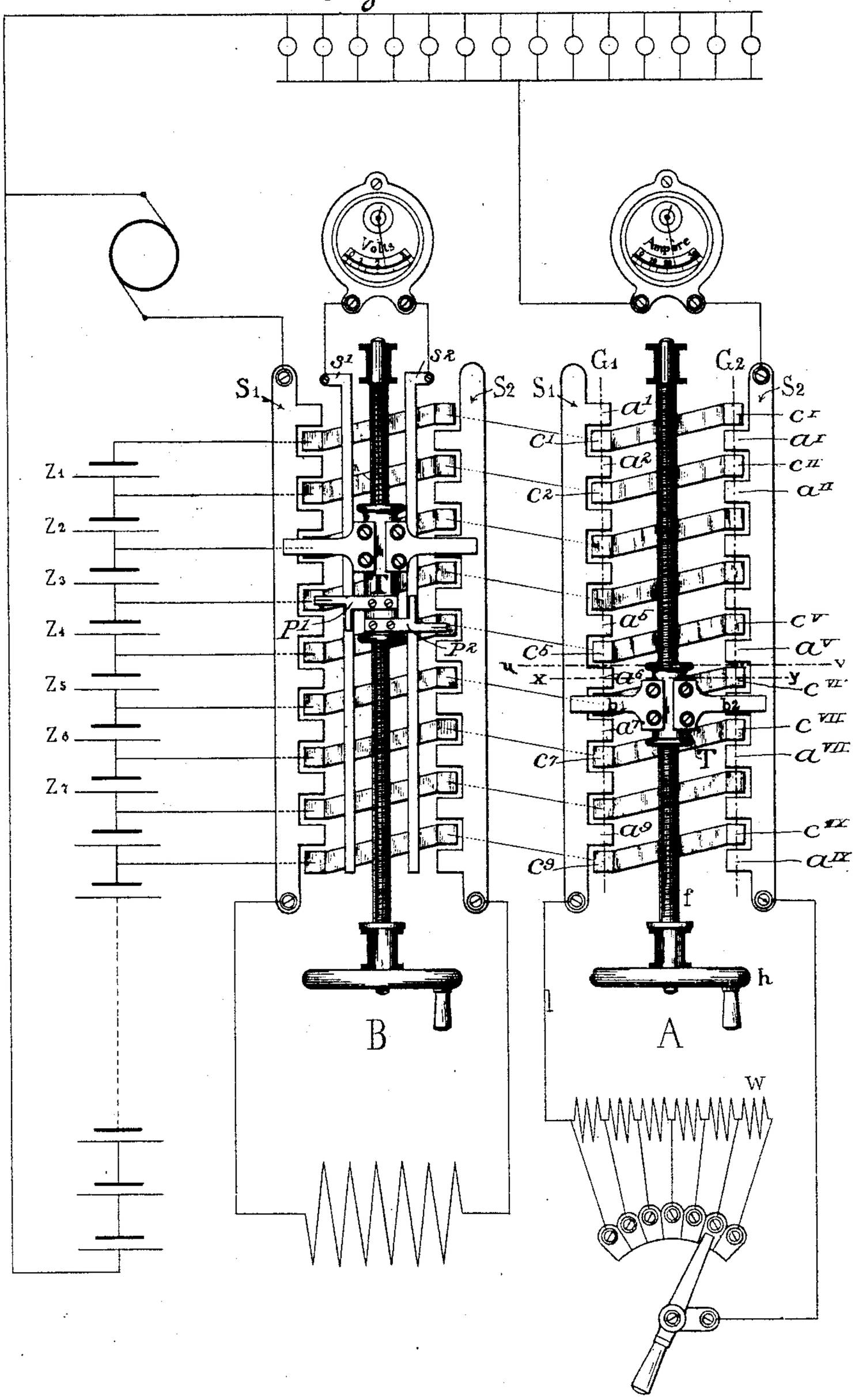
(No Model.) 3 Sheets—Sheet 1.

H. MÜLLER.

SWITCH FOR SECONDARY BATTERIES.

No. 516,379. Patented Mar. 13, 1894.

Fig. 1.



WITNESSES:
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ATTORNEYS.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

H. MÜLLER.

SWITCH FOR SECONDARY BATTERIES.

No. 516,379. Patented Mar. 13, 1894.

Fig 2.

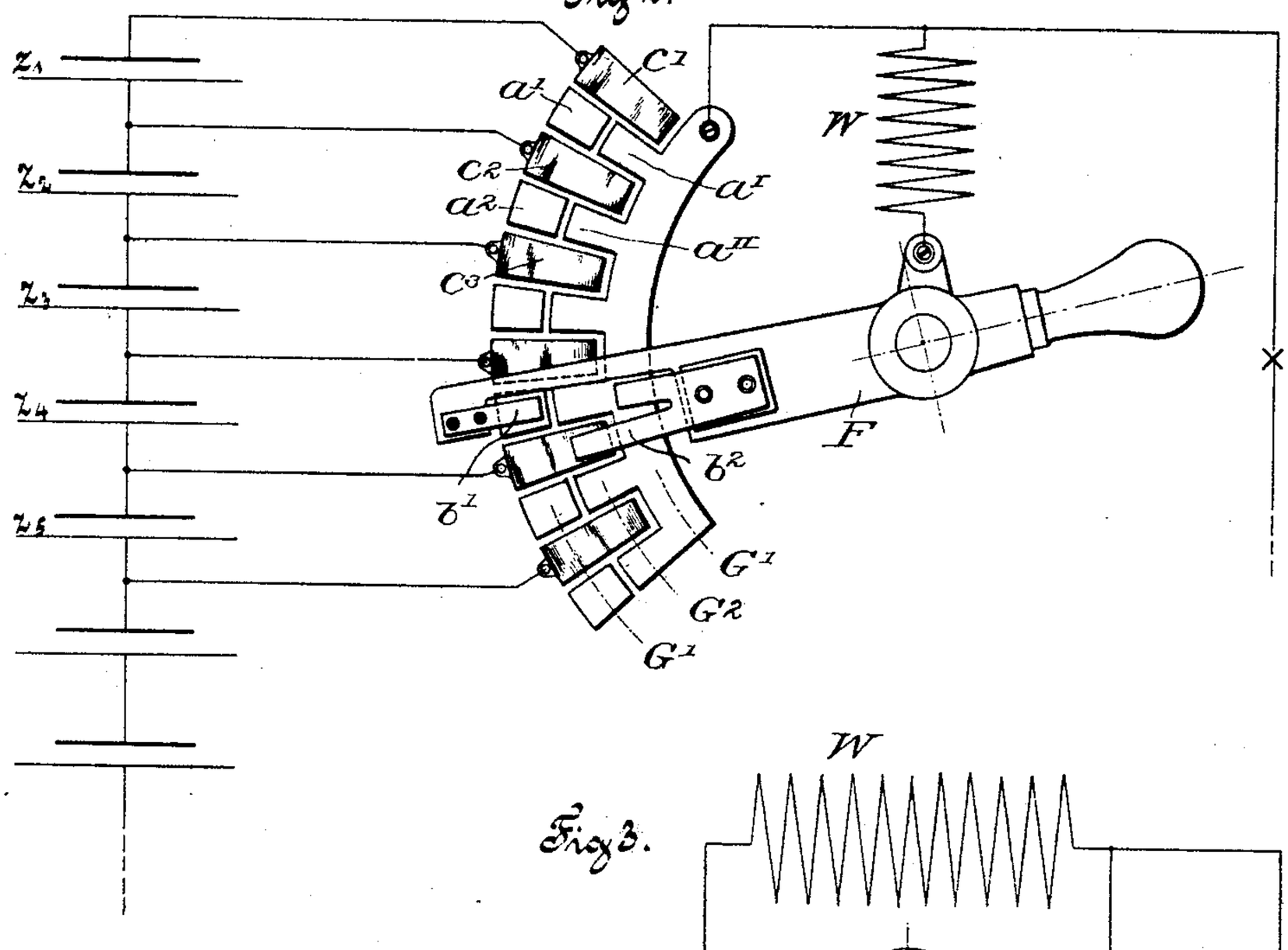
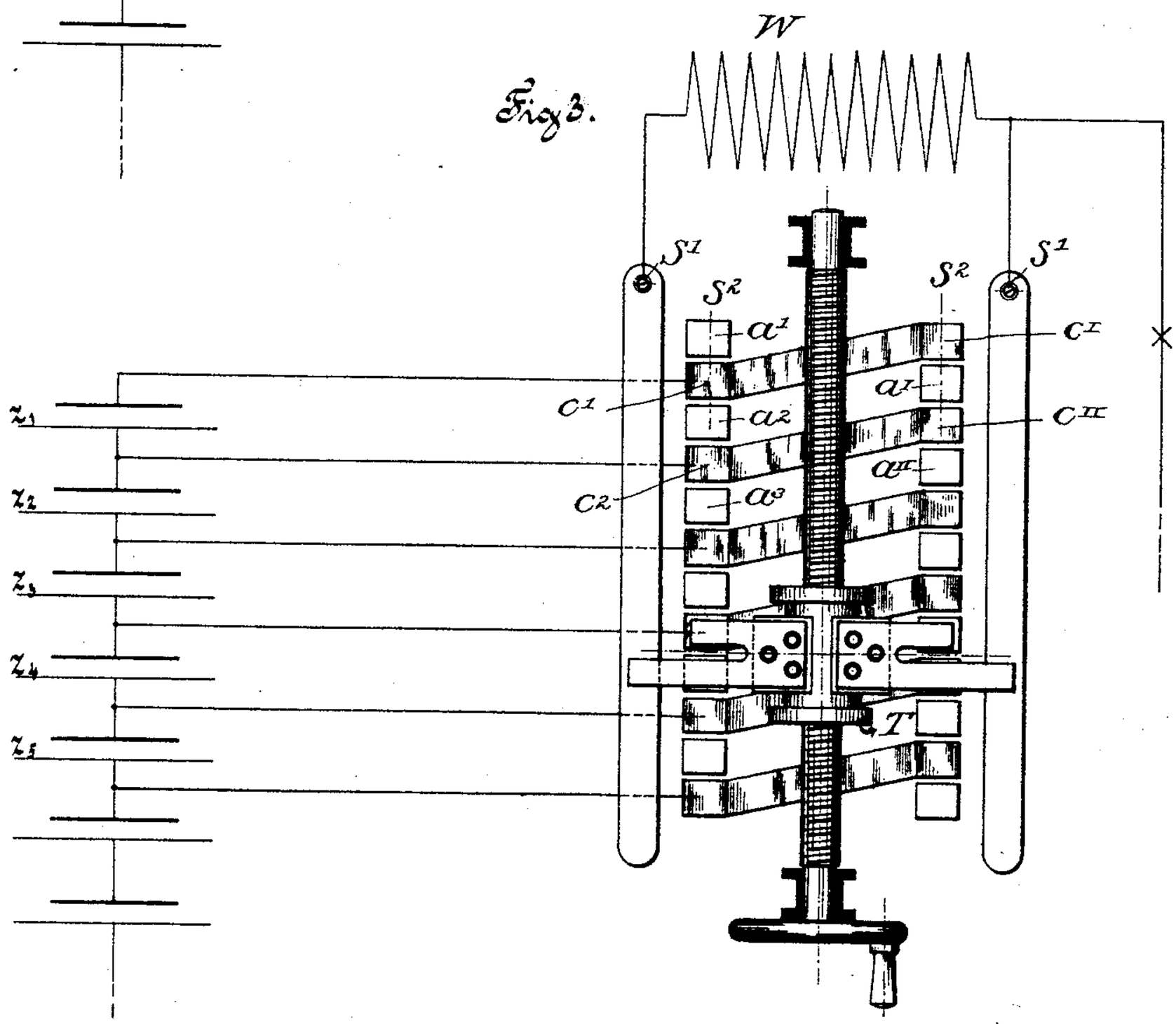


Fig 3.



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(No Model.) 3 Sheets—Sheet 3.

H. MÜLLER.

SWITCH FOR SECONDARY BATTERIES.

No. 516,379. Patented Mar. 13, 1894.

Fig 4

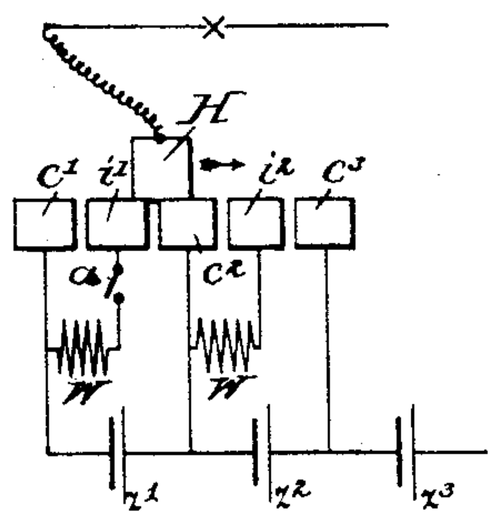


Fig 5

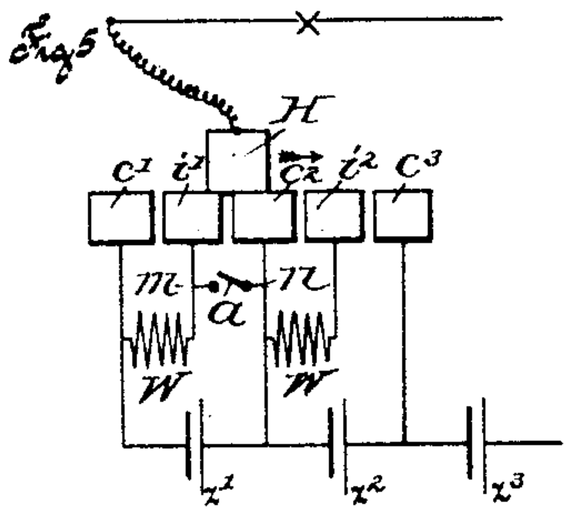


Fig 6

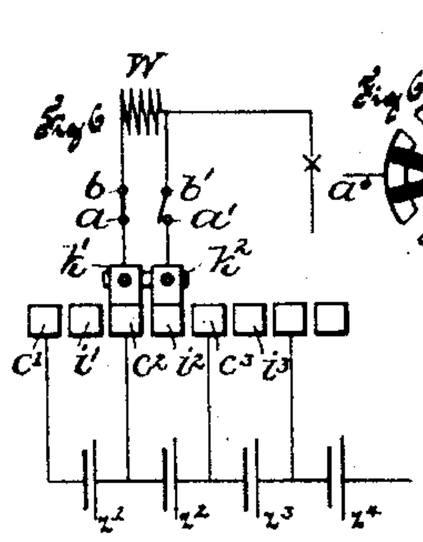


Fig 6a

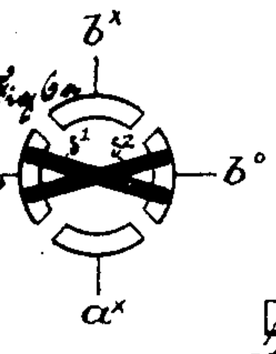


Fig 7

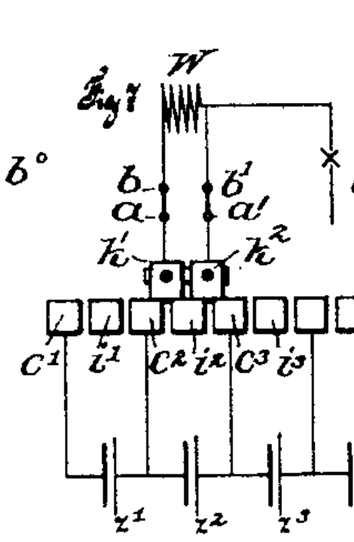


Fig 7a

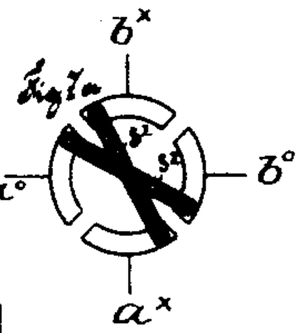


Fig 8

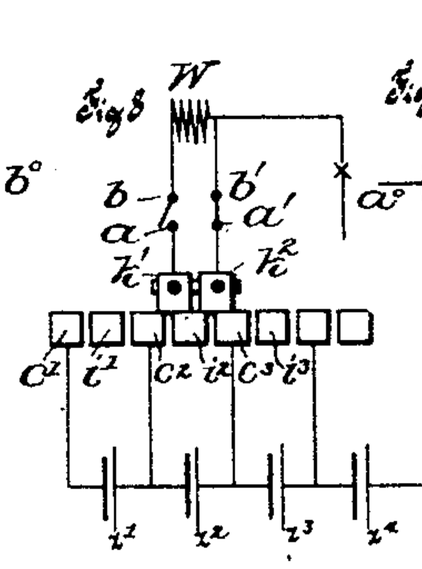


Fig 8a

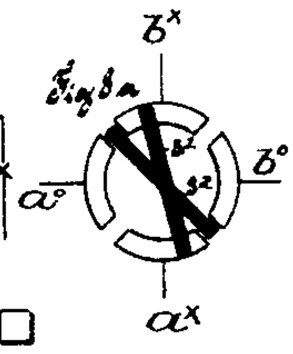


Fig 9

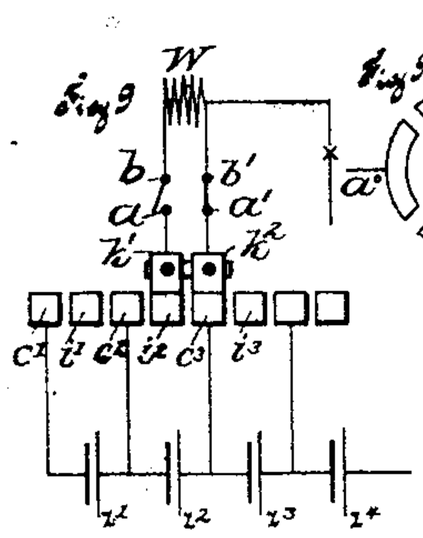


Fig 9a

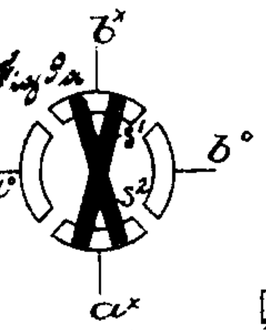


Fig 10

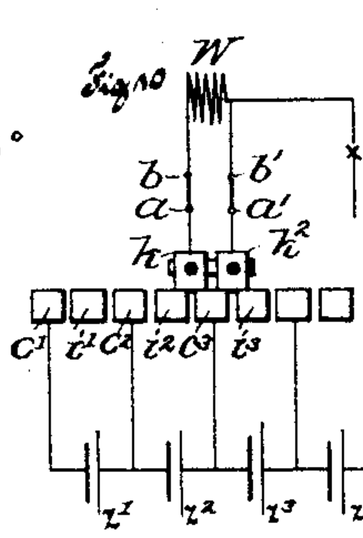


Fig 10a

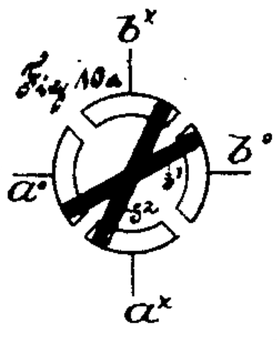


Fig 11

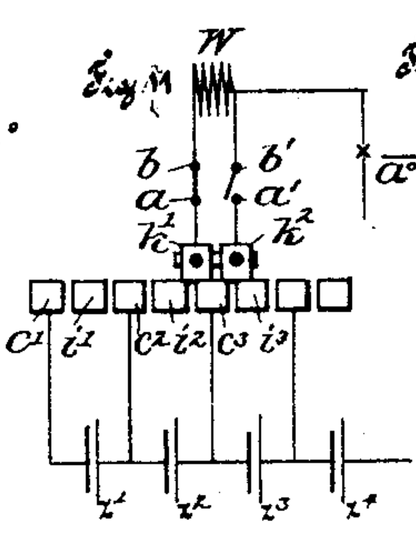


Fig 11a

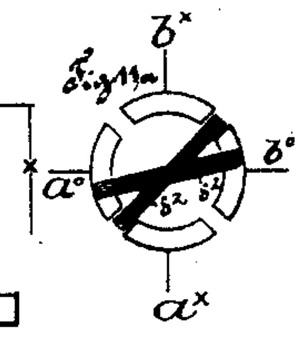


Fig 12.

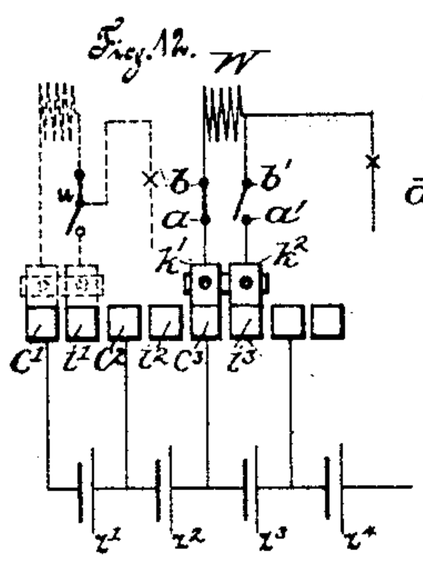


Fig 12a

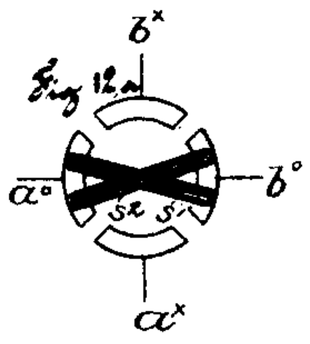
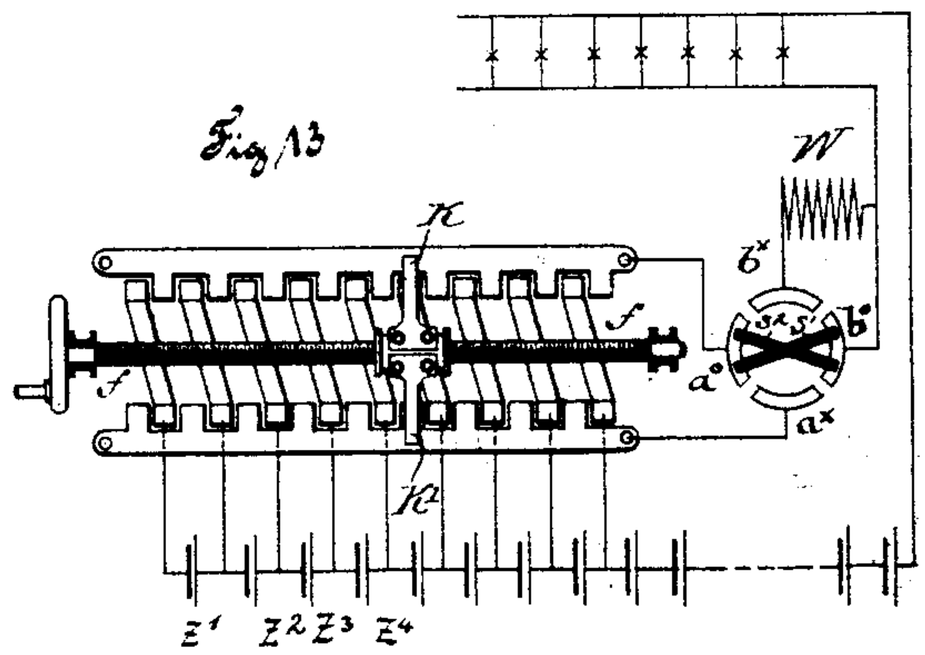


Fig 13



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UNITED STATES PATENT OFFICE.

HERMANN MÜLLER, OF NUREMBERG, GERMANY.

SWITCH FOR SECONDARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 516,379, dated March 13, 1894.

Application filed December 27, 1892. Serial No. 456,399. (No model.) Patented in Germany May 17, 1890, No. 59,323, and July 23, 1891, No. 62,229, and in England February 4, 1891, No. 2,040, and December 7, 1891, No. 21,369.

To all whom it may concern:

Be it known that I, HERMANN MÜLLER, a citizen of the Republic of Switzerland, residing in Nuremberg, in the Kingdom of Bavaria and Empire of Germany, have invented certain new and useful Improvements in Switches for Secondary Batteries, (for which Letters Patent were granted to me in Germany, No. 59,323, dated May 17, 1890, and No. 62,229, dated July 23, 1891, and in Great Britain, No. 2,040, dated February 4, 1891, and No. 21,369, dated December 7, 1891,) of which the following is a specification.

This invention relates to certain improvements in switches for secondary batteries and relates in its general features to the following improvements:—first, to a switch for secondary batteries which serves for the purpose of switching one cell after the other into the circuit without danger of short-circuiting it; secondly, of a device which serves for the purpose of preventing sparking on the fixed contact-pieces of the switch by transferring the generation of sparks to a special contact making and breaking device, the contacts of which can be conveniently and cheaply repaired; thirdly, an apparatus which serves to control the tension or state of charge in the cells in order to switch out the cells when they are charged to their maximum-tension.

For the purpose herein set forth, my invention consists of certain improvements in the construction of switches for secondary batteries, which will be fully described hereinafter and the new features of which will finally be pointed out in the claims.

In the accompanying drawings, Figure 1 represents a plan view of my improved switch for secondary batteries, showing also the device for controlling the tension or state of charge of the cells. Fig. 2 is a plan of a modified construction of my improved switch for secondary batteries, showing the movable contact-pieces arranged to turn on a pivot, so as to move through an arc of a circle. Fig. 3 is also a plan of my improved switch, this figure being a modified construction of Fig. 1. Figs. 4 and 5 are diagrams for illustrating the means by which sparks are prevented on the guide-ways of the switch. Figs. 6 and 6^a, 7 and 7^a, 8 and 8^a, 9 and 9^a, 10 and 10^a, 11 and 11^a and 12 and 12^a are diagrams which show the different positions of the contact-pieces in their passage over the guide-ways and the relative position of the contact-pieces by which the current is passed from the cells over said guide-ways and contact-pieces and Fig. 13 is a plan-view of my improved switch, showing the contact-pieces by which the current is conducted from the cells over the fixed guide-ways and movable contact-pieces to the line-wires, without the generation of sparks.

Similar letters of reference indicate corresponding parts.

Referring to the drawings (Fig. 1) z_1 z_2, &c., represent a number of secondary battery-cells which are connected to the contacts c_1 c_2 c_3 and c^{I} c^{II} c^{III}. Between c_1 c_2 c_3 there are metallic pieces a_1 a_2 a_3 which form together the guide G, for the sliding contact-piece b_1. In the same way a^{I} a^{II} a^{III} form together with the contacts c^{I} c^{II} c^{III} the guide way G_2 for the sliding contact-piece b_2. The two sliding pieces b_1 b_2 are fastened to the nut T and are insulated from each other. The nut T is moved up and down by the screw-spindle f which can be turned by means of the handle h. Parallel with the guide ways G_1 and G_2 there are arranged the sliding rods S_1 and S_2, which are always in contact with the guide pieces b_1 and b_2 respectively. Between the two sliding rods S_1 and S_2 there is a resistance W which serves the purpose of preventing short circuiting of a cell, when the sliding contacts b_1 and b_2 are moved and also diminishing (halving) the gradations of the tension when the screw-nut T is moved. This resistance can be regulated so that these gradations of the tension are not more than one volt. By using separate guide ways G_1 G_2 for each sliding contact b_1 b_2 according to the foregoing improvement the intermediate pieces a_1 a_2 a_3 and a^{I} a^{II} a^{III}, &c., can be made of metal and as shown in the diagram Fig. 1 all in one piece.

The direction of the current is as follows. As shown in the drawings the current passes from cell z_6 to the contact c_6, then through the sliding contact b_1 to the guide rod S_1 and then through the resistance w to the guide rod S_2 and through the ammeter to the lamps. In the position x y the current comes from

the same cell z_6 to the contact piece c^{VI} and from the latter directly to the lamps. In moving the screw nut T from one position to the next one, there is one position as shown by the line $u\,v$ in which the cell will send a current through the resistance w.

Instead of applying two guide ways G_1 G_2 in connection with two sliding contacts b_1 b_2 there can also be arranged three or more guide ways in connection with three or more sliding contacts. In this case the above mentioned gradations of the tension can be diminished to one third of the voltage of one cell.

The construction of this apparatus can be arranged as shown by Figs. 2 and 3. In Fig. 2 the two guide ways are circular instead of straight. In this case the sliding contacts b_1 b_2 are fastened to the end of a lever, which turns on a pivot forming the center of the circular way. In Fig. 3 the guide rods G_1 G_2 are separated from the guide ways S_1 and S_2 and the intermediate pieces a_1 a_2 a_3 and a^{I} a^{II} a^{III} are of single metal pieces. All these arrangements are characterized by each sliding contact having its separate guide way.

The device by which sparking is prevented on the guide-ways of the switch and transferred to a special contact-making and breaking device is shown in Figs. 4 to 13, in which Figs. 4 and 5 serve to illustrate the fundamental principle, while Figs. 6 to 12 show the different positions of the contact-pieces during the period of switching one cell in and out, for which two rotations of the spindle f are used.

In the figures z_1 z_2 z_3 represent the cells at the secondary battery and c_1 c_2 c_3, &c., the contact-pieces which are electrically connected with said cells. w w are the resistances, which are interposed between the intermediate contact pieces i_1 i_2 i_3 and the cells, and k is the sliding contact that passes along the contact-pieces c and intermediate pieces i, as shown in Figs. 4 and 5. The switch a is arranged either between the resistance w and the intermediate piece i, as shown in Fig. 4, or between the points m and n as shown in Fig. 5.

In both Figs. 4 and 5 the sliding contact k is shown when it leaves the intermediate piece i, so as to break circuit of the cell closed by the resistance w. As the breaking of the circuit would generate a spark at the intermediate piece i, the switch a is opened immediately before the contact piece k leaves the intermediate piece i, while the switch a, shown in Fig. 5 makes the short circuit between m and n so that in both cases this contact piece k leaves the contact-piece i_1 without forming a spark at the moment of interrupting contact with the same.

In Fig. 6 is represented the arrangement of a switch for secondary batteries with a sliding contact, composed of two contact-pieces k_1 k_2, which are electrically connected with each other by the resistance w. The intermediate pieces i_1 i_2 i_3 are made of non-conducting material. The switches a b and a_1 b_1 are arranged in the circuit with the resistance w and correspond to the switch a, shown in Fig. 4.

The operation of the switches in switching in and out the different cells of the battery is effected by the double switch, shown in Fig. 6_a, which is a combination of the two switches a b and a_1 b_2 and is composed of two single levers s_1 s_2, that are connected with but insulated from each other, and of four segments a° b°, $a^{\times}$ $b^{\times}$, which correspond to the correspondingly marked points of the switches a b and a_1 b_1 in Fig. 6. The double switch s_1 s_2 is moved simultaneously with the slide-piece of the battery-switch, so that by turning the former through an angle of one hundred and eighty degrees the double switch is shifted from the position shown in Fig. 6. to the position represented in Fig. 12, that is to say, as far as necessary to switch in and out one cell of the secondary battery.

In Figs. 6 and 6^a, the switch a b is closed and the switch a_1 b_1 opened. The current from the storage battery passes therefore from the contact piece c^2 through the resistance w to the lamps or other translating devices.

In Fig. 7 the sliding contact k_1 k_2 is moved to the right, so as to pass over the contact piece c^3. At the same time the double switch s' s^2 is moved for one-eighth of a rotation, so that consequently the switches a b and a_1 b_1 are closed and the storage-battery supplies the current from the contact piece c_3 to the lamps or other translating devices, while the cell z_2 is sending a current through the resistance w.

In Fig. 8 the sliding contact k_1 k_2 is shifted still more to the right, being still in contact with the pieces c_2 and c_3. The double switch s_1 s_2 has in the meantime been moved for another one-eighth of a rotation, so that the switch a b is opened, while the switch a_1 b_1 is closed, as shown in Figs. 8 and 8^a, consequently the cell z_2 sends no longer a current through the resistance w, so that the next shifting of the sliding contact k_1 k_2 to the position shown in Fig. 9 can take place without any sparking between the contact-piece c_2 and the sliding contact k_1.

In Fig. 10 both switches a b and a_1 b_1 are closed, so that the current passes from the cell z_3 to the contact-piece c_3 and to the place of use.

In Fig. 11 the sliding contact k_1 k_2 is still in connection with the contact piece c_3 as in Fig. 10, but as the double switch has moved through another one-eighth of a rotation the switch a_1 b_1 is opened, so that the current passes from the cell z_3 over the contact pieces c_3 and k_1 and through the resistance w. As no current passes over the contact k_2 there will be no sparking when the same leaves the contact c_3 and assumes the position shown in Fig. 12 in which the sliding contact k_1 k_2 assumes the same relative position toward the

cell z_3 which it has in Fig. 6 to the cell z_2, while the positions of the switches a b a_1 b_1 and s_1 s_2 correspond to the positions of the switches in Figs. 6 and 6ª respectively. The contacts have consequently arrived at the point which answers to the switching out of the cell z_2. When the sliding contact k_1 k_2 is shifted further on, the switches resume the same positions in the same or opposite succession, according to the direction in which the double switch is moved, consequently no generation of sparks will take place between the fixed contacts and the sliding contacts k_1 k_2, but the sparks are generated only at the points of contact of the double switch s^1 s^2 with the segments a b a_1 b_1, which can be readily renewed.

It is obvious that different arrangements of the switches can be made, as shown, for instance, in dotted lines in Fig. 12, in which by the combination of the switch a b with the switch a_1 b_1 a simple two-way switch is obtained.

Any suitable mechanism by which the motion of the sliding contacts k_1 k_2 is simultaneously transferred to a switching device can be used, so that the generation of sparks at the sliding contacts of the switches is prevented and transferred to removable and interchangeable contacts. Fig. 13 represents this arrangement applied to the above explained accumulator-switch.

The transmitting mechanism, such as a bevel gear-transmission by which the double sliding contacts s_1 s_2 are rotated simultaneously with the sliding motion of the contact pieces k_1 k_2 is not shown, but any suitable means may be used for imparting simultaneously rotary motion to the double switch s_1 s_2 and a traversing motion to the sliding contact k_1 k_2 in such a manner that one-half of a rotation of the double switch s_1 s_2 corresponds to the shifting of the sliding contact k k from one contact-piece to the next one. The further development of the arrangement shown in Fig. 5 would be analogous to that of Fig. 4, as here also instead of the switch a in Fig. 5 there would have to be arranged a switching apparatus actuating synchronously with the motion of the sliding contact k. As the necessary arrangement does not differ substantially from that which is shown in Figs. 6 to 12, I have not thought it necessary to give any further explanation.

The foregoing switches can also be used for primary batteries of all kinds.

The third feature of my improvement is shown at the left-hand of Fig. 1 in connection with my improved switch. There are provided two small guide ways s_1 s_2 which are connected to a voltmeter, and two small sliding contacts p_1 p_2 which make contact with s_1 and s_2 and which are fastened to but insulated from the screw nut T. These two sliding contacts are arranged at such a distance from each other, that they make contact with the terminals of one cell. The voltage of a cell, while being charged, increases from 1.8 to 2.7 volts. By measuring the voltage, the quantity of electrical energy stored in the cells can be determined. When the voltage of a cell is increased to 2.7 volts, the charge is completed and the cell is to be switched out. This is accomplished by the attendant who observes the voltmeter, but it may also be accomplished automatically by means of a suitable signaling device, which is actuated by an electro-magnet that makes contact when the highest voltage of the cell is obtained.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a distribution-switch for charging and discharging secondary batteries or for working of primary batteries, the combination with two sliding contacts, of two separated guide ways composed of contact-pieces alternating with isolated pieces of metal, each sliding contact having its own guideway, and a resistance with which the isolated pieces are connected substantially as set forth.

2. In a distribution-switch for charging and discharging secondary batteries or for working of primary batteries, the combination, with two sliding contacts, of two separated guide ways composed of contact-pieces alternating with isolated pieces, two guide contact bars, joined by a resistance, each sliding contact having its own way, substantially as set forth.

3. In a distribution-switch for charging and discharging secondary batteries or for working of primary batteries, the combination, with two sliding contacts, of two separated guide ways composed of contact pieces alternating with isolated pieces, two guide contact bars, joined by a variable resistance, each sliding contact having its own guide way, substantially as set forth.

4. In a distribution switch for charging and discharging secondary batteries, or for working primary batteries, the combination with two isolated sliding-contacts and a single actuating-device by which they are carried, of two separated guide-ways composed of contact-pieces alternating with isolated pieces of metal, each sliding-contact having its own way, substantially as set forth.

5. The combination, with a switch for secondary batteries, formed of fixed contact-pieces and sliding contacts, and a resistance interposed between the sliding contacts, of a switching-device that is operated simultaneously with the sliding-contacts, so as to permit the passing of the sliding-contacts from one fixed contact-piece to the other without generation of sparks at the contact-pieces of the switch, substantially as set forth.

6. The combination, with the fixed-contact-pieces of a secondary battery-switch, of sliding contact-pieces, guide-ways for the latter, a switching-device interposed between said guide-ways and the translating device, said switching device being rotated simultane-

ously with the motion of the sliding-contacts, and the resistance interposed between the contact-pieces and the switching-device, so that no sparking takes place when the sliding-contacts leave the fixed contacts, but the same is transferred to the switching device, substantially as set forth.

7. In battery switches, the combination with main sliding-contacts and guide-ways for the battery, of auxiliary sliding-contacts and guide-ways connected to the said main contacts, and a voltometer connected with the last-named guide-ways, so that the voltage of a single cell is indicated, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

HERMANN MÜLLER.

Witnesses:
WM. J. BLACK,
OSCAR BOCK.