(No Model.) 2 Sheets—Sheet 1.

I. H. FARNHAM.

OVERHEAD CROSSING APPLIANCE FOR ELECTRIC RAILWAYS.

No. 448,711. Patented Mar. 24, 1891.

Fig. 1.

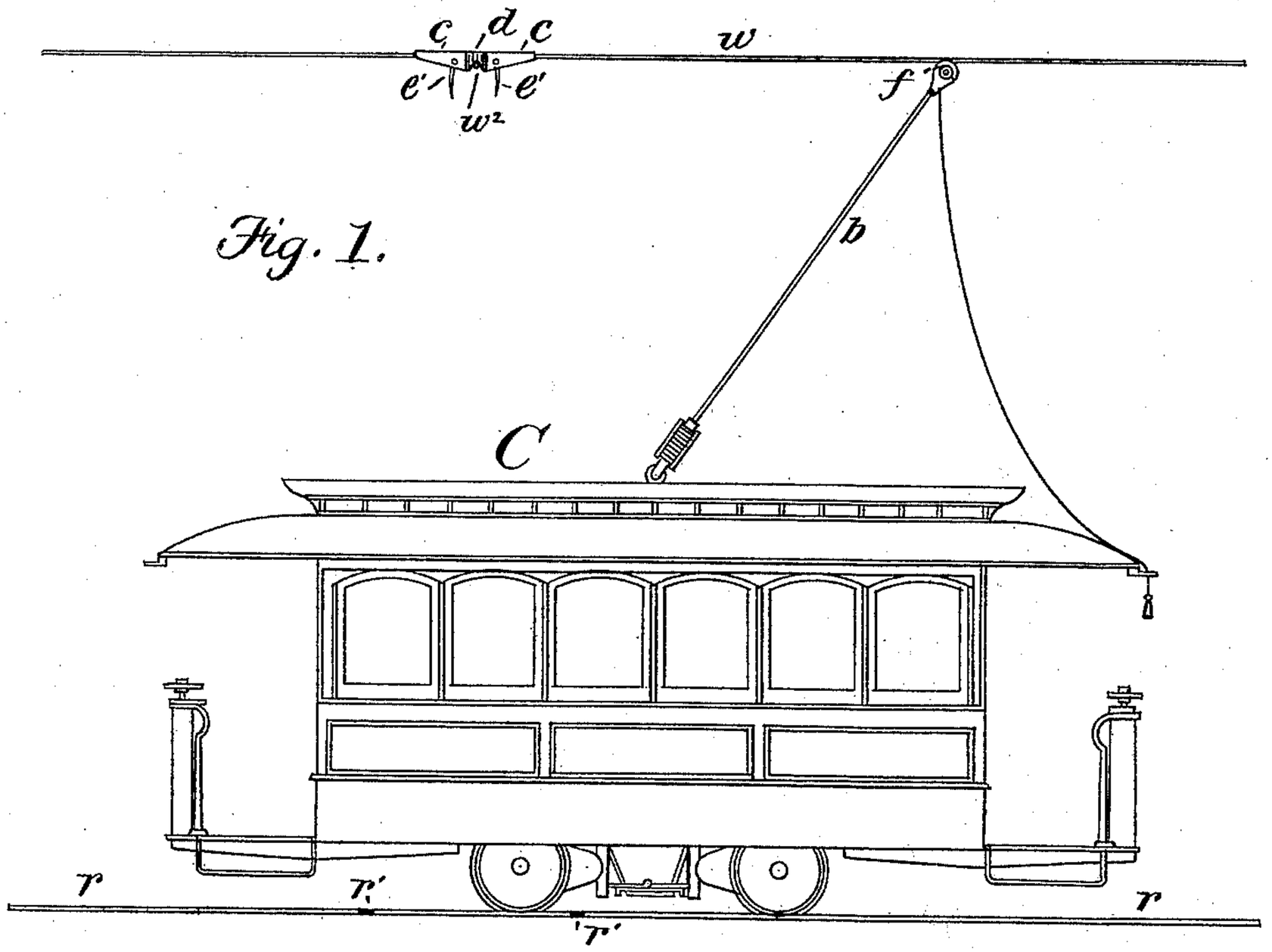

Fig. 2.

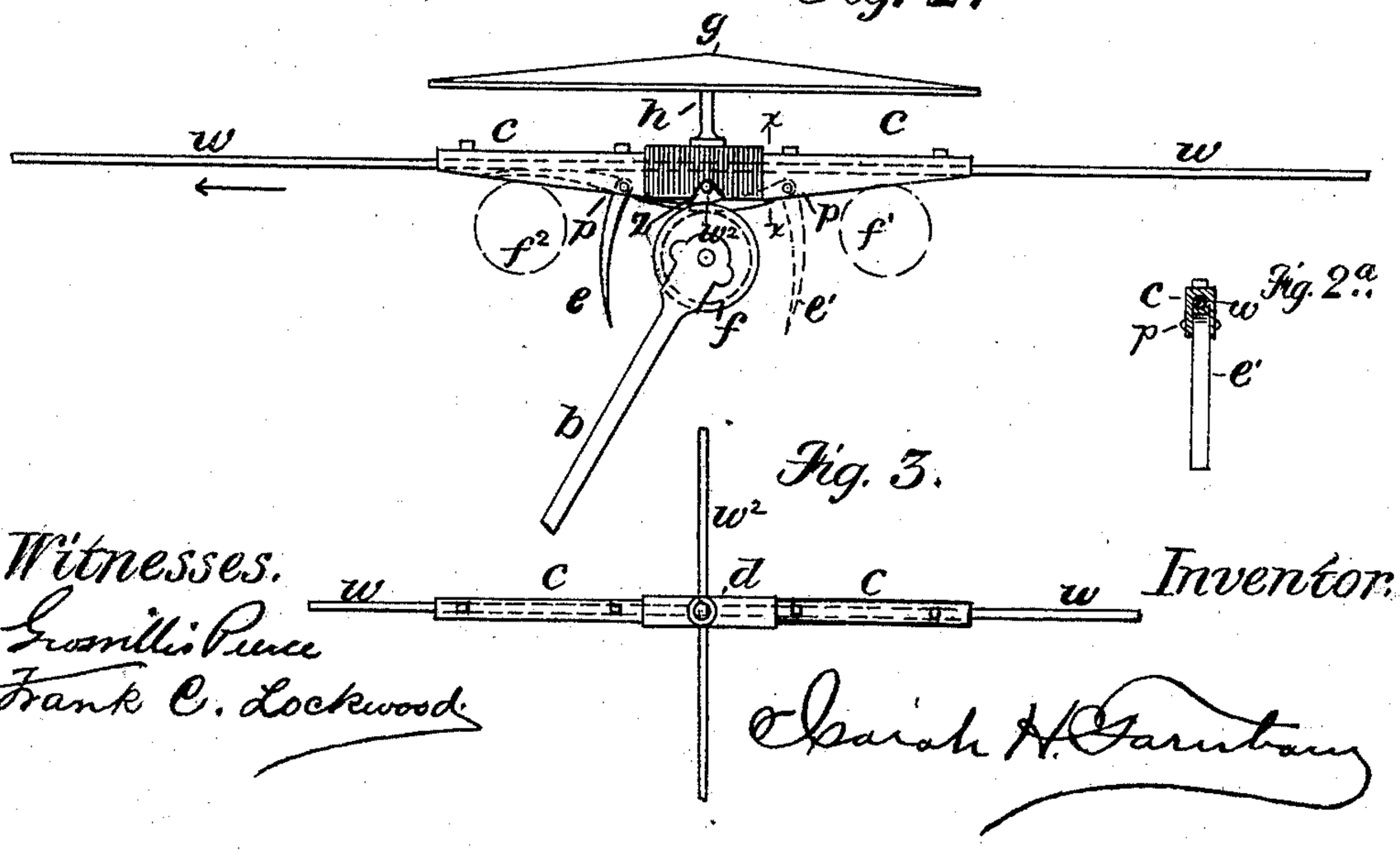

Fig. 2a.

Fig. 3.

Witnesses.
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Frank C. Lockwood.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

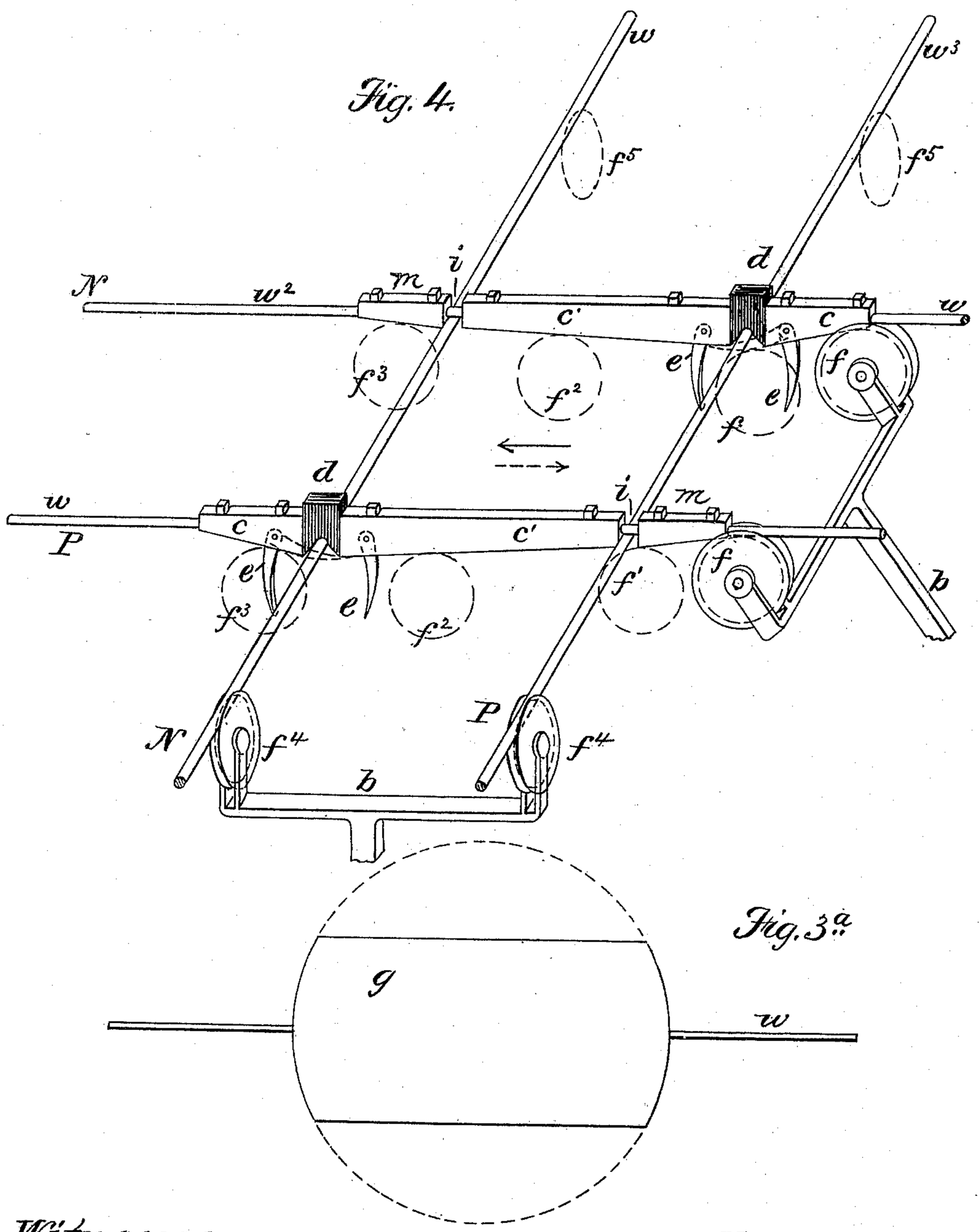

Fig. 3a.

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UNITED STATES PATENT OFFICE.

ISAIAH H. FARNHAM, OF WELLESLEY, ASSIGNOR TO THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY, OF BOSTON, MASSACHUSETTS.

OVERHEAD CROSSING APPLIANCE FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 448,711, dated March 24, 1891.

Application filed November 20, 1889. Serial No. 331,142. (No model.)

To all whom it may concern:

Be it known that I, ISAIAH H. FARNHAM, residing at Wellesley, in the county of Norfolk and State of Massachusetts, have invented certain Improvements in Overhead Crossing Appliances for Electric Railways, of which the following is a specification.

This invention relates to the electrical operation of railways, and comprises a peculiar arrangement of the frogs or crossing appliances associated with the contact devices which slide or roll upon or otherwise make contact with the supply line or lines of an electric traction system and which connect with an electric motor placed upon the vehicle which is to be moved.

A practical mode of operation for electrical railways is that of placing an electromotor on the car or vehicle to be moved and by extending the terminal or terminals of said motor upward by means of a flexible but sufficiently rigid mast surmounted by suitable contact-makers—such as brushes or trolleys—adapted to bear or roll upon the surface of a supply-wire extended longitudinally over the track, the said wire being connected with a suitable source of electricity conveniently located. A sufficient amount of electricity traversing the said supply-wire is thus caused to pass through the motor on the car and to energize the same.

My invention is particularly applicable to electrical railroads so operated, where the main electrical conductors are suspended, as above described, in the air, being suitably supported by means of cross-wires suspended from poles at the side of the road or otherwise, as may be found convenient. In such systems of electrically-operated railways the tracks cross each other at an angle, and as a consequence the electric-power conductors on the said tracks are also necessitated to cross each other.

The object of my invention is to provide at such crossings or intersections between the electric-power line, conductor, or "trolley-wire" (as it is technically termed) of one railway and that of another, one of the said lines passing under that of the other, an efficient means whereby the trolleys or traveling contact-pieces of cars on both railways are enabled each to maintain a constant contact with its own trolley-wire and whereby either is prevented from making contact with the trolley-wire of the other or from establishing electrical connection between the two crossing wires. In other words, the contact devices of the cars traversing the railway provided with the higher trolley-wire or power-conductor of the two at the crossing-point are by my invention enabled to remain continuously in electrical connection with their own power-conductor, notwithstanding the proximity of the lower crossing conductor, which otherwise would prove to be a mechanical obstacle to its progress, and this without any break in the line of said lower conductor without impairing the capability of the contact devices associated with the said lower conductor to remain in constant electrical contact therewith at such crossing-point, and without forcing the two conductors into electrical or mechanical contact.

For the accomplishment of these ends my invention consists in the provision at crossing-points of an automatically-operated bridging-connection connected with the upper power-conductor on one or both sides of the intersecting conductor, and adapted upon the passage of a car on the line of the said upper conductor to establish a mechanically-continuous bridge around and below the said intersecting conductor, which bridge is adapted to remain in position below the normally-lower conductor during the passage of said car to furnish electricity therefor and to constitute virtually a temporary section of the upper conductor on a plane lower than that of the crossing conductor, which normally is the lower of the two. This bridge-piece is brought into action by means of the trolley or contact appliance of the passing car being struck thereby and forced up into its working position, where it is retained and caused to act as the supply-conductor of the said trolley until the same has passed.

Another part of my invention consists in mounting the said bridge connection, as hereinafter shown, in such a way that when not actually required for use as a bridge over the crossing conductor it may be capable of automatically withdrawing itself, and being piv-

oted to or hung upon a fixture in mechanical connection with one side or the other of the crossing conductor it may, when the support of the contact device of the passing car is withdrawn, be permitted to swing in a vertical plane where it will cease to bridge over the other conductor, leaving a clear path for the passage of contact devices traversing the line of the said other conductor. Such a bridging conductor may hang upon one or both sides of the crossing conductor, and it is generally more convenient to attach one to both sides, so that it can be operated by a car passing in either direction.

The invention consists also in causing the upper crossing conductor to remain electrically continuous at the crossing-point and in providing means whereby the lower conductor when traversed shall be prevented from making contact therewith. It will be seen that I accomplish this by interposing an insulating-block between the said two conductors at the point of intersection, which insulating-block is transversely hollowed or grooved for the passage of the lower conductor, and which, moreover, together with the groove within which lies the crossing conductor, is adapted to be bridged over by the hanging bridge conducting piece already described.

It consists also in combining the said bridging and contact-preventing devices with the "double-trolley" system, so called, of car propulsion, in which there are two overhead supply-conductors, and in which both terminals of the car-motors extend upward by means of convenient devices making contact, respectively, with the said two overhead conductors.

My invention, in fact, is more essentially applicable to the efficient operation of this system than to others, for it is clear that since the two supply-conductors thereof are respectively the positive and negative conductors of a powerful source of electricity, it is absolutely necessary at points where two lines cross at an angle to prevent contact between the positive conductor of one of the lines and the negative conductor of the other, which contact would tend to short-circuit the dynamo and which would be liable to cause generally disastrous results.

The invention consists, moreover, in combining the instrumentalities already referred to with an insulating hood or covering placed over each crossing-point and adapted to maintain insulation during wet weather.

In the drawings which form a part of this specification, Figure 1 is a linear elevation of a car actuated by an electromotor receiving its electric energy from an overhead wire, which is crossed at an angle by a similar supply-wire, to which crossing my invention is applied. Fig. 2 is a side elevation of a detail showing on a large scale my invention and its mode of operation. Fig. 2^a is a cross-section on line $x\,x$ of Fig. 2. Fig. 3 is a plan view of the two intersecting overhead conductors, the hood or weather-guard shown in Fig. 3 having been removed. Fig. 4 is a perspective drawing of a double overhead conductor crossing, showing the special adaptability of the invention to a double conductor or trolley system; and Fig. 3^a is a plan view of a hood or weather-guard shown in elevation in Fig. 2.

Referring first to Figs. 1, 2, and 3, which show my invention in its simplest form, C is a street-railway car running on rails r, which at $r'\ r'$ are crossed by the two rails of another track laid at an angle with the rails r. The said car is propelled by an electromotor carried thereby, (not shown,) which motor receives its electric energy from an overhead supply-wire w, extended longitudinally over the said track r through the flexible and resilient mast b, which forms or supports a suitable conductor leading to the motor terminal. At the summit of said mast is a roller or trolley f, or any equivalent contact-maker, which, being pressed up against the under surface of the wire w, runs or rolls along the said wire, and, forming a constant traveling contact therewith, serves to conduct electricity therefrom to the motor.

The principal object of my invention is to facilitate and make practical the use of two overhead conductors, one serving as a supply and the other as a return wire. In such a case there would be two contact-makers, each leading through its own conductor down the mast to one of the terminals of the motor; or, if desired, there might be two masts; but this invention may also be employed in association with single-trolley systems, and for the purpose of easy explanation it is so shown in these drawings or figures.

Immediately over the crossing track r' is the supply-wire w^2 of said track. The wires w and w^2 are so arranged with respect to each other that they are at all times reciprocally insulated and can never be brought into contact. One way of accomplishing this is to mount, as shown, a block d of insulating material—such as vulcanized fiber, hard rubber, or hard wood suitably treated—in such a way that its mass is at the point of intersection interposed between the said two wires. As shown in Fig. 2, the wire w passes through the substance of the block d, which is immovably held in place by the clamping blocks or plates c, and these being at their under surface oppositely inclined, so as to form a plane inclining downward from both directions and having their lower edge surfaces not materially differing in size and shape from that of the supply-wire, form an inclined-plane conductor on which the trolley f may roll to the center downwardly and then up along the opposite one.

At the middle of the under side of the non-conducting block d I provide a groove or recess z, within which lies the lower conductor w^2 of the two which cross each other. It will, however, be observed that while there is no

mechanical obstacle preventing a trolley from maintaining its continuous contact with the wire w^2 the presence of the insulating-block d necessarily causes a gap equal to its length in the trolley-traveled conducting-surface of the conductor w, in which, however, electrical continuity is maintained by causing the main conductor to pass through the substance of said block, as indicated in dotted lines in Fig. 2.

To provide the necessary conductivity of the trolley-path in the line of the conductor w, I provide, as shown, a suspended conducting-lever e, hung on a suitable supporting-pin p in the clamp c, and hanging, as shown, in the path of the trolley f. Such a lever is preferably provided on both sides of the gap in the surface continuity of the conductor w, although if the cars run exclusively in one direction it is not essential to provide two levers, and one will suffice, that being hung at the side from which the cars approach. In operation this lever performs the function of a movable contact piece or bridge, which is hung with sufficient delicacy to respond easily to the impact of the approaching contact-maker, and which thereupon swings up in front of the same, furnishing a conducting-bridge upon which the said contact-maker can slide or roll, and from which, since the said bridge is electrically connected at its supported end with the wire w, it can receive electricity. When thrown up by the contact-maker into its active position, the bridge-piece is of sufficient length to extend completely over the insulating-piece and to make contact with the clamp c on the other side thereof. It will not when thrown up come into contact with the crossing-wire w^2, that being embedded in the recess z, in addition to which the suspended contact-piece may, if found necessary, be hollowed or bowed out at its upper surface the better to encircle without contingency of contact with the wire w^2.

In Fig. 2 it is assumed that the contact-maker f, which here is represented as a roller or trolley, is traveling in the direction of the arrow in full lines. The said trolley, supported on its mast b, is shown as having advanced down the inclined plane formed by the edge of the right clamp c from the position at the right of the center (where it, as well as the suspended lever e', is indicated in broken lines, and where it is indicated as f') to a position immediately below the transverse conductor w^2. In this position it has forced up the conducting bridge-piece e', which now unites the two clamps, and it is shown as rolling over the said bridge-piece and receiving current therefrom, the wire w^2 being fully protected from contact therewith. As soon, however, as the trolley leaves the upwardly-pressed lever e' the said lever by its own weight, being now unsupported, falls backward into its pendent position, leaving an unobstructed path open for trolleys traversing the line of conductor w^2. In passing from the central position to that at the left hand, where it is indicated as f^2, the trolley necessarily encounters the opposite suspended lever e; but the said levers are so hung that they swing with equal facility in either direction, and when struck by the advancing trolley they are thrown up at once into a recess or flanged hollow behind the lower surface of the clamp c, where it is indicated in the broken lines, and thus does not oppose the onward motion of the trolley. Thus without any necessary act of a person guiding the car the motion of the car itself establishes the bridge connection, and after the passage of the said car the bridge automatically drops itself out of the way, so that the trolley can freely pass over the intersecting wire w^2. It is necessary that at such crossing-points the operative appliances shall be protected from the weather, so that the insulation shall be properly maintained during wet weather, and for the purpose of preventing corrosion or impairment of the working-surfaces; and to this end I supply over each crossing-point a hood or canopy g, of any suitable material, which is mounted on the insulating-block d by a standard h and adapted to shed water. This is shown in side elevation in Fig. 2 and in plan in Fig. 3^a, and may be circular, square, or any desired form.

Fig. 4 shows the special applicability of my invention to the "double-trolley" system, so called. It shows in perspective the two overhead conductors w and w^2 of one track crossed at an angle by the two overhead conductors w' and w^3 of a transverse track. The conductor w is fitted, in the manner hereinbefore indicated, at the point at which it intersects w' with the interposed non-conducting block d and its inclined-plane clamps c and c', the latter of which may extend into close proximity to the second crossing conductor w^3, and may be re-enforced on the other side of said wire by an extension m. The inclined approaches to the insulating-block d are thus made gradual, and are also made to assist the traveling trolley over the second transverse wire w^3, which is not necessarily insulated, as will presently be pointed out. The insulating-block at the intersection of the conductor w' is provided with the hanging levers e, as already described, which, as indicated by broken lines, serve as conducting bridging-pieces over the break and over the transverse wire and which remove themselves out of the way as soon as they have performed the required service. The same appliances are also provided at the said intersections for the wire w^2; but in this case the said wire is insulated by its block d from the second crossing-wire w^3, while it is not necessary to insulate it from w'. This will be understood by considering the conditions. In a single overhead conductor and trolley-railway crossing another one of the same character at an angle it is possible to so arrange the overhead conductors that no electrical disadvantages will ac-

crue if they are brought into contact. This can be done by providing that the overhead conductors of both lines of road shall represent the same polarity or direction of electric current. In that case both, for example, being positive, a brief contact between them would not be productive of disaster. If, however, the two wires which cross each other should happen to be conductors connected with opposing poles of their respective sources of supply, it is evident that a short circuit will ensue which may be harmful; but in a system where both positive and negative conductors are overhead, as in all double-trolley systems, it is obvious that at each crossing-point the two positive conductors—one on each route—must necessarily pass over or under the negative wires on the route crossed, and it becomes absolutely essential to prevent a contact between the positive of one route and the negative of the other, while on the other hand it is not requisite that the two crossing wires carrying currents of like direction shall be mutually insulated. Thus while in the single overhead-conductor system it is merely a wise precaution to insulate the two wires crossing each other, in case they may represent opposing polarities, it is necessary in the case of a double-conductor system to insulate two of the intersections, because it is certain that each conductor of each polarity must cross one of opposite polarity. To indicate this condition, the wires w and w^2, being respectively the outgoing and incoming conductors of one track and adapted to supply current to and receive current from their cars by means of the trolleys f to f^3, (indicated in broken lines as traversing from right to left,) are marked P and N, while the crossing pair of wires w' and w^3, traversed by the trolleys f^4 and f^5, are marked, respectively, N and P.

The objections which have arisen to the construction and operation of double-trolley systems of electric propulsion, based upon the difficulty of safely crossing the negative and positive conductors are by my invention overcome, and it will be seen that by means of the principal feature of my invention, which consists of a suspended lever connected with one of the trolley-wires and adapted to be struck by the trolley traversing said wire and thereupon to rise up and form a bridge around the trolley-wire of the opposite polarity, I am enabled to construct an efficient and safe crossing, whereby the necessity of cutting the lower conductor for the purpose of allowing the passage of trolleys traversing the upper is dispensed with, which keeps the upper and lower levels of trolley-wires at critical points at all times well separated electrically, avoiding all chance of destructive contacts, which is of extreme simplicity in construction and operation, and which is automatic.

There are in practice occasional instances, of course, where it becomes unnecessary to maintain the contact of the trolley with the conducting-wire during the passage of a crossing—such, for example, as might occur when crossing a descending grade. It is, however, in all cases necessary to retain control of the trolley traversing the upper conductor, and to prevent it from making contact with the lower conductor as it crosses the same. In such cases the bridge need not necessarily be of conducting material, since it will only be used as a mechanical bridge and as a guide for its trolley, the car moving for a brief space by its momentum. The upper conductor is, however, necessarily in all cases made continuous, and, as already explained, by the adoption of the bridge expedient its continuity is readily secured.

Another and prominent feature of my invention is that the crossing devices are applied to any and all of the electric-power-conductor wires without cutting the same, and introducing the said devices between the severed ends, thus avoiding the consequent weaknesses and disadvantages which would arise from so doing. When a new route is laid out to cross at an angle a route already in operation, it is not required to cut the said wires of the old route, but the devices are secured thereto without in any way disturbing them, and when the said electric-power-conducting wires are put in place and stretched (and maintained) to the required tension the full tensile strength of the continuous wire is preserved, and the weakness which would be developed from the many joints in the line if the wires were cut at the crossings, by reason of the fact that a joint has not the strength of the continuous wire and that losses of electric current due to bad joints from insufficient contacts and corrosions would ensue, is avoided.

I claim—

1. The combination, substantially as hereinbefore described, of intersecting electric-supply conductors for an electric railway, with one or more automatically-operated conducting bridging sections therefor electrically connected with one of the said conductors, each bridge being a movable section of the upper trolley-conductor, of suitable length and shape, hanging in the path of the traveling contact, which movable section is adapted to be struck by the said traveling contact and thereupon forced into a position to complete the track for the passage thereof, but acting at all other times by its own gravity to fall away from said track and to maintain the discontinuity of said trolley-track, for the purposes specified.

2. In an electric railway having overhead supply-wires and at a crossing-point thereof, the combination of supply-conductors crossing or intersecting each other upon different levels or planes, and means for conducting the trolley traversing the upper conductor around the lower conductor and for continuously maintaining the electrical connection of said trolley with its said supply-conductor,

substantially as and for the purposes specified.

3. In an electric railway, the combination of crossing power-conductors, an insulating separating-block fixed between the said conductors at the point of intersection, a self-acting bridge-piece in electrical connection with the upper conductor and actuated by the passage of a traveling contact over said conductor to form a movable and temporary section of said conductor bridging around the lower conductor and the interposed insulation for the passage and feed of said traveling contact, whereby the said traveling contact may pass from one side to the other of the crossing conductor without interfering with the continuity thereof and without being disconnected from its own conductor, and a protecting hood or weather-guard mounted on said insulating-block and adapted to shed water and maintain the insulation of the apparatus, substantially as described.

4. The combination, in an electric railway, of a supply-conductor adapted to be engaged by a traveling contact, a second supply-conductor crossing the first at an angle, means, such as a non-conducting block, for permanently separating the said conductors, and a movable section of the first conductor capable of bridging the said separating medium and the second conductor and adapted to be brought into position so as to serve by the passage of the traveling contact, and thereupon to furnish a conducting-path for the said contact, but normally hanging from the first supply-conductor at one side of the point of intersection, whereby the traveling contacts of the second supply may pass without being obstructed by the said movable section, substantially as described.

5. In a double-trolley electric railway, direct and return electric conductors or power-lines crossing a similar double-wire system at an angle, each conductor of both sets being suitably insulated by an interposed non-conducting block from its crossing conductor of opposite polarity, and automatic bridging devices at the said insulated intersections adapted to establish for the transit of the traveling contacts of the conductors of the higher plane a temporary path around and under their crossing conductors, substantially as and for the purposes specified.

6. The combination, in an electric railway, of a supply-conductor adapted to be engaged by a traveling contact, a second and similar supply-conductor crossing the first at an angle therewith and on a lower horizontal plane, a non-conducting block interposed between said conductors at the point of intersection, the first conductor passing through and supporting the same and the second passing in a transverse groove or recess in the lower surface thereof, clamps holding the said insulating-block in place and forming inclined planes from the conducting-surface of the first supply-conductor on either side of the said block to the plane of the lower surface of said block, movable conducting-sections pivoted to the said clamps and capable of being swung in a vertical direction therefrom, the said sections being normally hung out of the line of the transverse second supply-conductor, for the purpose specified, but adapted to be swung into connection with the opposite clamp by the transit of a traveling contact, and thereupon to bridge the said insulating-block and the transverse conductor embedded therein, and to constitute, in combination with the said inclined planes on either side, a conducting path across the lower surface of said insulating-block for the passage of said traveling contact, substantially as described.

7. The combination, in an electric-railway crossing, of an electric conductor or power-line divided into two parallel branches, one of the said branches being permanently closed or continuous and the other being normally open, a second power-line crossing the first at an angle and passing between the closed and normally-open branches thereof, a non-conducting mass electrically separating the said two power-lines and grooved across its lower surface for the reception of the said second power-line, traveling contacts for the first lines, and means, substantially as indicated, actuated thereby for closing the normally-open branch thereof and for maintaining the same closed during the passage of said traveling contact over the crossing, whereby the said branch is formed into a path for the said contact over the face of said insulating-block and around and on a plane below the said crossing conductor, for the purposes specified.

8. The combination of two sets of double conductors or power-lines crossing each other and each adapted to be traversed by a traveling contact, the positive wire of each set being suitably insulated or prevented from coming in contact with the negative wire of the other set, with pivoted conducting-levers at the said insulated intersections hanging from the uppermost conductors, the said levers normally being hung upon one or both sides of the line of the intersecting conductor, so as to leave the said line free for the passage of its traveling contacts and being, when displaced, capable of automatically resuming their normal position and being adapted to be actuated by the traveling contacts of their own lines and to be swung thereby in a vertical plane into a substantially horizontal position, establishing the continuity of said line, and a path for the passage of the said actuating-contacts below and around the crossing conductors, whereby such crossings may be effected without liability to short-circuiting and without impairing the continuity of the lower main conductors.

9. In combination with two sets of crossing conductors or power-lines of electric railways, each set comprising a positive and a negative conductor, the conductors of the one set pass-

ing under those of the other and both adapted to be engaged by underrunning trolleys or traveling contacts, a temporary automatically established and disestablished conducting-path connected with the conductors of the higher plane and extending below the conductors of the lower plane at the intersections of the positive conductor of each set with the negative conductor of the other, whereby the underrunning trolleys of the said higher set of conductors are enabled to pass under the said lower set of conductors, substantially as described.

10. In an electric railway having for each track two overhead main conductors or power-lines, the combination, with two sets of such power-lines crossing each other at an angle, of an insulating-block interposed between the positive conductor of each set and the negative conductor of the other set at the intersections thereof, the lower plane conductor being depressed below the inferior surface of said insulating-block, and a temporary conducting-trolley path for the trolley of the conductor of the higher plane below and around the conductor of the lower plane, established during the passage of said trolley, the said conducting-path being composed of conducting inclined-plane abutments in connection on either side of said insulation with the higher conductor, and a self-acting bridge-piece normally suspended by one end from the said abutments to leave the crossing conductor unbridged, but adapted to have its free end thrown up and brought into contact with the opposite abutment, and thereby to complete the said conducting-trolley path when required, substantially as set forth.

11. In an electric railway having for each track two overhead main conductors or power-lines, the combination, with two sets of such power-lines crossing each other at an angle, of an insulating-block interposed between the positive conductor of each set and the negative conductor of the other set, the lower plane conductor being depressed below the under surface of said insulation, conducting inclined-plane abutments affixed to the higher conductor and in electrical connection therewith, the said planes forming a trolley-path to the plane of the lower conductor for the traveling contact of the upper conductor, and a freely-moving conducting bridge-piece suspended by one of its ends from one or both of said abutments and adapted to bridge across the insulating-surface and crossing conductor when struck by the traveling contact of the said upper conductor, and thereby to complete the said trolley-path between the two opposing abutments, whereby the trolley of the upper conductor is enabled at crossings to pass below the lower conductor without being disconnected from its supply-line and to automatically fall through the influence of gravity to its normal position, leaving clear the path of the lower conductor for its traveling contacts after the said upper contact has passed.

12. In an electric railway having overhead supply-wires and at a crossing-point thereof, the combination of continuous supply-conductors crossing or intersecting each other upon different levels or planes, and means for conducting the trolley traversing the upper conductor around the lower conductor and for continuously maintaining the electrical connection of said trolley with its said supply-conductor, substantially as specified.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 14th day of November, 1889.

ISAIAH H. FARNHAM.

Witnesses:

GEO. WILLIS PIERCE,

FRANK C. LOCKWOOD.