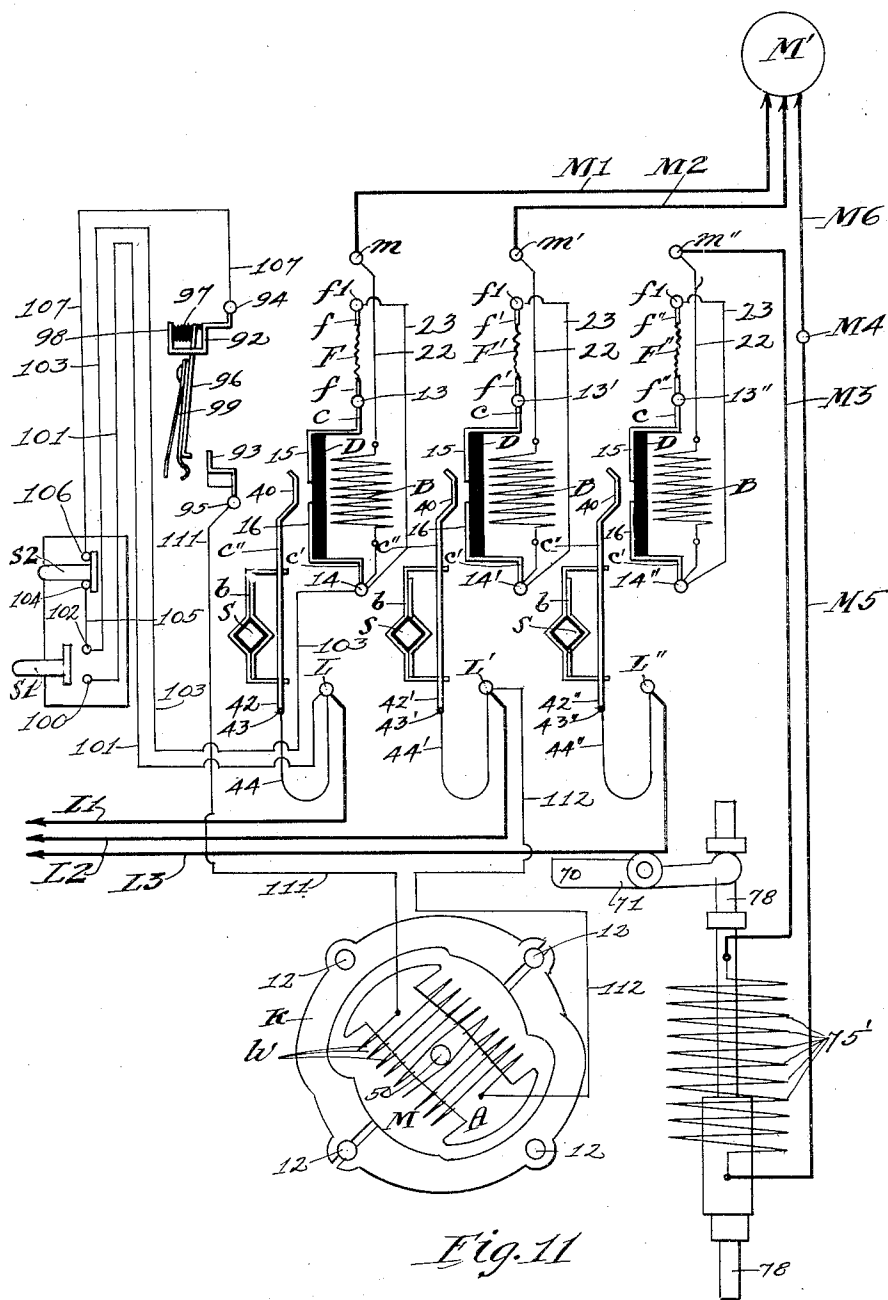


Fig. 11

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STARTING SWITCH FOR ELECTRIC MOTORS

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5 Sheets-Sheet 5

Fig. 13

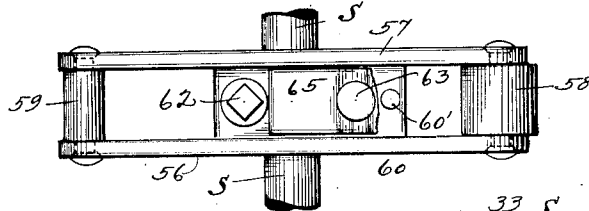


Fig. 15

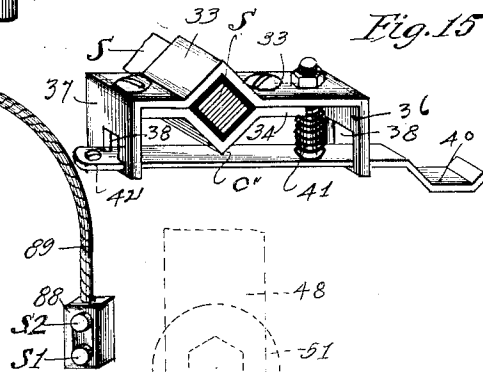


Fig. 12

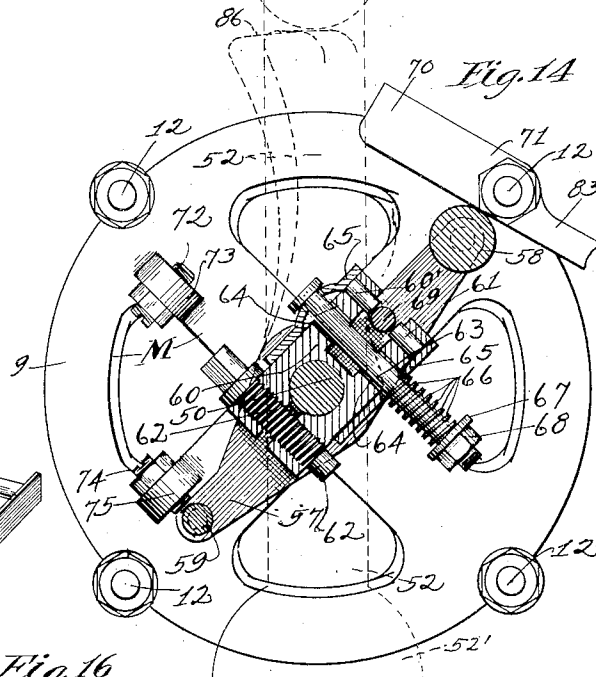
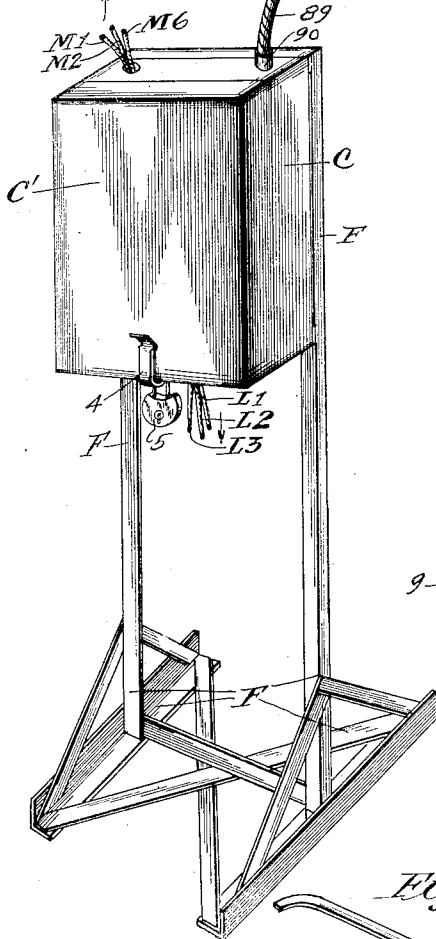
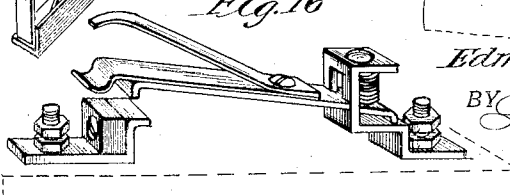


Fig. 16



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UNITED STATES PATENT OFFICE.

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STARTING SWITCH FOR ELECTRIC MOTORS.

Application filed March 30, 1920. Serial No. 372,375.

To all whom it may concern:

Be it known that I, EDMUND E. TAEUBERT, a citizen of the United States, and a resident of Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Starting Switches for Electric Motors, of which the following is a specification.

This invention relates in general to a form of electric switch generally known as the magnetic type, which is adapted to be interposed, as in the case of all switches, in the power circuit between the main source of current supply and the motor, and it relates more particularly to a switch having certain automatic features whereby the regulation of the electric current may be effected under all conditions and in all circumstances, without damage or injury to the elements included in the circuit.

The main object of my invention is to provide an electric switch of the magnetic type adapted to be connected with and to function between the power line, or source of supply, and the service line in which may be included an electric motor, or other power consuming element, having certain novel structural characteristics, arrangements of parts and features whereby the following subsidiary objects may be accomplished:

First: to allow the starting current from the power line to the motor to flow without interruption for a necessary length of time without the necessity of adjustment, so that the increase of current itself will retain the switch in starting position until the current has dropped to normal, at which time the switch will be automatically operated so as to include the fuses in the motor current.

Second: to provide, in such a switch, protection against overloading of the circuit, by the intrusion in said circuit of standard cartridge fuses adapted to adequately protect against excessive current.

Third: to provide means whereby the main contact members of the switch will automatically be disconnected by gravity when the power supply is off for any reason, the failure of the voltage in the power line

serving to deenergize the operating magnet, together with means whereby said magnet may not again be energized until the manual operation of the starting button; thus providing "no voltage" protection for the switch.

Fourth: to eliminate noise as far as possible, which in devices of this character, especially in the case of alternating current switches, employ magnets of the usual character. To this end I have provided a special form of alternating current magnet, in which entirely new principles are employed, so as to eliminate vibration and "singing" so common to alternating current magnets, as stated.

Fifth: the complete enclosure of all working parts of the switch in a heavy sheet iron case, suitably mounted for convenience and so arranged that the opening of the case will automatically open the switch and open the operating magnet circuit until the case is again closed. With the case and the switch open, as stated, the fuse clips are dead, thus rendering it possible to renew the fuse without danger of shock.

Sixth: the provision of a simple, convenient and effective design of switch, case and parts, easily accessible for the purpose of cleaning, renewing or for any other purpose; and the arrangement of all parts, wires, etc., in such a manner that they may be readily connected to the parts within the case, or withdrawn and disconnected therefrom.

In addition to the above general objects, some of the specific objects of invention are:

The provision of a switch having fuses connected with the power line and a movable switch contact member arranged for initial connection with said power line exclusively of said fuses and finally movable into and for connection with said power line inclusively of said fuses.

The provision, in a switch of the character described, of duplex power line contacts, movable switch members arranged for initial contact with one and final contact with the other contacts, electric fuses

being connected in the circuit when the final contacts are made.

The provision of a separable case in which the switch may be removably mounted, and means operable by the removal of one member of said case from the other, whereby the magnetic circuit may be broken and the switch rendered inoperative.

The provision of a switch having spaced main contact members connected with the power line and a movable member for contact successively therewith, and a suitable magnet for effecting the operation of said movable member, so as to provide an initial power circuit excluding the line fuses and a final circuit including said fuses.

The provision of a switch of the character stated embodying an alternating magnet and a contact member operated thereby, for initially operating said contact member to a partial extent and subsequently operating the same to a maximum extent for, respectively, cutting out and in the fuses of the line for the purposes mentioned.

Other objects may appear as the description progresses.

Referring to the drawings of my invention, forming a part of this application and appended hereto, I have shown one practical embodiment of my invention, which is capable of substantial modification and alteration, according to the necessities of each occasion. In said drawings—

Fig. 1 is a front elevation of my switch, with the front of the case removed.

Fig. 2 is a sectional elevation of the same.

Fig. 3 is an elevation, partly in section, of the controlling magnet and tripping mechanism.

Fig. 4 is a fragmentary elevation of the switch showing one of the switch contact tracks and roller operating thereover for guiding the movable switch contact into and from operating position.

Fig. 5 is a section of the same.

Fig. 6 is an enlarged fragmentary section of one of said tracks and associated parts.

Fig. 7 is a transverse section of the assembled switch.

Figs. 8, 9 and 10 are sections of my improved alternating current magnet, showing respectively, the rotatable armature thereof in completely closed, partially closed and completely open positions relative to the outer yokes, or keeper of the magnet.

Fig. 11 is a circuit diagram of the electrical connections of the switch and elements associated therewith.

Fig. 12 is a perspective view of the switch mounted upon a suitable frame, or stand, for convenience and accessibility.

Fig. 13 is an enlarged side view of the yieldable limiting member associated with the magnet tripping device for regulating the movement of the magnet armature.

Fig. 14 is an enlarged view of the magnet, and tripping mechanism, showing the latter mechanism in section.

Fig. 15 is a perspective view of one of the contact fingers and support therefor.

Fig. 16 is a view of the automatic safety cut-out switch.

I have employed similar characters throughout the several views of the drawings and in the specification hereinafter following for indicating the same and like parts, the structure and operation of which I will now describe in detail and at length in order that those skilled in the art may readily comprehend the use and operation of my improvements.

The following facts should be considered and understood at the outset of the description of my device, to-wit:

In the device of my invention I have provided means for overcoming all of the disadvantages of the usual forms of starters and other allied devices and at the same time have provided additional features and characteristics which have heretofore been unknown and afford a greater degree of protection, in a simple form and arrangement of parts, than said other device, and therefore afford a more elastic unit of operation, entirely automatic and having all necessary safety appliances so as to insure against damage and injury to the switch mechanism or the operator.

In the drawings hereinbefore referred to C represents a case and C' a cover therefor which is adapted to fit snugly over the turned edges 1 of the case and may be hingedly connected at the top edge by means of an angularly bent strip 2 which hooks under a correspondingly bent portion 3 of the case. At the bottom member C' is held against the case C by means of a hasp 4 and may be locked by means of an ordinary lock 5 engaging a staple 6 attached to the bottom of the case, the front end of the hasp being bent upwardly and outwardly in front of and in engagement with the front side of the cover as shown in Fig. 2.

The case C may be mounted on the wall in some cases or upon a suitable frame, or standard F adapted to rest upon the floor in any suitable location, the case being held on said frame by means of bolts 5', 5', etc., extending through the rear wall 6' of the case and the legs of the frame.

The upper portion of case C has a flat panel P of usual character and of insulating material, such as slate or the like, held on the side walls of the case by means of strap irons 7, 7, etc., riveted to the said side walls and attached to the panel P by means of bolts 8, 8, etc., said panel being substantially spaced from the rear wall 6' of the case so as to afford ample room at the rear

thereof for the necessary wires and connections leading to and from the several elements of the switch mechanism.

The lower portion of the case C, below the panel P houses a suitable and preferable form of alternating current magnet M which includes spaced end members 9, attached to the rear wall 6' of the case by means of bolts 10, which extend through feet 11, integral with said end members, and a central laminated keeper portion K, all of said magnet parts being held together by means of stay bolts 12.

A triple pole switch is mounted on the face of the panel P and near the upper edge thereof I have provided the usual cartridge fuses F, F', F'', held in ordinary fuse clips, *f, f', f''*. Below and slightly spaced from said fuses I have provided three pairs of contact plates, alined with the fuses, and the ends of the upper plates *c, c, c*, thereof are substantially spaced from the ends of the lower plates *c', c', c'*. The upper plates *c, c, c* are attached to the fuse clips *f, f', f''*, respectively, by means of screws, or terminals 13, 13', 13'', and the lower portions thereof are bent outwardly from the panel P and thence downwardly as shown, in the direction of the ends of the lower plates *c', c', c'*.

Likewise the lower plates are attached to the panel P by means of screws, or terminals, 14, 14', 14'', and are bent outwardly and upwardly in the direction of the upper plates. Thus the end portions 15, 15, 15 of the upper plates and those 16, 16, 16 of the lower plates are alined vertically and parallel with the panel P and said plates rest upon mountings D, D, D, of insulating material and comprise side plates 17, 17, 17, which are attached to metal brackets 18, 18, 18 held on the face of the panel, floor portions 19, 19, 19 attached to said side plates and forming supports for the contact plates C and C' and shorter side plates 20, 20, 20 suitably attached to the other members of the mountings and spaced from the space of the panel P.

Blow-out coils B, B, B, are provided, respectively, between the plates 19, 19, 19 of mountings D, D, D, and the face of the panel P and are wound around cores held between the floor portions described and said panel by means of screws 21, 21, 21. The wires 22, 22, 22, of said coils are attached at one of their ends to the motor line terminals *m, m' and m''*, respectively, at the upper end of the panel P and the other ends thereof are attached to the contact plate terminals 14, 14', 14'', respectively. The said terminals 14, 14', 14'', are connected by means of wires 23, 23, 23, with the fuse clip terminals *f, f', f''* at the upper ends of the fuse clips, respectively. Thus connections are established through and around the fuses F, F', F'', of the switch by

means of said parts and the arrangement described, for reasons which will hereinafter appear.

On the lower portion of the panel P and near the sides thereof I provide a pair of guide members G, provided with internally extended ribs 24, forming tracks for rollers R, carried on the opposite ends of a square transverse shaft S, said rollers having flanges 25, overlying the edges of said ribs. It will be noted that in the central portion of said guides I have provided pivoted switch members G', held on pivot screws 26, carried in bosses 27 formed on said guides and the contour of the ribs 24, on the guides G, conform substantially to that of the switch members G', as shown in Fig. 4.

The guide portions of said members include the curved extremes 28 and 29 of movement of the rollers R, the intermediate upper portions 30 concentrically formed around the axis of the members G' and the lower diagonal portions 31 paralleling the inner edge of members G' when in the position shown in Fig. 4. Guide members G are held on the face of the panel P by means of screws 32, or bolts extended through feet 32' thereof.

The shaft S, hereinbefore referred to, is of square cross-section and is completely insulated with mica or other suitable material and said shaft carries a triplet of contact plates, or fingers *c'', c'', c''*, which are yieldably held in brackets *b, b, b*, respectively, and consisting of members 33 and 34 held together on opposite sides of said shaft by means of screws 35. The extremities 36 and 37 of the members 33 are bent inwardly in the direction of the panel P and have slots 38 therein through which said contact fingers extend. Also, the upper ends of said fingers are bent inwardly to afford flat contact portions 40 for contact with the portions 15 of the stationary contact plates *c* and 16 of the lower plates *c'*. Springs 41 held between the outer portions of the plates 33 and the fingers *c''* serve to hold said fingers resiliently and yieldably at the bottoms of the slots 38 39 in the bracket members, so that they may yield outwardly when required.

The lower ends 42 42' and 42'' of fingers *c''* are attached at 43, 43, to wires 44, 44' and 44'', respectively, which are of ample length and flexible enough to permit the movement of the shaft S and connections, and said wires connect at their other ends with the line terminals L, L' and L'', leading to a source of current supply, as hereinafter more fully described. The reduced ends 45 of the shaft S which revolvably hold the rollers R, are long enough to accommodate a pair of nuts 46 and 47 between which are adjustably held, near each side of the switch, vertically disposed bars 48. These bars have square openings to receive the shaft S so as to prevent

the bars turning thereon, and have elongated slots 49, in their lower portions through which the extended ends of the armature shaft 50 of the magnet M extend. Thus the bars 48 are slidable on the shaft 50, and rollers 51, carried on said bars above the slots 49 are alined with and adapted to engage the edges of arms 52, 52 fixed to the shaft 50 adjacent to the bars 48. This structure is clearly shown in Figs 1 and 2.

Magnet M has a pivoted armature A, as shown in Figs. 8, 9 and 10, around which is a suitable winding *w*. The peripheral portions *a*, *a*, of said armature are spirally formed relative to the axis of the armature shaft 50, and the portions 53, of the keeper K of the magnet are also similarly and correspondingly formed so that the curves of the portions *a* and 53, during the movement of the armature, may at all times be so related that all points on the portions *a* of the armature will be equidistant from opposite points on the portions 53 of the keeper. In this connection, it will be noted that air gaps 54, are provided between opposite portions of the keeper K of the magnet and two of the stay bolts 12 of the magnet are of brass or other non-magnetic material so as to provide against what is known as a magnetic circuit.

The rotation of the armature shaft 50 is clockwise and the different positions thereof are shown in Figs. 8, 9 and 10. Thus, as the armature is rotated, the arms 52 which are fixed to said shaft midway of their ends, are also rotated in a clockwise direction as viewed in Fig. 2, and the cam portions 55, of said arms engage the rollers 51, on bars 48, and lift said bars together with the transverse shaft S and the contact plates *c''* thereon. With the parts in the positions shown in Fig. 2, the bars 48 are raised so as to make the movable contacts *c''* register and make contact with the lower contact plates *c'*. This initial action is accomplished through the medium of the starting button S¹ which effects the energization of the magnet M, as in other switches, and the fuses F, F' and F'' are omitted from the power circuit, the circuit being completed around the fuses by means of the wires 22, through terminals 14, 14' and 14'' and the coils B and motor line terminals *m*, *m'* and *m''*. The starting current is allowed to flow without interruption for a necessary length of time by means of the following described mechanism. On one end of the shaft 50 of the armature I provide a limiting device consisting of a pair of flat side members 56 and 57, which are connected at the opposite ends by transverse members 58 and 59, and a central split clamp member having a pair of arms 60 and 61 held on the shaft 50 by means of a heavy screw 62. On the

opposite side of shaft 50 I provide a plunger 63 extending through bores 64, 64 in arms 60 and 61 and also through plates 65, 65 adjacent to the outer sides of said members, a spring 66 being carried on one end of said plunger for compression between the plate 65 and a washer 67 held on the end of the plunger by means of a nut 68, as shown in Fig. 14. The ends of arms 60 and 61, through which the plunger 63 extends carry plungers 60' and 61' on their inner adjacent portions which engage the plates 65 and bear against opposite portions of a transverse pin 69 held in the side plates 56 and 57, the said plates being rigidly connected together in the manner described and not fixed to the shaft 50 have a differential movement relative to the clamp arms 60 and 61. The extent of this differential movement corresponds to the difference in diameter between the pin 69 of the device and the width of the gap between arms 60 and 61 adjacent to said pin.

Now, when the bars 48 have been actuated to the extent described for providing starting current without interruption to the motor, the transverse member 58 will engage the end 70 of a dog 71 pivoted on one of the stay bolts 12 of the magnet M, as shown in Fig. 3 at the intermediate position indicated in broken lines. The normal position of the limiting mechanism just described is indicated in full lines and the normal position of the member 71 is indicated in broken lines in Fig. 3.

Now when the mechanism is at rest member 58 will rest against an adjusting pin, or screw 72 held in a lug 73 on the magnet frame and the member 59 is adapted to rest against and be limited in the extent of its action by engagement with a similar screw 74 held in a similar lug 75 on the magnet frame.

The dog 71 is actuated by a solenoid Y having a coil 75' supported on a bracket 76 attached to the magnet frame. Said solenoid has an adjustable armature 77 carried on a vertically slidable stem 78 and slidably held at the top in a boss 79 formed on the magnet frame. The downward movement of the armature stem 78 is limited by means of nuts 80 on the upper end of the stem and above the boss 79 and other nuts 81, carried below the upper end of and within the counterbore 82 of said boss limit the movement of the stem upwardly. The outer end of the dog 71 has a yoke 83 thereon which straddles the stem 78 and is connected therewith for operation, the end thereof resting on the uppermost of the nuts 85 for movement with the stem.

Normally the armature and stem of the solenoid are held downwardly by gravity so that the yoke 83 of dog 71 is engaged by the

lower nut 85, so that the dog 71 may be raised thereby into the position shown in broken lines in Fig. 3.

The solenoid is adapted to be energized by means of the connections hereinafter described and in the manner stated, momentarily with the depressing of the starting button S^1 and the completion of the starting circuit. The armature of the solenoid is therefore elevated so that the nuts 85 raise the yoke 83 of dog 71 and thus prevent the further turning of shaft 50 of the magnet M , by reason of the engagement of the member 58 with the end of the dog 71, as shown in Fig. 3. With the drop in current and the normal amount of current in the power circuit, the solenoid is insufficient for supporting its stem and the member 58 is permitted to pass the dog 71, thus permitting the further rotation of shaft 50 of the armature.

The further movement of the shaft S and its contacts c'' , which corresponds to and is effected by the further rotation of shaft 50, further elevates the rollers R of shaft S into the extreme position 29 of the guides G as shown in Fig. 4 and the end portions 86 of the arms 52 engage and rest immediately beneath the rollers 51, as shown in broken lines at the right of Fig. 14. In this instance it is intended that the rollers 51 will be on the vertical center line of the armature shaft 50 and the members 56—57 and 60—61 are held by the pull of the magnet M in strained relation against the tension of the spring 66. This feature insures the restoration of the parts, from a dead center, to normal position and the fall by gravity, without obstruction, the moment the magnet M is deenergized for any reason whatsoever.

It will be noted in Fig. 12 that the starting and stopping buttons S^1 and S^2 are held in a suitable and well-known type of case 88 which may be attached in the manner shown, or otherwise, by means of a flexible tube 89, with the case C . This connection may be as shown in Fig. 2, by the employment of a nipple 90 and a lock nut 91 on the inner end thereof and adapted to engage the inner side of the upper wall of the case.

An automatic cut-out device is provided at one side of the switch on the panel P and includes a pair of clips 92 and 93 having terminals 94 and 95, respectively, for holding the said clips on the face of the panel P , and a bridge contact plate 96 pivotally held on the upper clip 92 so that when the front C' is removed from the case C a spring 97 carried between the outer lip 98 of clip 92 and the upper end of contact plate 96 will cause the opposite end of said plate 96 to disengage the lower clip 93. This automatic cut-out device is in series with the control magnet M so that it will be readily apparent that when the case cover is detached and removed, flat springs 99 attached

to the bridge plate 92 being held in engagement with a roller r carried on a stud r' on said cover when in normal position on case C , the magnet circuit will be broken and it will be impossible to make contact with the mechanism described between the stationary and movable contact plates of the line circuit.

Referring particularly to the circuit diagram in Fig. 11 it will be noted that line wires M^1 and M^2 connect respectively with line terminals m , and m' , while the terminal m'' connects with one end of the solenoid coil 75 by means of wire M^3 . The opposite end of coil 75' connects with an auxiliary terminal M^4 on the panel P by means of wire M^5 and the third line wire M^6 connects also therewith. Thus the solenoid Y is seen to be in series with one side of the motor circuit and it will be energized the moment the motor circuit is completed.

The point 100 of the starting button S^1 is connected by wire 101 with line terminal L of the switch, and point 102 of said button is connected by wire 103 with terminal 14, the starting circuit being completed by the depressing of button S^1 . Point 104 of stop button S^2 is connected with point 102 of start button S^1 by wire 105, and point 106 is connected by wire 107 with terminal 94 of the automatic cut-out device operated by the removal of the cover C' . The depressing of stop button S^2 breaks the circuit and opens the switch.

The source of current supply may be connected by means of wires L^1 , L^2 and L^3 with switch terminals L , L' and L'' so that when the power circuit is closed either through or around the fuses F , F' , F'' , current will be supplied to the motor. It will be understood in this connection that when the contacts c' and c'' are engaged the current flows through contacts c' , terminals 14, 14' and 14'' blow-out coils B , B , B , and to the motor terminals m , m' , and m'' . When contact is completed between the contacts c and c'' the current flows through contacts c , fuses F , F' , F'' , wires 23, blow-out coils B , and wires 22, to the motor terminals, thus cutting in the fuses in the circuit.

The automatic cut-out switch between terminals 94 and 95 is in series in one side of the magnet circuit to the start and stop buttons S^1 and S^2 , terminal 95 being connected with the winding w of the magnet M by means of a wire 111, the other end of the winding being connected with line terminal L' of the switch by means of a wire 112. Thus when the cover is removed the connection between the terminals is broken and the magnet circuit is opened so that the switch will be inoperative.

The blow-out coils B serve the usual purpose of extinguishing or preventing the arcing of the current between the ends of con-

tacts c' and c'' as the latter are moved upwardly in the direction of the former, and also between contacts c and c'' when the final circuits are established. The lines of force in the vicinity of the coils B act to prevent, or to extinguish any arcs which may be created between these elements. This phenomena is well known in the art and not of my discovery.

The contacts c'' , supported and operated in the manner and by the means hereinbefore described, when actuated preliminary to the starting contact are moved upwardly and inwardly in the direction of the face of the panel P, because of the diagonal tracks 31 of the guides G, over which the rollers R operate. The guide members G' normally occupy the positions indicated in Fig. 2 and are so held by gravity so as to provide free movement of the rollers R thereunder, as stated. Thus, the contacts c'' instead of being moved vertically into contact with the plates c , or c' , are moved both upwardly and inwardly and a quicker contact between the contacts may be effected by reason of this feature.

It will be observed that the contact of the members c'' with the plates c' begins with the meeting of the bent edges of the respective members and any arcing that may occur is confined to these points only inasmuch as subsequent motion of the contacts c'' results in a sliding engagement of the said members. This action gives a wiping contact assuring even wear thereof and practically precluding pitting of the respective members. The contact is made rapidly and as a further precaution against wear with a view to increasing the life of the contacts the action takes place in a strong magnetic field which will blow out any arc that may occur. The latter feature is a decided advantage in the case of higher voltages. The necessity of maintaining oil about the contacts is eliminated in my improved device.

Likewise, on the return stroke, when no voltage occurs on the power line, or when the stop button is depressed for opening the switch, the contacts c'' first move directly away from and out of contact with the contacts c instead of first sliding thereover for a slight distance, the rollers then moving over the track portions along the outer side of the guides G' and finally settling by gravity into the portions 28 of the guides G, as shown in Fig. 2. Of course, when the switch from the connections $c'-c''$ is made to the connections $c-c''$, the movement of the contacts c'' is vertical and parallel to the face of the panel P. On the restoration of the parts to normal position (this being accomplished, as stated, by gravity) the arms 52 are also dropped into the position indicated by broken lines in Fig. 2 by means

of the weighted ends 52' attached to the inner ends of said arms.

It will be observed that the device provides entirely automatic control and is not dependent upon the operator nor are expert adjustments required as in the case of timed current relay devices. After the current has subsided to normal adequate protection is afforded by the usual fuses which may be safely replaced by a novice. During the entire period of operation of the motor the contacts are maintained by the magnet M, which as explained exerts a constant pull in any position within its normal range of movement, and serves not only for the purpose of moving the contacts into initial starting position but further serves to maintain contact during the period of operation of the motor until the no voltage condition occurs.

While I have shown and described an alternating current magnet of my own design and invention in connection with my improved switch mechanism, it will be understood that I do not limit myself to the use of this or any other particular type of magnet, nor do I rely upon the specific character of any of the parts or the particular arrangements and relationships herein described for the accomplishment of the object of my invention. I conceive it to be possible within the scope of the appended claims, to substantially alter and modify the structure shown without departing from the spirit of my invention.

What I claim, is:

1. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members for said support, a power actuated oscillatable shaft, cams fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, said guide means being arranged to move said movable contacts slidably from one to another of the spaced stationary contacts in a starting operation, and having means for laterally retracting the movable contacts from engagement with the final stationary contacts when the circuit is open.

2. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members for said support, a power actuated oscillatable shaft, cams

fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, and means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, for the purpose described.

3. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members of said support, a power actuated oscillatable shaft, cams fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, said guide means being arranged to move said movable contacts slidably from one to another of the spaced stationary contacts in a starting operation, and means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, for the purpose described.

4. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members for said support, a power actuated oscillatable shaft, cams fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, said guide means being arranged to move said movable contacts slidably from one to another of the spaced stationary contacts in a starting operation, and having means for laterally retracting the movable contacts from engagement with the final stationary contacts when the circuit is open, and means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, for the purpose described.

5. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members for said support, a power actuated oscillatable shaft, cams fixed to

said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, and means for thereafter releasing said movable contacts for further operation and for engagement with the final stationary contacts.

6. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members on said support, a power actuated oscillatable shaft, cams fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, said guide means being arranged to move said movable contacts slidably from one to another of the spaced stationary contacts in a starting operation, means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, and means for thereafter releasing said movable contacts for further operation and for engagement with the final stationary contacts.

7. A starting switch for electric motors composed of a multiple contact device and including a plurality of sets of spaced stationary contacts, a plurality of movable contacts for engagement therewith, a common support for said movable contacts, fixed guide members for said support, a power actuated oscillatable shaft, cams fixed to said shaft, means operably connecting said cams with said movable contact support for advancing and retracting the movable contacts into successive engagement with corresponding members of said stationary contacts, said guide means being arranged to move said movable contacts slidably from one to another of the spaced stationary contacts in a starting operation, and having means for laterally retracting the movable contacts from engagement with the final stationary contacts when the circuit is open, means cooperating with said cams for momentarily stopping the sliding movement of said movable contacts for engagement with the initial stationary contacts, and means for thereafter releasing said movable contacts for further operation and for engagement with the final stationary contacts, for the purpose described.

8. A starting switch for electric motors in-

cluding a plurality of initial stationary contacts, a plurality of final stationary contacts alined therewith and spaced therefrom, a plurality of movable contact members operably disposed in the plane of said stationary contacts and normally disengaged therefrom, a common support for said movable contacts, said movable contacts being arranged for successive engagement with said initial and said final stationary contacts, guide means for said support including a trip device adapted to be actuated in a given direction for guiding the movable contacts into contact and arranged to thereafter guide said movable members into sliding contact with the final contact members, said trip device being reversely operable when the movable members are disengaged from the final contact member for guiding the movable members outwardly from the final contact member.

9. A starting switch for electric motors including a plurality of initial stationary contacts, a plurality of final stationary contacts alined therewith and spaced therefrom, a plurality of movable contact members operably disposed in the plane of said stationary contacts and normally disengaged therefrom, a common support for said movable contacts, said movable contacts being arranged for successive engagement with said initial and said final stationary contacts, guide means for said support including a trip device adapted to be actuated in a given direction for guiding the movable contacts into contact and arranged to thereafter guide said movable members into sliding contact with the final contact members, said trip device being reversely operable when the movable members are disengaged from the final contact member for guiding the movable members outwardly from the final contact member, and power operated means for momentarily holding said movable members in engagement with the initial contact members, and adapted to be thereafter automatically released for permitting the engagement of the movable members with the final contact members.

10. A starting switch for electric motors including a plurality of initial stationary contacts, a plurality of final stationary contacts alined therewith and spaced therefrom, a plurality of movable contact members operably disposed in the plane of said stationary contacts and normally disengaged therefrom, a common support for said movable contacts, said movable contacts being arranged for successive engagement with said initial and said final stationary contacts, guide means for said support including a trip device adapted to be actuated in a given direction for guiding the movable contacts into contact and arranged to thereafter guide said movable members into slid-

ing contact with the final contact members, said trip device being reversely operable when the movable members are disengaged from the final contact member for guiding the movable members outwardly from the final contact member, and power operated means for actuating said movable members simultaneously.

11. A starting switch for electric motors comprising a plurality of sets of initial and final contact bars, a plurality of movable contact bars for successive engagement respectively with the initial and final contact bars, a power actuated cam arranged for operating said movable bars, means connecting said movable bars with said cams, and guide means for effecting a longitudinal and lateral movement of said movable bars into and from contact with the stationary bars, said cam being arranged for electromagnetic operation.

12. A starting switch for electric motors comprising a plurality of sets of initial and final contact bars, a plurality of movable contact bars for successive engagement respectively, with the initial and final contact bars, a power actuated cam arranged for operating said movable bar, means connecting said movable bars with said cams, guide means for effecting a longitudinal and lateral movement of said movable bars into and from contact with the stationary bars, said cam being arranged for electromagnetic operation, and means cooperating with said cam for momentarily stopping the movement of said movable bars when engaged with the initial contact bars.

13. A starting switch for electric motors comprising a plurality of sets of initial and final contact bars, a plurality of movable contact bars for successive engagement, respectively, with the initial and final contact bars, a power actuated cam arranged for operating said movable bars, means connecting said movable bars with said cams, guide means for effecting a longitudinal and lateral movement of said movable bars into and from contact with the stationary bars, said cam being arranged for electromagnetic operation, and means cooperating with said cam for momentarily stopping the movement of said movable bars when engaged with the initial contact bars, said stopping means being arranged for electromagnetic operation.

14. A starting switch for electric motors comprising a plurality of sets of initial and final contact bars, a plurality of movable contact bars for successive engagement, respectively, with the initial and final contact bars, a power actuated cam arranged for operating said movable bars, means connecting said movable bars with said cams, guide means for effecting a longitudinal and lateral movement of said movable bars into

and from contact with the stationary bars, said cam being arranged for electro-magnetic operation, and means cooperating with said cam for momentarily stopping the movement of said movable bars when engaged with the initial contact bars, said stopping means being arranged for electro-magnetic operation, and for releasing said movable bars for further operation after a predetermined interval of time, for engagement with the final contact bar. 10

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Witnesses:

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