(No Model.) 7 Sheets—Sheet 1.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

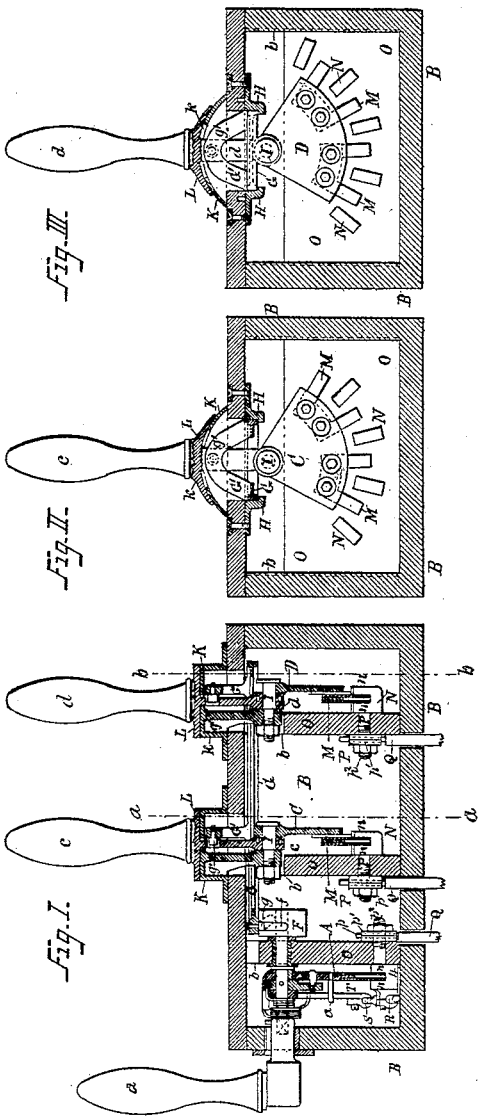

Fig. III.

Fig. II.

Fig. I.

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(No Model.) 7 Sheets—Sheet 2.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. V.

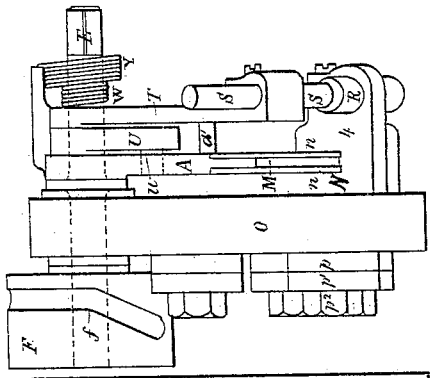
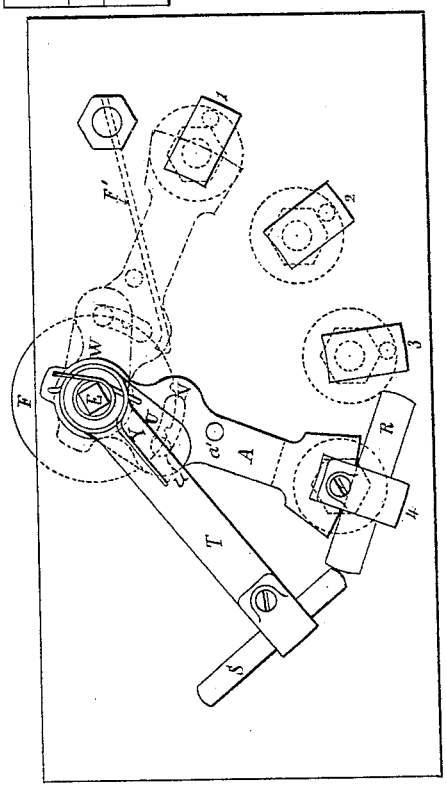


Fig. IV.



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(No Model.)

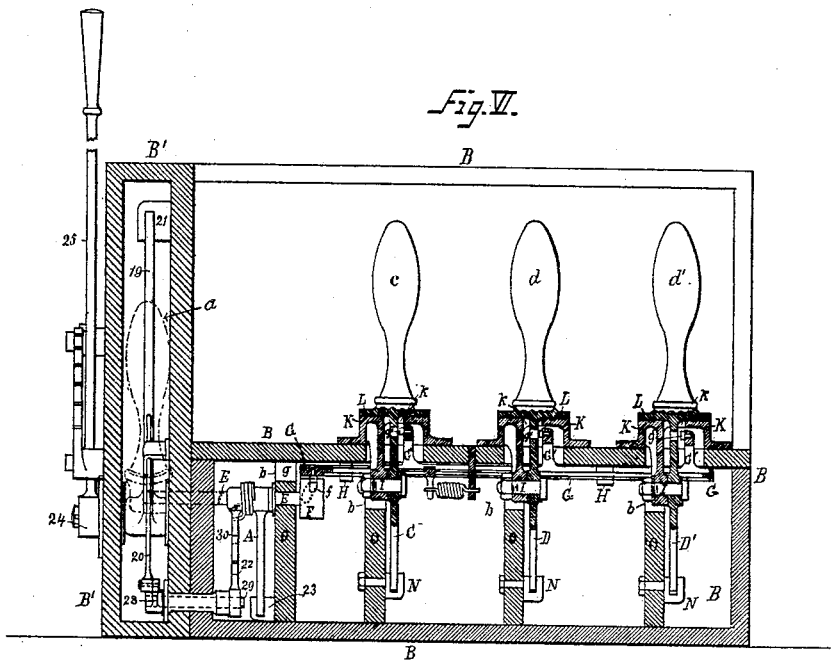
7 Sheets—Sheet 3.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. V.



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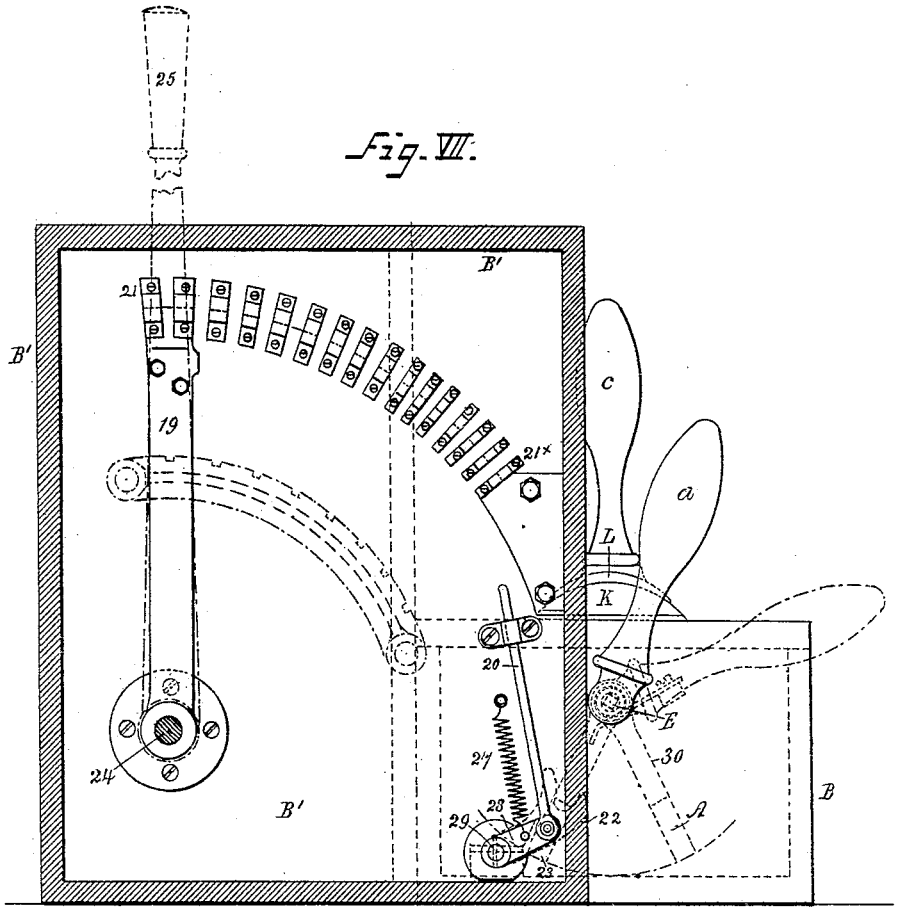
(No Model.) 7 Sheets—Sheet 4.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. VII.



WITNESSES:

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(No Model.)

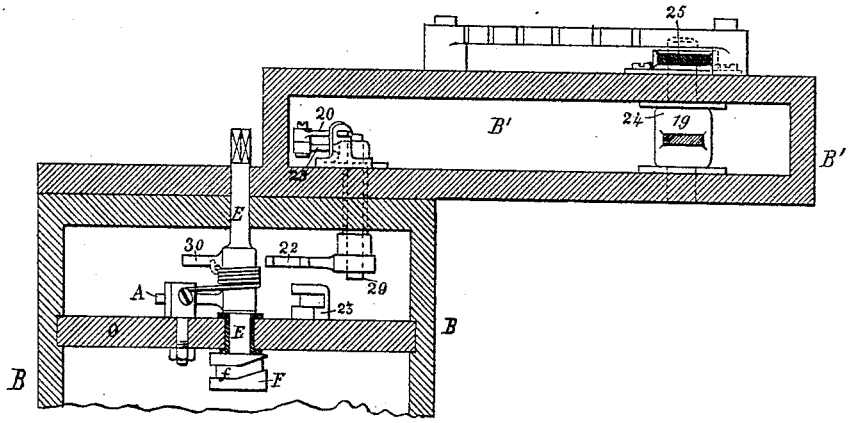
7 Sheets—Sheet 5.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. VIII.



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(No Model.) 7 Sheets—Sheet 6.

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. IX.

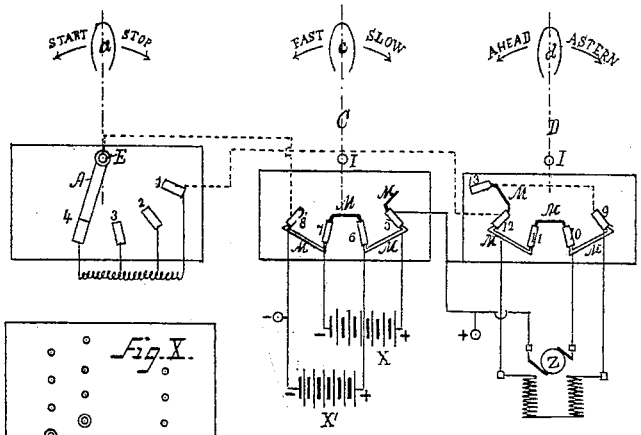

Fig. X.

Fig. XI.

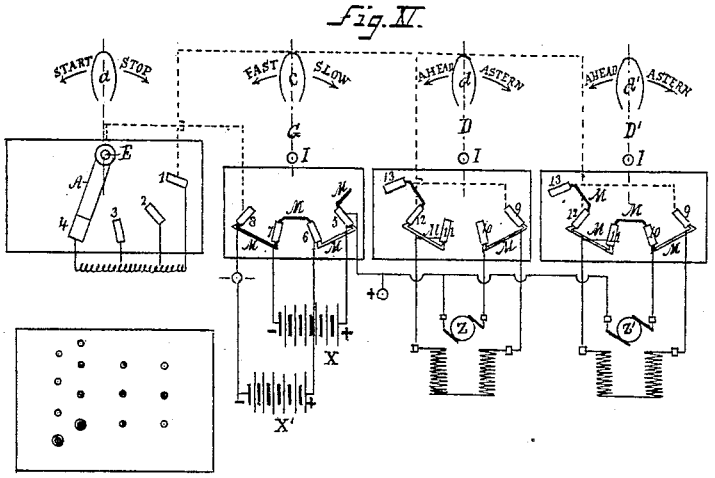

Fig. XII.

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7 Sheets—Sheet 7

M. IMMISCH.

SWITCH FOR ELECTRIC MOTORS.

No. 493,361. Patented Mar. 14, 1893.

Fig. XIII.

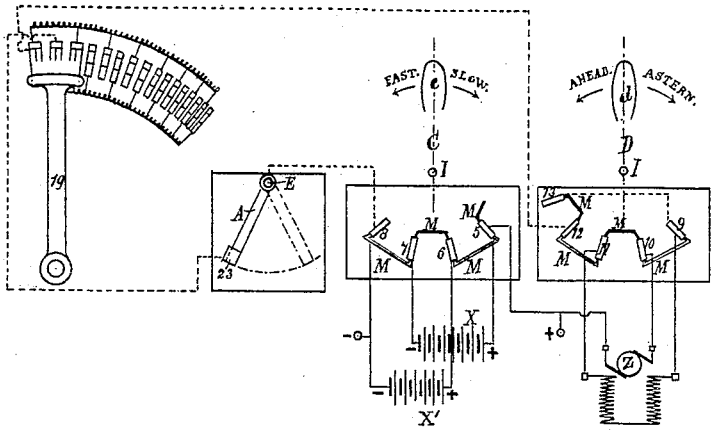
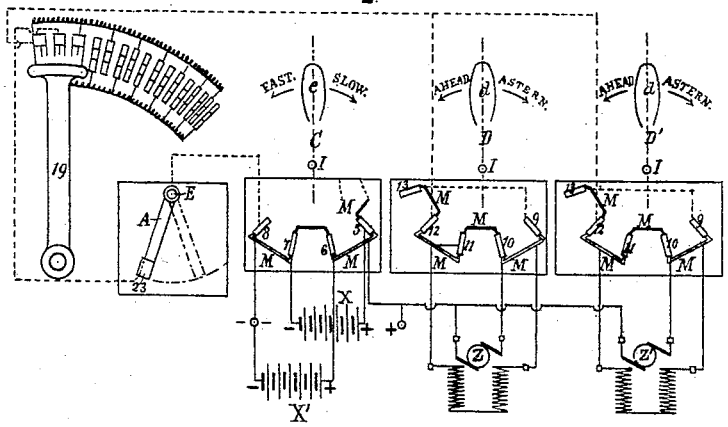


Fig. XIV.



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UNITED STATES PATENT OFFICE.

MORITZ IMMISCH, OF LONDON, ENGLAND, ASSIGNOR TO THE IMMISCH ELECTRIC NAVIGATION AND POWER COMPANY, OF NEW JERSEY.

SWITCH FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 493,361, dated March 14, 1893.

Application filed November 21, 1891. Serial No. 412,674. (No model.) Patented in England September 7, 1889, No. 14,113.

To all whom it may concern:

Be it known that I, MORITZ IMMISCH, a citizen of Great Britain, and a resident of London, in the county of Middlesex, England, have invented a new and useful Improvement in Switches for Electro-Motors, (patented in England September 7, 1889, No. 14,113,) of which the following, taken in connection with the accompanying drawings, is a full, clear, and accurate description.

My invention relates to switches for use with electro motors, to prevent any changes in their connections until after the circuit has been broken, and it consists of certain novel features of construction for producing various advantageous results as hereinafter more fully described.

In the accompanying drawings, Figure I, is a longitudinal section through the switch box showing my invention. Fig. II, is a transverse section on the line *a*, *a*, of Fig. I, showing the accumulator switch. Fig. III, is a transverse section on the line *b*, *b*, of Fig. I, showing the motor switch. Fig. IV, is an end elevation on an enlarged scale of the make and break switch, and Fig. V, is a side elevation of Fig. IV. Fig. VI, is a longitudinal section of a switch box in which a separate resistance lever is combined with the make and break switch or lever. Fig. VII, is an end elevation (partly in section) of Fig. VI, and Fig. VIII, is a horizontal section of a part of Fig. VII, showing the resistance lever and make and break switch in plan. The switch box illustrated in Figs. I to V inclusive is provided with one accumulator switch and one motor switch, while that illustrated in Figs. VI to VIII inclusive, is provided with one accumulator switch and two motor switches. Fig. IX, is a diagrammatic view showing the connection of a switch box with one accumulator switch and one motor switch, and Fig. X, is a plan view showing the terminals thereof. Fig. XI, is a diagrammatic view showing the connections of a switch box with one accumulator switch and two motor switches, and Fig. XII, is a plan view showing the terminals thereof. Fig. XIII, is a similar view to Fig. IX, and Fig. XIV, is a similar view to Fig. XI, each showing the connections when a separate resistance lever is used in combination with the make and break switch.

A make and break switch or lever A is placed in the circuit, and this is arranged in the same box B as the switch or switches C of the accumulators, and the switches D, D′, of the motors. The make and break switch A is arranged so that the handle *a*, for actuating same is applied thereto at one end of the box B, while the levers *c*, *d*, *d′*, of the accumulator and motor switches C, D, D′, project up through the top of the box. The make and break switch or lever A can move through an arc of a circle, and preferably acts in conjunction with a series of contact pieces 1, 2, 3, 4, between which suitable resistances are inserted (as shown in Figs. IX and XI), so that the circuit will be broken through a gradually increasing resistance, and re-established through a gradually decreasing resistance. The spindle E, of the make and break lever A, carries a cam F, with a groove *f*, in which is fitted a pin *g*, forming part of a movable locking bar or rod G, which in practice slides longitudinally in guides H, in the top of the switch box R. This locking bar G, has arms G′, projecting upwardly therefrom, equal in number to the accumulator and motor switches in the box, and each of these arms is provided with a pin *g′*, which serves to engage and lock the levers of such switches. The accumulator and motor switch levers are each pivoted to turn on a center I, within the box B, in a plane at right angles to the bar G. When the make and break lever A has been turned so as to break the circuit, the sliding bar G has been moved (by means of the cam F), so that the pins *g′*, on the arms G′ of such bar have been removed from out of the path of the levers, *c*, *d*, *d′*, of the switches C, D, D′, which are then able to be shifted as required. In the middle position of the switch levers the accumulators or motors (as the case may be) would be cut out, and in such position the return movement of the make and break lever A to re-establish the circuit, will, by moving back the sliding bar G, cause each of the locking pins *g′* to pass through a hole formed in each of such levers. The moving of the accumulator switch lever *c*, to one side of the

central position, will place the two sets of accumulators X, X′, (see Figs. IX, XI, XIII and XIV) in series, and its movement to the opposite side will place same in parallel. The moving of either of the switch levers *d*, *d′*, will cause the motor to which it belongs to run one way when such lever is moved to one side of the central position, and will reverse such motor when the lever is moved to the opposite side. When the accumulator and motor switches have been shifted to either side of the central position, the movement of the make and break lever A to close the circuit, brings the locking pins *g′* against the upper side of such levers, and prevents them being shifted again from such position until the circuit has been again broken.

The resistance between the contacts 1, 2, 3, 4, (see Figs. IX and XI) in connection with which the make and break switch A acts, will in themselves enable the speed of the motors Z, Z′, to be varied by cutting out or introducing more or less of such resistances from or into the circuit, and the facility of placing the two sets of accumulators X, X′, either in series or in parallel gives further scope for the same purpose. If desired, the resistances which the make and break switch is made to put in or take out, may consist of coils of the fields of the motors.

The separate reversing switches D, D′, for each motor enable any of the motors to be cut out if desired, or some to be run in one direction and some in another, which will find its special application in the case of the electrical propulsion of boats or vessels.

The arrangement described may also be applied to a direct system, but in such system the accumulator switch would of course not exist. It will be readily understood that any number of switches (both for accumulators and motors) may be combined with one make and break switch or lever.

The whole of the movable parts of the switches and also the locking bar G, are preferably secured to the lid of the switch box B, so that they can be removed with the lid. The switch levers *c*, *d*, *d′*, each work through a slot *k*, in a segmental piece K secured to the top of the lid and the upper surface of which is struck from the center I on which the lever turns. Above such segmental piece K the lever carries a cap or cover L, the under side of which is in contact with the top of the segmental piece over which it can slide, the cap being of such size that it still covers the slot through which the lever works when the lever is in the extreme position on each side. By these means wet and dirt are prevented from gaining entrance to the box and so damaging the contacts of the switches.

The contact pieces M carried by the levers of the switches C, D, D′, and also by the make and brake lever A, are preferably of U form (as shown on Sheet 1), forming springs, and they fit between two cheeks *n*, of the terminal contact pieces N of the switches, with a light spring action, so as to insure perfect contact.

The different sets of terminal contact pieces N, are each preferably secured to a separate slab of slate O, which is made to slide into grooves *b*, in the switch box B, so that when the lid has been removed (and with it the movable parts of the switches) such slabs O can be readily removed and examined or replaced if requisite. Each terminal is, as shown in Fig. 1, preferably formed at the end of a screwed stem P, which passes through the slab O, and a circular nut *p*, then screwed thereon. A circular washer *p′* is then placed over the stem P, and the hole for the insertion of the lead Q, is made through the abutting surfaces of the circular nut *p*, and the washer *p′*, a little less than one half of the section of the lead Q in each. A square or hexagonal nut p^2 is then screwed on the stem P of the terminal, and by tightening same the whole is firmly secured.

The last terminal contact piece 4, of the make and break lever A, is (as shown in Figs. IV and V) preferably provided with a carbon rod R, in contact with which rests a steel rod S carried by an auxiliary lever T loosely mounted on the spindle E of the make and break lever A, upon which latter a pin *a′* is arranged, so that when the lever A leaves the last terminal 4, the pin *a′* lifts the lever T carrying the steel rod S from out of contact with the carbon rod R and thus breaks the circuit.

In order to cause the actual break of the circuit to be as sudden as possible, the following arrangement is employed: The switch lever A is mounted loosely upon its spindle E, and an arm U secured to such spindle carries a pin *u*, which engages a segmental slot V in the lever A. A spring W, on the spindle E, is attached at one end to the loose lever A, and at the other end to the fixed arm U, as shown in Fig. IV, so as to connect said lever to the arm and thence to the spindle. The tendency of this spring W, is to force the pin *u*, of the arm U, to what may be termed the forward end of the segmental slot V, of the contact lever, retaining the pin in that position as in Fig. IV. When the spindle E, is actuated to move the fixed arm U, to the right hand of Fig. IV, and in what may be termed a rearward direction, the pin *u*, travels freely to the rear end of the slot V, and then acts on the lever A, to displace the same, causing this lever to share the rearward movement of the arm. During the initial movement of the pin *u*, through the slot V, the spring W, is put under tension, and the lever W, may be held against the action of said spring, in a rear position of the lever, by the frictional action of the spring cheeks *n n* of a terminal contact N, on a contact piece M, of the lever or the latter may be held in the position named, by the operator. Assuming that the lever A, has been carried to the rear position indicated

by dotted lines in Fig. 4, in contact with terminal 1,—the circuit being therefore complete and all the resistances cut out—a movement of the fixed arm U, by the spindle, in a forward direction, will first cause the pin u, to return to the forward end of the slot V; and then by the continued movement of the arm, the lever A, is carried forward to break the contact between it and terminal 1. Before this occurs, however, lever A will come in contact with terminal 2, the end of lever A being made wide enough to insure this. The lever A will thus be brought in contact with terminals 2, 3 and 4 in succession by the continued movement of spindle E, and upon leaving the last terminal 4, the tension of spring W will cause it to be thrown suddenly forward, and its pin a' coming into contact with the lever T, will raise same and break the contact between the steel rod S it carries, and the carbon rod R secured to terminal 4, thus suddenly breaking the circuit. Lever T is connected to lever A by a spring Y which is put into tension by the forward movement of lever A, so as to tend to force the steel rod S toward the carbon rod R, and as soon as the lever A is actuated so as to begin to move in the direction to re-establish contact, such spring Y acts upon lever T and brings its rod S in contact with carbon rod R, before lever A comes in contact with the terminal 4. By then moving the lever A back to its original position, the resistances between the terminals 4, 3, 2, and 1, will be successively cut out.

The spring arm F′ engages notches cut in the periphery of the cam F, and holds the switch in the position to which it may have been moved, without, however, preventing it being shifted to any other desired position, the object being to enable the operator to feel the different movements made, as the notches correspond to the different positions the switch occupies in cutting out or introducing the respective resistances between the terminals, and also in making and breaking the circuit.

If the size of switch box B and of the make and break lever A does not permit of a sufficient range of resistances being introduced and taken out in making and breaking the circuit, the make and break lever A may be combined with a separate resistance lever, in which case the former will be a simple make and break lever having a single contact terminal, and the resistance lever will be arranged so that it will lock the make and break lever and prevent it being shifted to make or break the circuit, except when all the resistances are in. A suitable arrangement for this purpose is illustrated in Figs. VI, VII and VIII, and consists in causing the resistance lever 19 to act upon a rod 20, when it reaches the position where all the resistances between the terminals 21, $21^{\times}$ are in, and by depressing such rod remove from the path of the make and break lever A, an obstruction or stop 22, which prevents it from coming into contact with or leaving (as the case may be) its terminal contact piece 23. The resistance lever 19 is mounted upon a spindle 24, in a separate box B′, connected to the main box B, and to the outer end of such spindle an actuating lever 25, is applied for the purpose of bringing the resistance lever successively into contact with the terminals 21, $21^{\times}$, and so (according to the direction of movement) introducing or cutting out the resistances between such terminals. When the lever 19 has been moved through all the resistances, and upon leaving the last terminal $21^{\times}$ breaks the circuit, its further downward movement brings it in contact with the top of the rod 20, which is capable of being depressed against the action of spring 27. The lower end of rod 20 is connected to a crank 28 mounted upon a spindle 29, which latter carries an arm 22 forming the stop for preventing the make and break lever A from entering into contact with or leaving its terminal 23, as the case may be. This stop-arm 22 is situated within the case B, and is in the same plane as an arm 30 mounted upon the spindle E of the make and break lever A. The end of arm 22 is bifurcated, and when rod 20 is depressed by the descent of the resistance lever 19, it brings the forked end into such a position that the arm 30 on spindle E, can enter or leave such fork, thus permitting the spindle E to be turned and cause lever A to come into contact with or leave its terminal 23. When this has been effected, and the resistance lever begins to move in the direction to reestablish the circuit, the spring 27 draws rod 20 and arm 22 back to their original positions, when the arm 30 on spindle E can no longer leave the forked end of arm 22, if it has been caused to enter same, so that the circuit cannot, therefore, be broken; or, if the arm 30 is not in such fork, it will not be able to enter same, and the circuit cannot therefore be re-established. The moving of the arm 22 (under the action of spring 27) back to its original position, occurs before the resistance lever comes in contact with the terminal $21^{\times}$.

Referring to Figs. IX to XIV inclusive, it will be seen that the accumulator switch has four terminals, 5, 6, 7 and 8, of which terminal 5 is connected to the + terminal of the set of accumulators X, and to the first terminal of each of the motor armatures, terminal 6 to the + terminal of the set of accumulators X′, terminal 7 to the − terminal of accumulators X, and terminal 8 to the − terminal of accumulators X′, and also to the make and break lever A. The accumulator switch lever has two pairs of contacts M, one of which pairs rests on terminals 7 and 8 and the other on terminals 5 and 6 (as shown by double lines in the drawings) when the accumulators are in parallel, while when in series these pairs rest one on terminals 6 and 7, and the other on terminal 5 only (as shown by the thick single lines in the drawings).

Each motor switch has five terminals, 9, 10, 11, 12, and 13, of which terminals 9 and 13 are

connected together, terminal 9 being also connected to one terminal of the field of its motor. Terminal 10 is connected to the second terminal of the armature of its motor, terminal 11, to the other terminal of the field of its motor, and terminal 12, to the first terminal of the make and break lever, or of the resistance lever when a separate one is employed.

When a separate resistance lever 19 is employed (see Figs. XIII and XIV), the single terminal 23 of the make and break lever A is connected to the contact pieces of such resistance lever. Each motor switch lever has two pairs of contacts M, which rest—one pair on terminals 12 and 13, and the other pair on terminals 10 and 11 for running in one direction (as shown by the thick single lines in the drawings), while for running in the opposite direction such pairs rest, one on terminals 11 and 12 and the other on terminals 9 and 10 (as shown by the double lines in the drawings). The current through the field is reversed in the two different positions, and the motor consequently reversed.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, I declare that what I claim is—

1. In combination with the switch lever or levers, as C, D, a make and break lever, as A, a cam, as F, on the axis of the make and break lever, and a movable locking bar engaging said cam and adapted to engage the switch levers, for preventing the adjustment of the switch levers except when the circuit is broken, substantially as herein described.

2. In combination with the make and break lever switch levers and locking devices, for preventing adjustment of the switch levers under certain conditions as specified, of a stop in the path of the make and break lever and a resistance lever adapted to engage the said stop, substantially as and for the purpose herein described.

3. The combination of the loose contact lever, as A, having the segmental slot V, and pin a' fixed arm, as U, upon the axis of said lever, having the pin u, fitted in said slot of the lever, spring, as W, connecting the contact lever to said arm, loose auxiliary lever, as T, on the axis of the contact lever, spring, as Y, connecting the two levers, and contact rods, as R. S, all substantially as and for the purpose herein described.

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