No. 625,915. Patented May 30, 1899.

T. VON ZWEIGBERGK.

CONTROLLER.

(Application filed Feb. 27, 1899.)

(No Model.) 3 Sheets—Sheet 1.

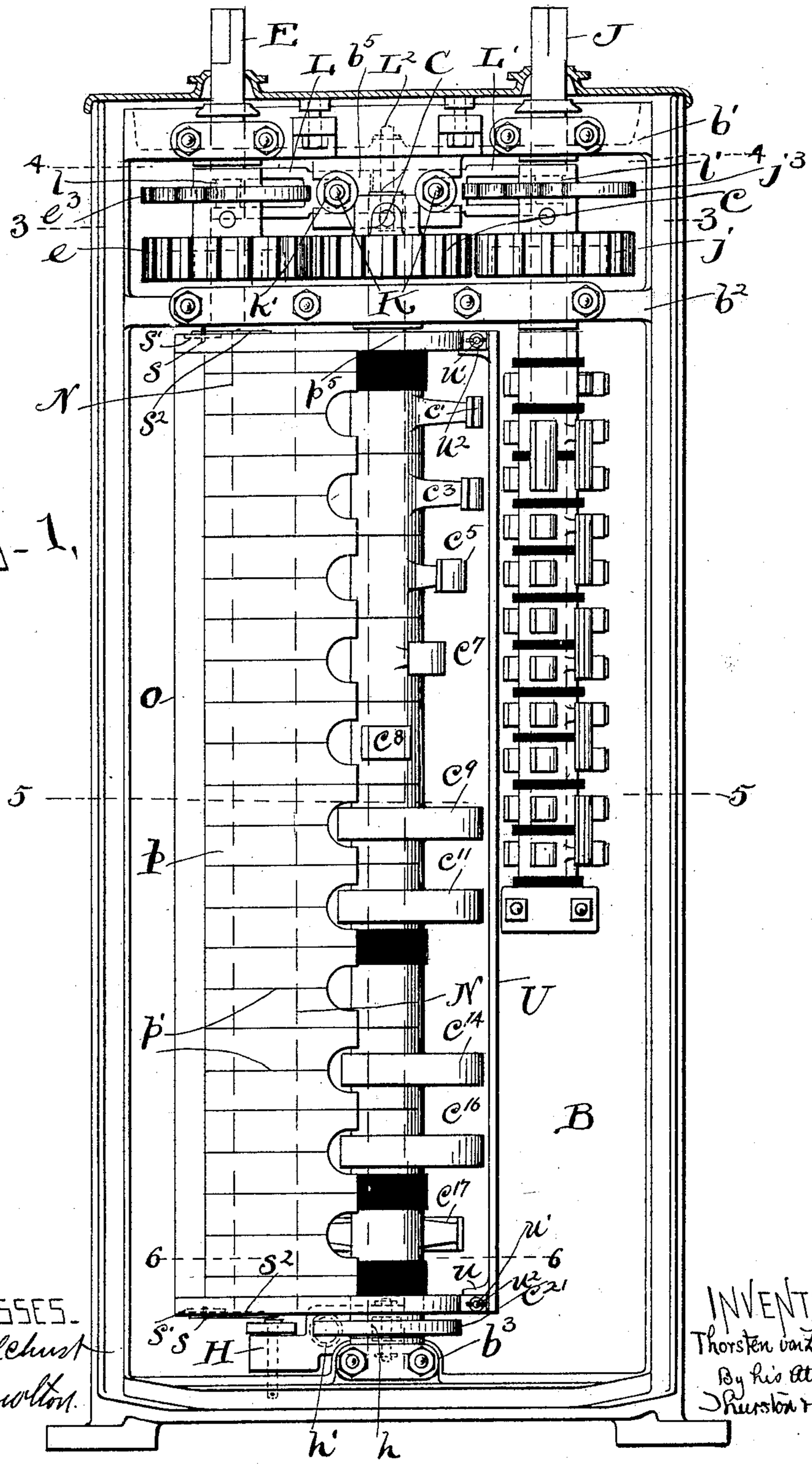

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

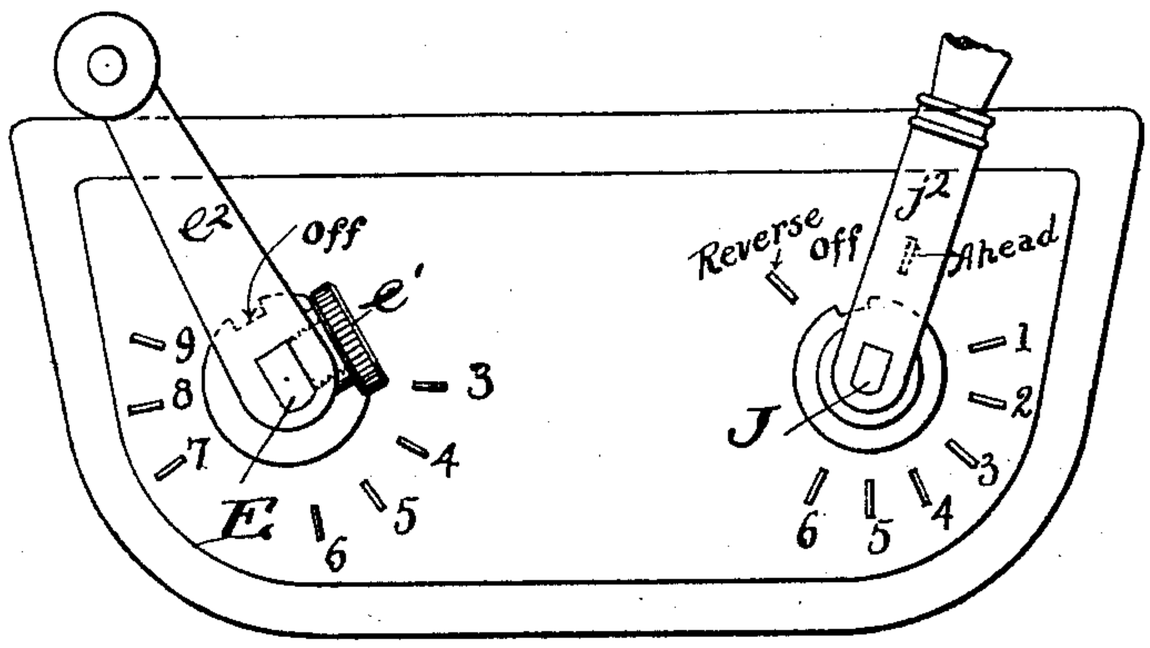

FIG. 2.

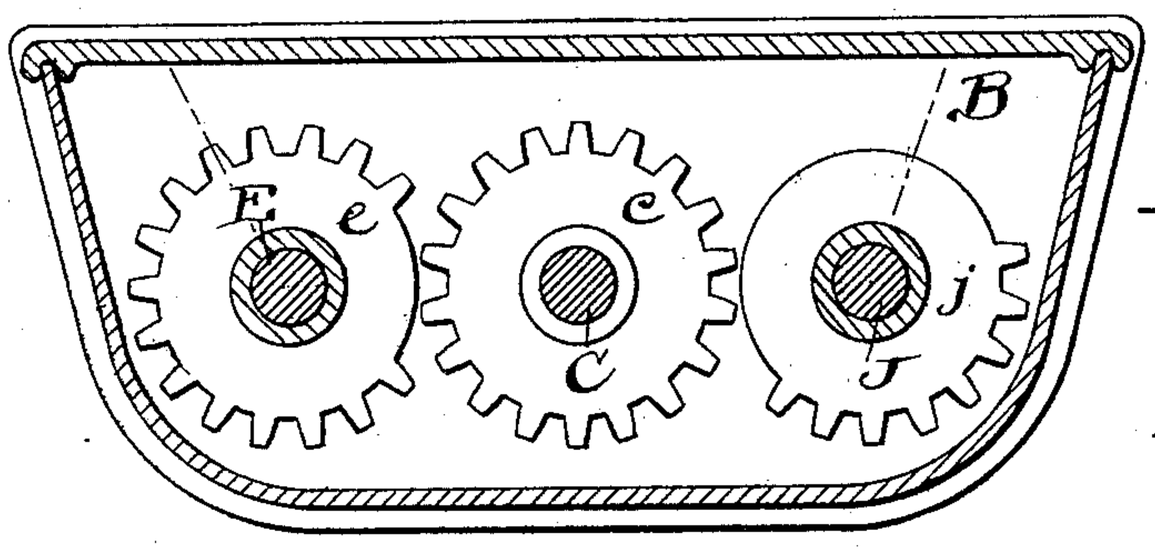

FIG. 3.

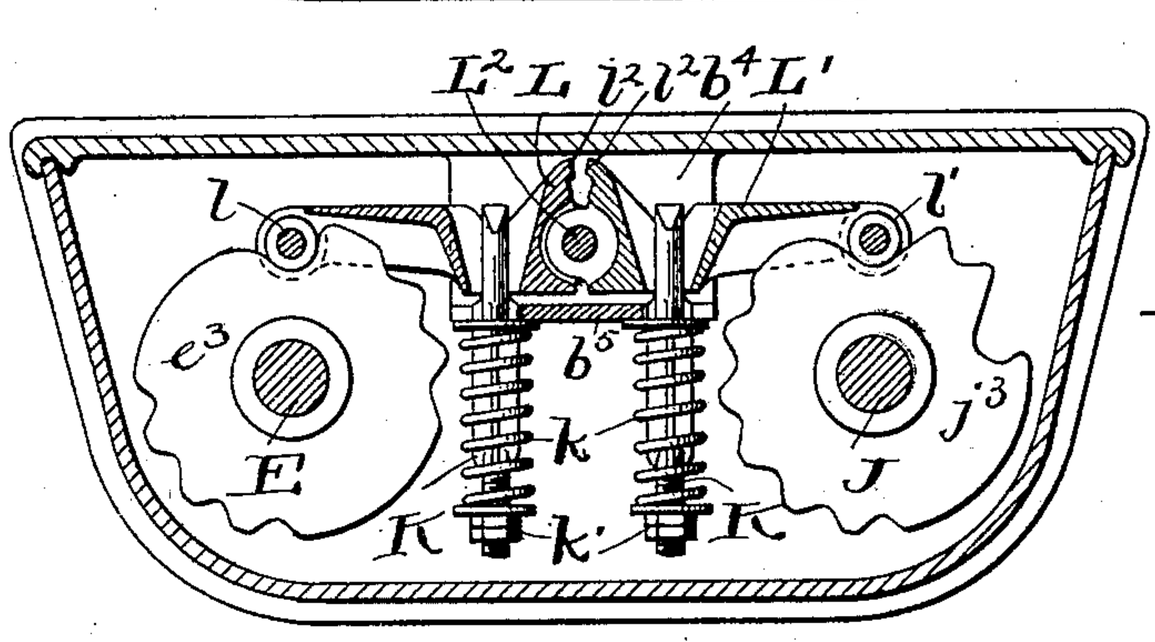

FIG. 4.

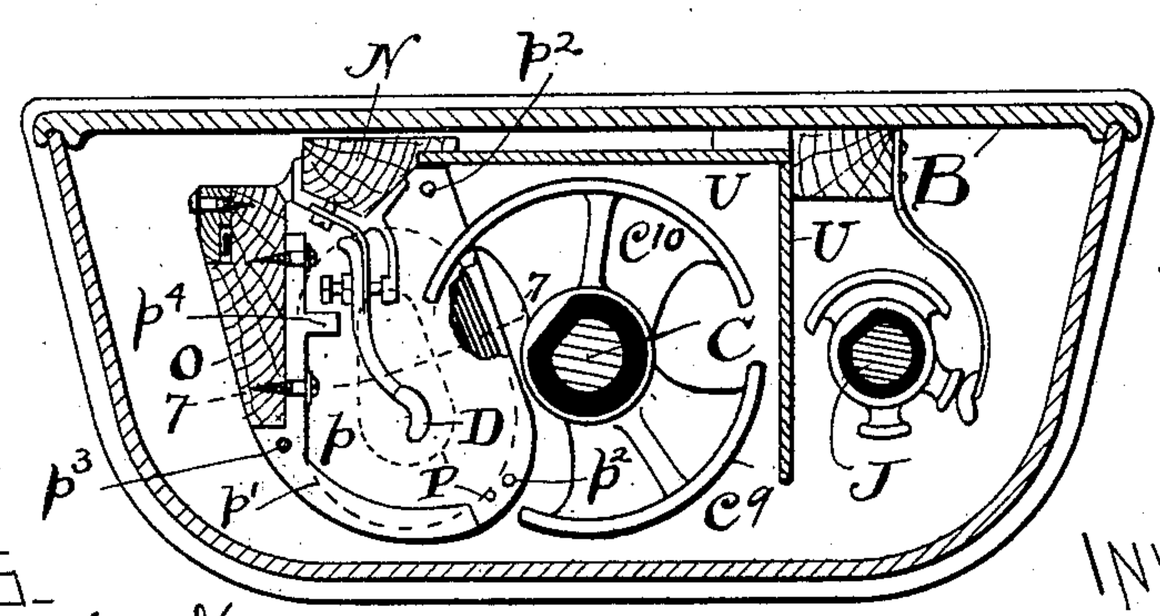

FIG. 5.

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(Application filed Feb. 27, 1899.)

(No Model.) 3 Sheets—Sheet 3.

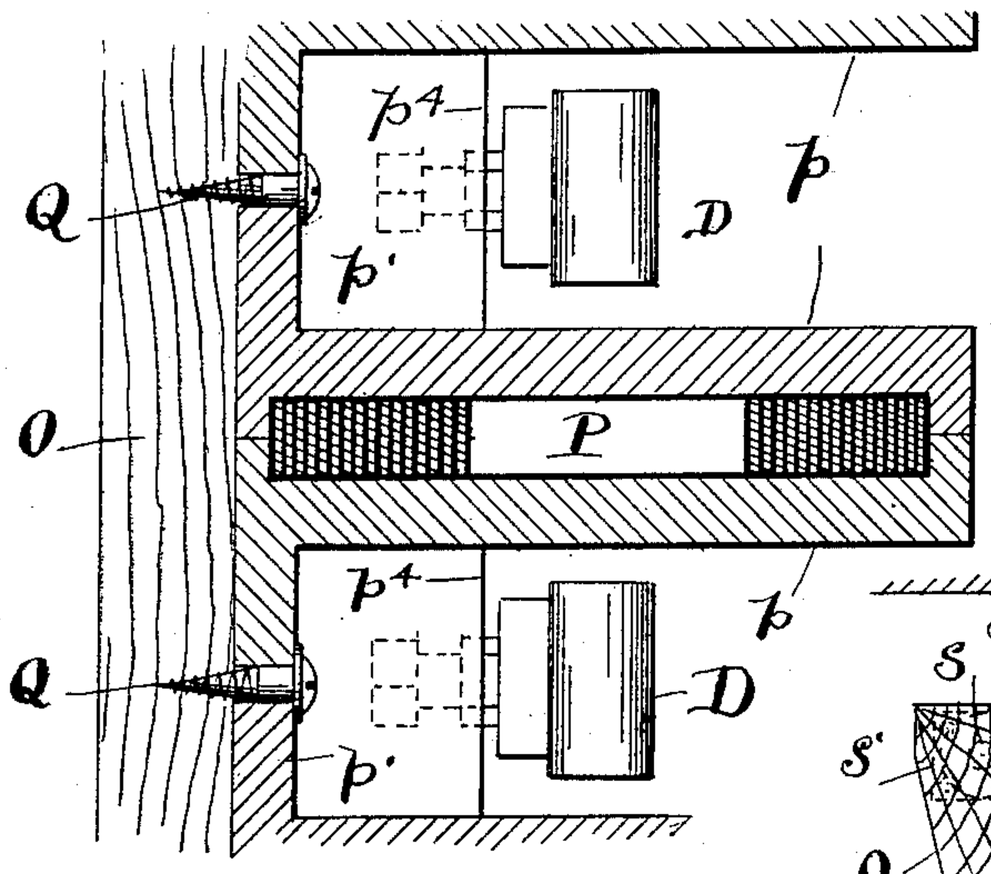


FIG. 7.

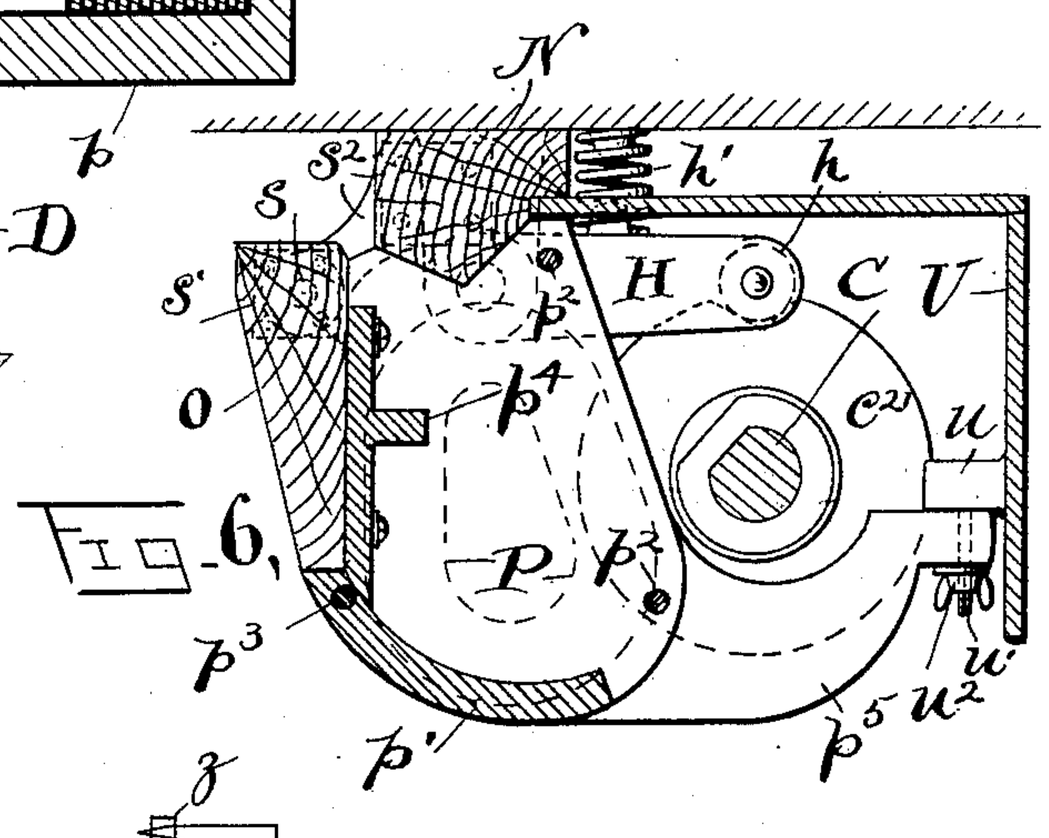
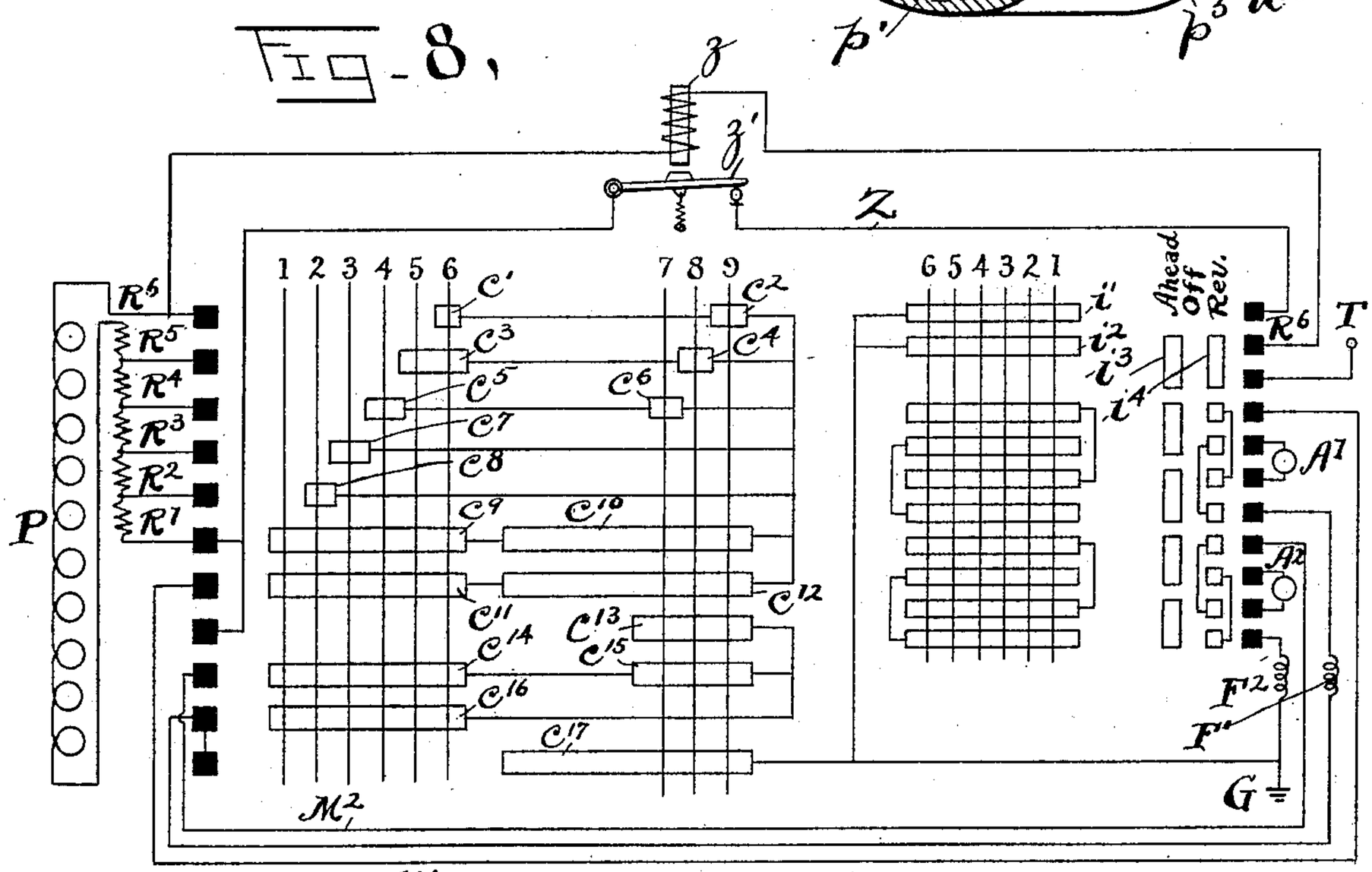


FIG. 6.

FIG. 8.



WITNESSES.

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UNITED STATES PATENT OFFICE.

THORSTEN VON ZWEIGBERGK, OF CLEVELAND, OHIO.

CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 625,915, dated May 30, 1899.

Application filed February 27, 1899. Serial No. 706,961. (No model.)

To all whom it may concern:

Be it known that I, THORSTEN VON ZWEIGBERGK, a subject of the King of Sweden and Norway, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Controllers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention relates to controllers primarily adapted for railway-motors. One of its objects is to provide an arrangement whereby the usual power-governing switch may be operated in its usual positions to govern a brake applied by another device, whereby the necessity of a special brake-governing switch is obviated. In seeking to accomplish this result in the simplest manner possible I have provided the reversing-lever with brake-applying positions and have so connected the governing-cylinder that when its operating-lever is at the "off" position the reversing-lever may connect the electric brake and turn the governing-cylinder to govern that brake. This is the form shown in the present application. It has the advantages of being very simple and cheap in construction and of taking up little space, but has the limitation that the reversing-lever is only adapted to apply the brake when the car is running forward and not when it is running backward.

The invention consists, in part, in the combination, with suitable power and brake circuits, of a governing-switch and a reversing-switch, the former being organized to govern a motor in the power-circuit and the latter to reverse such motor and the two together to control the motor in the brake-circuit by respectively governing and connecting it.

In the practical operation of the controller it has been found that in going from parallel to series if a motor is shunted a serious self-induction will result when the shunt is opened.

My invention includes such an arrangement of the contacts of the governing-switch that in going from parallel to series the circuit shall be opened for a sufficient time to prevent this strain of self-induction and also to stop sparking of the brushes of the shunted motor, but shall not be opened long enough to materially affect the velocity of the motors.

The invention also includes a very efficient arrangement of blow-out coils and shields to prevent the harmful effect of sparking at the controller, a simple and efficient interlocking device to prevent the inopportune action of either of the controller-levers, and simple means for allowing the brake-current of the motors to build up rapidly when first applied. All these points are hereinafter explained and are definitely included in the claims.

In the drawings, Figure 1 is a front elevation of the controller, the inclosing cover being removed. Fig. 2 is a plan; and Figs. 3, 4, and 5 are horizontal sections on the lines 3 3, 4 4, and 5 5, respectively, of Fig. 1. Fig. 6 is a horizontal section, on an enlarged scale, on the line 6 6 of Fig. 1. Fig. 7 is a vertical section on the line 7 7 of Fig. 5. Fig. 8 is a diagram illustrating the connection and operation of the controller.

Referring to the parts by letters, B represents the frame of the controller. Webs b', b^2, and b^3, extending integrally from the frame, form, with their cap-plates, the bearings for the different shafts of the controller. The shaft of the main or governing switch is designated C and is journaled in the bearings b^2 b^3. This shaft carries the segments c' to c^{17}, which have hubs surrounding the shaft and are separated into groups by insulating-washers, the segments c' to c^{12} being all electrically connected together, as are the segments c^{13} to c^{16}, the segment c^{17} being insulated from the rest and connected with the ground. The disposition of the segments and their connection will be understood from the diagram Fig. 8 and will not be further elaborated herein.

At the upper end of the shaft C is a gear c, which is adapted to mesh with a gear e on the shaft E, to the upper end of which is secured, and preferably locked by the thumb-screw e', the operating-lever e^2. The gear c may likewise mesh with a gear j on the shaft J of the reversing-switch. The upper end of this shaft is engaged by the reversing-lever j^2, while below the gear are the contact-segments, disposed and connected as illustrated in the diagram.

As will be seen from Fig. 3, the teeth on the gear e are stripped at the point which is opposite the gear c when the governing-handle it at the off position, and the teeth on the

gear *j* are stripped for such portion of the circumference as is opposite the gear *c* when the reversing-lever is at the "reverse," the "off," or the "ahead" positions. Thus it follows that if the reversing-lever is at the ahead or the reverse position the gear *c* may be rotated by the rotation of the shaft E, and thus the turning of the governing-handle turns the governing-cylinder to govern the motors.

The diagram shows in the left-hand half the governing-switch, the contact-fingers which engage with it, the blow-out coil P, and the lines to the various parts of the resistance R' to R⁶. The lines from the governing-switch to the reversing-switch for the first and second motors are designated M' and M², respectively, and at the right hand is indicated the reversing-switch and the two motors the armatures and fields of which are designated A' A² F' F². The contact-segments of the reversing-switch are placed in three vertical rows, one of which is for the reverse position, one for the ahead, and one for the electric-brake position, the connection by this switch for each of the electric-brake positions being just the same. With the exception of the contact-segments *i'* to *i*⁴, which engage with the upper three contact-fingers, the remaining segments for the ahead and reverse positions are connected as usual in a reversing-switch and the segments for the brake positions are connected in the same manner as those for the reverse position.

As will be seen by the diagram, when the reversing-switch is in its ahead or its reverse position the current coming in from the trolley T passes by reason of the segments *i*³ or *i*⁴ and the line R⁶ to the governing-switch, (and through such resistance as it cut it,) through the motors, and finally to the ground, while if the reversing-switch is in any of its brake positions (numbered 1 to 6) the connections with the field and armatures of the motors are the same as with the reverse position; but the trolley is disconnected and the line R⁶ from the controller is grounded by the segment *i*². The motors are thus short-circuited through whatever resistance the governing-switch has in, and they thus act as a brake.

When the reversing-lever is being turned from the "ahead" to the first "brake" position, the teeth on the gear *j* mesh with the gear *c* and turn the governing-cylinder to complete the connection through the resistance, and the continued forward movement of the reversing-lever simply rotates the governing-cylinder to cut out resistance.

In the present form there are six brake positions with varying resistance, and hence there are six series positions of the governing-switch, the motors being coupled in series when used as a brake. The brake, however, requires more resistance than is desirable to have in the circuit when the trolley-current is on, and hence the first two positions of the governing-switch have no corresponding notches in the indicator-wheel, and the first stop made when the governing-switch is turned on by the governing-handle is at the position No. 3.

The indicator-wheels on the shafts E and J are designated *e*³ *j*³, respectively. They are each engaged by one of the rollers *l l'*, carried by a pair of arms L L', which are journaled on the same pivot-pin L², which has its bearings in the web *b'* of the frame and a web *b*⁴, projecting forward below the web *b'*, the two webs being joined by the integral vertical plate *b*⁵. The rollers *l l'* are drawn toward their indicator-wheels by the springs *k*, which take around the rods K, which at one end have T-heads taking behind the arms L L' and at the other end nuts *k'*, by which the springs are adjusted.

Behind the pivot L² the arms L L' extend in the form of a pair of opposite toes *l*². These toes are far enough apart when the indicator-plate *e*³ is at the off position and the reversing-switch at either the ahead or the reverse position, so that either indicator-plate, and hence either switch, may be moved. When either switch is moved, however, the corresponding roller is moved rearward and the corresponding toe *l*² is moved up against the other toe and prevents the movement of the other lever, and hence locks the other cylinder. This forms a very simple and efficient interlock, preventing the operation of the governing-lever when the reversing-switch is at the off position or at an electric-brake position and preventing the operation of the reversing-lever whenever the governing-lever is at an on position. The governing-cylinder being released entirely by the governing and reversing levers when the former is at the off position and the latter is not at an electric-brake position, I provide another indicator-wheel or detent-plate to prevent the accidental displacement of this cylinder. This indicator-plate (designated *c*²¹) is locked at the lower end of the shaft C and has on its rear side a notch into which takes a roller *h*, carried by the pivoted arm H, which is forced toward the shaft C by the spring *h'* between the arm and the back of the frame.

The contact-fingers which engage with the governing-cylinder are designated D. They are carried by a strip of wood N, secured to the controller-frame. Boxes *p*, containing solenoids P, are placed between the contact-fingers to blow out the spark when the contact is broken. In order that this spark may neither pass to the controller-casing in front of the contact-finger nor to the support for the contact-finger or its adjusting-screw, I provide suitable shields between the boxes *p*. These shields are indicated by *p'* and are made by extending beyond the upper and lower surfaces of the boxes the front and side walls thereof, as shown in the drawings. The shields which extend rearward on the outer side of the contact-fingers furnish means for securing the boxes in place, screw-bolts Q clamp-

ing this portion of the shields to the wooden bar O. A lug p^4 is formed on this shield in front of the adjusting-screw of the contact-finger to protect that screw from sparks. The boxes p are all united by pins p^2, which connect the upper and lower halves of each box, and by pins p^3, which connect proximate boxes together through their contacting shields.

The wooden bar O is supported on vertical pivots at its upper and lower ends, and thus the bar and all the boxes as a whole may be swung away from the contact-fingers to adjust or clean them. The pivoting of this wooden bar is caused by studs s, which project integrally from plates s' at each end of the bar and take into plates s^2, which are secured to the upper and lower ends of the wooden strip N. On the upper and lower sides of the top and bottom shields are the fiber plates or arms p^5. These arms furnish convenient means for locking the whole blow-out device in place, the means shown being the thumb-nut u^2, which screws onto a bolt u', projecting loosely through the arm p^5 from a lug u, carried on the strip U, which stands between the governing and reversing switches.

In series-parallel controllers if there is a large enough gap between the last series position and the first parallel position to prevent the arcing over of the current with which they are adapted to operate—five hundred volts, for example—the velocity of the motors will diminish while the controller is moving from this distance to a great enough extent to give a serious jerk when the connection is made. On the other hand, if one motor is shunted and in going from parallel to series this shunt is suddenly broken a serious induction "kick" will exist, which is liable to injure the motors and also causes a spark at the brushes of this shunted motor. I have discovered that I can overcome each of these disadvantages by opening the circuit for a short distance between the last series and the first parallel positions, the distance not being great enough to allow the velocity of the motors to materially decrease. This is shown in the diagram by the close approach of the parallel segments c^{10}, c^{12}, and c^{17} to the series segments c^9, c^{11}, c^{14}, and c^{16}.

In order to allow the motor to build up rapidly when it is used as a brake, I provide an automatic switch between the reversing or brake-applying switch and the resistance, which short-circuits that resistance as soon as the brake is applied, but opens such short circuit as soon as the current builds up to the desired amount. This is illustrated in Fig. 8, wherein Z represents an electromagnet placed in the line R^6, leading from the reversing-switch to the resistance. This electromagnet when energized operates to draw toward it the armature z', which thus opens the line Z, leading from the reversing-switch to the other end of the resistance. This latter line is out of engagement altogether, except when the reversing-switch is at one of its electric-brake positions, and at these positions is thrown out as soon as the brake-current has risen sufficiently to energize the magnet with the desired force. Thus no delay is experienced in the application of the brake and at the same time the current generated is perfectly governable, as the governing resistance is brought back into the circuit as soon as the current of the motor builds up.

Having described my invention, I claim—

1. The combination, with suitable power and brake circuits, of a governing-switch and a reversing-switch, the former being adapted to govern a motor in the power-circuit and the latter to reverse such motor and to change the connections thereof from the power to the brake circuit, said reversing-switch having a plurality of positions where these changed conditions are maintained, and means whereby the movement of the reversing-switch in these positions governs the motor in the brake-circuit, substantially as described.

2. The combination of a governing-switch and two independent handles, either adapted to operate said switch, one to govern motors in running and the other to apply an electric brake, substantially as described.

3. In a controller, the combination of a governing-cylinder, two shafts independent of the cylinder, a pair of independent handles for operating said shafts, and a suitable connection between each of said shafts and the governing-cylinder whereby either handle may operate the governing-cylinder without displacing the other handle, substantially as described.

4. In a controller, the combination of a governing-cylinder, a gear-wheel secured thereto, a governing-handle and a brake-applying handle, each on shafts independent of each other and independent of the governing-cylinder, each of said shafts having a gear adapted to mesh with the gear on the shaft of the governing-cylinder whereby either handle may turn the cylinder, substantially as described.

5. In a controller, the combination of a governing-switch, two handles for operating the same, each independent of the other, one of said handles adapted to operate the switch for the usual governing of motors and the other handle so connected that its operation may reverse the motors, disconnect the source of power from them and put the motors in such circuit that movement of the governing-switch governs them as an electric brake, substantially as described.

6. The herein-described controller for governing reversing and braking electric motors, which consists of a governing-cylinder, a reversing-cylinder, two independent handles, that is, a governing-handle, for operating the governing-cylinder, and a reversing and braking handle for operating the reversing-cylinder and also for operating both of said cylinders, and suitable means operated by the reversing-handle for disconnecting the motors

from the source of power and short-circuiting them, substantially as described.

7. The combination of a governing-switch, a reversing-switch having a position for reversing a motor and a plurality of positions in which it is adapted to apply an electric brake, the electrical connections made by the reversing-switch being the same at each of these electric-brake positions, combined with a governing-switch, and a connection between it and the reversing-switch whereby the movement of the reversing-switch from one brake position to another moves the governing-switch to govern such brake, substantially as described.

8. The combination of a governing-cylinder, a reversing-cylinder having a position for reversing a motor and positions in which it is adapted to apply an electric brake, a connection between the reversing-cylinder and the governing-cylinder whereby the rotation of the former applies a brake and rotates the latter to govern such brake, substantially as described.

9. The combination of a governing-cylinder and gear-wheel carried thereby, a reversing-cylinder and gear-wheel secured to it, said latter gear-wheel being out of mesh with the gear-wheel on the governing-cylinder when the reversing-cylinder is at the ahead or reverse position, means for bringing said gear-wheel into mesh when the reversing-lever is drawn beyond the ahead position, the segments of the reversing-cylinder being adapted to connect in an electric brake when said gear-wheels are in mesh, and the governing-cylinder being adapted to govern such brake at such time, substantially as described.

10. The combination with a switch, a series of contact-fingers, a hinged bar, a series of boxes carried thereby and adapted to stand between the contact-fingers, and means carried within said boxes for blowing out sparks at the fingers, substantially as described.

11. A contact-finger D, a pair of boxes p, one above and one below the finger, means contained within said boxes for blowing out sparks, the front and outer walls of said boxes being extended integrally toward each other in the form of a flange p', said flanges lying along the front and outer side of the contact-finger and contacting with each other, whereby the finger lies within the space bounded above and below by the two boxes and at its front and outer sides by said flanges, in combination with a supporting-bar, to which said flanges are secured.

12. The combination of a series of contact-fingers, a series of boxes containing blowing-out means and placed between the fingers, a series of shields connecting the boxes, a hinged bar to which said boxes and shields are secured, and means for holding the same in closed position, with the boxes between the fingers and the shields on the front and the sides thereof, substantially as described.

13. In a series-parallel controller, in combination, contact-fingers, contact-segments adapted to connect motors in series and other segments adapted to connect them in parallel, said segments being so placed that in going from series to parallel the circuit is opened, said open portion being materially less than the distance from the last series to the first parallel position, substantially as described.

14. The combination of a motor, a governing resistance, a governing-switch adapted to control such motor by varying the resistance in circuit, means for closing the motor-circuit on itself through the resistance, a magnet in such closed circuit, a normally open shunt around the resistance, means for closing said shunt when the brake is applied, and means whereby said magnet when sufficiently energized opens said shunt, substantially as described.

15. The combination of a governing-controller adapted to cut out resistance, a brake-applying switch adapted to connect the line R^6 from the last resistance to the ground instead of to the source of power, a second line Z leading from the brake-applying switch to the resistance, and adapted when the brake is applied to short-circuit resistance, a magnet in the line R^6 adapted when sufficiently energized to open the line Z, substantially as described.

16. A series-parallel controller adapted by a movement in one direction to perform the following sequence of operations, first connecting the motors in series, second opening this series connection, third grounding the motor next to the trolley, and fourth connecting the two motors in parallel.

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

THORSTEN VON ZWEIGBERGK.

Witnesses:

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PHILIP E. KNOWLTON.