No. 817,597. PATENTED APR. 10, 1906.

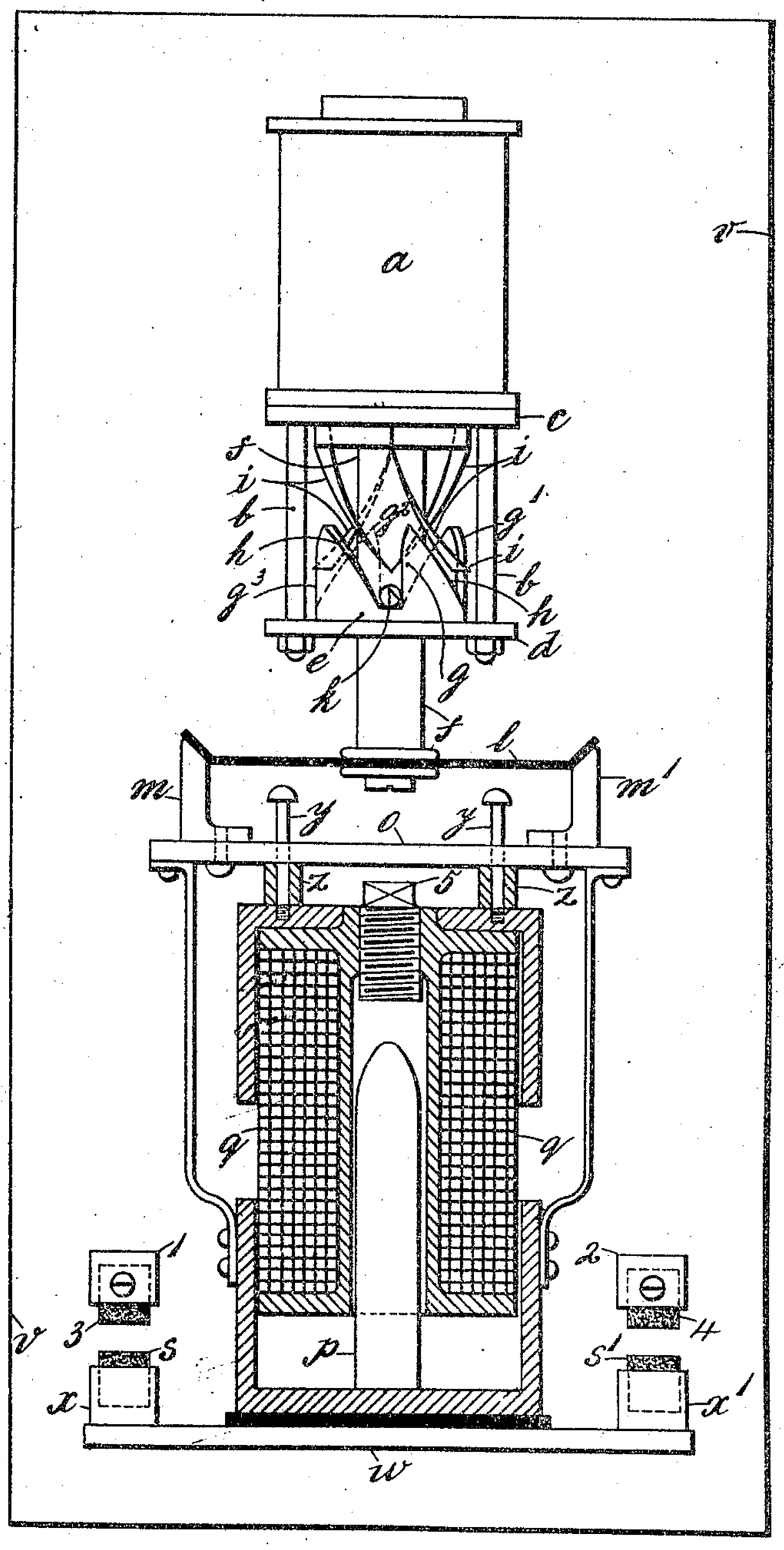
C. SMART.

APPARATUS FOR COMMUTING ELECTRIC CURRENTS PASSING THROUGH LAMPS, &c.

APPLICATION FILED SEPT. 19, 1904.

4 SHEETS—SHEET 1.

Fig. 1



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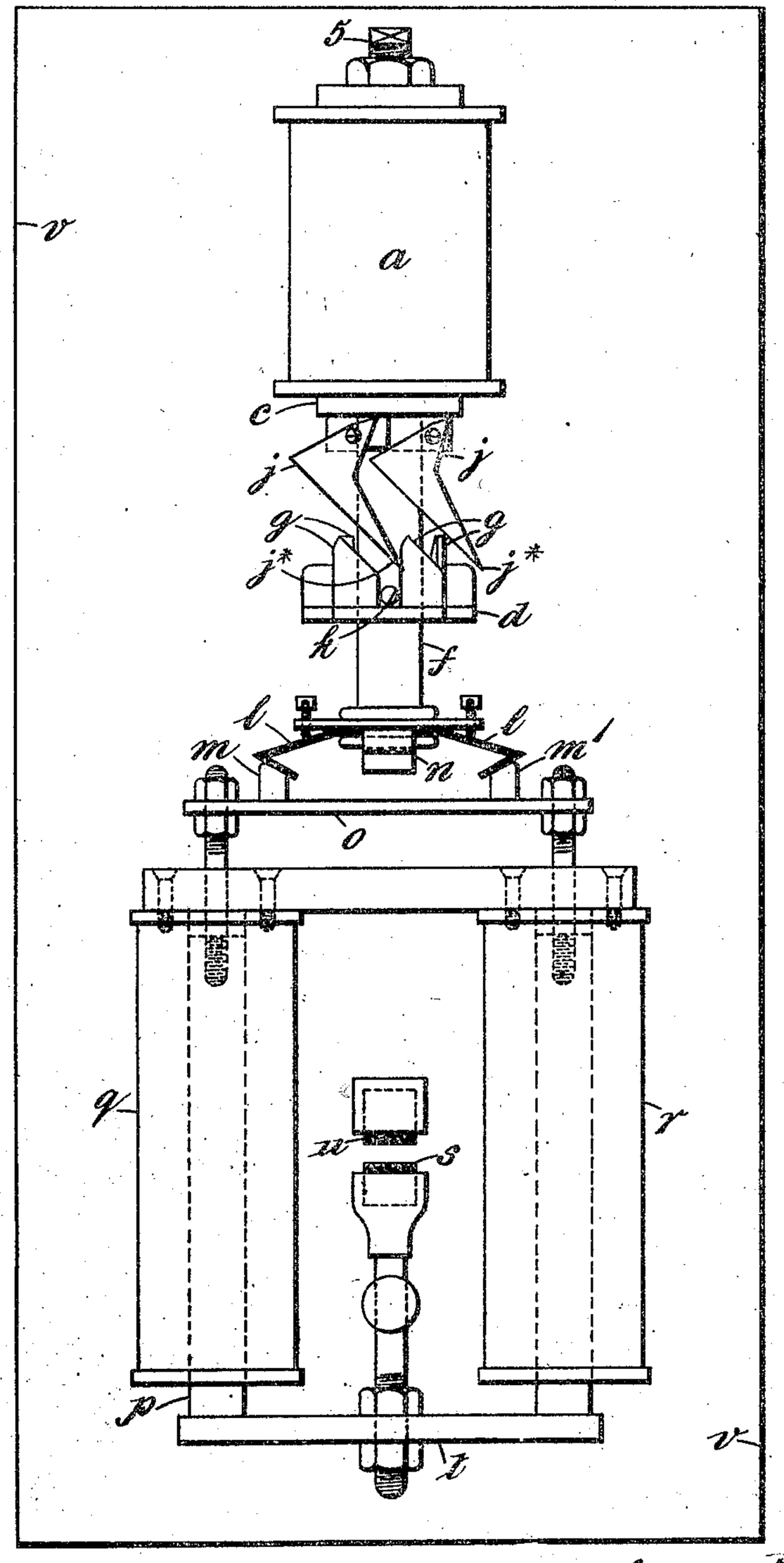
4 SHEETS—SHEET 2.

Fig. 2



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4 SHEETS—SHEET 3.

Fig. 3

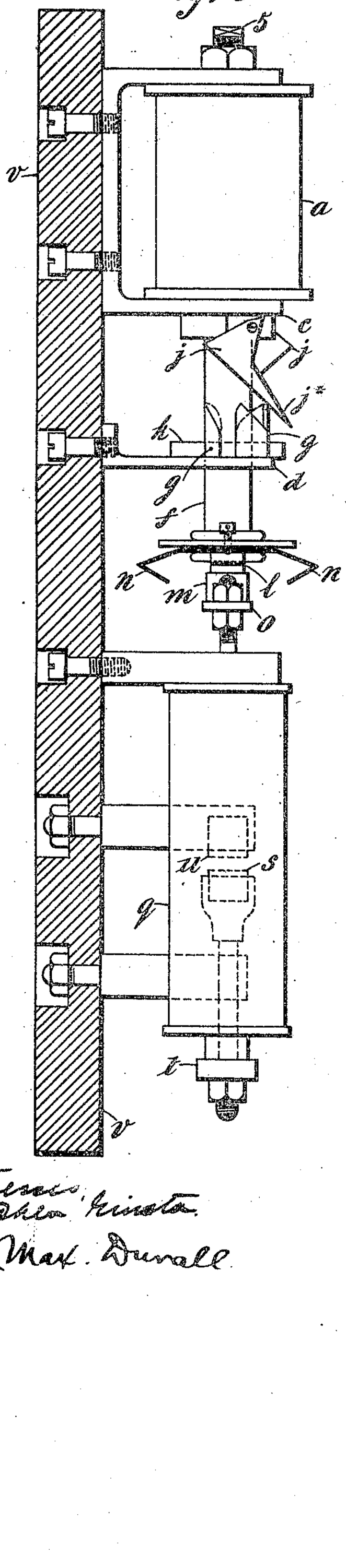


Fig. 5

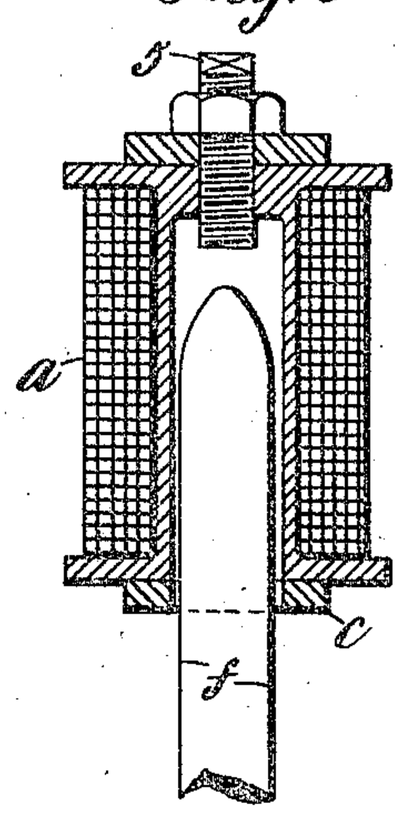


Fig. 4

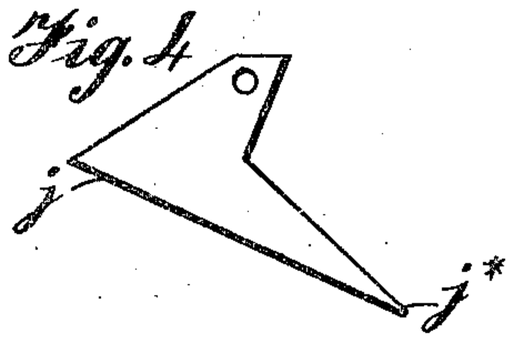
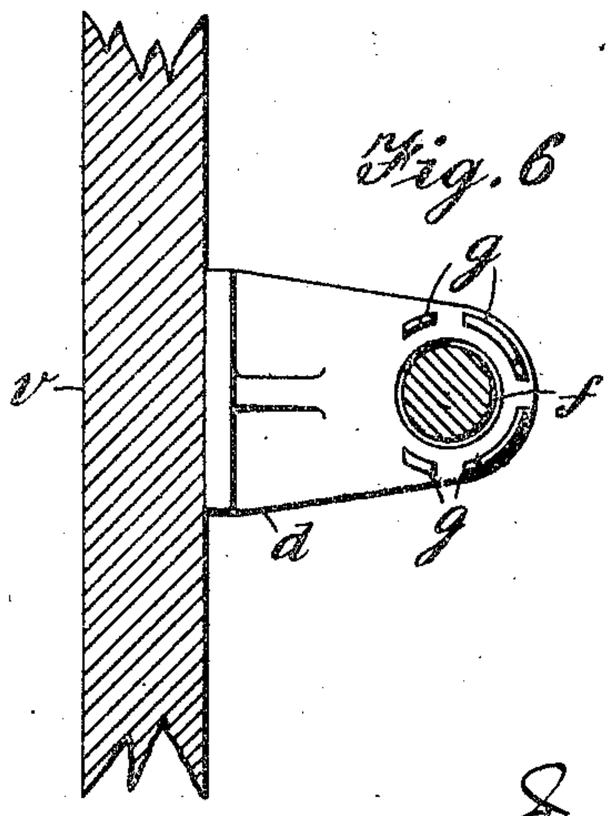


Fig. 6



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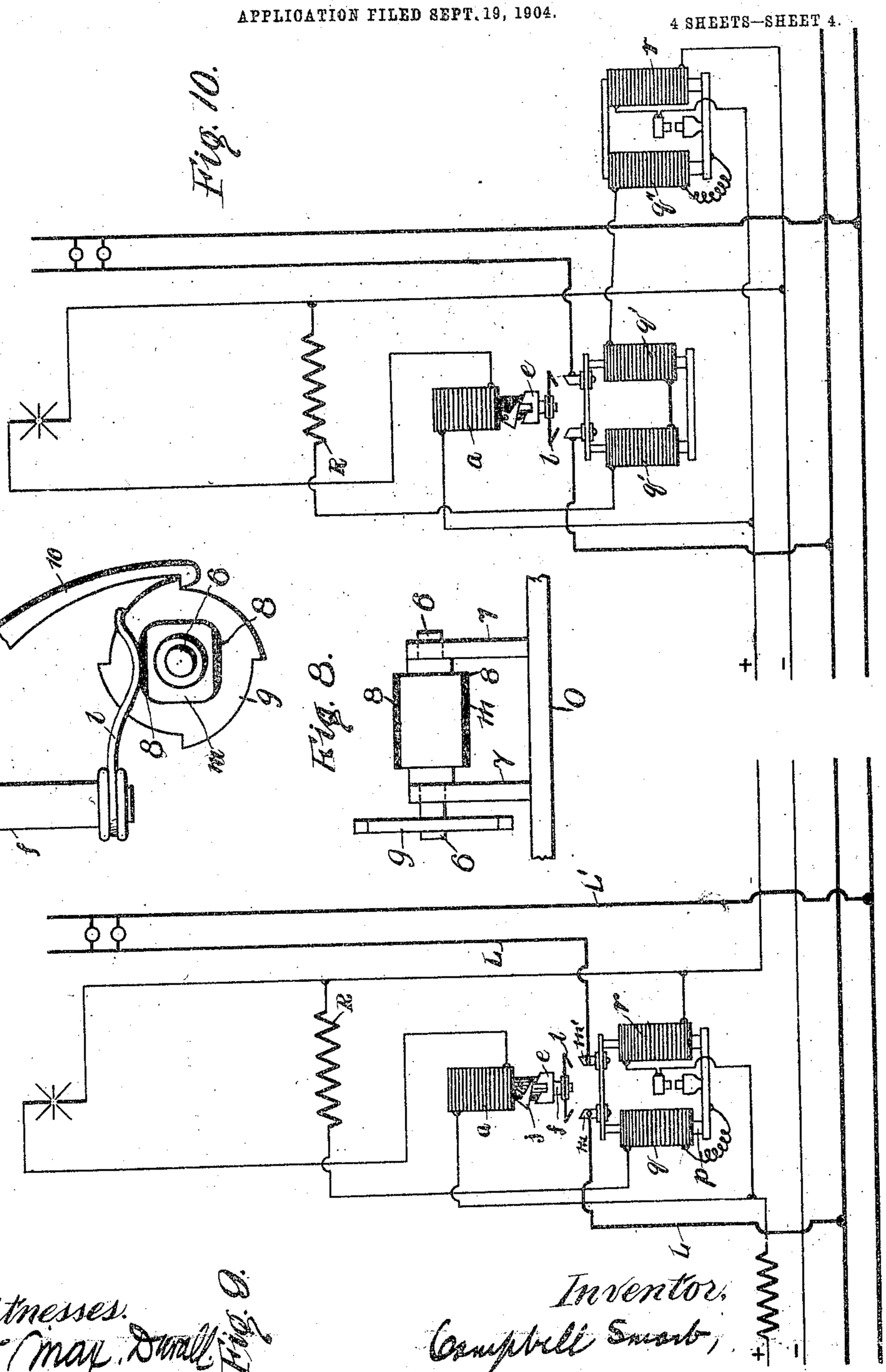
4 SHEETS—SHEET 4.



UNITED STATES PATENT OFFICE.

CAMPBELL SMART, OF SWANSEA, ENGLAND.

APPARATUS FOR COMMUTING ELECTRIC CURRENTS PASSING THROUGH LAMPS, &c.

No. 817,597. Specification of Letters Patent. Patented April 10, 1906.

Application filed September 19, 1904. Serial No. 225,062.

To all whom it may concern.

Be it known that I, CAMPBELL SMART, a subject of the King of Great Britain, residing at 13 Carlton Terrace, Swansea, in the county of Glamorgan, England, have invented new and useful Improvements in Apparatus for Commuting Electric Currents Passing Through Combined Arc and Incandescent Lamp Circuits, of which the following is a specification.

My invention relates to improvements in commutators for electric currents of combined arc and incandescent lamps; and the objects of my invention are, first, to provide means for varying the current passing through the circuits of electric arc and incandescent lamps in such manner that when the arc-lamps are burning during evening load the incandescent lamps will be cut off, while to switch on the incandescent lamps (say for midnight load) the arc-lamps are switched off, the apparatus being brought automatically into the proper position for the next operation of switching off the incandescent lamps and switching on the arc-lamps for evening load; second, to provide means for automatically correcting any defects in the working of the apparatus caused by the failure of an arc-lamp. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a front view of the apparatus. Fig. 2 is a front view of similar apparatus somewhat modified. Fig. 3 is a side view of Fig. 2. Fig. 4 is a separate view of one of the pivoted metal arms shown in Fig. 3. Fig. 5 is a separate section through the solenoid *a*. Fig. 6 is a horizontal section through the ratchet-shaped teeth *g*, Fig. 1. Figs. 7 and 8 are detail views of a modified switch. Figs. 9, 10 and 11 show the arrangement of circuits for connecting my apparatus to the main conductors.

Similar letters and figures refer to similar parts throughout the several views.

In the arrangement illustrated in Fig. 1, *a* is a main vertical solenoid the coils of which are in series with that of the arc-lamp. Below this solenoid and connected by rods *b b* with the support *c*, which carries it, is arranged a horizontal plate *d* in the form of a bracket, upon which is fixed firmly a vertical brass cylinder *e*, through which passes freely the core *f* of the solenoid or a continuation of it. The cylinder *e* is formed into four vertical ratchet-teeth *g g' g² g³*—that is to say, teeth having vertical faces—while their backs *h* are inclined or curved down at an angle nearly to the root of the next succeeding tooth. Between each two adjoining teeth is arranged a flexible spring *i* of sufficient strength, the upper end of which is firmly fixed to the support *c* of the solenoid above and then is curved laterally to a shape approximately resembling that of the back of the ratchet-teeth *g*, its lower end coming in contact, or nearly so, with the vertical face of the next succeeding tooth on the brass cylinder, as shown in Fig. 1.

Instead of the springs *i* pivoted metal arms may be used, as shown in Figs. 2, 3, and 4, in which two metal arms *j* of suitable shape are pivoted from the under side of the solenoid-flange and counterbalanced in such a manner that their points *j** hang normally past the faces of the teeth *g*, above referred to, but are capable of being swung back sufficiently far to allow a transverse pin *k* in the solenoid-core (referred to later) to pass between them and the vertical faces of the teeth.

The lower part of the central core *f* of the solenoid, or of an extension of it, is (in both forms) provided with a strong transverse pin *k*, fixed in it in such a position that as the core *f* is raised or lowered the pin *k* (the ends of which extend somewhat beyond the outer diameter of the teeth *g*) has a stroke somewhat greater than the height of the teeth, so that it descends to the bottom of the space between the teeth *g*, if allowed to do so, and rises a sufficient distance above the points of the latter to bring it in line with their vertical faces. In descending the pin *k* passes down along the vertical face of a tooth, pressing back the pivoted metal arm *j* (or the spring *i*) until it has reached the lowest point of its stroke and is clear of the point of the pivoted arm or the spring, which flies back over it. When the pin rises, it passes and is guided along the inclined back of the pivoted arm or spring and at the same time turns, taking with it the core *f*, to which it is attached, through one-fourth of a circle round the vertical center of the solenoid *a*. The pin *k* is shown extending through the core at each side, so that its two ends act alternately on the pivoted metal arms or springs, and

thus the core is turned once round by equal steps at each four movements up and down of the solenoid-core. Only two teeth and springs or pivoted arms need be used instead of four.

The same result may be obtained by making one of the contact-blocks with an insulated side and turning it so as to present a metal and insulated side alternately to a moving switch-blade, and so close and open the circuit. This modified method of applying the principle described may evidently be effected in different ways. For instance, as illustrated in Figs. 7 and 8, one of the contact-blocks *m* or *m'* instead of being fixed may be made capable of revolving upon a horizontal spindle and having four sides of metal and ebonite alternately, so that if it be turned round through a quarter-revolution at a time a conducting and non-conducting face alternately will be presented to the switch-blade *l* as the latter rises and falls. In this arrangement the core *f* of the main solenoid *a* does not turn round at intervals, as first described; but the same object is attained by its alternate rising and falling without turning. The intermittent revolution of the contact-block is effected by means of an arm carried by the core and having connected with it a pawl engaging with a four-toothed ratchet-wheel upon the spindle, so that the wheel (and with it the contact-piece) is turned through one tooth every time the solenoid-core rises.

At the lower end of the core *f* or its extension is fixed a transverse insulated metal conducting-strip or switch-blade *l*, capable of adjustment, which at every alternate movement of the core *f* up and down takes up a position at the bottom of the stroke, with its ends in electrical contact with two opposite contact-blocks *m m'*, which are connected in series with the circuit of the incandescent lamps, and so switches them on. At every alternate ascent of the core *f* the latter is moved through one quarter of a revolution, and the circuit is broken and continues broken when next the core *f* drops, as the conducting-strip or switch-blade *l* is now at right angles to the contact-blocks *m m'* and not touching them. A second and similar conducting-strip or switch-blade *n* is fixed at right angles to the one, *l*, already described, but, as shown in Figs. 2 and 3, slightly higher up, so that it cannot touch the contact-blocks *m m'*. The object of this is to enable the switch to be closed by raising the contact-blocks *m m'* to meet this second conducting-strip or switch-blade *n*, as explained later. The switch-blade is shown of a somewhat different shape in Fig. 2 than in Fig. 1 and may be of any suitable shape.

Referring now to Figs. 9 and 10, which show the arrangement of circuits, it will be seen that if the arc-lamps are burning the core *f* will be raised in the solenoid *a*, and with it the transverse conducting-strip or switch-blade *l*, Fig. 1, the blade being in such position that when it falls it will join together the contact-blocks *m m'*, thus switching on the incandescent lamps. This will occur when the arc-lamps are switched off for the after-midnight lighting. At daylight the arc-lamps are switched on and the core rises and turns through a quarter of a revolution. They are then switched off and the core falls, and the transverse conducting-strip or switch-blade *l* is then in a position at right angles to the contact-blocks *m m'* and the incandescent lamps are off.

The incandescent lamps would light up automatically if an arc-lamp failed during evening lighting; but the switch belonging to it would go out of "step" if the arc righted itself. To provide for this, I mount the contact-blocks *m m'* described upon an insulating bar *o*, Fig. 1, attached to or connected with an iron frame carrying the core *p* of a second solenoid *q*, (or two solenoids may be more convenient, as shown in Fig. 2,) arranged at some distance below the first one, *a*, already described and the coils of which are in series circuit with the substitute or auxiliary resistance R of the arc-lamps in question, Fig. 9. Thus on the failure of an arc-lamp the contact-blocks *m m'* rise and intercept the main core *f* in its descent, preventing the pin *k* in the latter from going down low enough to pass the pivoted metal arm or spring, between which and a tooth it is moving, so that when the first solenoid *a* is next energized the pin rises to its former position only and does not revolve, and so does not cause the core *f* to revolve through a fourth of a revolution, thus keeping the apparatus in step with others on the same system. Should the arc remain faulty until its circuit is opened—say at midnight—the core *f* drops to its lowest position in the same way as all the others, and the transverse pin *k* is ready to turn the core *f* round when the latter rises again, and so switch off the incandescent lamps. The contact-blocks *m m'* are attached to the circuit-leads by flexible conducting-wires in the usual way.

y y are guide-pins for the bar *o*.

z z are tubular distance-pieces round the pins *y y*, limiting the descent of the bar *o*.

A shunt-winding may be added to the lower solenoid *q*, or a separate shunt-solenoid may be used to combine an arc-lamp automatic cut-out and cut-in action with the switch, and a suitable carbon or other contact-maker is arranged to close the circuit through the substitute resistance R. For this purpose the lower solenoid last described is slightly increased in size, so as to allow a shunt-winding to be placed beneath the series winding, and upon the under side of the iron frame which carries the core of the lower

solenoid, as already described, but insulated from the frame, is fixed a transverse horizontal brass bar *w*, carrying on each end a holder *x x'* for a short carbon rod *s s'*, above which are fixed (to the slate base) two metal pillars or holders 1 2, carrying similar carbon contacts 3 4, with which the carbons *s s'* on the brass bar *w* come in contact when the lower solenoid comes into action and its core rises on the failure of an arc. This would form a double break. The upper carbon contacts 3 4 would be connected with the substitutional resistance and with the series winding of the lower solenoid *q*. The shunt-winding of the solenoid would be connected across the arc and could be regulated so as to act at any desired voltage by adjusting the position of an iron screw 5, which can be screwed in and out through the top of the solenoid above the upper free end of its core. The contacts described need not necessarily be of carbon, but may be arranged so as to form a good rubbing metallic contact, or in a modified form of construction and arrangement a separate shunt-wound solenoid *r* is fitted alongside of the series one *q*, as shown in Figs. 2, 3, and 9, and a carbon block *s* is fixed on the iron frame *t* between the two solenoids capable (when it is raised by the magnetism of the solenoids) of making electrical contact with a carbon block *u*, fixed to the slate base *v* above it, Figs 2 and 3, thus closing the substitute resistance-circuit. This cut-out and cut-in would operate in the usual manner and would be capable of adjustment to cut out the arc-lamp at any desired voltage and cut it in again when its carbons close again.

A separate magnet having series coil *q''* and shunt-coil *r* may be used to control the circuit of substitute resistance R, as shown in Fig. 10.

The action of the second switch-blade *n* is as follows: When the arc-lamps and the incandescent lamps are both off during the day, the switch-blade *l* is at right angles to the contact-blocks. Now supposing that the carbons of an arc-lamp have stuck open and no current can pass through it. When switched on in the evening, it will not light; but the automatic cut-out will act and the contact-blocks will consequently rise. If there were no second switch-blade *n* in position above the contact-blocks, then no lamps would light; but by fixing this second switch-blade *n* at right angles to the first one *l* and at a somewhat greater height (so that when the contact-blocks are down it cannot touch them, but can do so when they are up) under these circumstances the incandescent lamps light up.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a switching mechanism for a combined arc-lamp and incandescent-lamp system, means operating upon each alternate failure of current in the arc-circuit to close the incandescent circuit, and a controller therefor in the arc-circuit; substantially as described.

2. In a switching mechanism for a combined arc-lamp and incandescent-lamp system, a two-part switch for controlling the incandescent circuit adapted to close said circuit when the parts are in alinement, electromagnetic means in the arc-circuit for holding the switch open, and means for throwing the parts of said switch out of alinement; substantially as described.

3. In a switching mechanism for a combined arc-lamp and incandescent-lamp system, a two-part switch for controlling the incandescent circuit adapted to close said circuit when the parts are in alinement, electromagnetic means in the arc-circuit for holding the switch open, means for throwing the parts of said switch out of alinement, and auxiliary mechanism for rendering the last-named means ineffectual; substantially as described.

4. In a switching mechanism for a combined arc-lamp and incandescent-lamp system, a two-part switch for controlling the incandescent circuit adapted to close said circuit when the parts are in alinement, electromagnetic means in the arc-circuit for holding the switch open, means for throwing the parts of said switch out of alinement, and auxiliary mechanism controlled by the potential across the arc-lamp circuit for rendering the last-named means ineffectual; substantially as described.

5. In a switching mechanism for a combined arc-lamp and incandescent-lamp system, a two-part switch for controlling the incandescent circuit adapted to close said circuit when the parts are in alinement, electromagnetic means in the arc-circuit for holding the switch open, means for throwing the parts of said switch out of alinement, and auxiliary mechanism controlled by the potential across the arc-lamp circuit for rendering the last-named means ineffectual and for inserting a resistance in the arc-circuit in shunt to the arc-lamp; substantially as described.

6. A switch for electric circuits provided with contacts for electric conductors and having main and auxiliary blades arranged at an angle to each other, an electromagnet for moving said blades toward and from the contacts, and an electromagnet for moving said contacts toward and from said blades; substantially as described.

7. A switch for electric circuits provided with contacts for electric conductors and having main and auxiliary blades arranged at an angle to each other, means for placing said blades alternately in alinement with said contacts, an electromagnet for moving said blades toward and from said contacts, and an

electromagnet for moving said contacts toward and from said blades; substantially as described.

8. A switch for electric circuits provided with contacts for electric conductors and having main and auxiliary blades arranged at an angle to each other, means for placing said blades alternately in alinement with said contacts, an electromagnet for moving said main blade into engagement with the contacts, and an electromagnet for moving said contacts into engagement with said auxiliary blade; substantially as described.

9. A switch for electric circuits provided with contacts for electric conductors and having main and auxiliary blades arranged at an angle to each other, an electromagnet for moving said blades toward and from the contacts, means coöperating therewith for rotating the blades, and an electromagnet for moving said contacts toward and from said blade; substantially as described.

10. A switch for electric circuits provided with contacts for the conductors of a main circuit and having main and auxiliary blades arranged at an angle to each other, an auxiliary controlling-circuit, an electromagnet in series therewith arranged to move said blades toward and from the contacts, and an electromagnet having a coil in shunt to said circuit arranged to move said contacts toward and from said blades; substantially as described.

11. A switch for electric circuits provided with contacts for the conductors of a main circuit and having main and auxiliary blades arranged at an angle to each other, an auxiliary controlling-circuit, an electromagnet in series therewith arranged to move said blades toward and from the contacts, and an electromagnet having a coil in shunt to said circuit arranged to move said contacts toward and from said blades and to close a shunt across said circuit through a resistance; substantially as described.

12. A switch for electric circuits provided with contacts for the conductors of a main circuit and having main and auxiliary blades arranged at an angle to each other, an auxiliary controlling-circuit, an electromagnet in series therewith arranged to move said blades toward and from the contacts, and an electromagnet having a coil in shunt to said circuit arranged to move said contacts toward and from said blades and to close a shunt across said circuit through a resistance and through an auxiliary coil on said shunt-magnet; substantially as described.

13. A switch for electric circuits provided with contacts for electric conductors, an electromagnet having a movable core carrying blades arranged at an angle to each other, a stationary cylinder or ring surrounding said core provided with projecting teeth, a transverse pin in the core adapted to engage said teeth, and a movable guide arranged to shift said pin from one tooth to another; substantially as described.

14. A switch for electric circuits provided with contacts for electric conductors, an electromagnet arranged to reciprocate said contacts, an electromagnet having a movable core carrying blades arranged at an angle to each other, a stationary cylinder or ring surrounding said core and provided with projecting teeth, and a movable guide arranged to shift said pin from one tooth to another; substantially as described.

15. A switch for electric circuits provided with contacts for electric conductors, an electromagnet having a movable core carrying blades arranged at an angle to each other, a stationary cylinder or ring surrounding said core and provided with projecting teeth, a transverse pin in the core adapted to engage said teeth, a movable guide arranged to shift said pin from one tooth to another, an electromagnet arranged to reciprocate said contacts and an auxiliary magnet for controlling the circuit thereof; substantially as described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

CAMPBELL SMART.

Witnesses:
WILLIAM S. REES,
TREVOR THOMAS.