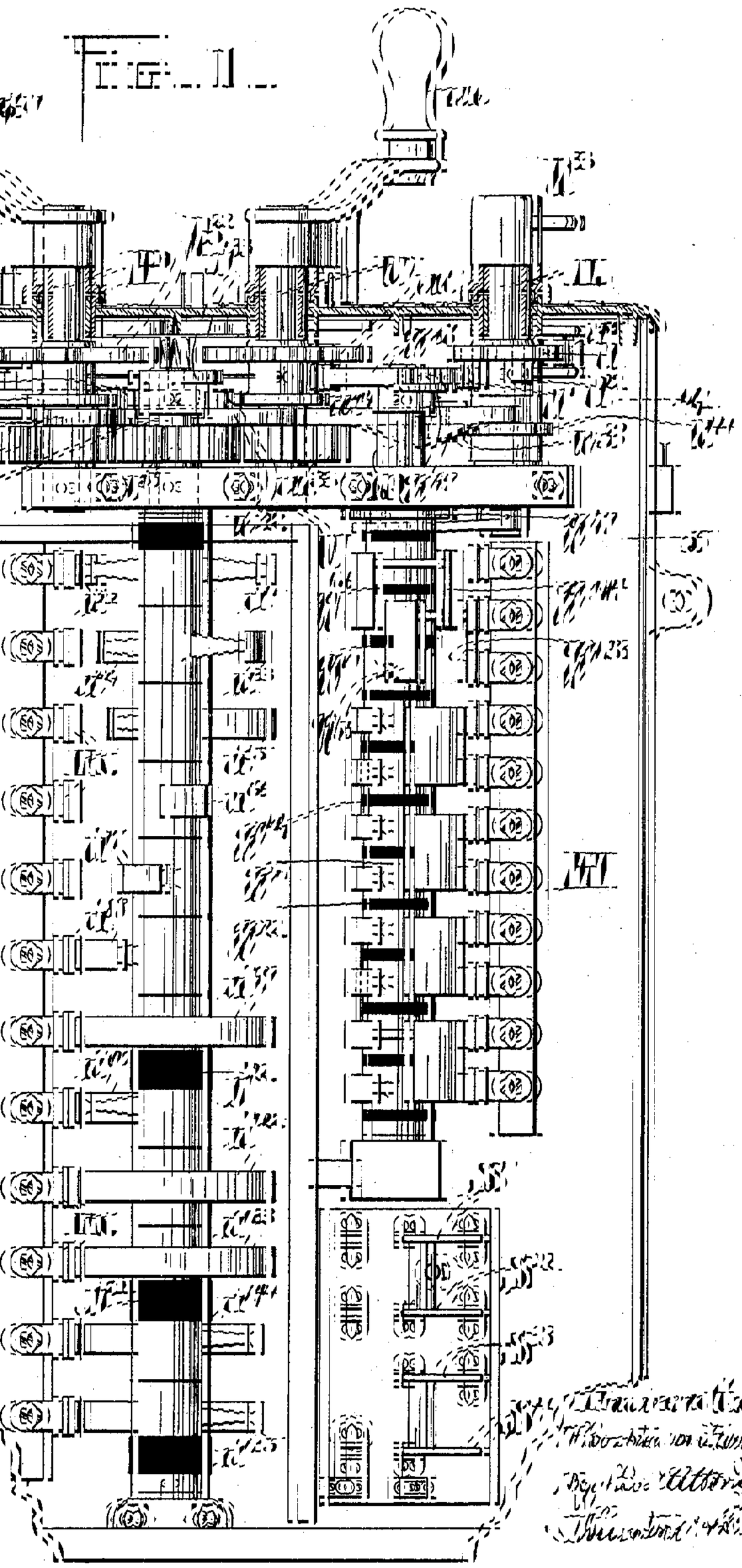
CONTROLLER.

(Application filed Feb. 27, 1899.)

3 Sheets—Sheet 1.

(No Model.)

FIG. II.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 627,376. Patented June 20, 1899.

T. VON ZWEIGBERGK.

CONTROLLER.

(Application filed Feb. 27, 1899.)

(No Model.) 3 Sheets—Sheet 2.

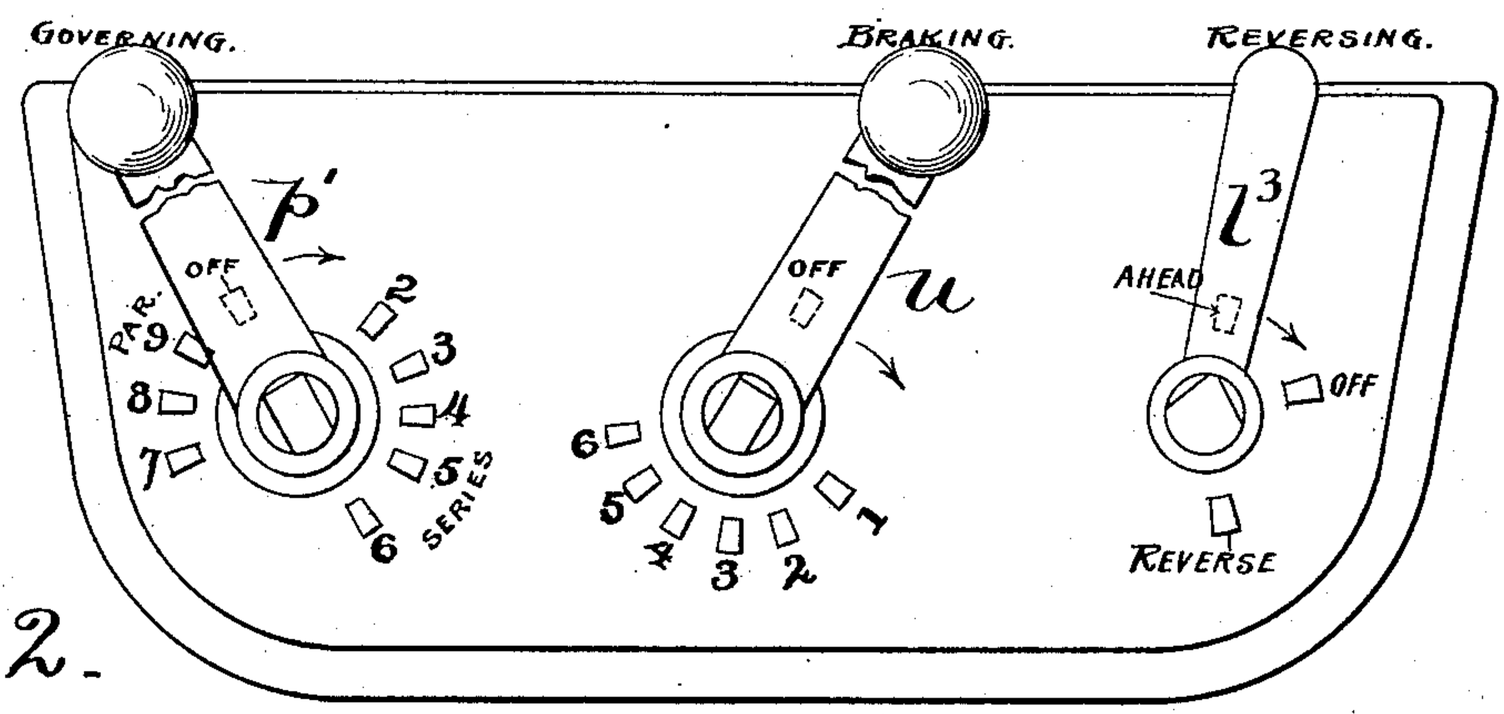


FIG. 2.

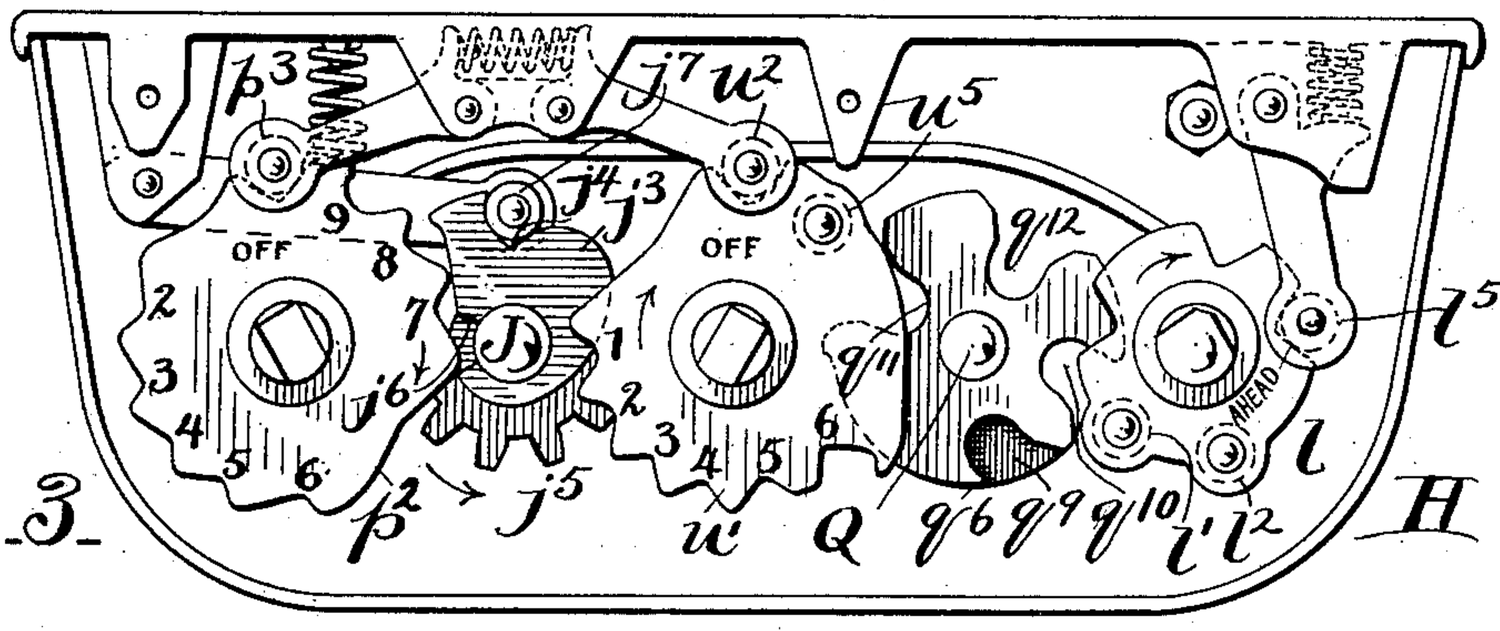


FIG. 3.

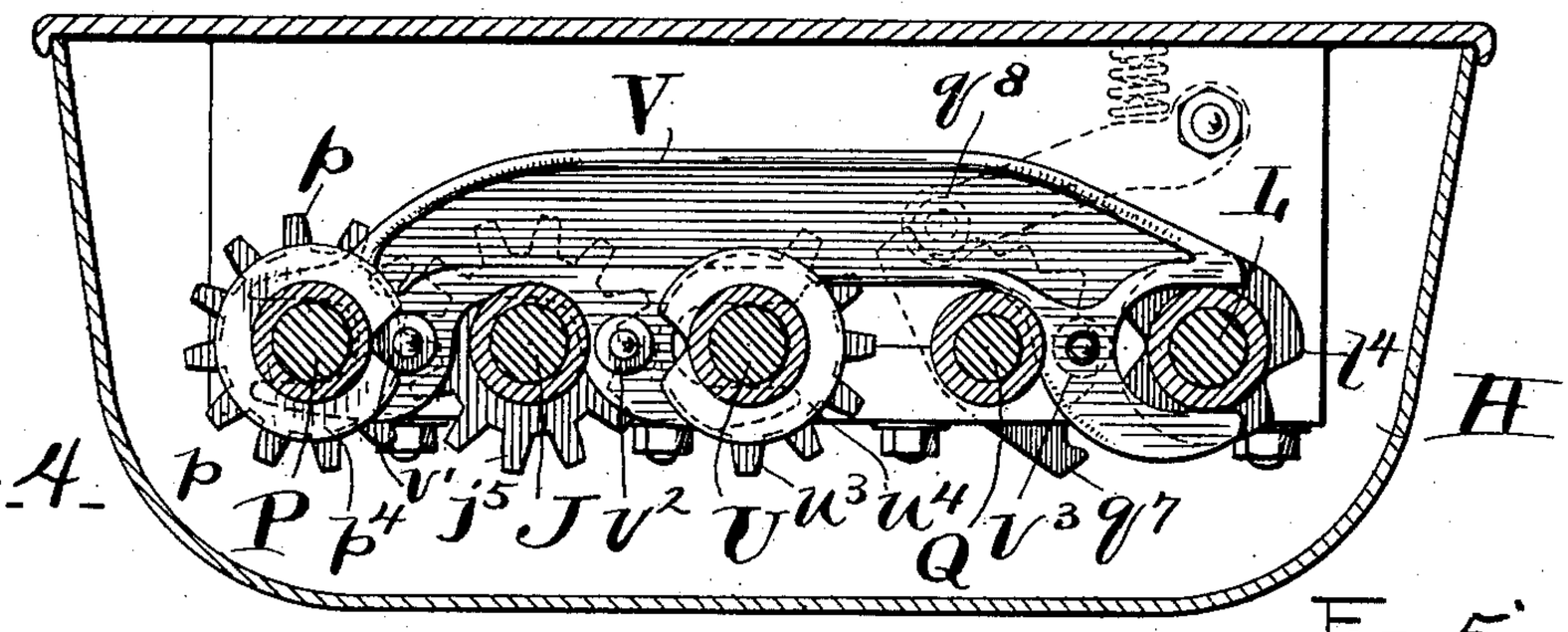
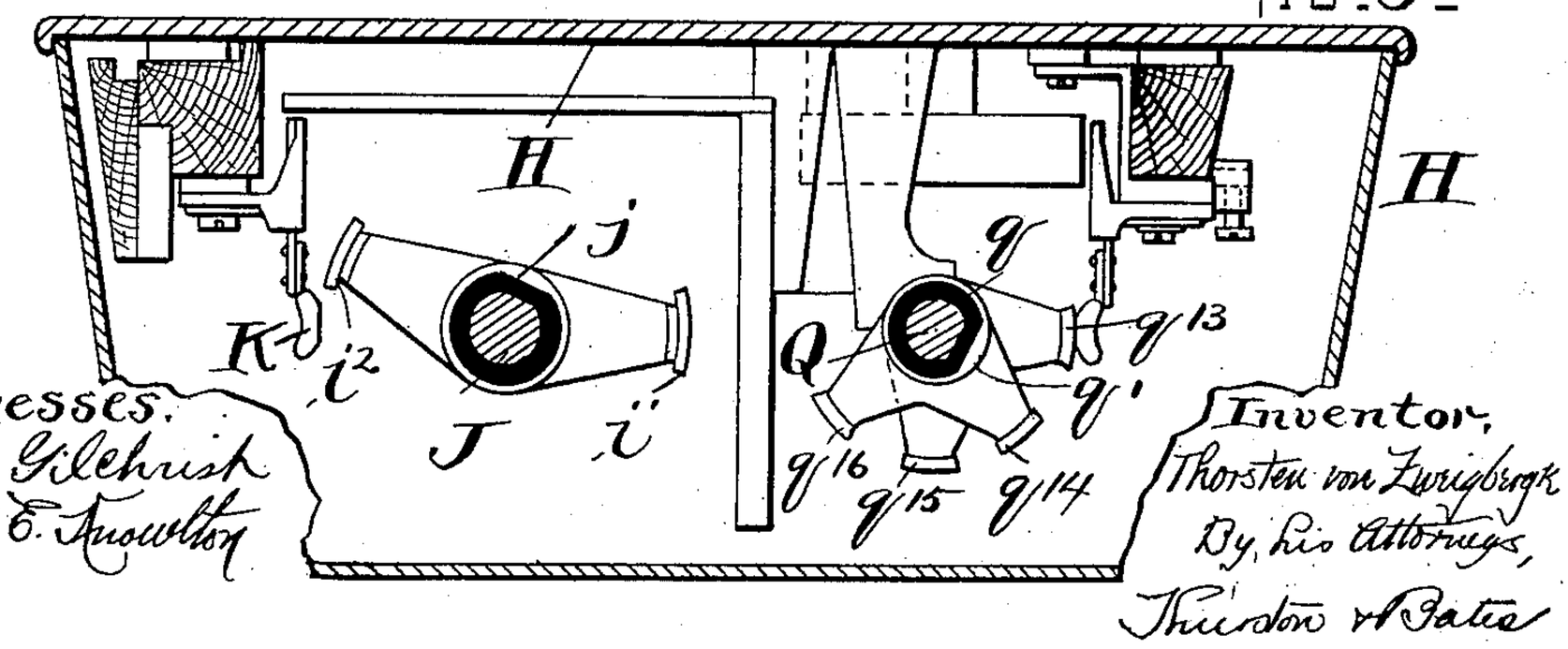


FIG. 4.

FIG. 5.



Witnesses.
E. B. Gilchrist
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Inventor,
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By his Attorneys,
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No. 627,376. Patented June 20, 1899.

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(Application filed Feb. 27, 1899.)

(No Model.) 3 Sheets—Sheet 3.

FIG. 8.

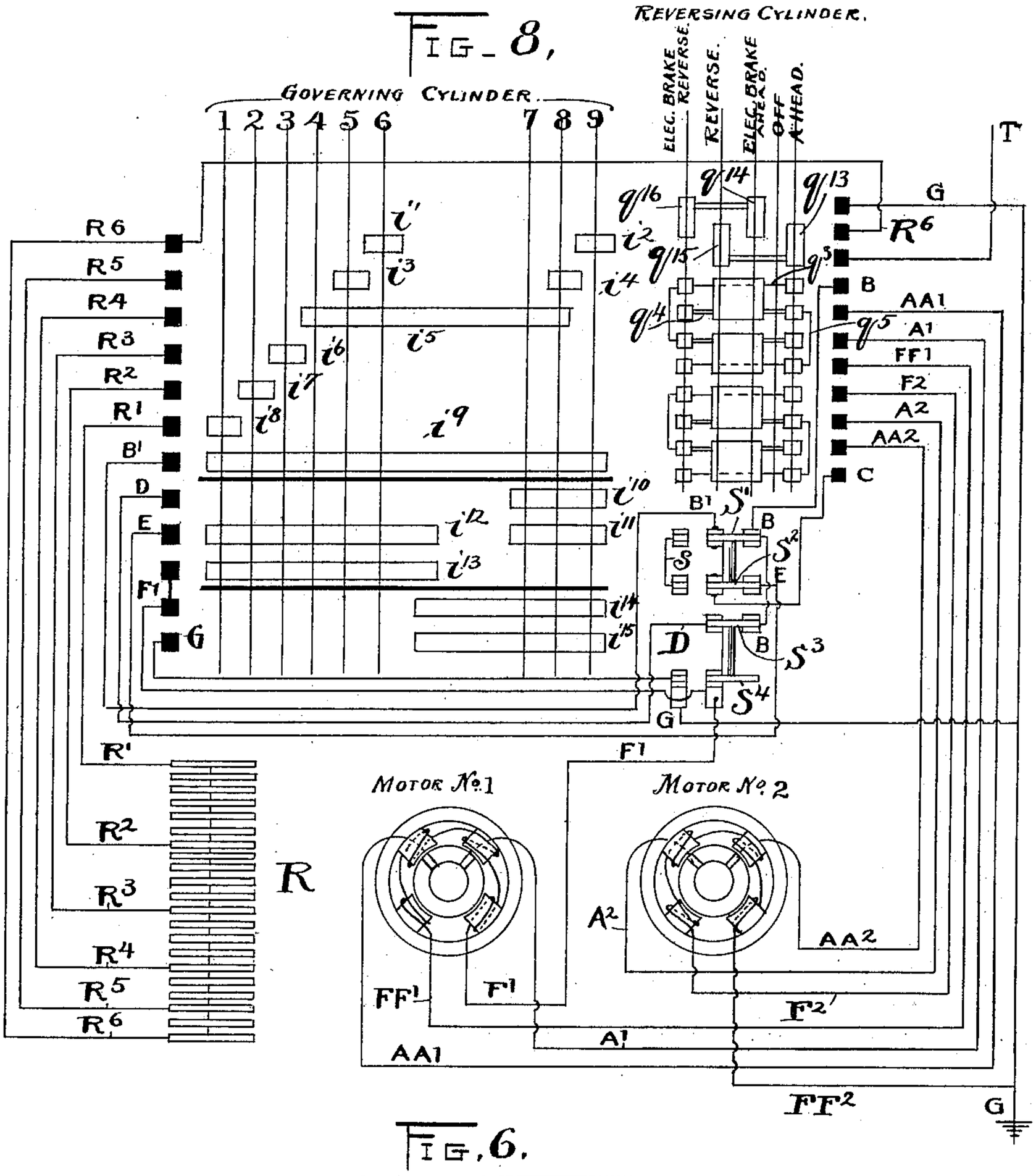


FIG. 6.

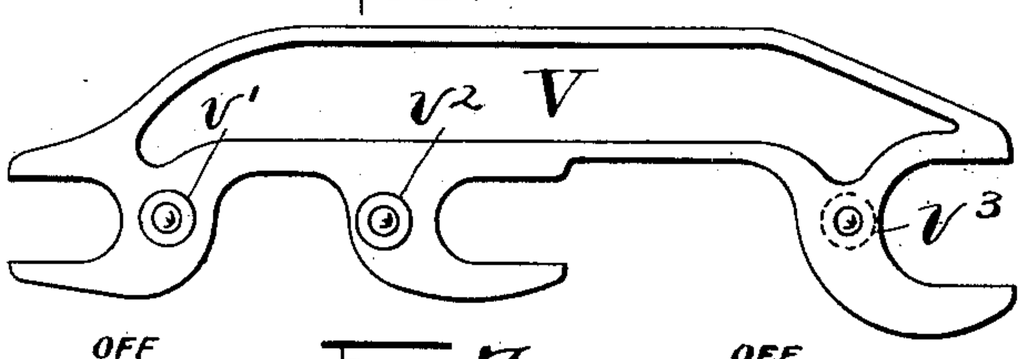
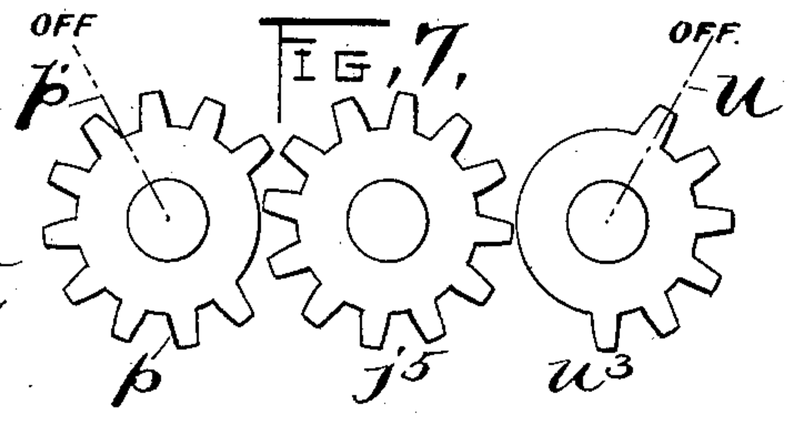


FIG. 7.



Witnesses,
E. B. Gilchrist
Philip E. Knowlton

Inventor,
Thorsten von Zweigbergk.
By his Attorneys,
Thurston & Bates

UNITED STATES PATENT OFFICE.

THORSTEN VON ZWEIGBERGK, OF CLEVELAND, OHIO.

CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 627,376, dated June 20, 1899.

Application filed February 27, 1899. Serial No. 706,962. (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 governing-switch may be operated by a separate brake-applying handle for controlling a brake whether the car is going forward or backward, thus obviating the necessity of a separate brake-governing cylinder or special brake positions of the governing-switch or its handle.

Another object is to provide a controller adapted to govern and reverse motors and establish an electric brake, which shall have a separate handle to be operated for each of these three results, but in which only two controlling-cylinders are employed, thus reducing the size and cost of the controller without altering its method of operation by the motorman.

Another object is to so connect the parts of the controller and to insert cut-out switches at such points that if either motor burns out it may be conveniently cut out and the controller used on the other motor.

The invention may be best summarized as consisting in the combination of means hereinafter described, and definitely set out in the claims.

In the drawings, which clearly disclose my invention, Figure 1 is a front elevation of the controller, with the usual cover removed. Fig. 2 is a plan of the same. Fig. 3 is a plan with the top cover removed. Figs. 4 and 5 are horizontal sections on the lines 4 4 and 5 5, respectively, of Fig. 1. All the figures above mentioned show the governing and braking parts of the controller at the "off" position and the reversing parts at the "ahead" position. Fig. 6 is a detached view of the yoke for interlocking the operating-handles, as hereinafter described. Fig. 7 is a diagrammatic plan of the gears operating the main controller-cylinder, and Fig. 8 is a diagram of the controller and its connections with the motors and resistance.

The controller shown includes three operating-handles connected, as hereinafter explained, with a governing and reversing switch, each consisting of a row of contact-fingers and a coöperating contact-cylinder, the term "cylinder" being used in its ordinary acceptation in the controller art and meaning a shaft and various contact-segments carried thereby through the intervention of suitable insulation.

H represents a suitable frame which supports the various parts of the controller. The shaft of the main or governing cylinder J is journaled in suitable bearings carried by the frame, and may be rotated therein. On this shaft are the contact-segments i' to i^{15}, which are separated from the shaft by the insulated sleeve j and divided into groups by the insulating-collars j^2. The plates i' to i^9 are all electrically connected together and likewise the plates i^{10} to i^{13} and the plates i^{14} to i^{15}, and each of these three groups are insulated from each other and from the shaft. These plates engage with contact-fingers which are shown in the drawings at K. They are connected with different portions of the resistance R and with the reversing-switch, as shown in the diagram Fig. 8.

The controller is of the series-parallel type, and its electrical operation will be readily understood from the diagram Fig. 8, wherein T represents the line from the trolley; G, the line to the ground; R' to R^6, the lines to and from the resistance. A' AA' F' FF' and A^2 AA^2 F^2 FF^2 represent the lines to and from the armature and field of the first and second motor, respectively, and B, B', C, D, and E represent lines connecting the governing-switch with the reversing-switch through interposed cut-out switches to be hereinafter described.

On the upper end of the main controller-cylinder is a detent-wheel j^3, having a notch j^4, in which takes a spring-pressed roller j^7, this construction normally holding the cylinder in place. Below the detent-wheel is a gear j^5, which is adapted to mesh with a gear p on the shaft P, to the upper end of which is secured a handle p', which is the operating-

handle for governing the motors. If this handle p' is turned, the gear at the lower end of the shaft is turned, and this turns the gear j^5, thus rotating the main controller-cylinder. A detent-wheel p^2 on a shaft P and a spring-pressed roller p^3, engaging therewith, holds the shaft until proper force is applied to move it.

The reversing-cylinder is shown at the right of the main cylinder. It is built up of a shaft Q, around which is placed an insulating-sleeve q, around which sleeve are placed hubs q', separated from each other by the insulated collar q^2 and carrying the contact-segments. The arrangement and connection of the segments on this cylinder are such that the switch may connect either contiguous contact-fingers together or alternate fingers. This may be easily understood from Fig. 8, wherein the double horizontal lines q^4 represent the arms projecting from a hub q' and supporting the plates and electrically connecting them together, and the single horizontal lines q^3 represent electrical connections between the single segments on either side of the double segments without touching the latter, the double segments being each supported from one hub and extending over, but not touching, the next hub.

The lines q^5 represent electrical connections between alternate segments, as shown.

The turning of the reversing-switch is caused by the turning of the notched head q^6, attached to the shaft Q. A usually-notched detent-wheel q^7 on the shaft Q and engaged by the spring-pressed roller q^8 holds the wheel in the usual desired position, but allows it to be moved therefrom by a pull of the proper amount. The head q^6 is turned by the engagement with one of its notches q^9 q^{10} by one of the rollers l' l^2, carried on the under side of the plate l, which is secured to the shaft L, journaled in bearings carried by the frame and having at its upper end the reversing-lever l^3. This lever when operated partially rotates the shaft L and turns the plate l, and its rollers engage with the notches of the head q^6, turning the reversing-cylinder. The plate l and lever l^3 are normally held in place by the roller l^5, spring-pressed into one of the notches in the plate l.

The braking in the controller shown is accomplished by opening the connection from the trolley and reversing the motors and closing their circuit upon themselves through the resistance, thus causing them to generate current which retards them and the carriage. As the electromotive force dies down from the decreasing armature speed the resistance is successively cut out. The car is thus brought to a stop by the current which its motors generate. The establishment of the brake connections is provided for by such connection between the brake-handle and the governing-cylinder and reversing-cylinder that when the brake-handle is turned the reversing-cylinder will be turned to open the connection to the trolley and connect the reversing-cylinder with the ground, (with which the last motor is also connected,) and the further movement of the brake-handle will move the governing-cylinder to cut out resistance.

As will be seen from the drawings, the teeth on the gear-wheel p are stripped at the point which comes opposite the gear-wheel j^5 when the governing-handle is at the off position, and thus the governing-cylinder is rendered independent of that handle and may be turned without disturbing it. Likewise when the reversing-lever is either at the ahead or reverse positions the rollers carried by its plate l are disengaged from the head q^6, and the reversing-cylinder may be turned independently of the reversing-lever. Now the brake-lever, which is designated u, is secured at the top of a short shaft U, journaled in suitable bearings and carrying a detent-wheel u', with which a usual spring-pressed roller u^2 engages, holding it in different positions, except against a reasonably-heavy pull. This shaft U carries a gear u^3, which may engage with the gear j^5. The teeth on the gear u^3 are also stripped opposite the gear j^5, (when the gear u^3 is in the off position,) so that it normally does not interfere with the operation of that gear j^5 or the main cylinder.

Carried on the under side of the detent-wheel u' is a roller u^5, which is adapted to engage with one of the notches q^{11} q^{12} of the head q^6, but is normally free therefrom. Thus when the brake-lever is at its off position it and its immediately-connected parts are independent of and do not interfere with the governing or reversing parts. When, however, it is desired to apply the electric brake, the lever is drawn toward the operator into the position marked 1 in Fig. 2. This causes the roller u^5 to engage with one of the notches in the head q^6 and shifts the reversing-switch, so as to open the line to the trolley and substitute a line to the ground therefor and reverses the motors, and after this is done the teeth of the gear u^3 engage with the gear j^5 and rotate the main cylinder, so as to establish the connection through the resistance, and a continued rotation of the handle u cuts out resistance until the position 6 is reached, when the whole resistance is cut out and the motors are simply short-circuited. In this position the handle must stop, as the last notch on the detent-wheel u' is reached, and, as shown, it is of such construction that the detent-wheel cannot be revolved beyond it, the roller u^2 preventing. In the construction shown the detent-wheel j^3 is cut away at j^6 to allow room for the roller u^5 in this sixth position.

The opening of the trolley-line and the connection of the conductor it usually connects with with the ground, is established by the upper portion of the reversing-switch. As will be seen by the diagram Fig. 8, in either the ahead or the reverse positions the plate q^{13} or the plate q^{15} connects the line from the trolley (designated T) with the line R^6 to the main cylinder, while in either of the electric-

brake positions the line from the trolley is open and the plates q^{14} or q^{16} connect the line R^6 with the ground G. With the exception of changing the line R^6 from the trolley to the ground the connections for the ahead position of the reversing-switch and for the "electric-brake reverse" are the same, and likewise those for "electric-brake ahead" and "reverse."

It will be seen that if the reversing-switch has been turned to the reverse position by the movement of the reversing-lever it will be moved to a different position by the brake-lever u than if the reversing-lever were at the ahead position. This is caused by the roller u^5 engaging with the notch q^{12} of the head q^6 instead of with the notch q^{11}. Thus if the reversing-lever moves the reversing-switch to the ahead position it leaves it in a position to be engaged by the roller u^5 and moved by it to the electric-brake-ahead position, which, as shown by the diagram, is between the ahead and reverse positions, whereas if the reversing-lever has left the switch in the reverse position the same movement of electric-brake handle moves it to the electric-brake-reverse position, which is still farther to the left.

In order that neither the electric-brake handle nor the reversing-handle may be operated when the governing-handle has the current on and in order that, likewise, the governing-handle and the reversing-handle may not be operated when the brake is applied and that neither the governing-handle nor the brake-handle may be operated when the reversing-lever is at the off position, (thus allowing the simple removal of the handle l^3 at the off position to lock the whole machine,) the following system of interlocking members is provided: On the shafts P, U, and L are collars p^4, u^4, and l^4, respectively, and a yoke V, formed as shown in Fig. 6, rides above the gears and loosely takes around each of said shafts and has on it rollers v' v^2 v^3, which are adapted to engage, respectively, with the notches in the collars p^4, u^4, and l^4. As shown, the notches to be engaged by the rollers are on the left-hand side of the shafts U and L and on the right-hand side of the shaft P. Thus when the roller v' is in engagement with the notch of the collar p^4 (which it is only when the governing-handle is at the off position) the rollers v^2 v^3 are out of the notches of the other two collars. When, however, the governing-lever is turned to any operative position, the collar p^4, acting on the roller v', forces the whole yoke to the left and the rollers v^2, v^3 take into the notches in the other two collars, the notch in the collar u^4 being such that it holds the braking-lever at the off position, and there being two notches in the collar l^4, one for the ahead position of the reversing-lever and one for the reverse position. Thus when the governing-handle is at an operative position neither the braking-handle nor the reversing-handle can be moved.

If the brake-lever be turned to a brake position, a portion of the collar u^4 where there is no notch bears against the roller v^2 and prevents the shifting of the yoke and locks the governing-handle against movement, while a portion of the head q^6, which the rollers on the plate l are not adapted to take into, comes into the path of those rollers and prevents movement of that plate, and thereby locks the reversing-lever, so that after the braking-lever has started it alone can move. When the reversing-switch is at the ahead position, the portion of the head q^6 which comes into the path of the roller l' by the turning of the brake-lever is that where the notch q^9 is located, and in order that the roller l' may not take into this notch the notch is is only made of half-depth and the roller l^2 is made short enough to go into it, while the roller l' cannot. When the reversing-lever is at the reverse position, the roller l^2 is in the position in front of the notch q^9, and the movement of the brake-lever brings a concentric portion of the head q^6 beyond the notch in front of the roller, and thus locks the parts. When the governing-handle is at the off position, if the reversing-lever is moved to its off position a part of the collar l^4 which has no notch comes opposite the roller v^3 and prevents the shifting of the yoke, and this locks the governing-handle against movement at the same time the head q^6 on the reversing-switch is turned just enough to bring the projecting portion between the notches q^{11} and q^{12} into the path of the roller u^5, so that the braking-lever cannot be turned. Thus the off position of the reversing-lever locks the whole machine.

In order to provide simple and efficient means for cutting out either motor when it burns out, switches are connected with the lines from the main controller to the reversing-switch and from the field of the first motor as follows: The line B', which conveys the current from the plate i^9 to the reversing-switch, passes through the switch S'. The line leading back from the field of the first motor to the controller has connected to it the switch S^4, which may connect it to the ground G. The line leading from the controller back to the second motor passes through the switch S^2, and the line leading from the line B back to the controller (for use when the motors are to be in parallel) passes through the switch S^3. The switches S' S^2 are connected by a cross-bar to operate in unison, and likewise the switches S^3 S^4. When the switches S' S^2 open the lines from B' to B and from E to C, it connects together (by the conductor s) the line B' and C—that is, the line which normally goes to the first motor is connected to go directly to the second motor. If both the switches are closed, which is the position shown in the drawings, the current after passing through such portion of the resistance as

the position of the main controller causes goes from the contact-plate i^9, via the line B′, through the switch S′, around the armature and field of the first motor, and back via the line F′ to the plate i^{13}, (if the main controller is in series position,) from there to the plate i^{12}, via the line E, through the switch S^2 to the line C, and around the armature and field of the second motor to the ground. If now the motor No. 1 burns out, the switches S′ S^2 are simply thrown over to the left and are connected by the line *s*, and thus the line B′ is connected directly with the line C, and the current passes from the controller through the second motor to the ground, leaving the first motor out. If the second motor burns out, the switches S^3 S^4 are opened. This connects the line F′, returning from the first motor, directly with the ground, and thus the first motor is in and the second motor is idle.

When the controller is in parallel position, the current passes from it via the line B′ to the line B and through the first motor to line F′, to plates i^{14} and i^{15} and the ground, and also from the line B beyond the switch S′ back through the switch S^3 to the line D, to the plates i^{10} i^{11}, to the line E, and back through the switch S^2 to the line C and through the second motor to the ground. Thus the motors are connected in parallel. If the first motor burns out, the first switch is opened and the current passes directly from B′ via switch S′, connection *s*, and switch S^2 to the line C and through the second motor to the ground, while the line D back to the controller for the second motor is of no avail, since the switch S′ is opened. Thus when the first motor is out the parallel positions operate the second motor the same as the corresponding series positions. Likewise if the second motor burns out switches S^3 S^4 are opened and the line from the controller passes directly to the first motor and through it to the ground and the line to the second motor is opened by the switch S^3, and thus when this motor is cut out the connection through the other motor is the same for the parallel positions of the controller as for the corresponding series positions. It thus results that when either motor is cut out the remaining motor may be operated by the controller the same on the parallel positions as on the corresponding series positions. This is important, for although there is no necessity for turning the controller to the parallel positions no harm now results if it is done, and thus locks preventing it so turning are rendered unnecessary by this invention.

Having described my invention, I claim—

1. The combination, with a controller-frame, of two independent rotatable controller-cylinders journaled therein side by side with their axes parallel but not in alinement, three independent operating-shafts journaled side by side and parallel with each other but not in alinement, and suitable gear connections between the operating-shafts and the cylinders whereby one shaft may operate one cylinder, another shaft the other cylinder and the third shaft the two cylinders, substantially as described.

2. The combination with a motor, of a switch adapted to govern it, a switch adapted to reverse it, means for applying each of said switches separately, an independent lever or brake applying member, and connecting means between the same and said two switches whereby the movement of said member moves both of said switches to connect or govern the motor as an electric brake, substantially as described.

3. The combination of a governing-switch, a reversing-switch, and a separate brake-applying handle normally independent of the governing-switch and the reversing-switch but adapted to move both of said switches, substantially as described.

4. The combination of a governing-switch, a reversing-switch, a brake-applying handle adapted to move both switches and means whereby the movement of said handle to the same brake position moves the reversing-switch to different positions according to whether it was at the ahead or the reverse position, substantially as described.

5. The combination of a governing-switch and reversing-switch, three operating-handles all independent of said switches, one of said handles adapted to operate the governing-switch, one the reversing-switch, and the other the two switches and thus apply and govern an electric brake, and means whereby the reversing-switch is turned to a different position by the brake-handle when the reversing-handle is at the ahead position than it is when the reversing-handle is at the reverse position, substantially as described.

6. The combination of a governing-cylinder, a reversing-cylinder, a pair of operating-handles one for each cylinder, and a braking-handle adapted to operate both of said cylinders without disturbing their handles, substantially as described.

7. In a controller, in combination, a governing-cylinder, a reversing-cylinder, a governing-handle, a reversing-handle, each of said handles being adapted to operate its respective cylinder, a braking-handle, suitable connection between the same and the two cylinders whereby the braking-handle is adapted to turn the reversing-cylinder and the governing-cylinder to apply and govern an electric brake, and means for preventing such operation when the governing-handle is at an "on" position, substantially as described.

8. The combination of a reversing-switch, a plate rigid therewith, a reversing-handle, a plate operated thereby, said two plates having coöperative projections and recesses whereby they may engage, a brake-applying handle, a third plate operated thereby and adapted to engage the plate on the reversing-switch, the position of such engagement depending upon the position in which the reversing-lever has

left the reversing-switch, substantially as described.

9. The combination of a controller-frame, a governing-cylinder and a reversing-cylinder suitably journaled therein, three independent shafts P, U and L journaled in said frame, an independent operating-lever for each of said shafts, suitable connections between the shafts P and U and the governing-cylinder, and between the shafts U and L and the reversing-cylinder, whereby the shaft P may operate the governing-cylinder, the shaft L the reversing-cylinder, and the shaft U the two cylinders, substantially as described.

10. In a controller, the combination of a governing-cylinder, two shafts independent of the cylinder, one operated by a governing-handle and the other by a braking-handle, and a suitable connection between each of said shafts and the governing-cylinder, whereby either handle may operate that cylinder, a collar on each of said shafts having a notch in it, suitable means, as rollers carried by a yoke, adapted to enter either notch but not both at the same time, and the turning of either collar operating to move said means out of the notch of that collar and into the notch of the other collar, thus interlocking the shafts, substantially as described.

11. A controller-frame, three independent shafts journaled therein, an independent lever for each of said shafts, said levers operating through said shafts to govern motors and reverse them and apply an electric brake respectively, each of said shafts having on it a collar which has a notch with an inclined wall, in combination with a rigid yoke carrying rollers adapted to engage with said three notches whereby the movement of any of said shafts forces the roller which is in its notch out of the same, thus obviating the necessity of a spring to give the yoke a determinate normal position out of engagement with any particular collar, substantially as described.

12. The combination with a series-parallel controller for governing a pair of motors, of a cut-out switch for each motor and such connections that when either motor is cut out by its cut-out switch the remaining motor may be operated on the parallel positions of the controller the same as on the corresponding series positions, and thus locks preventing the turning of the controller to the parallel positions when a motor is cut out are rendered unnecessary, substantially as described.

13. The combination, with a controller, a reversing-switch and a pair of motors, of the line for the first motor from the controller to the reversing-switch, a line from the first motor back to the controller, a line from the controller to the reversing-switch for the second motor, a branch line from the line first mentioned back to the controller and adapted to be connected by it to the second motor-line from the controller to place the motors in parallel, and switches in these lines which are adapted to open the series lines to the first and second motors and connect the line normally for the first motor with the second motor, thus cutting out the first motor, and are also adapted to open the branch line mentioned and connect the line from the first motor back to the controller with the ground, thus cutting out the second motor, substantially as described.

14. The combination of a series-parallel governing-controller, a reversing-switch, a line B′ leading from the governing-controller to the reversing-switch and passing through a switch S′, lines leading from the reversing-switch to the first motor, a line F′ from the first motor back to the controller, a switch S^4 adapted to connect said line with the ground, a line as E adapted to carry the current from the governing-controller in series position through switch S^2 to reversing-switch, lines from the reversing-switch passing to the second motor, a line from the second motor to the ground, a branch line connected with the line B from switch S′ to the reversing-switch and passing through switch S^3 back to the controller and adapted to be connected by it when in parallel position with the line E, and means for connecting together the lines B′ and E when the switches S′ S^2 are opened, whereby the opening of said switches S′ S^2 cuts out the first motor and the opening of the switches S^3 S^4 cuts out the second motor, substantially as described.

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

THORSTEN VON ZWEIGBERGK.

Witnesses:
ALBERT H. BATES,
PHILIP E. KNOWLTON.