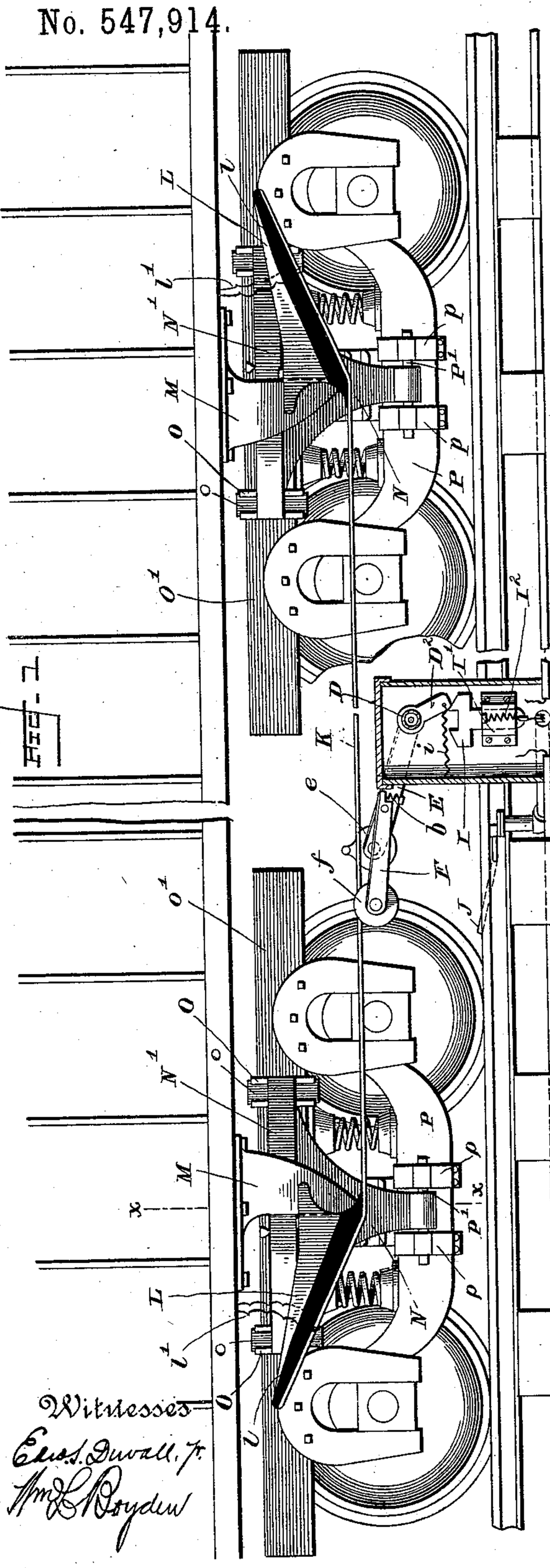
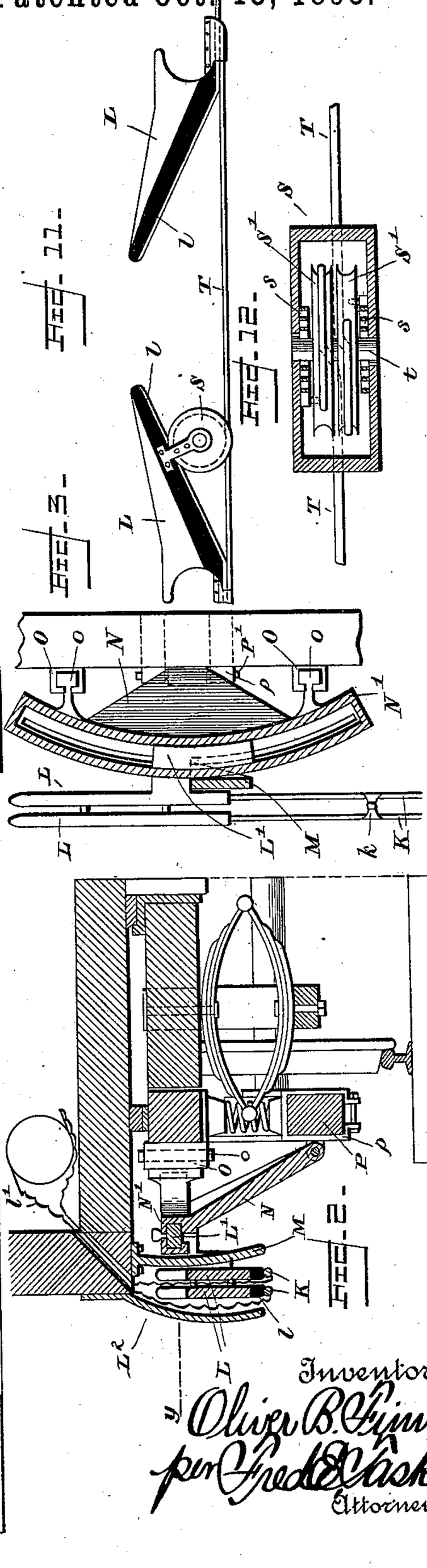
(No Model.) 2 Sheets—Sheet 1.

O. B. FINN.

SERIES ELECTRIC RAILWAY.

No. 547,914. Patented Oct. 15, 1895.





Witnesses
Chas. S. Duvall, Jr.
Wm. L. Boyden

Inventor
Oliver B. Finn
per Fred'k Baker.
Attorney

(No Model.)

2 Sheets—Sheet 2.

O. B. FINN.

SERIES ELECTRIC RAILWAY.

No. 547,914. Patented Oct. 15, 1895.

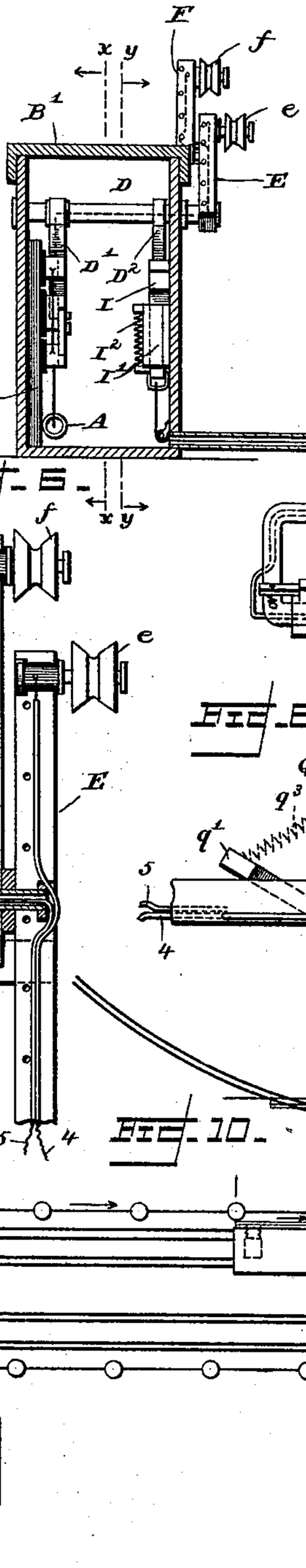


FIG. 4.

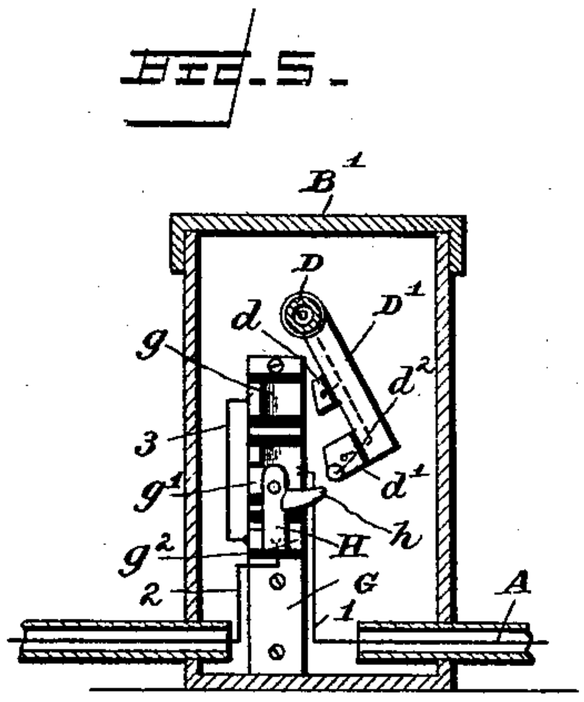


FIG. 5.

FIG. 6.

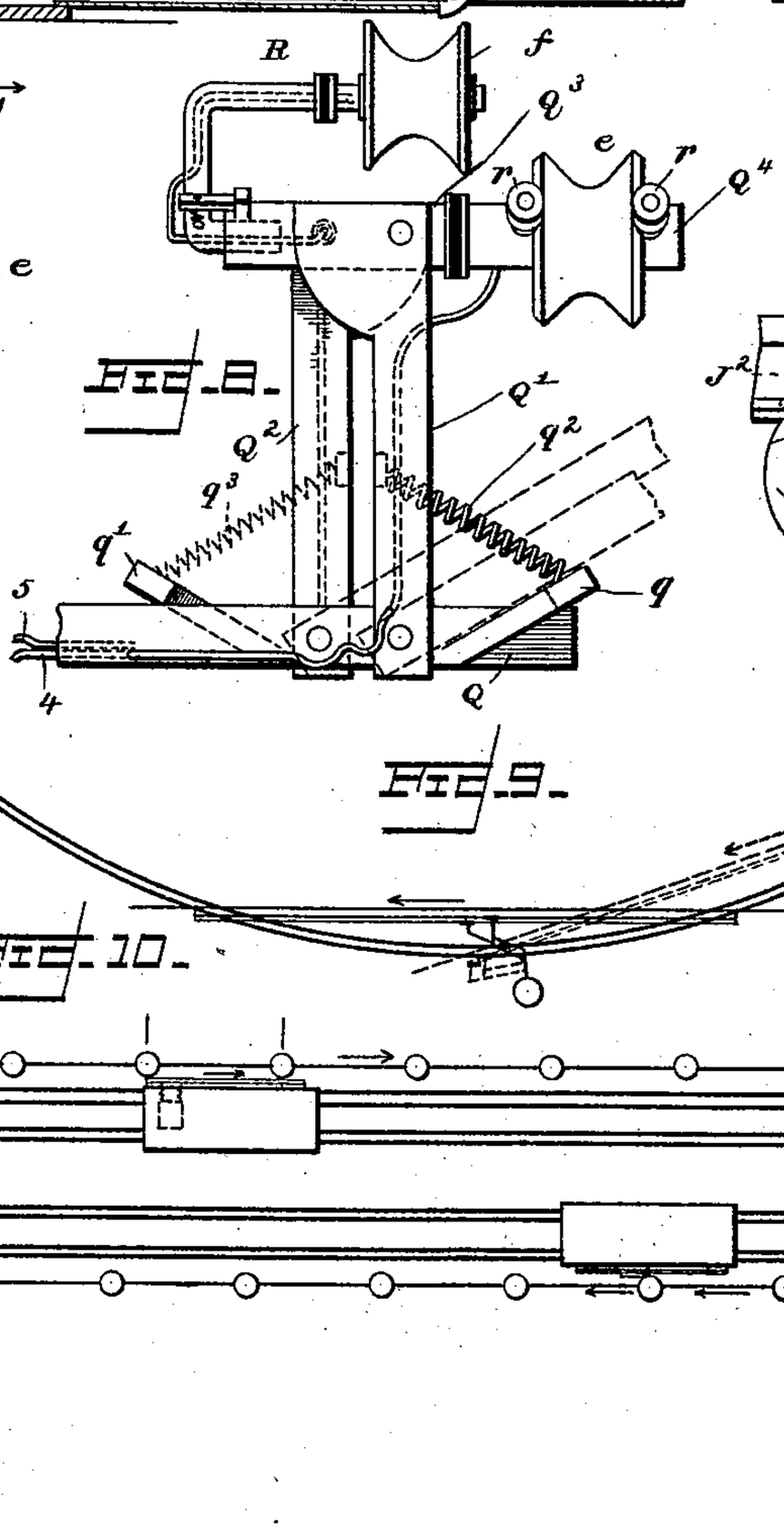


FIG. 8.

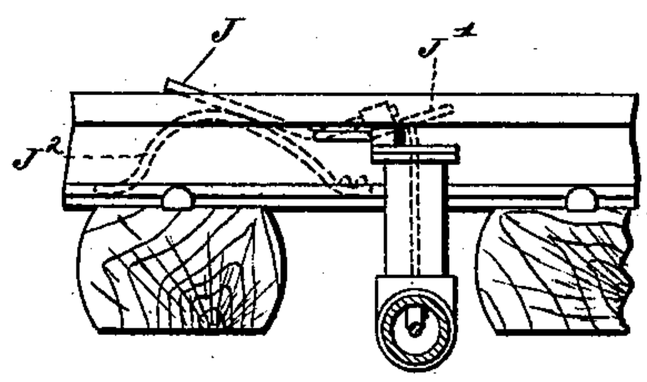


FIG. 7.

FIG. 9.

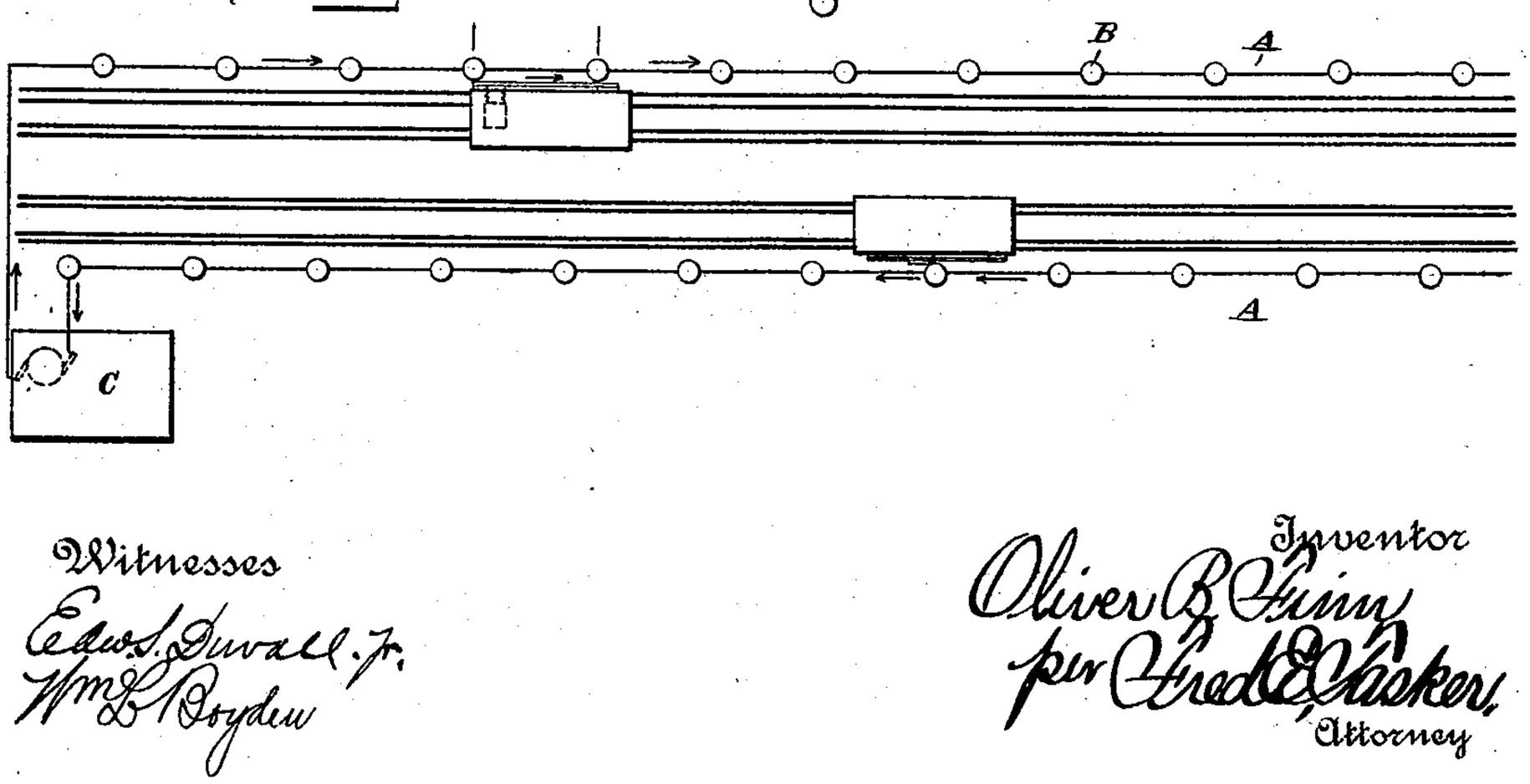


FIG. 10.

Witnesses
Edwd. Duvall. Jr.
Wm. L. Boyden

Inventor
Oliver B. Finn
per Fred'k. Baker.
Attorney

UNITED STATES PATENT OFFICE.

OLIVER B. FINN, OF PHILADELPHIA, PENNSYLVANIA.

SERIES ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 547,914, dated October 15, 1895.

Application filed March 29, 1894. Serial No. 505,601. (No model.)

To all whom it may concern:

Be it known that I, OLIVER B. FINN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Electric Railways; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention has reference to mechanism for transmitting electrical currents through moving vehicles either for the purpose of propelling them or for other purposes, such as heating or lighting.

My object more particularly is to provide means whereby what is known as the "series" system or circuit may be successfully employed, and to this end I contemplate the use of a single main conductor or line-wire located along the path of the moving vehicle and adapted to be intercepted by the vehicle to make an insulated circuit within the moving vehicle a part of the single-line circuit. Heretofore most electric-railway systems have been arranged to employ a multiple-arc circuit, and few, if any, have used a series circuit; but I consider that a system of the latter kind posseses many advantages over one of the former, since it may be operated more economically and can be more cheaply constructed. Any number of moving vehicles may be in series on such a line and be propelled along without electrically interfering with one another, and the main conductor may be buried in the ground or suspended upon poles throughout the length of the closed circuit, so that leakage of the current is effectually avoided, there being at intervals line-contact mechanisms which are engaged by insulated conductors on the moving vehicle, so that said vehicle is brought successively into insulated circuit, whereby the electrical motor or translating device is energized for the purposes of propulsion, &c. My line-contact or feeder-connection mechanisms are of an improved character in many respects and especially in that they have their exposed parts electrically charged only when a vehicle passes, and after it has passed said parts are automatically insulated or thrown out of circuit, and hence any one touching them will not be injured at these times.

My invention also embraces means for supporting the electrical conductor on the moving vehicle in such a way that it may automatically adjust itself, so as to keep the same relative position to the line-conductor and its contact mechanism during all the oscillations and uneven movement of the vehicle.

It also includes special mechanism for use on curves, whereby the line-contact mechanisms may have a lateral adjustability to correspond with the lateral movement of the vehicle-conductor in a horizontal plane as the vehicle swings around a curve.

It comprehends, in fact, a plan of construction which is applicable to existing railways now used for the purpose of steam traffic without necessitating therefor the building of a new road; and the invention also comprises numerous details in the construction, arrangement, and combination of parts substantially as will be hereinafter described and claimed.

In the annexed drawings, illustrating my invention, Figure 1 is a partial side elevation of a car having my improved conductor thereon and showing the arrangement of the line-contact mechanism with one of the line-boxes, which is shown in section on the line *y y* of Fig. 4. Fig. 2 is a cross-section of the same on the line *x x* of Fig. 1. Fig. 3 is a horizontal section on the line *y y* of Fig. 2. Fig. 4 is a cross-sectional elevation of one of the main-line-contact mechanisms. Fig. 5 is another sectional elevation of the same, taken at right angles to the section in Fig. 4 and on the line *x x* of that figure. Fig. 6 is an enlarged detail sectional view of the exposed pulley-carrying arms belonging to the line-contact mechanisms. Fig. 7 is a detail view showing the track-lever which belongs to the line-contact mechanisms. Fig. 8 is an enlarged elevational view representing a modified form of line-contact mechanism for use on curves. Fig. 9 is a diagrammatic view showing the relative movement on a curve of the vehicle-conductor and the line-contact mechanism. Fig. 10 is a diagrammatic view of my improved series system electric railway. Fig. 11 is a view representing a form of mechanism for connecting the conductors at the adjacent ends of two cars, so as to make a

continuous train-conductor. Fig. 12 is an enlarged sectional plan view of one of the boxes and its inner spring-pulleys belonging to this arrangement.

Similar letters of reference designate corresponding parts throughout all the different figures of the drawings.

Referring first to Fig. 10, where I have delineated my system in a diagrammatic view, it will be seen that I show two parallel railway-tracks with a car on each one, said cars being designed to move in opposite directions. Alongside of the tracks at some suitable point is the main conductor consisting of a single wire, as A, which is preferably inclosed within a protecting-tube or some suitable insulating-covering. When there are two tracks, as in this instance, the main conductor must run alongside of each track. This main conductor or line-wire may be buried in the ground or it may be placed upon the surface of the ground or upon the ties and may be located outside of the tracks or between the rails or at such other points as may be suitable and convenient. Along the length of the main conductor A are placed boxes or casings B, that contain contact mechanism whereby connection is made between the line-wire and the vehicle-conductor. These casings B are placed at any suitable distance apart—say, for instance, about the length of the car. They are of any suitable form and size, having, preferably, removable covers B′, (see Figs. 4 and 5,) and they contain all the parts of the contact mechanism except the projecting pulley-carrying arms, with which the vehicle-conductor comes in contact in the manner in which I shall hereinafter fully describe.

C, Fig. 10, denotes the generating-station which supplies the line-wire A. The line-wire A is of course made in sections, which extend between the casings B, and certain parts of the mechanisms within these casings act as circuit-closers (inoperative when the parts are in their normal position and no car is passing) to complete the line-wire circuit. The boxes B effectually protect the mechanism of the line-contact devices from injury or interference by ignorant or malicious persons. This general arrangement of parts is believed to constitute the best application of the series circuit railway in actual practice. Journaled in each casing B is a short horizontal shaft D, one end of which projects through one side of the casing (see Figs. 1 and 4) and carries an integral or rigidly-attached arm E, having at its outer end a grooved pulley *e*.

F denotes a second arm, which is pivoted to the arm E at some suitable point, say about midway of its length, and extends forwardly somewhat beyond the end of arm E in the same direction and carries at its end a grooved pulley *f*, so that the two pulleys *e* and *f* lie in substantially the same horizontal plane, (see Fig. 1,) but in slightly-separated vertical planes, (see Figs. 4 and 6,) the pulley *f* being in a horizontal plane slightly above pulley *e*, but capable of being depressed into the same plane with pulley *e*, and then both capable of being jointly depressed into a plane slightly below the normal plane of pulley *e*, when the vehicle-conductor comes into contact with said pulleys in order to intercept therefrom the current from the line-wire A. A spring *b* connects arms E and F and returns the arm F upwardly after the depressing agency is removed from the pulley.

Within casing B, near the wall opposite that through which the shaft D projects, said shaft carries a rigidly-affixed downwardly-extending arm D′, which has an upper lug *d* and a lower lug *d′*, (see Fig. 5,) both projecting in the same direction, but the upper one being preferably shorter than the lower one, as it is obliged to move through a shorter arc than the lower one when the arm D′ is oscillated. These two lugs are insulated from the arm D′, as shown. On the side wall of the casing B, adjacent to arm D′, is bolted or otherwise secured a vertical support or backing-strip G, which carries three insulated blocks *g*, *g′*, and g^2. Opposite the upper two of these blocks *g* and *g′* the lugs *d* and *d′* are situated and adapted to be oscillated into or out of contact with them. On the middle block *g′* is pivoted a short arm H, which acts as a circuit-closer, it being adapted to connect the block *g′* with the block g^2 or to break the connection, since the lower end of the lever H can be moved onto or off the block g^2. The upper end of arm H above its vertical point is in position to be struck by the lug *d′* on the arm D′ when the latter is oscillated, and this will result in removing the arm H from the block g^2. The arm H is provided with a projection or curved lug *h*, situated thereon adjacent to the lug *d′*, and the lug *d′* carries thereon a horizontal pin d^2. When the lug *d′* strikes the upper end of lever H and removes said lever from block g^2, the lug *h* will move up behind the pin d^2, and then when the lug *d′* moves backward again the pin d^2 will act upon the lug *h* and return the lever H to its former vertical position, where it again connects the blocks *g′* and g^2.

I will now explain the wiring whereby the current flows from the main conductor A into the pulleys *e* and *f*. One section of the main conductor—as, for instance, wire 1—which enters one side of casing B, (see Fig. 5,) connects with the middle block *g′*, and the next section of the main conductor—as, for instance, wire 2, Fig. 5—which enters the other side of casing B, connects with the lower block g^2. As we have already seen, the circuit-closer H normally connects the blocks *g′* and g^2, so that the short circuit of the main line is normally continuous, and it is only broken when it is intercepted for the purpose of including the moving vehicle in the main circuit. A wire 3 connects the upper block *g* with the lower one g^2. When the arm D′ is oscillated so as to bring the lug *d* into contact with the block *g* and the lug *d′* into contact with the block

g', and simultaneously to remove the circuit-closer H from the block g^2, it will be evident that the current instead of having a short circuit from the wire 1 to the wire 2, through the block g' and block g^2 and lever H, will flow through the arm D′ in two directions through such conductors as may be placed thereon for the current, it being remembered that the arm itself is not a conductor, although its lugs d and d' are adapted to be charged. The passages for the current along the arm D′ are found in insulated wires which run along said arm and along the shaft D. (See Fig. 4.) One of these wires leads from lug d and the other from lug d'. One of them, as 4, (see Fig. 6,) leads along arm E to the pulley e, and the other, as 5, leads along arm E for a short distance, then through the hollow pivot F′, on which arm F turns, and then along arm F to pulley f. These insulated wires 4 and 5 may be supported upon the arms E and F and upon the other parts in any suitable and convenient manner. They may, if desired, be let into grooves and then covered with plates or strips, which will conceal them from view.

I will now describe the mechanism for locking and unlocking the contact mechanism. The shaft D has within box B another downwardly-extending arm D^2 in addition to the arm D′. (See Figs. 1 and 4.) A spring i, connected to the lower end of this arm D^2 and to the wall of box B, acts to draw the arm D^2 into a notch in the upper end of a latch-slide I whenever opportunity offers, and this action when it occurs elevates slightly the arms E and F. This slide I has a vertical movement in a socket I′, fastened on the inner wall of casing B, while a spring I^2, fastened on the outside of socket I′ and to the lower end of slide I, acts to draw the slide upward. Close by the edge of the railway-rail (see Figs. 4 and 7) is an inclined lever-arm J, rigid with a short horizontal shaft or pin j, which is mounted loosely and rotatably in a horizontal opening in the rail, and on the other end of which is an oppositely-inclined lever-arm J′. From the lever-arm J′ a cable runs in some suitable manner (preferably over pulleys and through a protecting-tube) to the lower end of slide I, to which it is fastened. Under the lever-arm J is a powerful flat spring J^2. The arm J will be depressed by the flange of the wheel of the passing car, since the spring J^2, although it can withstand ordinary pressures thereon, is not calculated to resist the pressure as large as the weight of the moving vehicle, and the consequence will be that the depression of lever J will draw upon the cable and pull the slide downward out of engagement with the arm D^2. The lever J is so situated relatively to the contact mechanism that this disengagement of the latch I from the arm D^2 will take place just at the time when the shoe or shoes belonging to the vehicle-conductor come in contact with the wheels e and f, and the disengagement will continue until and after the vehicle-conductor has completed this engagement with those wheels and depressed them to the desired extent, thereby deflecting the arm D^2 away from the latch I, so that as long as the wheels e and f are in contact with the conductor the arm D^2 will be outside of the notch in slide I, because although the flange of the car-wheel will remain but momentarily upon the spring J, yet when the spring is released the arm D^2 cannot again be engaged by the latch I until the former again occupies a vertical position, which cannot take place so long as the conductor acts to depress the wheels e and f; but when the vehicle-conductor ceases to act upon these wheels spring i will return the arm D^2 into engagement with the latch I, whereby the arms E and F and the wheels e and f are securely locked in an insulated position, so that although they are exposed outside of the box B they will not be injurious to any person handling them when a train is not passing. It will be understood that when the arm D^2 is engaged by the latch I the arm D′ will be in the position shown in Fig. 5, where its lugs d and d' are not electrically charged; but when the arm D^2 is out of engagement with the latch I, a condition which, as we have seen, occurs only when the vehicle-conductor is in contact with the wheels e f, then the lugs d and d' contact with blocks g and g', the circuit-closer H is away from block g^2, and the electric current flows into the electromotor on the moving vehicle.

I will now describe the construction and operation of the conductors carried by the car or other moving vehicle. Generally there will be two of these conductors, especially if the series circuit is being used. They are located horizontally at the outside of the car and longitudinally parallel therewith, extending the distance, say, between the centers of trucks. They are simply two wires K K, of suitable size and strength, placed a short interval apart in the same plane. The interposed insulating-pieces k keep them the proper distance apart, which is such that they can conveniently enter the groove in the wheels e f. The ends of the wire conductors K are fastened to the inclined shoes L L, there being a shoe for each end of each wire, the members of each pair of shoes being fastened together and the lower sections l of the shoes being insulated from their remaining portions, as shown. Wires l' lead upward from the insulated portion l into the car to the electromotor or other translating device. In the use of electrical conductors of this kind it becomes a matter of the highest importance that they shall preserve at all times the same relative position to the track in order that they may unerringly engage all the contact-wheels that may be in their path of movement. This is obvious when we consider the extensive oscillatory motion both sidewise and vertically to which an easy-riding car or vehicle is subjected. In view of this motion it is not advisable to support the con-

ductor or conductors upon the car-body alone or upon the trucks alone, since the motion of either of these alone would be sufficient to consequently vary the position of the conductor and destroy all regularity of engagement thereof with fixed points along the track. In devising means to meet this need I have contrived a support for the conductors which makes use both of the car-body and the truck. This mode of support, which permits the conductor to automatically adjust itself so as to preserve at all times its relative position, I will now proceed to describe. On the outside of the truck is arranged a bracket or loosely-supported plate N, the lower end of which is pivoted to the equalizing-bar P, while the upper part is provided on its inside face with a pair of rectangular or dovetailed ribs *o*, which are adapted to slide vertically in the correspondingly-shaped vertical guides O, securely fixed upon the top beam O′ of the truck-frame. (See Figs. 1 and 3.) The pivoting of the lower end of the casting N to the bar P is preferably effected by means of the straps *p p*, secured to the bar P, which affords journal-bearings for the pivot-journal P′. As will be seen by referring to Fig. 1, the shoes L already mentioned, to which the ends of the conductor K are fastened, are situated adjacent to the plate N. The inner member of the pair of connected shoes L is provided with an integral right-angled projection, as shown in Fig. 3, which carries at its end an arc-shaped horizontal arm L′, which is movable within a correspondingly-curved guideway formed in the upper part of the plate N, said guideway being designated by the reference-letter N′. A rigid hanger M is securely fastened to the under side of the car-body and depends alongside of the shoes L, directly in front of the rigid projection on the inner shoe and between the shoe and the guide N′, so that the shoe in reality has a bearing against this hanger M. Outside of the shoes L L is a guard or protector L^2. Thus it will be seen that these various parts, arranged as I have described, permit the ordinary oscillations of the car-body to take place without deflecting the conductors from their path of rectilineal movement. The vertical movement of the truck upon its spring is allowed to take place without affecting the conductor because of the working of the ribs *o* in the guides O. The horizontal play of the truck does not affect the conductor because of the curved slide L′ moving in the guide N′; also, the oscillation of the car-body takes place without materially affecting the position of the conductor because of the loose connection of the hanger M with the shoes, as already explained.

Although the arrangement which I have already described is amply sufficient to maintain the normal position of the conductor or conductors at all times when the moving vehicle or train is pursuing a rectilineal movement or is moving upon tracks having but a very slight curvature, yet it is found necessary on sharp curves to provide some additional mechanism to maintain contact between the conductor and the contact mechanisms, because, as is represented in the diagrammatic view, Fig. 9, when the car turns a sharp curve the conductors must necessarily be carried inwardly quite a distance away from the rail, especially if the moving vehicle and the conductor have considerable length. In order that the contact of the conductor with the contact mechanism may be maintained, even upon curves of this character, I arrange the wheels *e* and *f* so that they may have a lateral movement automatically. The construction whereby this is effected is shown in Fig. 8. In this figure the shaft Q corresponds to shaft D in the other figures. The wheels *e f* are supported by a parallel motion connected to shaft Q, so that they may have considerable lateral movement in a horizontal plane. The parallel motion is arranged as follows: An arm Q′ is pivoted at its lower ends to one side of the shaft Q, while a parallel arm Q^2 is pivoted at its lower end to the opposite side of the shaft Q at a point not far from the pivotal point of arm Q′. Parallel to shaft Q is a shaft Q^3, to the opposite sides of which the upper ends of arms Q′ and Q^2 are pivoted. Thus we have the four inter pivoted parts Q Q′ Q^2 Q^3, which constitute the parallel motion, and it is obvious that shaft Q^3 may be moved to the right or left without being deflected from its parallelism with shaft Q. On the shaft Q at one end is an inclined stop *q*, which limits the movement of arm Q′ in that direction, and at the other side is a stop *q′*, which limits the movement of arm Q^2 in that direction. Thus the shaft Q^3 has a considerable endwise play during the movement of the arms in one direction or the other between these stops *q* and *q′*. A spring q^2 is attached to the stop *q* and to the arm Q′, and another spring q^3 is arranged between stop *q′* and arm Q^2. These springs serve to return the parallel motion to its inclined position after its lateral deflection in one direction or the other by the engagement therewith of the vehicle-conductors. It will not be necessary, however, to employ more than one of these springs at the same time. One will be used when the mechanism is arranged on what is termed a "convex" curve and the other when it is used on a concave curve. Normally the parallel motion occupies a position resting against one of the stops and is deflectible through the limit of motion to the other stop. Therefore the spring keeps the parallel motion in its normal position. The outer end of shaft Q^3 is designated Q^4 and is insulated from the balance of the shaft. To this end section the insulated wire 4 leads, and on it the wheel *e* is loosely mounted, so as to rotate, and is held in place between the guide-rollers *r r*. At the other end of shaft Q^3 the angular arm R is movably

supported. It carries the wheel *f* on the insulated end of the arm. The arm R has substantially the same relative position with regard to the shaft Q^3 that the arm F has to the arm E. The insulated wire 5 leads to the wheel *f*. The balance of the contact mechanism with which this modified form of laterally-adjustable wheel-carrying devices is used is the same as that found in the other figures of the drawings.

When my invention is employed on a series-circuit railway, there will of necessity be two parallel longitudinal conductors on the moving vehicle, and they will be arranged and supported in the manner which I have already described. I do not wish, however, to be restricted to the use of two conductors or to the application of the invention to the series system only. The automatically-adjustable supporting mechanism for the vehicle-conductor will be found as useful for one conductor as for two and as valuable on a multiple-arc or other railway as in a series system. I deem, also, that many other features of the invention may have an equal breadth of use and operation. It will often be found advisable to have a continuous conductor running the entire length of a train of two or more cars, and in order that I may lose none of the advantages of the automatically-adjustable supporting means when a continuous conductor of this kind is used I have devised means for connecting the ends of the conductors at the ends of two adjacent cars. An example of this mechanism is shown in Figs. 11 and 12.

L L denote the two opposite shoes on the adjacent end of the two cars, said shoes having the insulated parts *l l*.

S denotes a casing, which may or may not be used. When used, it is supported by the insulated parts *l l*. Journaled in this casing is a horizontal shaft *t*, on which are the pulleys S′ S′, which are provided with coiled springs *s*.

T T represent sections of wire located in line with each other and attached to the shoe L of the two cars, respectively, and running around the pulley S′ S′. These sections pass out of the casing S at such points below the pulleys S′ that they will be in alignment with each and with as small a gap as possible between them, so that they in reality constitute one continuous conductor between the two shoes of the two cars, which conductor is extensible by virtue of the spring-pulley arrangement. These spring-pulleys act to keep the wires T coiled closely thereon, but permit of the unwinding of the wires for the purpose of lengthening the same in order to compensate for the movement of the adjacent ends of the two vehicles, which movement at one time may make the distance between the two vehicle ends greater or less than at another time.

The operation of the various parts of my improved series-system electric railway will be evident from the foregoing detailed description of the construction and arrangement. It will be obvious that the movement of the vehicle will cause its conductor to engage the trolley-like arms belonging to the contact mechanisms, whereby the current is intercepted from the main circuit and carried through the vehicle-circuit, which for the time being is included in the main circuit.

Numerous details in the various branches of the invention may be varied as to their construction without departing from the invention, and I reserve the liberty of making such changes as experience may suggest.

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

1. In an electric railway, the combination with a moving vehicle, of an electrical conductor, a support therefor on the truck, and a depending arm on the car body, which arm engages said support.

2. In an electric railway, the combination with a moving vehicle, of an electrical conductor supported longitudinally, and means for keeping the conductor from oscillating, consisting of a movable connection with the truck, and an engaging arm rigid on the car body, substantially as described.

3. In an electric railway, the combination with a moving vehicle, of a longitudinal electrical conductor, and means for supporting both ends thereof so that it will be automatically adjustable for the purpose of maintaining the same relative position with respect to fixed objects along the track, said means consisting of a bracket on the truck, to which bracket the conductor is adjustably connected, and an arm on the car body engaging the bracket.

4. In combination with a moving vehicle, a non-oscillating electrical conductor supported longitudinally thereon, and automatically adjustable mechanism therefor, arranged on the vehicle truck and on the vehicle body, substantially as described.

5. The combination with a moving vehicle, of a horizontal longitudinal electrical conductor and means for supporting the same in a non-oscillating position, consisting of a bracket pivoted to the base of the truck and movably connected to the upper part of the same, said bracket having a horizontal curved guide in which an arm of the conductor is movably placed and a depending hanger on the car-body loosely engaging said arm.

6. The combination with a moving vehicle, of a longitudinal electrical conductor consisting of a wire having an inclined shoe connected to each end and means for supporting the same in a non-oscillating position consisting of a movable connection with the truck, and a depending arm on the car body, substantially as described.

7. The combination with a moving vehicle, of a longitudinally-arranged electrical con-

ductor consisting of a shoe having an inclined face and a wire attached to said shoe, together with means for supporting the shoe and wire in a non-oscillating position consisting of a movable connection with the truck, and a depending arm on the car body, substantially as described.

8. The combination with a moving vehicle, of a longitudinally-arranged electrical conductor consisting of a wire, an inclined shoe at each end thereof to which the wire is attached and means for automatically adjusting and supporting said conductor, consisting of a bracket pivoted to the base of the truck and movably connected to the upper part of the same, said bracket having a horizontal curved guide in which an arm of the conductor is movably placed, and a depending hanger on the car body loosely engaging said arm.

9. The combination with a moving vehicle, of a horizontal longitudinal electrical conductor, and means for supporting the same in a non-oscillating position, consisting of a bracket pivoted to the base of the truck, and having slides engaging guides in the top part of the truck, said bracket having also a horizontal guide engaged by an arm of the conductor, and a depending arm on the car body loosely engaging said arm, substantially as described.

10. The combination with the moving vehicle, of a non-oscillating electrical conductor supported longitudinally thereon, automatically adjustable mechanism therefor arranged on the vehicle truck and on the vehicle body, a main-line wire, and devices whereby the vehicle conductor is brought into the circuit of the main line, substantially as described.

11. In combination with a moving vehicle, an electrical conductor carried laterally thereon, a single main-line and laterally adjustable contact means consisting essentially of pivotally-hung vertically-depressible wheel-carrying arms arranged and adapted to be operated upon by the conductor so as to preserve the engagement of the conductor with the contact means when the vehicle turns a curve.

12. The combination with a moving vehicle of a longitudinally-arranged electrical conductor and means for supporting the same in a non-oscillating position upon the vehicle, the main circuit and laterally-adjustable contact means arranged to be engaged by the vehicle conductor, said means consisting of the pivotally-supported vertically-depressible wheel-carrying arms together with the controlling springs substantially as described.

13. The combination with the longitudinally arranged electrical conductor supported laterally on the moving vehicle, a single main-line conductor, contact-mechanisms situated at intervals along said line, and provided with wheel-carrying arms whose wheels are engaged by the moving conductor, said arms being depressible from their normal plane when the conductor is in contact therewith, the train-operating devices for locking and releasing said wheel-carrying arms, said devices being so arranged relatively to the arms, that when the devices are depressed by the train the arms will be simultaneously depressed by the vehicle conductor, substantially as described.

14. In a series circuit electric railway, the moving conductor on the vehicle in combination with the main-line wire and the mechanisms for intercepting the current from said wire, said mechanisms consisting essentially of the projecting wheel-carrying arm, the shaft to which it is affixed, said shaft having depending arms, a circuit-closer operated by one of said arms to open or close the main-line circuit, and the vehicle-wheel operated means for locking and unlocking the aforesaid shaft, said means consisting of a rail lever and a connection between it and a latch which engages the shaft, substantially as described.

15. In combination with a moving vehicle conductor, the single main circuit, the intercepting mechanisms located along the length of the latter at suitable intervals and consisting essentially of circuit breaking and closing means, securely inclosed within a box or casing, projecting wheel-carrying arms with which the vehicle conductor engages and mechanisms operated by the wheel of the passing vehicle for locking and releasing said arms, substantially as described.

16. The combination with the longitudinal horizontal electrical conductor supported laterally on a moving vehicle, the main line circuit, the intercepting mechanisms whereby the conductor takes the current from the main line, said mechanisms consisting essentially of a projecting wheel-carrying arm, the circuit closer operated thereby, and the various electrical connections, the train-operated track lever, and the spring catch operated thereby, substantially as described.

17. The combination with a moving vehicle, an electrical conductor carried thereby, a single main circuit, and laterally adjustable contact means adapted to be operated upon by the conductor, said means consisting essentially of a parallel motion hung pivotally so as to swing in a vertical and also in a horizontal plane and wheel carrying arms supported in said parallel motion, substantially as described.

18. The combination with the electrical conductor supported laterally on the moving vehicle, a single main line, contact mechanisms situated at intervals along said line and provided with wheel-carrying arms whose wheels are engaged by the moving conductor, one of said arms being pivoted to the other and yieldingly tensioned thereon, and the train-operating devices for locking and releasing said arms, substantially as described.

19. In combination with the railway cars

and the conductors carried thereby, the connections between the ends of said conductors comprising self-winding spring drums.

20. In combination with the railway cars and the conductors carried thereby, with extensible or yielding connections between the ends of said conductors, said connections comprising self-winding spring drums.

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

OLIVER B. FINN.

Witnesses:
J. FRED. KELLEY,
WM. L. BOYDEN.