C. J. KINTNER.

SAFETY APPLIANCE FOR RAILWAYS.

APPLICATION FILED APR. 14, 1903. RENEWED JAN. 25, 1904.

915,188.

Patented Mar. 16, 1909.

4 SHEETS—SHEET 1.

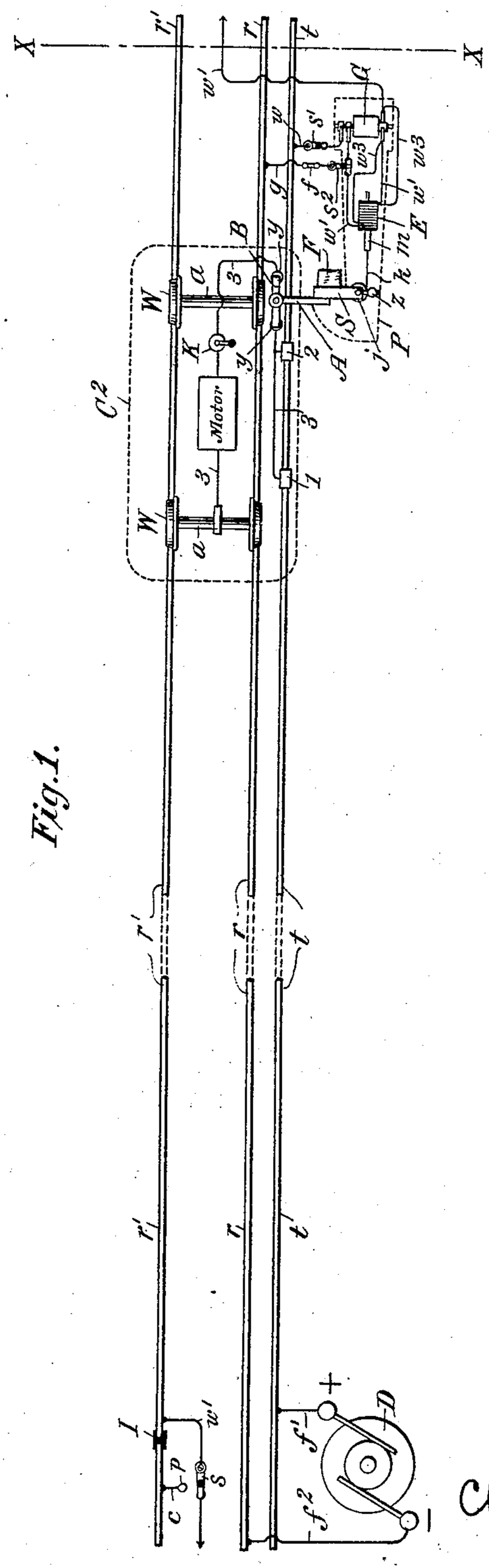

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2.

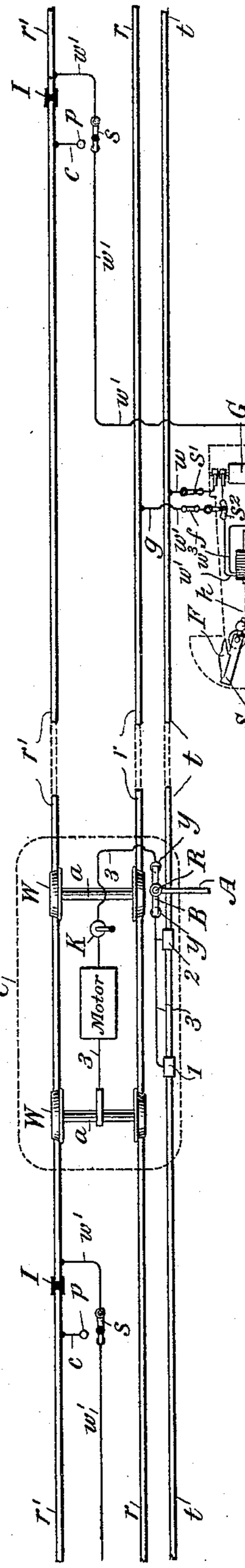

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Fig. 4.

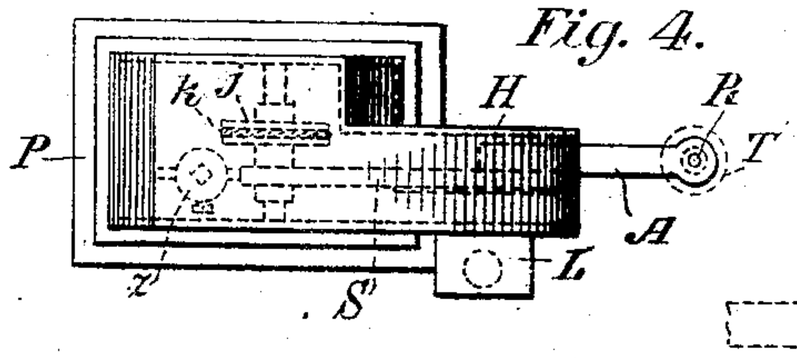


Fig. 5.

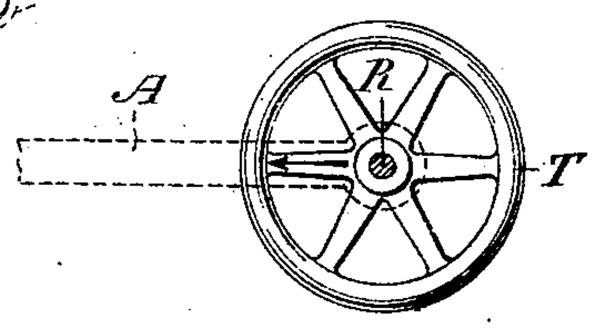
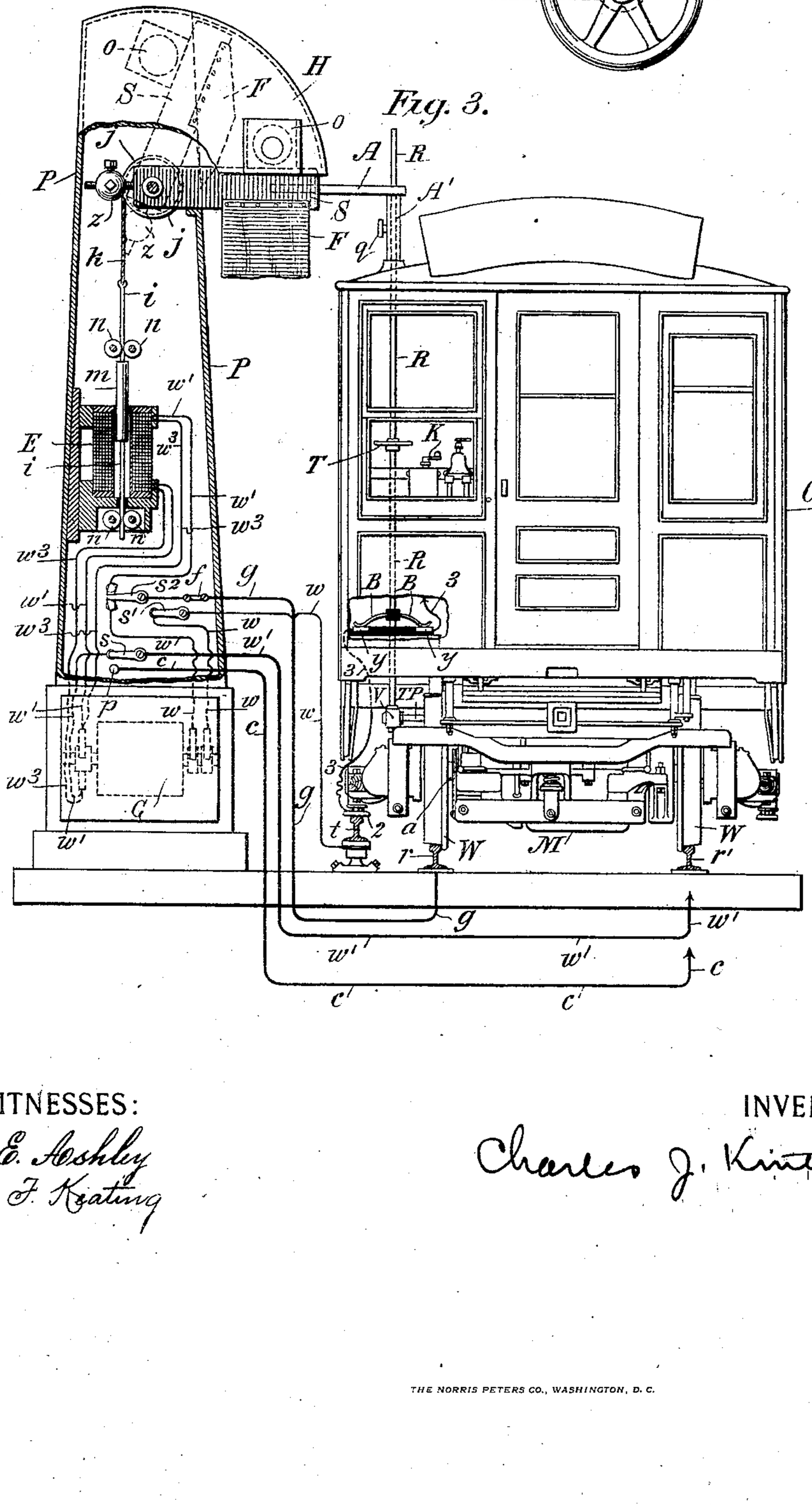


Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 7.

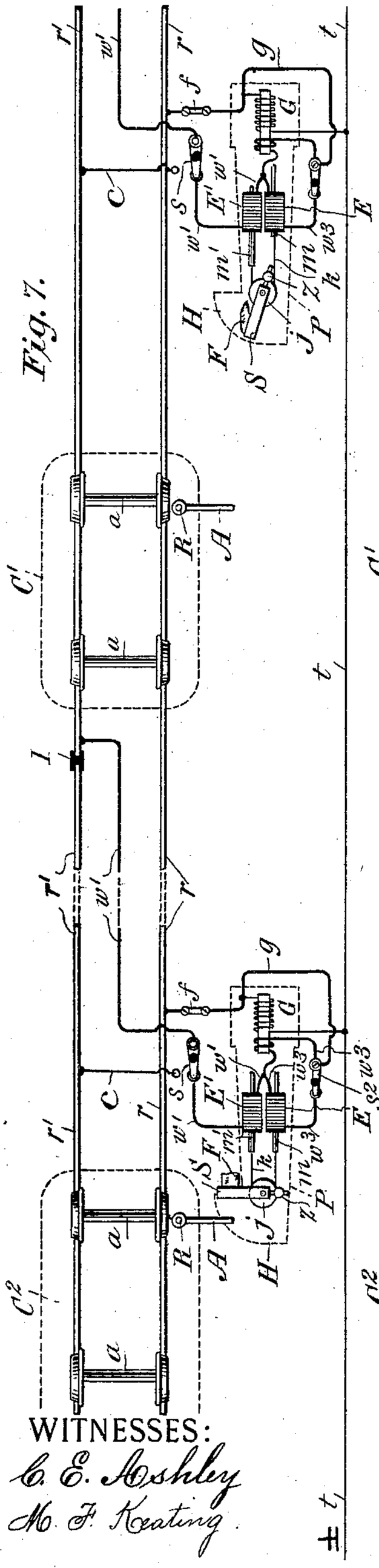


Fig. 6.

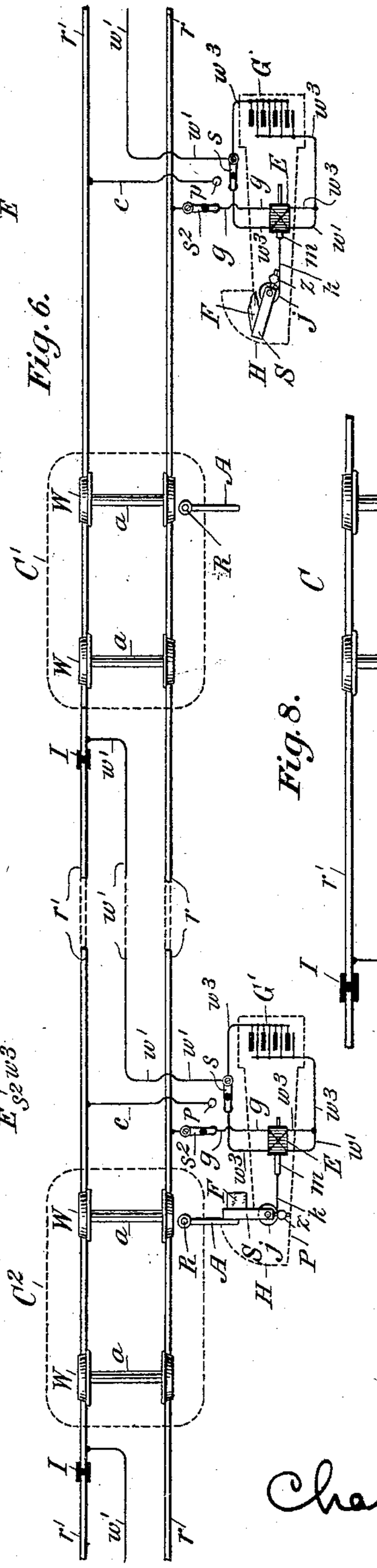
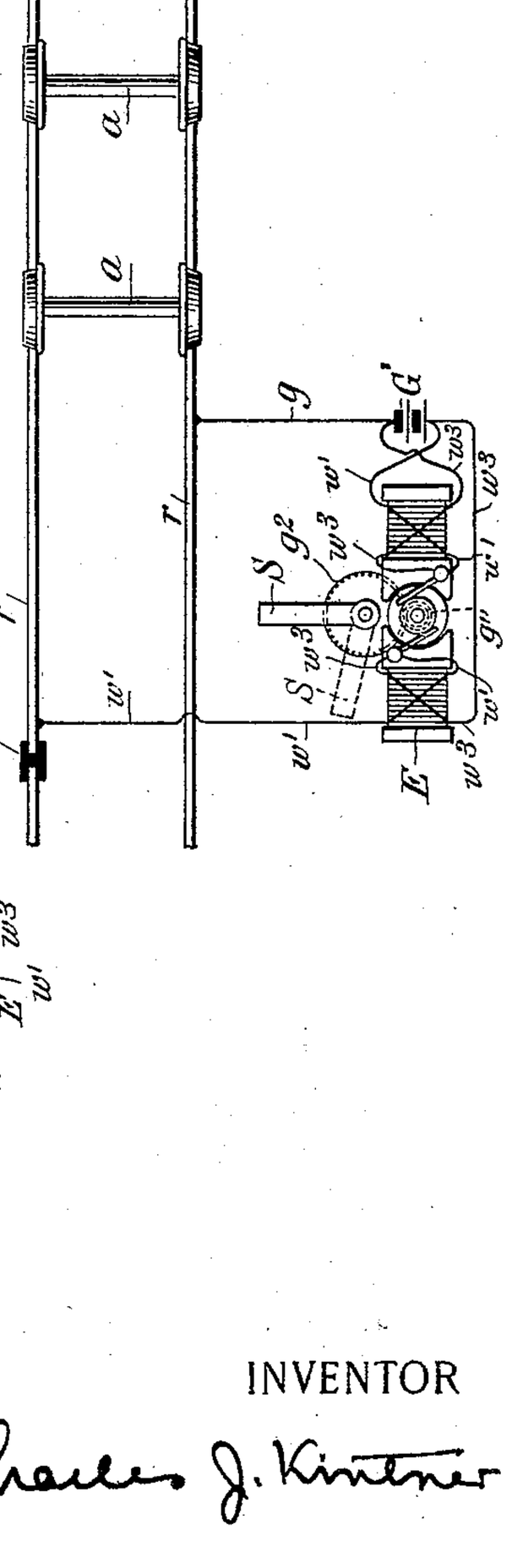


Fig. 8.



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CHARLES J. KINTNER, OF NEW YORK, N. Y.

SAFETY APPLIANCE FOR RAILWAYS.

No. 915,188. Specification of Letters Patent. Patented March 16, 1909.

Application filed April 14, 1903, Serial No. 152,494. Renewed January 25, 1904. Serial No. 190,616.

To all whom it may concern:

Be it known that I, CHARLES J. KINTNER, a citizen of the United States, residing at New York, borough of Manhattan, county and State of New York, have made a new and useful Invention in Safety Appliances for Railways, of which the following is a specification.

My invention is directed particularly to appliances for preventing collisions between cars or trains traveling over the same track and to this end it consists—first, in novel means for automatically giving warning to an engineer or motorman of the presence of a car or train in advance; second, in novel means for automatically stopping a car or train when it approaches too closely to a car or train in advance, should the motorman or engineer fail to observe the danger signal set by the preceding car.

My invention will be fully understood by referring to the accompanying drawings, in which,

Figures 1 and 2 illustrate diagrammatically, when placed end to end with Fig. 1 upon the left, a system of electric railways and two cars traveling thereover with my novel apparatus applied thereto. Fig. 3 is an enlarged sectional view taken through Fig. 1 on the line X—X illustrating in elevational view the front end of a car and a semaphore post with a semaphore and its operating mechanism, together with the automatic means carried by a car for stopping it, the semaphore post and a portion of the car being broken away for the purpose of illustrating the structural arrangement of the entire apparatus, the electrical circuits being shown in diagrammatic view, and the semaphore controlling solenoid or electromotive device and its support in sectional view. Fig. 4 is a plan view of the semaphore post as seen looking at Fig. 3 from the top toward the bottom of the drawing, part of the interior structural apparatus of the semaphore mechanism being shown in dotted lines, a lamp box attached to one side of the semaphore hood and the switch operating arm of the automatic controller carried by the car for stopping it being shown in full lines, and the free end of said switch operating arm in dotted lines. Fig. 5 is an enlarged sectional view taken through the switching rod which controls the movement of the automatic controller arm carried by said rod; means in the nature of a wheel for manually operating this rod being shown in full lines and a portion of the switch operating arm in dotted lines. Fig. 6 is a diagrammatic view illustrating a modified form of the invention as applicable to motor-cars, engines or trains propelled by means and sources of motive power carried wholly by the car, such, for instance, as steam, gas, air, storage batteries, or the like, two of such cars being diagrammatically illustrated in this view of the drawing also. Fig. 7 is a diagrammatic view similar to Figs. 1 and 2 of a modified form of the invention illustrating its application and use with alternating currents; and, Fig. 8 is an enlarged detail view illustrating a modified form of differential electro-motive device and its circuits and circuit connections for operating a signal by the presence of a car upon a corresponding section of the track.

For a full and clear understanding of the invention, such as will enable others skilled in the art to construct and use the same, reference is had to the accompanying drawings, and first to Figs. 1 and 2 the former being placed to the left of the latter in such manner as to make the system continuous. r, r^1 represent the tram or service rails of a railway, said tram rails constituting the usual line of way, and t a third rail or trolley conductor located preferably to one side of the rail r. D is a power house dynamo or generator having its positive pole connected by a branch feeder f^1 to the third rail or conductor t and its negative pole by a branch feeder f^2 to the tram or service rail r which is bonded throughout its length in the usual manner and provided, if need be, with an additional conducting surface in the nature of a broad flat copper strip secured either to one flange or web of the rail throughout its length by screws passing through oblong slots closely adjacent to the ends of the rails; or, located entirely beneath the bottom surface thereof between it and the ties in such manner as to give the best possible conductivity for the entire system. The third rail or conductor t and the return tram rail r as thus connected to the power house generator constitute the power circuit. The tram or service rail r^1 is divided into sections of the desired length and insulated from each other at their ends, as shown at I, I, I, said sections constituting the lengths of the signaling blocks. P, P are semaphore or signal posts having curvilinear hoods or covers H, H, as clearly

illustrated in detail in Figs. 3 and 4, said posts being provided with doors and lock and key attachments (not shown) for enabling only authorized persons to obtain access thereto. These posts are located preferably a distance from the outgoing end of each section sufficient to warrant the fact that a car C^1 or C^2 will stop after the motive power has been automatically cut off on passing any exposed semaphore or signal and the brakes applied—as will be described later on—before the rear-wheels of said car pass out of the section. This distance will be elected by the engineer constructing the road and will generally be dependent upon the length of the cars or trains to be run. W, W represent the car-wheels and *a*, *a*, the axles thereof, the structural arrangement being such that said car-wheels and axles constitute good conductors for the current which operates the signaling and car-stopping apparatus. w^1 is a conductor running in each instance from one end of the sectional rail r^1 to the semaphore or signal post where it is connected directly to one of the commutator brushes of the generator part of a motor-generator G. *c*, *c*, etc. are branch conductors attached to and located near the outgoing end of each sectional rail r^1 and provided with contact points *p*, *p*, etc. adapted to contact with switches *s*, *s*, etc. said contact points *p* and switches *s* being located preferably within the semaphore posts P, as shown in Fig. 3, the function of these switches *s*, contact points *p* and branch conductors *c* being to connect in series any two or more of the sectional rails r^1, r^1 and to disconnect the corresponding signal apparatus. The motor parts of the motor-generators G are connected by commutator brushes directly with the third rail or conductor *t* through conductors *w*, and switches s^1, on one side, and by switches s^2, fuses *f* and return conductors *g* directly to the tram or service rail *r* on the other side which constitutes the return circuit for the entire system. The motor portions of these motor-generators are, therefore, it is apparent, in multiple arc relation with the third rail or conductor *t* which supplies the power or working current to the motors on board of the cars through contact shoes or current collectors 1, 2, service conductors 3, 3, controller K, motor M, to the axles *a* in the usual manner.

B is a switch included in the conductor 3 and consisting of good conducting yielding springs, the free ends of which rest upon copper or other good contacting points *y*, *y*, said switch being supported by a rod R, (see Fig. 3) journaled vertically in the motorman's cab of the car and having adjustably attached to its upper or exposed end by a sleeve A^1 and set-screw *q* a controller or switching arm A adapted to extend outward into the path of operating devices or trips located beside the track. T is a manual operating wheel or handle on the rod R accessible to the motorman and in close proximity to the usual manual motor controller K. V is a valve attached to the lower end of the operating rod R and located in the exhaust train-pipe TP, said valve being normally closed when the apparatus is in the position shown in all of the figures of the drawings, but particularly in Fig. 3. These parts just described constitute as a whole the automatic controller or governing the movement of the vehicle over the line of way. E is a solenoid coil which, together with its movable core, constitutes electrical trip operating means, and is provided with differential or double windings, said coil being secured in the manner shown in Fig. 3 and the ends of said windings connected respectively, one set in a closed circuit w^3 with the generator portion of the motor-generator G, so that so long as said motor-generator is operating current will flow continuously through this coil of the solenoid; the other coil of said solenoid is normally open and is connected through the generator of the motor-generator directly to the conductor w^1 on the one side running to the end of the next sectional tram-rail r^1 in advance and on the other side through the switch s^2, the fuse *f* and common return or earth wire *g* to the rail *r*, the arrangement being such that when any car is standing upon a section the wheels and axles thereof will close the circuit between the service or tram-rail *r* and that particular sectional service or tram-rail r^1 and cause a current to flow in reverse direction to that which is continuously flowing through the coil connected in closed circuit w^3 with the motor-generator G. *m* represents the solenoid core which is secured to or constitutes a part of accurately trued guide-rods *i*, *i*, adapted to move vertically between pairs of brass guide-rolls *nn*, *nn*, with as little friction as possible. The upper end of the guide rod *i* is connected by a cord *k* directly to a pulley *j* on a shaft which supports a semaphore or trip S, the journals of said shaft being provided with ball bearings, not shown, so as to minimize the frictional movement thereof.

z is an adjustable counter-weight for accurately adjusting the relative weights of the parts so as to operate in the best possible manner.

F is a red flannel flag secured to the lower edge of the semaphore S which is also preferably of red color.

L is a lamp-box secured at the lower edge and on one side of the hood or cover H containing a lamp adapted to emit light through two clear or white glass panes, one in the front of the box and the other on the opposite side of the hood H.

o is a red glass pane secured to the upper

edge of the semaphore S, the arrangement being such that when the semaphore is in the lower position as shown in Fig. 3 the lamp in the box L, which may be an oil lamp or electric if preferred, will cause the signal to give red rays indicating danger.

It will be apparent to those skilled in the art that the parts of the signal indicated by the letter *o* and the corresponding opening in the side of the hood H for admitting of the use of the same as a night signal with the lamp L may be utilized after the manner of the well known form of disk signal, known generally in the art as the Hall signal, as disclosed in various U. S. patents, and found in general public use throughout the United States.

In existing systems of electric railways of the third rail type it is customary to utilize currents of relatively high potential varying from 500 to 750 volts. It would, therefore, be impracticable to utilize currents of such relatively high voltage in connection with the sectional tram-rails r^1, r^1, owing to the fact that these rails are not usually well insulated, being generally spiked directly to wooden ties; consequently, I make use, in this connection, of motor-generators G, the motor parts of which are adapted to be driven by currents of the same voltage as are the motors M on board of the cars, and as above indicated of relatively high voltage. The generator parts of these motor-generators are designed to generate currents of relatively low voltage and the desired quantities, say in the neighborhood of from 1 to 10 volts and 4 to 20 amperes, so that all of the conductors w^1, w^2 w^3 and their associated switches *s*, s^1, s^2, fuses *f* and common return wires *g* should be of good current carrying capacity and all of said conductors correspondingly well insulated. The conductors *w*, w^1, *g* and *c* running from the third rail *t*, tram-rails *r*, r^1 to the semaphore posts should be well insulated and inclosed preferably in armored conduits between their points of attachment to said rails and the switches in said posts.

The operation is as follows:—In all of the semaphore posts where no cars are traveling over the sections corresponding thereto the semaphore arms S are held in their concealed or upper positions, as shown in dotted lines in Fig. 3 and in full lines in Fig. 2, owing to the fact that the motor-generators being continuously in operation there is flowing through the generator portions thereof and, consequently, through the corresponding solenoid coils of the solenoids or electromotive devices E, by way of circuits w^3, w^3, sufficient current to maintain said semaphores in their upper positions against the predetermined weight of the semaphores over and above the weight of the adjustable counterweights *z*. As soon, however, as a car enters a section, as is the case in Fig. 2 of the drawings, a branch circuit is established from one commutator brush of the generator part of the motor-generator G by way of the conductor w^1 (see Fig. 1) through the oppositely wound coil of the electromotive device or solenoid E to the switch s^2, fuse *f*, earth wire *g*, tram-rail *r*, wheels W, W and axles *a*, *a*, of the car C^1, sectional rail r^1, conductor w^1, switch *s*, to the other commutator brush of the generator of the motor-generator; consequently, the differential effect of the current through the two windings of the solenoid or electromotive device E is such as to nullify the current effects of the normally closed control circuit and demagnetize the core *m*, thereby allowing the predetermined weight of the semaphore or trip arm S to prevail and cause the same to act as a power device of another character so as to drop into the exposed position shown in full lines in Figs. 1 and 3; hence the motorman on board of the car C^2 following observes the semaphore and also the red flag F at the lower edge thereof. If at night time, he observes the red light or signal, owing to the fact that the red glass *o* carried by the semaphore arm S has passed between the two transparent or white glass panes at the lower edge of the hood H and into the path of the rays of light passing to the rear-ward from the lamp or signal inclosed in the lamp-box L. It will be apparent, therefore, that the trip operating arm S and the signal embracing the parts just referred to are operated in unison. Should the motorman fail to observe this signal and his car continues to advance the switch or controller arm A carried by the rod R ultimately comes into mechanical contact with the free end of the semaphore arm or trip S as clearly indicated in Figs. 1 and 3 and, therefore, rotates the same to the rearward, thus causing the switch B to be rotated through an angle approximating 90° thereby operating the automatic controller and effectually rupturing the circuit 3 at the contacts *y*, *y*, and at the same time opening the exhaust valve V in the train-pipe TP so that the brakes are applied in the well known manner generally used for applying air-brakes; such for instance, as those of the Westinghouse type. The car is, therefore, immediately brought to a stop before the front-wheels thereof reach the incoming end of the next section in advance, thus leaving it in the position to continue to maintain its semaphore signal in the rear in the same position as that now shown in Fig. 1, or danger. The motorman, therefore, permits his car to remain in the position indicated until the signal is restored to safety which occurs when the car C^1 passes out of the section over which it is now moving and into the next section in advance, at which time the semaphore arm S and flag F (Fig. 1) will be restored to their positions of safety as before, owing to the ac-

tion of the current from the motor generator through the continuously closed circuit w^3 and one of the solenoid coils only. When this occurs the motorman then rotates the hand-wheel T (see Figs. 3 and 5) from left to right until the index or arrow thereon indicates the fact that the switching arm A carried at the upper end thereof is in the position shown in Fig. 3 and the switch B in operative contact with the metal contacts y, y, again restoring the circuit through the motors on board of his car, after which he may operate his manual controller K in the usual manner and proceed. The car C^1 having passed into the next section in advance the semaphore arm or trip S in Fig. 2 is, for reasons above pointed out, moved into the position of danger or the same as that now shown in Figs. 1 and 3, thus giving warning to the motorman on the following car C^2 that car C^1 is now upon the section just referred to.

In Figs. 1, 2 and 3 I have shown fuses f in the common earth or return wire g. These fuses which may be replaced by any automatic cut-out devices have an especial function in that they prevent damage to the apparatus in the event of a short circuit being had between the third rail or conductor t and any one of the sectional tram or service rails r^1, in which event the fuse will be blown, thereby instantaneously stopping the motor generator of the particular block section and causing the semaphore arm S to appear at danger.

Should any semaphore or any part of the signaling and stationary car stopping apparatus embodied in the semaphore post P be rendered inoperative or ineffective, as for instance, in the manner just indicated, it only becomes necessary for an authorized person to open the door of the semaphore post (see Fig. 3) and turn the switch s into contact with the contact point p, thereby connecting the two adjoining sectional rails r^1, r^1 in series relation and making the next apparatus in the rear the operative apparatus for the two block sections thus united, at the same time disconnecting the earth or return circuit of the particular apparatus just disconnected by opening the switch s^2. In order to avoid the semaphore arm S appearing at danger under these conditions it is only necessary to rotate said arm to its extreme left-hand position past its center of gravity, or to adjust the counter-weight z to such a position as will hold it in its upper or concealed position.

In Fig. 6 of the drawings I have illustrated a modified form of the invention adapted especially for use with cars or trains which are propelled in each instance by motors and a source of power carried wholly thereby, such for instance as a steam engine, gas engine, compressed air, or storage batteries. In this instance the local low potential sources of electrical energy G^1 which control the movements of the signals or semaphores and hence the operation of the switching arms carried by the cars are storage or primary batteries having sufficient current capacity to perform the desired effect. These batteries are connected each to one coil of its solenoid E in a continuously closed circuit w^3 as before and to the other differentially wound coil by a conductor w^1 to the end of the next adjoining sectional tram or service rail r^1, the other end of said coil being connected as before to the rail r through an earth wire g and switch s^2, the switch s being provided as in the other modified form of the invention for disconnecting the semaphore operating apparatus and connecting the two adjoining sectional rails r^1, r^1 in series relation, the switch s^2 being designed for disconnecting the earth wire. The other features of this modified form are not substantially different from those disclosed in the first described form of the invention, and the switching arm A of the automatic controller is connected to a switching or controller rod R as before which in turn is connected directly either to the throttle valve or other valve or switch for automatically controlling the application of the applied power and also to the air or other brakes in a manner which will at once be obvious in view of what has been heretofore said in connection with the brakes in the first described modified form of the invention. The operation of this modified form is not substantially different from that disclosed in the first form, it being understood, however, that the batteries G^1 are local, one in each semaphore post, and supplant or take the place of the generator parts of the motor generators G illustrated in Figs. 1, 2 and 3. Where storage batteries are used they may be either transported to the semaphore posts on hand-cars, or by other means; or a low voltage generating circuit might extend over the entire route and be connected to the batteries by switches at such times as it becomes necessary to recharge them, such matters being obvious to those skilled in the art.

In Fig. 7 I have illustrated a still further modified form of the invention adapting it for use with alternating electrical currents. t, as before, is the current feeder, in this instance connected directly to an alternating current generator of the desired voltage and G, G, G are the current potential reducing devices here shown as converters or transformers having their primary circuits connected in multiple directly to the feeder t on one side and to the return or tram-rail r on the other; f, f, being fuses or automatic cut-out devices as before and serving the same function as they served in the modified forms shown in Figs. 1 and 2. The electromotive devices which control the movements of the semaphore arms or trips S are in this

instance composed each of two independent solenoid coils E, E¹ having laminated cores m, m^1 connected to cords k on the opposite sides of the pulley j. The coil E is located in a permanently closed circuit w^3 with the secondary of the converter or current potential reducing device G, the coil E¹ being connected on one side directly to the secondary of the converter and on the other by way of the conductor w^1, switch s to the incoming end of the next sectional service or tram-rail r^1 in advance. s^2, s^2 are switches for disconnecting the continuously closed circuits w^3, w^3. The operation of this modified form of the invention will be entirely obvious to those skilled in the art it being apparent that the high potential currents transmitted through the primary coils of the current potential reducing devices G set up in the secondary coils currents of relatively low potential, one set of currents passing constantly through the closed circuits w^3 and the solenoids E, while the companion or differentially acting set of currents will pass through the coils E¹ when a car C¹ is passing over a given section, in which event the differential action or pull of the two solenoids is such, upon the laminated cores m, m^1, that the weighted semaphore arm or trip S will assume the position shown on the extreme left and be located in the path of the switch or controller arm A on the car C². As the car C¹ advances it will ultimately enter the next section in front and in like manner cause the semaphore arm or trip S of that section to assume the position of danger, owing to the differential action or pull of the two solenoid coils E, E¹ upon their cores m, m^1. In the meantime the semaphore arm or trip S on the left will have been restored to safety, owing to the action of the coil E in the continuously closed circuit w^3. As before described in connection with Figs. 1 and 2, should a short circuit occur between any part of the high potential circuits and any one of the sectional rails r^1, or other attached conductors, the low resistance offered thereto will necessarily blow the fuse f, thereby disconnecting the primary of the converter and, consequently, discontinuing the current flow in the secondary coil thereof, so that the semaphore will naturally be at once placed at danger, in which event the fuse may be restored; but if the damage has been serious the switch s may be turned so as to connect the conductor w^1 with the branch conductor c, thus uniting the two sectional conductors in series and constituting the next semaphore in the rear a signal for the united sections which now act as one block.

In Fig. 8 of the drawings I have illustrated a further modified form of differential electromotive device for controlling the movements of the semaphore arms. In this instance I have replaced the solenoids, which heretofore have been described as the electromotive devices for moving the trips or semaphore arms, by a series wound rotary motor E, in which there is a double or differential winding from the poles of the local or operating generator G¹. The circuit connections in other respects are substantially the same as those disclosed in connection with the hereinbefore described modified forms of the invention, it being apparent that when there is no car on any section, all of the trips or semaphore arms S will be held at their upper or concealed positions, as shown in dotted lines by reason of the action of the rotary armature of the motor through the pinion g^1 and gear-wheel g^2 attached to the shaft which supports the semaphore arm S. This constant tendency to rotate the semaphore arm is due to the action of the constantly closed circuit from the battery G¹, through the conductors w^3 and one series winding of the motor. When the car C enters the corresponding section, as shown, a differential branch is closed by way of the conductor w^1, through the other or series differential winding of the motor, conductor w^1, sectional tram-rail r^1, car-wheels and axles a, return rail r and earth wire g, so that when both differential currents are flowing the weight of the semaphore, acting as a power device of another character, will be sufficient to rotate it into the danger and stopping position as shown in full lines. In those modified forms of the invention wherein current potential reducing devices are utilized they have all been shown as having their motors or primary circuits in multiple arc relation with the current feeder t and the return or service rail r which is the preferred arrangement.

I do not limit my invention to any of the especial details of construction shown in the accompanying drawings and hereinbefore described, as obviously a number of the features thereof might be departed from and still come within the scope thereof and within the skill of those versed in the application of electrical energy generally, it being apparent to those skilled in the art, to make a single illustration, that there are many modifications of generating devices for converting high potential currents, both alternating and direct, into low potential currents so as to make them available under all of the conditions hereinafter claimed, and my claims are designed to be of such scope as to include all such modifications and adaptations.

I am aware that it has heretofore been proposed to utilize differential electromotive devices for controlling railway signals in the manner described and shown in U. S. patent to S. C. Hendrickson, No. 276,038, of April 17th, 1883, and I make no claim hereinafter broad enough to be anticipated by anything

found in said patent, the arrangement of circuits and circuit connections therein being such that two complete sets of differential electromotive devices are necessitated for each block section to effect what may be termed a block signal result for a following train, the distance between which sets shall be such that the front end of a train must reach the outgoing set before the rear end thereof leaves the set last passed; my invention contemplating in this particular an arrangement of circuits and circuit connections with differential devices and one or more sources of electrical energy for controlling the display or movement of railway signals in such manner that the block signal sections may be of any desired length and controlled each by a single differential electromotive device, the especial points of novelty in this respect being particularly pointed out in the claims which follow.

I believe it is also broadly new with me to combine a source of relatively high electrical potential and current potential reducing devices in direct circuit connection with electromotive devices for making it possible to utilize the tram or service rails of an electric railway as a part of the signaling circuit and without the intervention of relays or circuit making and breaking contacts, and in such manner as to utilize directly a part of such current of reduced potential to positively control the movements or display of the signaling devices, and my claims are generic as to this feature. Nor do I limit myself to any especial type of signal, my invention being applicable with signals generally, whether audible or visual.

I am aware that prior to my invention attempts have been made to operate or control railway signals by electrical currents produced by dynamo electric generators both of the direct and alternating current type by first generating currents of high electrical potential and afterward reducing such current potential at intervals along the road to low voltage and conveying the same to sectional tram or service rails to which electric relays were permanently connected, the arrangement being such that when a car or train entered upon any section the currents of low potential would be short-circuited to that particular relay, and I make no claim hereinafter broad enough to include any such method of operation or structural apparatus, my most generic claim in this particular being directed to means for controlling the display or operation of railway signals by electrical currents of low potential through the agency of an electromotive device having two circuits designed to convey said currents from a source of electrical energy, one of which circuits is permanently closed through the electro-motive device and the other normally open but connected to the electromotive device, the source of electrical energy and also at its opposite ends to parallel conductors extending over the road-way, the arrangement being such that movable circuit closing devices carried by or moving with the car or train, such for instance as the wheels and axles thereof, will close the normally open circuit and cause the signal to be operated or displayed, the normally closed circuit being so arranged, as hereinbefore described, as to hold or display the signal normally at safety.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is:—

1. A railway signal operatively connected to a single differential electromotive device having one of its differential circuits permanently closed through a source of electrical energy and the other connected also to said source of electrical energy and to two parallel contacting electrical conductors extending for a definite distance over the road-way; in combination with circuit closing means carried by or movable with a car or train for closing said second differential circuit.

2. A railway signal operatively connected to a differential electromotive device having one of its differential circuits permanently closed through a source of electrical energy and the other connected to a source of electrical energy normally open but connected to an insulated section of one of the tram or service rails on one side and to the other tram or service rail on the other side; in combination with the wheels and axles of a car resting thereon.

3. A railway system embracing a pair of tram or service rails one of which is divided into insulated sections; in combination with a signal one for each section and a differential electromotive device for controlling the display of said signal, one of the differential circuits being permanently closed through a source of electrical energy and the other connected to the source of electrical energy in open circuit, one end thereof being connected to a sectional tram or service rail and the other end to the remaining tram or service rail.

4. A railway system embracing two lines of tram or service rails one of which is divided into insulated sections each electrically connected through one differential-circuit of a differential electromotive device and a source of electrical energy to the other tram rail, the other differential circuit being included in a permanently closed circuit, the movable part of said electromotive device being operatively connected to a signal and the arrangement such that under normal conditions the signals all remain at safety under the influence of the permanently closed differential circuits and are displayed at danger when a car or train passes over the

block section corresponding to that particular signal.

5. A railway system embracing a pair of tram or service rails one of which is divided into insulated sections electrically connected each to one differential circuit of an electromotive device included also in circuit with a source of electrical energy and the other tram rail, the other differential circuit being permanently closed through the source of electrical energy and the movable part of the electromotive device operatively connected to a semaphore arm; in combination with a moving car or train provided with means for disconnecting its motor from its source of motive power, said means being provided with a switching arm extending into the path of the free end of the semaphore.

6. A railway system embracing a series of signals each operatively controlled by a differential electro motive device, one branch of which is included in a permanently closed circuit with a source of electrical energy, the other branch thereof being included in circuit with a source of electrical energy, an insulated track section and a return track rail parallel with the first-named insulated track section.

7. In a railway system a signal controlling electro-motive device having two circuits one of which is permanently closed through a source of electrical energy of relatively low voltage and the other including the same source of electrical energy and connected at its opposite ends to parallel track or service rails; in combination with circuit closing means carried by or movable with a car or train.

8. A railway signal operatively connected to an electro-motive device having two circuits one of which is permanently closed through a source of electrical energy of relatively low voltage and the other including the same source of electrical energy and connected at its opposite ends to the parallel tram or service rails; in combination with an automatic cut-out device included in the latter circuit and adapted to rupture the same on the passage of an abnormal current therethrough.

9. A railway signal operatively connected to a differential electro-motive device having one circuit permanently closed through a source of electrical energy and the other through the same source of electrical energy with its opposite ends connected to the parallel tram or service rails; in combination with an automatic cut-out device included in the latter circuit and adapted to rupture the same on the passage of an abnormal current therethrough.

10. A railway system embracing two lines of tram rails one of which is divided into insulated sections; in combination with a source of electrical energy of relatively high voltage operatively connected with a third rail or conductor and the continuous tram rail; a series of current potential reducing devices located at points approximating the ends of the sectional tram rails; the secondaries of said current potential reducing devices being included each in a normally closed and a normally open circuit with a differential electromotive device the movable parts of which are operatively connected to a signal, the normally open circuits being connected respectively to the sectional and continuous tram-rails.

11. A railway system embracing a power house generator; a third rail or conductor operatively connected thereto; a pair of tram or service rails one of which is permanently connected to the power house generator and the other of which is divided into insulated sections; a series of current potential reducing devices located at intervals along the route having their primary circuits connected directly to the high potential circuit and their secondary circuits connected in multiple with differential electromotive devices operatively connected to signals, one branch of each electromotive device being permanently closed and the other normally open and including the insulated sectional rails and the main or return rail.

12. A railway system embracing two lines of tram or service rails, one of which is divided into insulated sections; in combination with signals and controlling electromotive devices therefor operatively connected each to a source of electrical energy, a sectional tram rail and the continuous tram rail; together with switches for connecting two or more of the sectional tram rails in series relation and disconnecting the coresponding signals.

13. Means for automatically stopping a car consisting of a vertically journaled rod extending through the top of a car and operatively connected to means for disconnecting the motor thereof from its source of motive power; together with means operatively connected to the same rod for operating the air-valve of an air-brake, said rod being provided at its upper end with a switching arm extending laterally into the path of means located beside the track; in combination with a hand-wheel located accessible to the motorman for manually controlling the movements of the aforesaid parts.

14. Means for automatically stopping a car consisting of a vertically journaled rod extending through the top of a car and operatively connected to means for disconnecting the motor thereof from its source of motive power; together with means operatively connected to the same rod for operating the air-valve of an air-brake, said rod being provided at its upper end with a switching arm extending laterally into the path of

means located beside the track; in combination with a hand-wheel located accessible to the motorman for manually controlling the movements of the aforesaid parts, said hand-wheel being provided with an index for indicating its position.

15. A railway system embracing a main line of tram or service rails continuous throughout its length and electrically connected to one pole of a power house generator; a second line of tram or service rails divided into insulated sections; semaphore signal posts located at points near the ends of said sections and inclosing current potential reducing devices operatively connected in circuit with a third rail or conductor extending over the route; differential electromotive devices inclosed in said semaphore posts, the differential circuits thereof being connected, one in each instance, in closed circuit with the current potential reducing device and the other in open circuit with a sectional rail and the continuous tram rail; together with semaphore arms journaled in said semaphore posts and operatively connected to the movable parts of the electromotive devices; said semaphore arms being normally held in concealed position within the posts.

16. A railway system embracing a pair of tram or service rails one of which is continuous throughout its length and the other divided into insulated sections; a relatively high potential alternating current feeder extending over the route; a series of converters having the primaries thereof electrically connected with the high potential circuit, the secondaries of said converters being of relatively low resistance and including each a differential electromotive device operatively connected to a signal, one branch of the differential electromotive device being permanently closed and the other branch thereof connected directly to a sectional tram or service rail on one side and to the continuous tram or service rail on the other.

17. In a system for controlling the movements of electrically operated railway vehicles, the combination with the power circuit, of a normally closed controlling circuit governed by the power circuit, and means for deenergizing said controlling circuit and automatically breaking the power circuit on the vehicle and applying a brake.

18. In a system for controlling the movements of electrically operated railway vehicles, the combination with the power circuit, of a normally closed controlling circuit governed by the power circuit, a track signal governed by the controlling circuit, and means for deënergizing said controlling circuit and automatically stopping the vehicle.

19. The combination with a line of way having a normally closed electrical controlling circuit, of a vehicle movable along said line of way, an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, and electrical trip-operating means on said line of way and included in said controlling circuit and operative for normally holding said trip out of action.

20. The combination with a line of way and with a vehicle movable therealong, of an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, and a solenoid connected with said trip and electrically operative for normally holding said trip out of action.

21. The combination with a line of way and with a vehicle movable therealong, of an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, electrical trip-operating means on said line of way and operative for normally holding said trip out of action, and a power device of another character for shifting said trip into action.

22. The combination with a line of way and with a vehicle movable therealong, of an electrical controlling circuit, an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, a signal device, and electrical means on said line of way and governed by said controlling circuit for operating said trip and signal device in harmony.

23. The combination with a line of way divided into blocks, of a normally closed block circuit, a vehicle movable along said line of way and adapted to nullify the effects of said block circuit, an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, and electrical trip-operating means on said line of way and governed by said block circuit and operative for normally holding said trip out of action.

24. The combination with a line of way and with a vehicle movable therealong, of a normally closed electrical controlling circuit, an automatic controller governing the movement of said vehicle, a trip on the line of way and movable into the path of said controller, a signal device, and electrical means on said line of way and governed by said controlling circuit and operative for normally holding said trip out of action and said signal at clear.

25. The combination with a line of way and with an electrically propelled vehicle movable therealong, of manual and automatic brake-controllers, manual and automatic power-controlling switches the latter of which is movable in unison with the automatic brake-controller, and a trip on the line of way and governing the operation of said automatic controller and switch.

26. The combination with a line of way and with an electrically propelled vehicle movable therealong, of an automatic controller governing the movement of said vehicle a trip on the line of way movable into the path of said controller, electrical trip-operating means on said line of way, a power circuit for the vehicle having a return feeder connected with the rails of the line of way, and a controlling circuit fed by current from the power circuit and governing said trip-operating means and adapted to nullify the current effects of the controlling circuit by the presence of said vehicle.

27. The combination with a line of way and with an electrically-operated vehicle movable therealong, of a power circuit for operating said vehicle, automatic power and brake controlling means governing the movement of said vehicle, and a controlling circuit fed by current from the power circuit and governing the operation of said automatic power and brake controlling means and adapted to be nullified in its effects by the wheels and axles of said vehicle.

28. A safety system for railways including a power circuit which embraces a power house generator, a feeder and one of the track rails, the latter being electrically continuous throughout its length, and the other rail divided into insulated sections; in combination with a series of signals and trips or stop devices associated in pairs, there being one such pair for each section, and each pair normally held out of action by an electromotive device included in a closed electrical circuit and adapted to be operated by the force of gravity in harmony or unison when said circuit is broken; together with circuit connections between the electromotive devices and the sectional track rails, whereby when any such sectional track rail and the continuous track rail are electrically connected, the corresponding signal and stop device will be released, substantially as described.

29. A power circuit embracing a power house generator, a feeder and one of the track rails which is electrically continuous throughout its length; the other track rail being divided into sections electrically insulated from each other; a trip or stop device for each section normally held out of action by an electromotive device included in a permanently closed electrical circuit; circuit connections between each electromotive device and the corresponding sectional track rail, the circuit relations thereof being such that when any sectional track rail is electrically connected to the continuous track rail the trip or stop device is automatically released and assumes an operative position, substantially as described.

30. A power circuit embracing a power house generator, a feeder and one of the track rails which is electrically continuous throughout its length; the other track rail being divided into sections electrically insulated from each other; a trip or stop device for each section normally held out of action by an electromotive device included in a permanently closed electrical circuit; circuit connections between each electromotive device and the corresponding sectional track rail; in combination with an automatic controller carried by a car and provided with means adapted to be actuated by the stop device when released, substantially as described.

31. A trip or stop device operatively connected to the movable part of a controlling electromotive device included in a closed electrical circuit and normally held out of action and within a housing or inclosure, so that it is protected from the weather and from the malicious interference of trespassers; in combination with an automatic controller carried by a car and provided with means adapted to be actuated by the stop device; together with circuits and circuit connections operatively connected with the electromotive device and adapted to be actuated by the car in its movements so as to release the stop device and place it in operative relation with the aforesaid controller, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES J. KINTNER.

Witnesses:
JAMES P. J. MORRIS,
M. F. KEATING.