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DOUBLE TROLLEY LINE SWITCH

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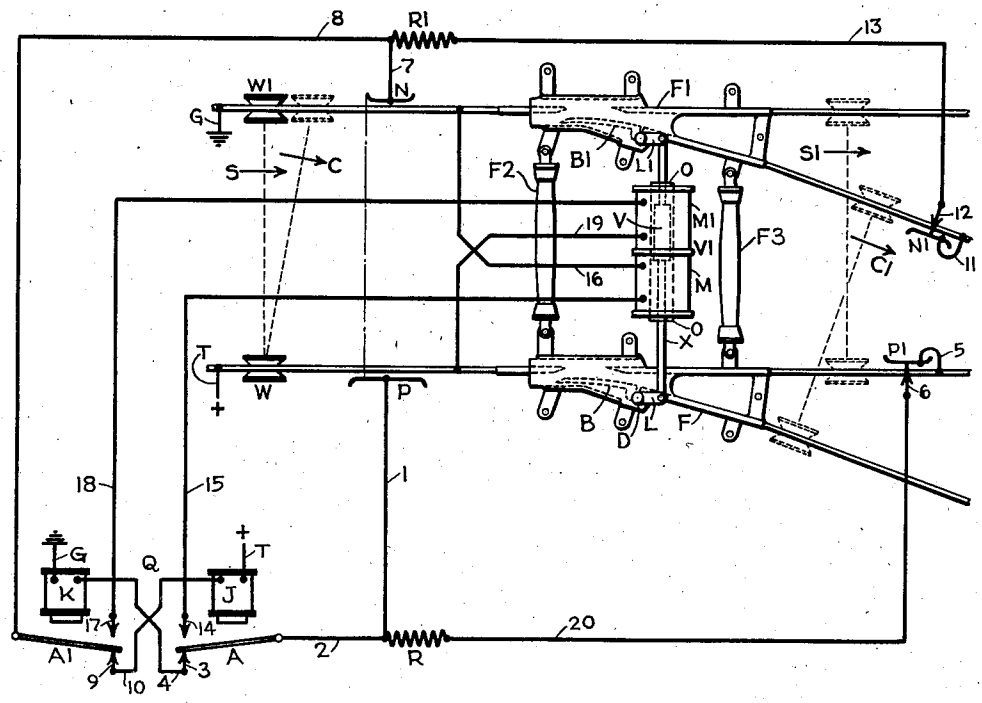


Fig.1

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DOUBLE TROLLEY LINE SWITCH

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My invention relates to improvements in the automatic operation of trolley frogs employed to direct current collectors either along main conductors or onto branch conductors at a turnout in an overhead trolley conductor system.

My invention has particular application to the automatic operation of trolley frogs employed to direct the current collectors of a trolley bus or coach that collect current for the propulsion of the vehicle from a pair of overhead conductors.

One object of my invention is to provide apparatus that is automatically and electrically operated to direct the current collectors either along the main conductors or onto the branch conductors without requiring any attention on the part of the operator of the vehicle.

Another object of my invention is to provide a system of electrical connections for effecting the aforesaid automatic and electrical operation of the apparatus employed to direct the movement of the collectors along the said conductors.

A further object of my invention is to provide electrically operated relays that are operatively associated with the said circuits for selectively controlling the automatic operation of the trolley frogs.

Another object of my invention is to provide apparatus for retaining the selection effected by the operation of the relays until the current collectors pass beyond their respective trolley frogs.

A further object of my invention is to provide contact devices in each overhead conductor having a predetermined relation one to the other and to the trolley frogs, for utilizing the relative longitudinal positioning of the current collectors one to the other, as determined by the angularity of the vehicle with respect to the overhead conductors as they pass the said contact devices, to determine selectively the operation of the relays and the said trolley frogs.

These and other objects will manifest themselves as the following description is read in connection with the accompanying drawing in which:

Figure 1 is a diagrammatic representation of my invention showing the relative longitudinal positioning of the current collectors as effected by the angularity of the vehicle with respect to the overhead conductors and the relation between the various devices and their electrical connections.

Transportation systems are, at present, employing two types of electrically propelled vehicles. One type comprises the conventional trolley car operating in a fixed path upon track rails, and obtaining current for the propulsion of the vehicle via a single collector traveling upon a single overhead conductor of one polarity, and the wheels of the vehicle operating upon track rails of the opposite polarity; while the other type comprises the conventional trolley bus or trolley coach that is free to cruise in the regular traffic lanes of a thoroughfare, and which coach obtains current for propulsion of the vehicle from two current collectors traveling upon two overhead conductors of opposite polarity.

In the operation of trolley cars, the rails at the turn out point are positioned to direct the movement of the car either along the main tracks or onto the branch tracks of the turn out, and it has been customary to utilize the drag on the trolley pole, as effected by the directed movement of the car, to direct the single overhead collector onto the proper conductor.

However, in the operation of trolley coaches it has been necessary to provide a swivel connection between each current collector and its respective trolley pole in order to retain the collectors on their respective conductors as the vehicle cruises freely in the traffic lanes of the thoroughfare. Accordingly, it has been found necessary to direct the movement of the collectors through the trolley frogs at a turn out in the overhead conductors.

To provide the required directing of the collectors either along the main conductors or onto the branch conductors, each trolley frog is provided with a movable tongue element that is operated selectively to provide a definite path of travel for the current collector through the said frog.

Heretofore, such trolley frogs have been provided with an electro-magnetic device actuated selectively in response to the operator of the vehicle either applying or removing operating current from the propulsion motors of the vehicle, which principle of operation is also extensively employed in the operation of track switches at a turn out point in the track rails.

However, such principle of current selective operation requires a certain amount of attention on the part of the vehicle operator, and, as aforesaid, one object of my invention concerns the automatic operation of the movable tongue elements of the trolley frogs without requiring any attention on the part of the vehicle operator.

In this respect it has been observed that the

longitudinal positioning of the current collectors of a trolley coach varies in accordance with the angularity of the vehicle with respect to the main conductors.

Accordingly, I have made use of the observed variations in the longitudinal positioning of the current collectors, to position automatically the movable tongue elements of the trolley frogs for directing the collectors along their respective main conductors when the trolley coach is moving in a path substantially parallel with the main conductors as the collectors approach the trolley frogs, and to position automatically the movable tongue elements for directing the collectors onto their respective branch conductors when the trolley coach is moving in a curved or angular path with respect to the main conductors and substantially in the direction of the branch conductors as the collectors approach the trolley frogs.

To describe the observed variations in the longitudinal positioning of the current collectors, a brief description of the arrangement of the current collectors and their respective trolleys poles is given.

As aforesaid, each current collector is secured to the end of its respective trolley pole by means of a harp having swivel connections permitting both horizontal and vertical movement of the trolley poles relative to their collectors, while each collector remains longitudinally in contact engagement with its respective conductor.

To permit cruising of the trolley coach over the regular traffic lanes, and to permit the coach to weave its way through traffic, the trolley poles of the coach are preferably much longer than in the case of trolley cars, generally being about 18 feet in length.

Each of the poles are pivotally secured to the top of the trolley coach to swing freely about two transversely aligned points, and either in a horizontal or vertical plane.

The overhead conductors are spaced approximately two feet apart. Therefore, the transversely aligned points on top of the trolley coach are fixed at two feet apart.

Accordingly, it will be apparent that the collectors will remain transversely in alignment one with the other, and in a plane substantially at right angles with the main conductors, as long as the trolley coach travels in a path parallel with the main conductors.

However, as soon as the trolley coach moves in a curved or angular path with respect to the main conductors, it will be apparent that the outside collector, relative to the curve that the coach is describing, will longitudinally lead the other collector with respect to a transverse plane at right angles with the main conductors. Obviously, the longitudinal distance the outside current collector leads the inside collector is determined entirely by the degree of angularity of the coach relative to the main conductors.

Accordingly, it will be apparent that in order to utilize the aforesaid lead of one collector over the other to provide automatic and selective operation of the trolley frogs, it is necessary to provide members positioned adjacent the respective conductors, and on the approach side of the trolley frogs, that are adapted to be engaged either simultaneously or sequentially by the current collectors, for determining the selective operation of the trolley frogs.

In the preferred embodiment of my invention, an electro-magnetic device is provided for selectively operating the movable tongues of each trolley frog to the required position. Contact devices are located adjacent each main conductor on the approach side of the frog and electrically connected in circuits including the conductors and the electro-magnetic device. The position of the contact devices relative one to another longitudinally along the trolley wires and the aforesaid circuits is such that the movable tongues automatically and selectively operate to direct each current collector onto the proper conductor as determined by the longitudinal positioning of the collectors relative one to the other as they pass the contact devices.

In this respect, it has also been observed that traffic congestion, and the angle of the branch conductor relative to the main conductor, is often such as to limit the angular relation that the trolley coach may assume relative to the main conductors, and, in such circumstances, the lead of the outside collector over the inside collector may be extremely small.

The effect of the foregoing circumstances, is to reduce materially the time in which selective operation of the movable tongue elements of the trolley frogs is to be accomplished, which time is further affected by the speed of the vehicle as the collectors pass the contact devices.

Accordingly, to eliminate the aforesaid marginal characteristics of the associated apparatuses under such circumstances, I have incorporated electrically operated relays in my system, which relays are operatively associated with the contact devices and the electro-magnetic means of the trolley frogs, in such a manner that proper selection and frog operation is obtained when the lead of one collector over the other is extremely small and even when the coach travels at relatively high rates of speed.

Therefore, having outlined in detail the foregoing conditions encountered in the operation of trolley coaches, a full understanding of the operation of the preferred embodiment of my invention may be obtained by referring to Figure 1 of the drawing, in which T and G illustrate the main conductors, and *t* and *g* the corresponding branch conductors.

The characters F and F1 diagrammatically illustrate the trolley frogs placed in each respective conductor at the turn out, which frogs are laterally spaced by conventional insulators F2 and F3 respectively.

The frog F1 in the negative main conductor G is provided with a movable tongue element B1, which tongue element is pivotally mounted upon the body of the frog F1 and operatively connected by a lever or arm L1.

Similarly, the frog F in the positive conductor T is provided with a movable tongue element B, which tongue element is pivotally mounted upon the body of the frog F and operatively connected by a lever or arm L.

The electromagnetic means for operating the movable tongue elements is diagrammatically illustrated as V1, which means comprises a pair of magnet coils M and M1 having a reciprocating plunger V operating therein, and operatively connected to the arms L and L1 by means of connecting rods X.

The connecting rods X are slidably mounted in bearings O, and it will be apparent that energization of coil M1 shifts the plunger V towards trolley frog F1, and that energization of coil M shifts the plunger V towards the trolley frog F. It will be further apparent that shifting plunger

V towards the frog F1 moves the movable tongue elements B and B1 into the dotted positions illustrated, in which position the tongue elements will direct the respective current collectors along the main conductors. Similarly, shifting plunger V towards the frog F moves each movable element B and B1 into engagement with its respective main conductor for directing the respective collectors onto the branch conductors *t* and *g* respectively.

In Figure 1 the characters W and W1 designate the positive and negative current collectors, respectively, and the transverse dotted lines designated by the arrows S, S1 and C, C1 illustrate the relative longitudinal positioning of the current collectors as they approach and leave the trolley frogs F and F1 in the straight ahead direction along the main conductors and in the curve direction onto the branch conductors.

Thus, a trolley coach traveling straight-ahead in a path substantially parallel with the main conductors T and G, will have its collectors positioned as illustrated by the arrows S and S1, while a trolley coach traveling in a curved or angular path relative to the main conductors T and G as it approaches the frogs F and F1 will have its collectors positioned as illustrated by the arrow C. However, after the collectors move through the respective frogs and engage the branch conductors *t* and *g*, the collectors assume the relative position designated by the arrow C1, inasmuch as the coach is ordinarily moving in a path substantially parallel with the branch conductors at such time.

To utilize the aforesaid relative positioning of the current collectors W and W1 as they approach the frogs F and F1 to determine selectively the operation of the electromagnetic means V1, contact devices P and N are positioned adjacent the respective main conductors on the approach side of the frogs F and F1, and arranged so that they will be electrically connected to their respective trolley conductor as the corresponding collector passes therethrough.

As illustrated by the transverse dot-dash line connecting the contact devices P and N, the contact device P is positioned so that it is electrically connected to the positive conductor T before the contact device N is electrically connected to the negative conductor G, when the trolley coach is moving in a path substantially parallel with the main conductors and with the collectors W and W1 positioned as indicated by the arrow S.

However, in positioning the contact device P relative to the contact device N, the contact device N must be retained in a position relative to contact device P, so that it is electrically connected to the negative conductor G before contact device P is connected to the positive conductor T, when the trolley coach is moving in an angular or curved path relative to the main conductors and with the collectors positioned as indicated by the arrow C. As hereinbefore mentioned, the aforesaid relation between the contact devices N and P must be such as to provide the proper operation for the smallest longitudinal distance that the collector W1 may lead the collector W, when the collectors are to be directed onto the branch conductors *t* and *g*.

Accordingly, inasmuch as this longitudinal distance may be very small under certain conditions of operation, I have provided a fast acting relay Q having relay coils J and K and armatures A and A1 respectively.

Therefore, in the illustrated embodiment of my invention, I have arranged the circuits including the contact devices P and N, and the relay coils J and K, so that the relay coil K is energized when collectors W and W1 pass the contact devices P and N in the relative position indicated by the arrow S, and that the relay coil J is energized when the collectors W and W1 pass the contact devices P and N in the relative position indicated by the arrow C.

I have also arranged the aforesaid circuits so that the energization of relay coil K operates its armature A1 to determine selectively the energization of magnet coil M1, while energization of relay coil J operates its armature A to determine selectively the energization of magnet coil M.

I have also provided retaining circuits for each of the relay coils J and K, which circuits are provided with series resistors R and R1 of relatively high resistance for limiting the current to an amount insufficient to raise the armature A or A1, but retaining the current sufficient to retain the armatures in their raised positions. In this respect it is to be noted that the retaining circuits are alternately disconnected from their respective relay coils and that the resistors R and R1 are alternately placed in circuit with their respective magnet coils M and M1. Accordingly, it is evident that current flows through one of said resistors and the corresponding magnet coil, when the corresponding armature is retained in its raised position.

To de-energize the retaining circuit for either relay coil J or K, and thereby to restore the respective armature A or A1 to normal, I have provided a normally-closed contact-device P1 in the main conductor T on the leaving side of the frog F for de-energizing relay K, and another normally-closed contact-device N1 adjacent the branch conductor *g* for de-energizing relay coil J.

Each of the contact devices N1 and P1 are normally electrically connected to their respective conductors and electrically disconnected therefrom when the corresponding collector passes therethrough.

Therefore, it will be apparent that I have provided electrically operated means for retaining the relay and associated circuits in their selectively operated positions until the collectors have completely traversed their respective trolley frogs.

Operation

Normally, the movable tongue elements B and B1 may be in either of their operative positions, but the armatures A and A1 of relay Q assume the positions illustrated in Figure 1.

The magnet coils M and M1 are normally deenergized, and the relay coils J and K are energized by currents of low magnitude. As hereinbefore mentioned, the latter energization of relay coils J and K is insufficient to provide an operation of either armature A or A1 to its raised position.

The circuit providing the low current energization of relay coil J is completed from positive potential T, through the relay coil J, wire 10, contact 9, armature A1, wire 8, resistance R1, wire 13, through the normally closed contact 12 of contact device N1, wire 11 to negative potential via the negative conductor *g*.

Similarly, the circuit providing the low current energization of relay coil K is completed from positive potential via positive conductor T, wire 5, through the normally closed contacts 6 of the contact device P1, wire 20, resistance R,

wire 2, armature A, contact 3, wire 4, through relay coil K to negative potential G.

Current collectors moving straight-ahead along the main conductors

As outlined hereinbefore, a trolley coach moving straight ahead in a path substantially parallel with the main conductors, positions the current collectors substantially as illustrated by the arrow S.

Accordingly, collector W engages contact device P and closes a circuit for energizing relay coil K, before collector W1 engages the contact device N. The circuit for energizing relay coil K is completed from the positive conductor T through the collector W and contact device P, wires 1 and 2, armature A, contact 3, wire 4, coil K to negative potential G.

The aforesaid energization of relay coil K, via contact device P, raises armature A1 out of engagement with contact 9, and into engagement with contact 17. Disengagement of armature A1 and contact 9 opens the low current circuit including resistance R1 and relay coil J, while the raising of armature A1 into engagement with contact 17 renders the low-current retaining-circuit including resistance R and relay coil K effective to retain the armature A1 in its raised position, when the collector W disengages the contact device P.

As the trolley coach continues its straight ahead movement, the collector W1 engages contact device N, thereby closing a circuit for energizing the magnet coil M1 sufficiently to move the plunger V towards the trolley frog F1, thus positioning the movable tongue elements B and B1 for directing the collectors through their respective frogs and along the main conductors T and G.

The circuit for energizing the magnet coil M1 is completed from the positive conductor T, through wire 19, magnet coil M1, wire 18, contact 17, armature A1, wires 8 and 7, through the contact device N and collector W1 to the negative conductor G.

As hereinbefore mentioned, the engagement of armature A1 and contact 17 renders the circuit including the relatively high resistance R1 and magnet coil M1 effective, when the collector W1 is out of engagement with the contact device N. The latter circuit including the resistance R1 and the magnet coil M1 is completed from the positive conductor T, through wire 16, magnet coil M1, wire 13, through the normally closed contacts 12 of contact device N1, wire 11 to negative potential via the negative conductor *g*.

After the collectors pass through their respective frogs, the relative positions of the collectors are substantially as illustrated by the arrow S1, and the collector W subsequently engages the contact device P1, thereby electrically disconnecting the contacts 6 from the positive conductor T.

Disconnecting contacts 6 of the contact device P1 from the positive conductor T, opens the retaining circuit for relay coil K, and thus restores the armatures and circuits to their normal conditions, as illustrated in Figure 1.

Current collectors moving from the main conductors onto the branch conductors

As outlined hereinbefore, a trolley coach moving in a curved or angular path relative to the main conductors, positions the current collectors as illustrated by the arrow C.

Accordingly, collector W1 engages contact device N and closes a circuit for energizing relay coil J, before collector W engages the contact device P. The circuit for energizing relay coil J is completed from positive potential T through coil J, wire 10, contact 9, armature A1, wires 8 and 7, through the contact device N and current collector W1 to the negative conductor G.

The aforesaid energization of relay coil J, via contact device N, raises armature A out of engagement with contact 3 and into engagement with contact 14. Disengagement of armature A and contact 3 opens the low current circuit including resistance R and relay coil K, while the raising of armature A into engagement with contact 14 renders the low-current retaining-circuit including resistance R1 and relay coil J effective to retain the armature A in its raised position, when the collector W1 disengages the contact device N.

As the trolley coach continues its movement to the branch conductors, the collector W engages contact device P, thereby closing a circuit for energizing magnet coil M sufficiently to move the plunger V towards the trolley frog F, thus positioning the movable tongue elements B and B1 for directing the collectors through their respective frogs and onto the branch conductors *t* and *g*.

The circuit for energizing the magnet coil M is completed from the positive conductor T, through the collector W and contact device P, wires 1 and 2, armature A, contact 14, wire 15, magnet coil M, wire 16 to the negative conductor G.

As hereinbefore mentioned, the engagement of armature A and contact 14 renders the circuit including the relatively high resistance R and magnet coil M effective, when the collector W is out of engagement with the contact device N The latter circuit including the resistance R and the magnet coil M is completed from the positive conductor T, through wire 5 and the normally closed contacts 6 of contact device P1, wire 20, resistance R, wire 2, armature A, contact 14, wire 15, magnet coil M, wire 16 to the negative conductor G.

After the collectors pass through their respective frogs, the relative positions of the collectors are substantially as illustrated by the arrow C1, and the collector W1 subsequently engages the contact device N1, thereby electrically disconnecting contacts 12 from the negative branch conductor *g*.

Disconnecting contacts 12 of the contact device N1 from the negative conductor *g*, opens the retaining circuit for relay coil J, and thus restores the armatures and circuits to their normal conditions, as illustrated in Figure 1.

Having thus described my invention, I claim:

1. In a switching system for a pair of current collectors mounted upon a vehicle; a source of power; a pair of main trolley-conductors, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two positions for guiding a collector either along the corresponding main conductor or from the said main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to

the other of its operable positions as determined selectively by the selective energization of the said electromagnets; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices having a normally-open switch adapted to be closed by the corresponding collector in passing the said device; a pair of relays, each relay having an operating coil and switches operated thereby; an operating circuit for the operating coil of one of the said relays including the source of power, the normally-open switch of the contact device located adjacent one of the said conductors and a normally closed switch of the other of said relays; an operating circuit for the relay coil of the other of said relays including the source of power, the normally-open switch of the contact device located adjacent the other of said conductors and a normally closed switch of the said one relay; an operating circuit for one of the said electromagnets including the source of power, the normally-open switch of the contact device located adjacent the said other conductor and a normally-open switch of the said one relay; an operating circuit for the other of said electromagnets including the source of power, the normally-open switch of the contact device located adjacent the said one conductor and a normally-open switch of the said other relay; the position of the current collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the said positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to determine selectively the energization of the operating coils of the said relays in accordance with the selective closing of the switches of the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said devices, thereby to determine selectively the energization of the operating circuits of the said electromagnets; and means, operatively associated with the actuating mechanism for the said one movable element and the said other movable element, for correspondingly moving the said other movable element to its corresponding operable positions.

2. A system as defined in the preceding claim including a contact device located adjacent one of the main conductors beyond the leaving end of the corresponding frog, and a contact device located adjacent one of the branch conductors beyond the leaving end of the corresponding frog, each of the latter contact devices having a normally-closed switch adapted to be opened by the corresponding collector in passing the said device; a retaining circuit for the relay coil of the said one relay including the source of power, the normally-closed switch of the aforesaid contact device located adjacent the main conductor and a normally-closed switch of the said other relay; and a retaining circuit for the relay coil of the said other relay including the source of power, the normally-closed switch of the aforesaid contact device located adjacent the branch conductor and a normally-closed switch of the said one relay.

3. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two positions for guiding a collector either along the corresponding main conductor or from the said main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be electrically connected to the corresponding main conductor by a collector passing the said device; a pair of relays, each relay having an operating coil and switches operated thereby; a control circuit for energizing the operating coil of one of said relays including the contact device adjacent one of said conductors, a normally-closed switch of the other of said relays and an electrical connection to the other of said conductors; a control circuit for energizing the operating coil of the other of said relays including the contact device adjacent the said other conductor, a normally closed switch of the said one relay and an electrical connection to the said one conductor; an operating circuit for one of said electromagnets including the contact device adjacent the said other conductor, a normally-open switch of the said one relay and an electrical connection to the said one conductor; an operating circuit for the other of said electromagnets including the contact device for the other of said electromagnets including the contact device adjacent the said one conductor, a normally-open switch of the said other relay and an electrical connection to the said other conductor; the position of the current collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the said positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to connect selectively the said contact devices to their respective conductors as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said contact devices, thereby to determine selectively the energization of the operating coils of the said relays and the selective energization of the said electromagnets as determined by the selective energization of the operating coils of the said relays; and means, operatively associated with the actuating mechanism for the said one movable element and the said other movable element, for correspondingly moving the said other movable element to its corresponding operable positions.

4. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements

including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the frogs, each of the said devices adapted to be electrically connected to the corresponding main conductor by a collector passing the said device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to connect selectively the said contact devices to their respective conductors as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said devices; a relay having an operating coil and a normally-open switch closed by the energization of the said operating coil; a circuit for energizing the said operating coil including the main conductors and the contact device adjacent one of the said main conductors; an operating circuit for one of the aforesaid electromagnets including the main conductors, the normally-open switch of the said relay and the contact device adjacent the other of said conductors; control means operatively associated with the said relay and the contact device adjacent the said other main conductor, for retaining the said switch open when the contact device adjacent the said other conductor is connected to its respective conductor before the device adjacent the said one conductor is connected to its respective conductor; means, operatively associated with the said control means and the contact device adjacent the said one conductor, for rendering ineffective the said control means when the contact device adjacent the said one conductor is connected to its respective conductor before the device adjacent the other conductor is connected to its respective conductor, thereby to operate selectively the said actuating mechanism and associate means for moving each of the said movable elements to one of their operable positions, when the normally-open switch of the relay is closed and the contact device adjacent the said other conductor is electrically connected thereto; and means operatively associated with the other of said electromagnets for energizing the same, thereby to operate the said actuating mechanism and associate means for moving each of the said movable elements to the other of their operable positions.

5. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices having a normally-open switch adapted to be closed by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to close selectively the normally-open switches of the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the contact devices; a first relay having an operating coil, a normally-closed switch opened by the energization of the said coil and a normally-open switch closed by the energization of the said coil; a second relay having an operating coil and a normally-closed switch opened by the energization of the latter coil; a circuit for energizing the operating coil of the said first relay including the main conductors, the normally-closed switch of the said second relay and the normally-open switch of the contact device adjacent one of said conductors; an operating circuit for one of the aforesaid electromagnets including the main conductors, the normally-open switch of the first relay and the normally-open switch of the contact device adjacent the other of said conductors; a circuit for energizing the operating coil of the said second relay including the main conductors, the normally-closed switch of the first relay and the normally-open switch of the contact device adjacent the said other conductor; thereby to operate selectively the said actuating mechanism and associate means for moving each of the said movable elements to one of their operable positions, when the normally-open switch of the said first relay is closed and the normally-open switch of the contact device adjacent the said other conductor is closed; and means operatively associated with the other of said electromagnets for energizing the same, thereby to operate the said actuating mechanism and associate means for moving each of the said movable elements to the other of their operable positions.

6. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable posi-

tions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the contact devices; a relay having an operating coil and a normally-open switch closed by the energization of the said operating coil; means operatively associated with the said operating coil and the contact device adjacent one of the said main conductors, for energizing the said coil; means operatively associated with one of said electromagnets, the normally-open switch of the said relay, and the contact device adjacent the other of said main conductors, for energizing the said one electromagnet when the normally-open switch of the said relay is closed and the contact device adjacent the said other conductor is actuated; control means operatively associated with the said relay and the contact device adjacent the said other main conductor, for retaining the said switch open when the contact device adjacent the other of said conductors is actuated before the contact device adjacent the said one conductor; means operatively associated with the said control means and the contact device adjacent the said one conductor, for rendering ineffective the said control means when the contact device adjacent the said one conductor is actuated before the contact device adjacent the said other conductor thereby to operate selectively the said actuating mechanism and associate means for moving each of the said movable elements to one of their operable positions, when the normally-open switch of the relay is closed and the contact device adjacent the other of said conductors is actuated; and means operatively associated with the other of said electromagnets for energizing the same, thereby to operate the said actuating mechanism and associate means for moving each of the said movable elements to the other of their operable positions.

7. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including an electromagnet operably associated therewith for moving the said one element to one of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable position; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said devices; a relay having an operating coil and a normally-open switch closed by the energization of the said operating coil; means operatively associated with the said operating coil and the contact device adjacent one of the said main conductors, for energizing the coil of the said relay; means operatively associated with the said electromagnet, the normally-open switch of the said relay, and the contact device adajcent the other of said main conductors, for energizing the said one electromagnet when the said normally-open switch of the said relay is closed and the contact device adjacent the other of said conductors is actuated; control means operatively associated with the said relay and the contact device adjacent the said other conductor, for retaining the said switch open when the contact device adjacent the other of said main conductors is actuated before the contact device adjacent the said one conductor; means operatively associated with the said control means and the contact device adjacent the said one conductor, for rendering ineffective the said control means when the contact device adjacent the said one conductor is actuated before the contact device adjacent the said other conductor; means operatively associated with the said one element for moving the said one element to the other of its operable positions; and means operatively associated with the said other element, for moving the same to the other of its operable positions.

8. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact de-

devices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the contact devices; a pair of relays, each relay having an operating coil and a normally-open switch closed by the energization of the corresponding coil; means operatively associated with the coil of one of said relays and the contact device adjacent one of the said main conductors, for energizing the coil of the said one relay; means operatively associated with the coil of the other of said relays and the contact device adjacent the other of said main conductors, for energizing the coil of the said other relay; means operatively associated with one of said electromagnets, the switch of the said one relay, and the contact device adjacent the other of said conductors, for energizing the said one electro-magnet when the normally-open switch of the said one relay is closed and the contact device adjacent the said other conductor is actuated; means operatively associated with the other of said electromagnets, the switch of the said other relay, and the contact device adjacent the said one conductor, for energizing the said other electromagnet when the normally-open switch of the said other relay is closed and the contact device adjacent the said one conductor is actuated; a first control means operatively associated with the said one relay and the contact device adjacent the said other conductor, for retaining the switch of the said one relay open when the contact device adjacent the other of said conductors is actuated before the contact device adjacent the said one conductor; a second control means operatively associated with the said other relay and the contact device adjacent the said one conductor, for retaining the switch of the said other relay open when the contact device adjacent the said one conductor is actuated before the contact device adjacent the said other conductor; means operatively associated with the said first control means and the contact adjacent the said one conductor, for rendering ineffective the said first control means when the contact device adjacent the said one conductor is actuated before the contact device adjacent the said other conductor, thereby to operate selectively the said actuating mechanism and associate means for moving each of the said movable elements to one of their operable positions, when the normally-open switch of the said first relay is closed and the contact device adjacent the other of said conductors is actuated; and means operatively associated with the said second control means and the contact device adjacent the said other conductor, for rendering ineffective the said second control means when the contact device adjacent the said other conductor is actuated before the contact device adjacent the said one conductor, thereby to operate selectively the said actuating mechanism and associate means for moving each of the said movable elements to the other of their operable positions, when the normally-open switch of the said other relay is closed and the contact device adjacent the said one conductor is actuated.

9. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the contact devices; a pair of relays, each relay having an operating coil and switches operated thereby; a control circuit for energizing the coil of one of the said relays including the contact device adjacent one of said conductors, a normally-closed switch of the other of said relays and an electrical connection to the other of said conductors; a control circuit for energizing the operating coil of the other of said relays including the contact device adjacent the said other conductor, a normally-closed switch of the said one relay and an electrical connection to the said one conductor; means operatively associated with one of said electromagnets, a normally-open switch of the said one relay, and the contact device adjacent the other of said conductors, for energizing the said one electromagnet when the normally-open switch of the said one relay is closed and the contact device adjacent the said other conductor is actuated; and means operatively associated with the other of said electromagnets, a normally-open switch of the said other relay, and the contact device adjacent the said one conductor, for energizing the said other electromagnet when the normally-open switch of the said other relay is closed and the contact device adjacent the said one conductor is actuated.

10. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a contact device located adjacent each

main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact deveices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said devices; a pair of relays, each relay having an operating coil and a normally-open switch closed by the energization of the corresponding coil; means operatively associated with the coil of one of said relays and the contact device adjacent one of the said main conductors, for energizing the coil of the said one relay; means operatively associated with the coil of the other of said relays and the contact device adjacent the other of said main conductors, for energizing the coil of the said other relay; means operatively associated with one of the said electromagnets, the normally-open switch of the said one relay, and the contact device adjacent the said other conductor, for energizing the said one electromagnet when the normally-open switch of the said one relay is closed and the contact device adjacent the said other conductor is actuated; means operatively associated with the other of said electromagnets, the normally-open switch of the said other relay, and the contact device adjacent the said one conductor, for energizing the said other electromagnet when the normally-open switch of the said other relay is closed and the contact device adjacent the said one conductor is actuated; a first control means operatively associated with the said one relay and the contact device adjacent the said other conductor, for retaining the switch of the said one relay open when the contact device adjacent the other of said conductors is actuated before the contact device adjacent the said one conductor; and a second control means operatively associated with the said other relay and the contact device adjacent the said one conductor, for retaining the switch of the said other relay open when the contact device adjacent the said one conductor is actuated before the contact device adjacent the said other conductor.

11. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a single contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the position relative one to the other longitudinally entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, and the positioning of the collectors and the aforesaid predetermined position of the contact devices being such as to actuate selectively the contact devices as determined by the angularity of the vehicle relative to the main conductors as the collectors pass the said devices; a pair of relays, each relay having an operating coil and a normally-closed switch opened by the energization of the corresponding coil; a control circuit for energizing the coil of one of the said relays including the contact device adjacent one of said conductors, the normally-closed switch of the other of said relays and an electrical connection to the other of said conductors; a control circuit for energizing the operating coil of the other of said relays including the contact device adjacent the said other conductor, the normally-closed switch of the said one relay and an electrical connection to the said one conductor; whereby the said relays are selectively operated in accordance with the selective actuation of the said contact devices; switch means operatively associated with the said relays and actuated selectively as determined by the selective actuation of the said relays; and means operatively associated with the said switch means and the said electromagnets, for energizing selectively the said electromagnets as determined by the selective actuation of the said switch means.

12. In a switching system for a pair of current collectors mounted upon a vehicle; a pair of main trolley-conductors of opposite polarity, and a branch conductor for each main conductor; a trolley frog at the junction of each main and branch conductor, each frog having a movable element operable either to one or to the other of two operable positions for guiding a collector either along the corresponding main conductor or from the main conductor onto the corresponding branch conductor; an actuating mechanism for one of the said movable elements including two electromagnets operably associated therewith for moving the said one element either to one or to the other of its operable positions; means operably associated with the said actuating mechanism and the other of said movable elements, for correspondingly moving the said other movable element to its corresponding operable positions; a single contact device located adjacent each main conductor in a predetermined position relative one to the other longitudinally of the main conductors and in advance of the entering end of the said frogs, each of the said devices adapted to be actuated by a collector passing the corresponding device; the position of the collectors relative one to the other longitudinally of the main conductors varying with the angularity of the vehicle relative to the main conductors, the positioning of the said collectors as they pass the contact devices and the aforesaid predetermined position of the contact devices being such that the device adjacent one conductor is actuated before the device adjacent the other conductor when the vehicle moves in a path substantially parallel with the main conductors, and such that the

device adjacent the said other conductor is actuated before the device adjacent the said one conductor when the vehicle moves in an angular path relative to the main conductors and substantially in the direction of the branch conductors; a pair of relays, each relay having a normally deenergized operating coil and a normally-open switch closed by the energization of the corresponding coil; a first control circuit for energizing the operating coil of one of the said relays including the contact device adjacent one of the said conductors and an electrical connection to the other of said conductors; a second control circuit for energizing the operating coil of the other of said relays including the contact device adjacent the other of said conductors and an electrical connection to the said one conductor; means operatively associated with the first control circuit and operating in response to an energization of the said other relay, for retaining the relay coil of the said one relay deenergized; means operatively associated with the second control circuit and operating in response to an energization of the said one relay, for retaining the relay coil of the said other relay deenergized; whereby the said relay coils are energized selectively as determined by the selective actuation of the said contact devices; means operatively associated with one of the said electromagnets and the normally-open switch of one of the said relays, for energizing the said one electromagnet; and means operatively associated ewith the other of said electromagnets and the normally open switch of the other of said relays, for energizing the said other electromagnet, whereby the said electromagnets are energized selectively as determined by the selective closing of the said normally-open switches.

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