No. 708,656. Patented Sept. 9, 1902.

T. E. MURRAY & J. VAN VLECK.

ELECTRIC RAILWAY.

(Application filed Feb. 26, 1902.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

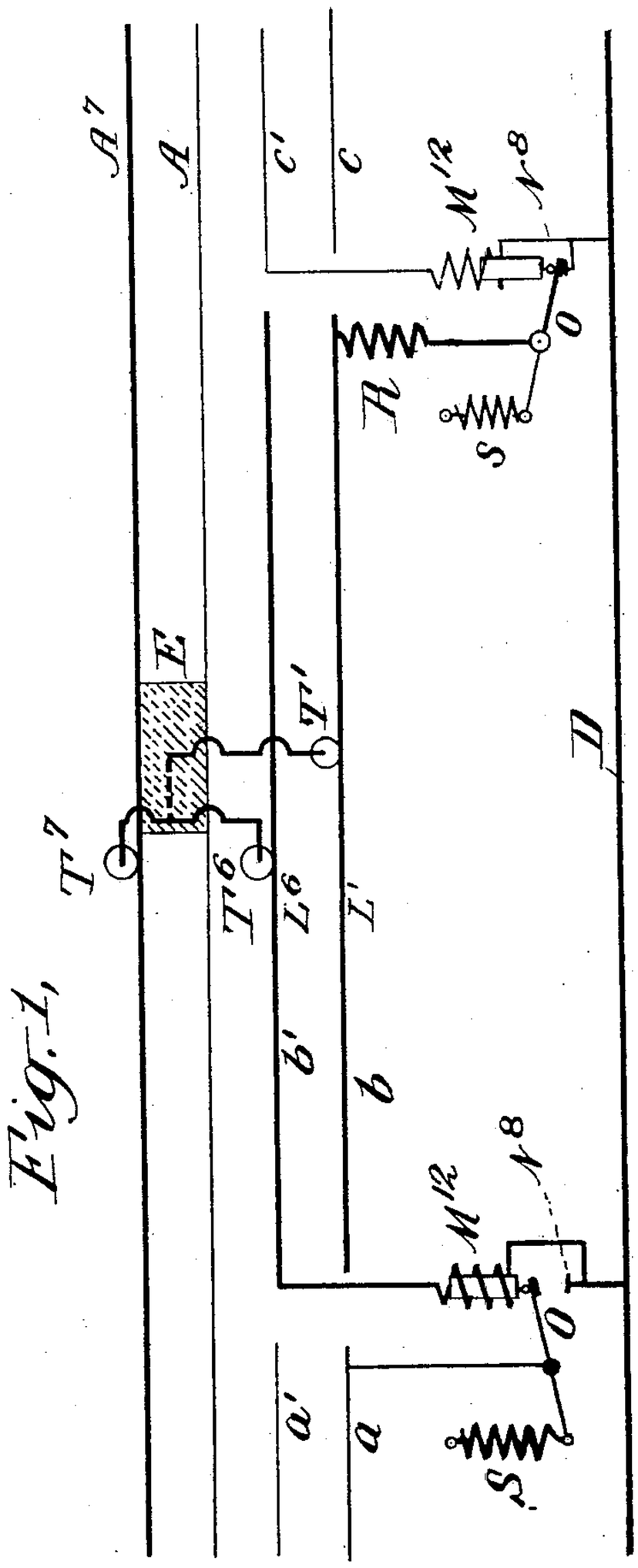


Fig. 2.

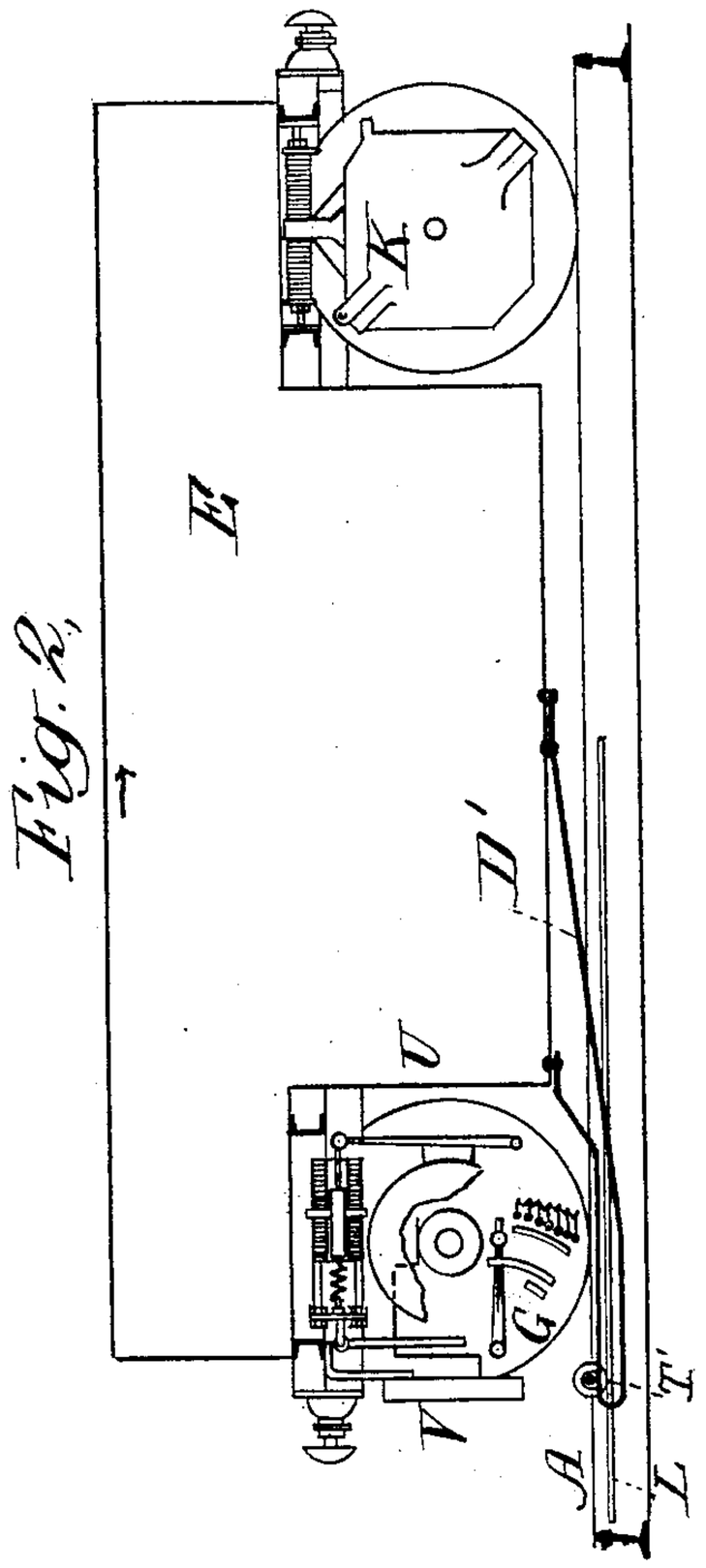
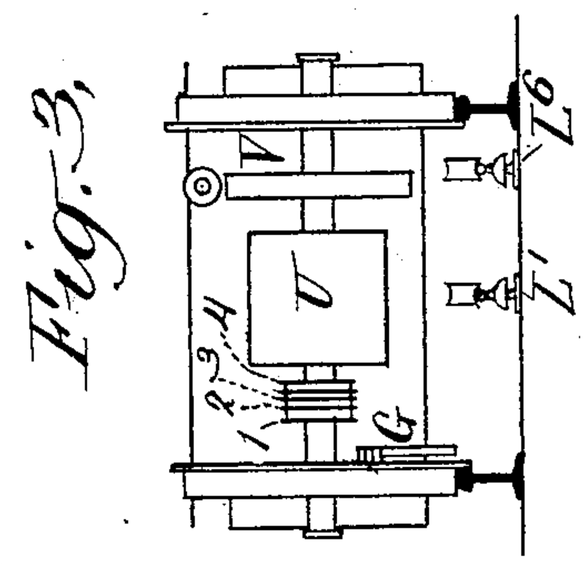


Fig. 3.



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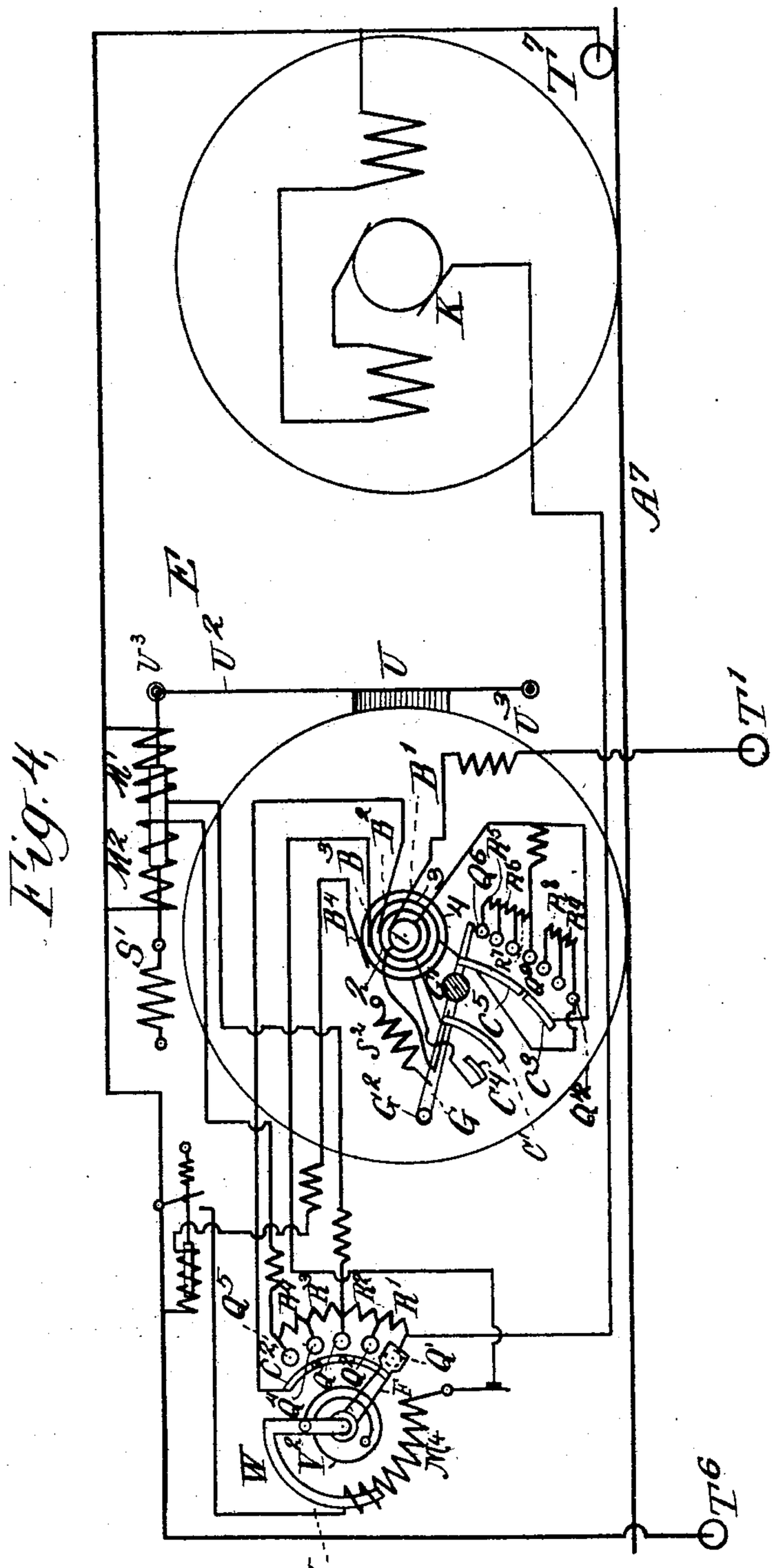

Fig. 4.

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(No Model.) 4 Sheets—Sheet 3.

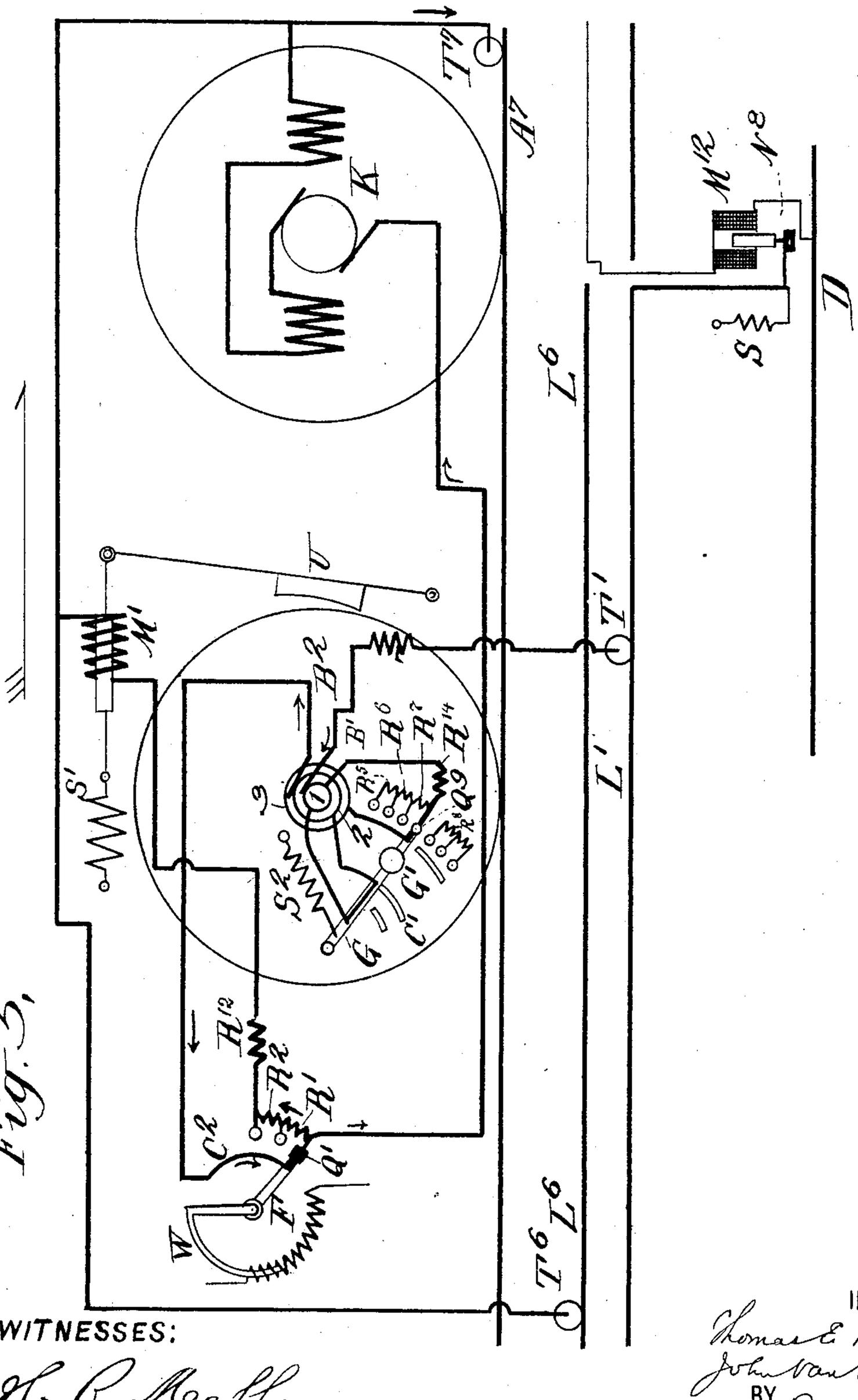

Fig. 5,

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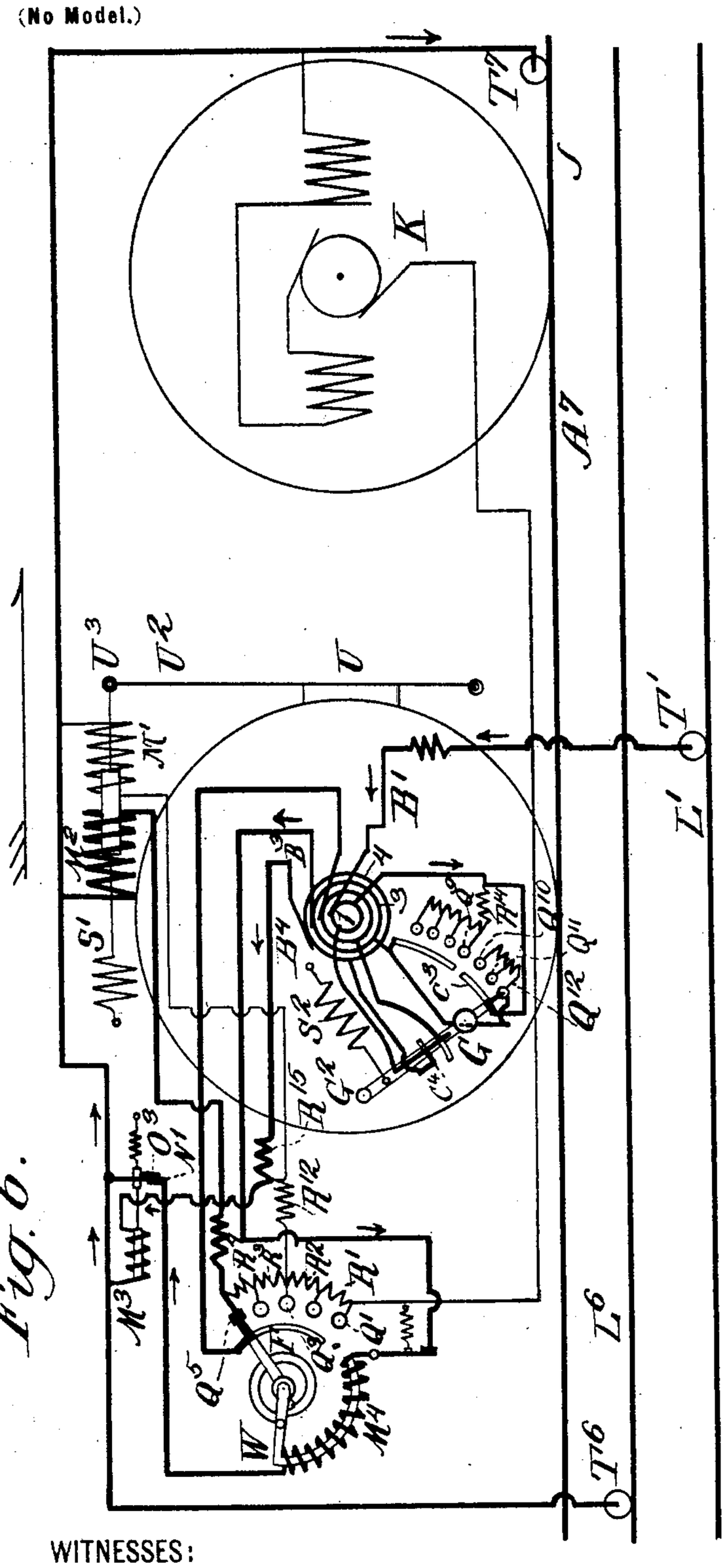

Fig. 6.

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UNITED STATES PATENT OFFICE.

THOMAS E. MURRAY AND JOHN VAN VLECK, OF NEW YORK, N. Y.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 708,656, dated September 9, 1902.

Original application filed November 22, 1901, Serial No. 83,318. Divided and this application filed February 26, 1902. Serial No. 95,677. (No model.)

To all whom it may concern:

Be it known that we, THOMAS E. MURRAY and JOHN VAN VLECK, of the city, county, and State of New York, have invented a new and useful Improvement in Electric Railways, of which the following is a specification.

Our invention relates to an electric railway having a track and stations disposed at intervals along the same and cars electrically propelled on said track.

Our invention consists, first, in the construction of the line in block-sections provided with means whereby the section next to and immediately succeeding that upon which the car is advancing is rendered dead, so as to protect the car from rear collisions; second, in the construction of the devices for automatically varying the strength of current actuating the motor, and, third and more particularly, the construction of the governor carried on one of the car-wheels and the controlling device associated therewith.

This application is a division of another application for Letters Patent filed by us November 22, 1901, Serial No. 83,318.

In the accompanying drawings the various parts and combinations, together with the electrical mechanisms and connections, are shown symbolically. In each figure representing electrical circuits and connections live connections, through which currents are passing under the described conditions, are indicated by thick lines. The line which begins at ring 1 and ends with ring 3 and includes R^{14} in Figure 5 is shown heavy in that figure to keep the drawings in correspondence with the similar drawings in other divisions of this application. The current passing on that line plays no part in the mechanism herein specifically described and need not be considered. It feeds other mechanism not herein shown or set forth, which operates coincidently with the described mechanism.

Fig. 1 is an electrical diagram, in which the car E is also represented symbolically, illustrating the arrangement of the block-sections and associated mechanism. Fig. 2 is a side elevation of the car. Fig. 3 is an end view of the car. Fig. 4 is an electrical diagram showing the relation and position of the various mechanisms and connections with the car at rest on its track. Fig. 5 is an electrical diagram showing the relation of parts, mechanism, and connections with the car running at normal speed on the main trolley-line. Fig. 6 is an electrical diagram showing the car running at excessively-high speed on the main trolley-line and being automatically checked by the centrifugal governor G.

Similar characters of reference indicate like parts.

The main trolley-line and block system is illustrated by electrical diagram in Fig. 1. The track-rails on which said car travels are shown at A and A^7, A^7 being the return-conductor. Three block-sections *a b c* of the main line L′ and *a′ b′ c′* of the breaker-line L^6 are indicated. The car E is located on block *b* and has a trolley T^7 in contact with the return-rail A^7 and trolleys T′ and T^6 both connected to said return-trolley and respectively in contact with lines L′ and L^6. As will be hereinafter explained, current from L′ has to pass through controlling and operating mechanism on the car before reaching T′, whereas L^6 is directly connected to trolley T^6 and trolley T^7 to return A^7, so as to allow current to flow directly from T^6 to T^7. Each block-section is connected at one end to the main feeder-line D through a circuit-breaking lever O, which by the action of spring S, attached to it, normally closes contact with the feeder at N^8, as shown at the right of Fig. 1, so that current proceeds from said feeder to section *b* of line L′, trolley T′, return-trolley T^7, and return-rail A^7. Each corresponding parallel section of the breaker-line L^6 is also connected to the main feeder-line D through the coil of a solenoid M^{12}, and the core of said solenoid is connected to lever O. Consequently when circuit is made from feeder D to breaker-line L^6, to trolley T^6, and return-trolley T^7 and rail A^7 the solenoid M^{12}, as shown on the left of Fig. 1, attracts circuit-breaking lever O and opens contact N^8, so that circuit is broken from feeder D to section *a* of line L′. Thus the current which passes over a given block-section of L′, as *b*, both actuates the motor and opens the circuit which connects the feeder to the next following block-section *a*, so that the car in moving over the line is always succeeded by a

dead block-section, over which, of course, no following car can pass. It is often desirable that a car in approaching a station or other stopping-point shall slow down. This we effect by interposing a suitable resistance R, Fig. 1, in the branch leading from switch-lever O to the block-section upon which it is desired speed shall be diminished. Thus, as shown on the right of Fig. 1, by reason of the presence of the resistance R less current would pass upon section *b* than upon section *a* of line L'. We term a section provided with such a resistance for the purpose stated a "special block-section." The car E has a motor K arranged to actuate the car-wheels at one end of the vehicle, and at the other end one wheel carries on its inner side the centrifugal governor G. The automatic brake U and its mechanism are supported from the car-frame in any suitable manner, and so also is the controller V. The series of contact-rings 1 2 3 4 are disposed on the car-axle and suitably insulated and electrically connected, as hereinafter explained. The arrow in Fig. 2 indicates the direction of movement of the car. The trolley T' is journaled in the upper side of the doubled bar D', which bar is secured to the under side of the car-body. In passing over switches the lower side of the bar D' meets the rails, and so lifts the trolley T' clear of the junction and prevents injury to it.

The brake, governor, and controlling mechanism of the car can best be described with reference to Fig. 4, which shows all diagrammatically. The car is here at rest. The wheels and return-trolley T^7 are of course on the rails, but the trolleys T' and T^6 are shown as having run off lines L' and L^6. The brake-shoe U is mounted on an arm U^2, pivoted at U^3. The upper end of arm U^2 is connected to the core of the antagonistic solenoid-coils M^2 and M', and said core is connected to one end of a spring S'. Spring S' normally tends to hold the brake-shoe against the wheel-rim. Solenoid M' when energized, acting against the spring, withdraws said shoe. Solenoid M^2 when energized reinforces the pull of the spring. The governor consists of an arm G, having at one end a weight G' and pivoted at the other end G^2 to the inside face of one of the car-trucks. The arm is connected to a spring S^2, which normally holds its weighted end near the wheel-center. When the wheel revolves, the centrifugal force tends to throw the weight G' outwardly or toward the wheel-rim against the action of the spring. On the wheel-face are four contact-plates C' C^3 C^4 C^5, with which the governor-arm may make electrical contact, as hereinafter described. The free end of the governor-arm also sweeps over a series of contact-points Q^6 to Q^{12}, between which are resistances R^5 to R^9. Electrically connected with the governor-arm, contact-plates, and points are the insulated rings 1 2 3 4 of the car-axle. Against these rings bear brushes B' to B^4. The controller V has a pivoted arm W, a curved portion of which enters and forms the core of a curved solenoid M^4. When said solenoid is energized, it draws in its core and so causes another arm F, connected to arm W, but insulated therefrom, to sweep over a contact-plate C^2. A volute spring V^2, connected at one end to arm F and at the other end to a fixed point, maintains the end of arm F at one extremity of contact-plate C^2 and also upon the first of a series of contact-plates Q' to Q^5, between which contact-points are interposed resistances R' to R^4. This controller, as hereinafter explained, operates as an electrically-actuated speed-regulator for the car.

The operation of the apparatus.—In order to avoid complication and to render the description clear, we now proceed to assume certain conditions of speed, &c., and to describe the operation of the various mechanisms in these circumstances.

First. The car is running at normal full speed on main line L'. This condition is illustrated diagrammatically in Fig. 5, in which for the sake of clearness the parts of the system not directly affected and acting are omitted. The relation of the weight G' on governor-arm G and the spring S^2, acting on said arm, is to be such that when a predetermined or normal speed of the car is attained said arm shall be thrown outwardly by the centrifugal force due to the rotation of its supporting-wheel. The end of said arm shall make contact with the contact-point Q^9, so cutting out of circuit the resistances R^5, R^6, and R^7. The "full-speed" current now passes from main line L' to trolley T', to brush B' and ring 1, to and along a conductor on the governor-arm G, but insulated therefrom, to contact-plate C', to ring 2, to brush B^2, to controller contact-plate C^2, where the circuit divides, as indicated by the short arrows, part of the current then proceeding by controller-finger F to contact-point Q' and so to the motor K and trolley T^7, to the return-rail A^7, and part through the resistances R', R^2, and R^{12} and solenoid M' to said return-trolley T^7. The solenoid M' then overpowers spring S' and moves the brake-shoe U away from the car-wheel.

Second. The car attains an excessive speed or a speed greatly above that predetermined and normal. This condition is illustrated in Fig. 6, parts not affected being omitted, as before. By the increased action of the centrifugal force due to the rotation of the car-wheel the governor-arm G is caused to move outwardly until it makes contact with the limiting contact-point Q^{12} and with contact-plate C^4. Current now passes from line L' and trolley T' to brush B', ring 1, to and along a conductor on governor-arm G, but insulated therefrom, to contact-plate C^4, to ring 4, brush B^4, resistance R^{15}, and solenoid M^3 to return-trolley T^7 and return-rail A^7. Solenoid M^3 being thus energized draws in its core, thus

moving its associated pivoted circuit-closing lever O^3 to close contact at N'. Current may now pass from ring 1 to governor contact-plate C^3, governor-arm G, contact-point Q^{12}, ring 3, brush B^3, controller-solenoid M^4, and closed contact N' to return. Solenoid M^4, acting on controller-finger F, moves that finger from contact-point Q' to contact-point Q^5, as shown. The current passes to Q^5 in the manner illustrated in Fig. 5—that is to say, from trolley T' to ring 1, thence by way of the governor-arm to ring 2, thence by brush B^2 to plate C^2 and arm F, and so to Q^5 when said arm is in contact therewith, as shown in Fig. 6. Q' is connected to one terminal of the motor K, the other terminal of said motor being connected to the return-trolley T^7. Therefore this movement of finger F brings all of the controlling-resistances R' R^2 R^3 R^4 into the motor-circuit. It will also be observed that while one terminal of the brake-solenoid M' is connected to return, the other terminal is connected to controller contact-point Q^3. Therefore the controller-resistances R' R^2 and the additional resistance R^{12} are also brought into the circuit of that solenoid. The intervention of these resistances into the circuits of both the motor and the solenoid M' reduces the current in both circuits, while in addition full current is established from controller contact-point Q^5 through the solenoid M^2 to return. The strength of solenoid M' being thus decreased, the spring S' and the opposing solenoid M^2 conjointly act to bring the brake-shoe U against the wheel.

Let it now be assumed that, third, the car attains a speed above normal, but not so great as last considered. Still referring to Fig. 6, the governor-arm G will move outward to a less extent and close contact with either contact-point Q^{10} or Q^{11}. In such case either or both of the resistances interposed between said contact-plates would be brought into the circuit of controller-solenoid M^4 and the controller-finger F would be moved from contact-point Q' to a less extent than before, thus putting in a part of the controller-resistances R' R^2, &c., and so cutting off current to the motor until the speed fell to the normal rate, when the governor-arm G would once more return to Q^9.

We claim—

1. In an electric railway, the combination of a track, a car, a main feeder-line, a main conductor-line divided into block-sections, and a breaker-line parallel to said conductor-line and divided into similar block-sections, a circuit-breaker interposed between one end of each main conductor-line block-section and said main feeder, and means for electrically opening said circuit-breaker interposed between the opposite end of each breaker-line block-section and said main feeder, substantially as described.

2. In an electric railway, the combination of a track, a car, a main feeder-line D, a main conductor-line L' divided into block-sections a, b, a breaker-line L^6 divided into similar block-sections a', b', a circuit-breaker O interposed between block-section a and main feeder-line D, a solenoid M^{12} interposed between block-section b' and said main feeder-line and operating to control said circuit-breaker, and circuit connections on said car for closing circuit between lines L', L^6 and return, substantially as described.

3. In combination with an electric-railway car, a motor, means for varying the strength of current actuating said motor, a contrifugal governor controlling said means and having an arm eccentrically pivoted upon one of the car-wheels, substantially as described.

4. In combination with an electric-railway car, a motor, a centrifugal governor having an arm pivoted eccentrically upon one of the car-wheels and a variable resistance on said wheel in circuit with said motor, said resistance being controlled by said arm, substantially as described.

5. In combination with an electric-railway car, the governor-arm G, eccentrically pivoted on one car-wheel, a variable resistance controlled by said arm, pivoted finger F, and means for electrically vibrating the same, variable resistance controlled by said finger, and motor K and circuit connections, substantially as described.

6. In combination with a main-line conductor, a car provided with means for taking current from said conductor, an arm pivoted eccentrically on one of said car-wheels, a variable resistance controlled by said arm, and a driving-motor for said car in circuit with said resistance; whereby changes of position of said arm due to changes in centrifugal force dependent on speed of rotation of said car-wheel shall cause a variation in strength of current actuating said motor, substantially as described.

7. In an electric railway, a main-line conductor, a car provided with means for taking current from said conductor, and on said car, a driving-motor, a controlling device constructed to control the current passing to said motor, means for electrically actuating said controlling device, and a centrifugal governor actuated by said car-wheel and controlling said actuating means, substantially as described.

8. In an electric railway, a main-line conductor, a car provided with means for taking current from said conductor, means on said car for varying the strength of said current, a solenoid operated by said variable current and a driving-motor on said car; the said controlling-solenoid being constructed and arranged to control the current passing to said motor, substantially as described.

9. In combination with an electric-railway car, a motor, a variable resistance in the circuit thereof, electrically-actuated means for varying said resistance, a variable resistance

in the circuit of said means, and a centrifugal governor controlling said last-named resistance.

10. In combination with an electric-railway car, a motor, an electrically-actuated speed-regulator therefor, and means for cutting resistances into the circuit of said speed-regulator controlled by the speed of travel of said car.

11. In combination with an electric-railway car, a motor, an electrically-actuated speed-regulator therefor, a centrifugal governor, and a variable resistance governed and controlled by said governor and interposed in the circuit of said speed-regulator.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

THOMAS E. MURRAY.
JOHN VAN VLECK.

Witnesses:
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I. A. VAN WART.