(No Model.) 4 Sheets—Sheet 1.

J. H. GUEST.

CLOSED CONDUIT ELECTRIC RAILWAY.

No. 537,414. Patented Apr. 9, 1895.

Fig 2.

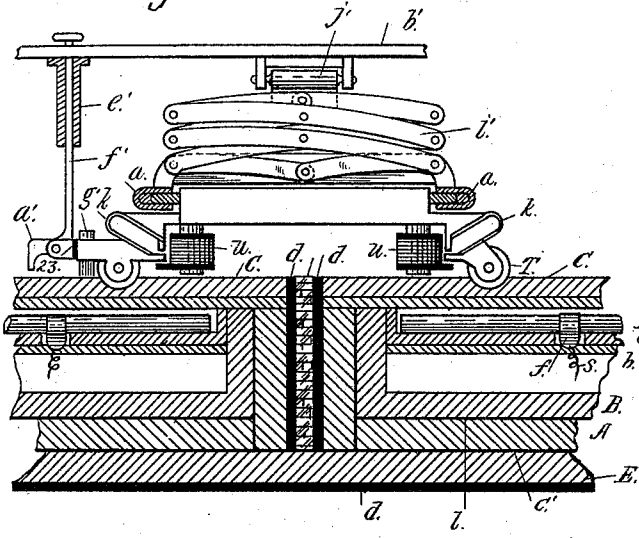


Fig 1.

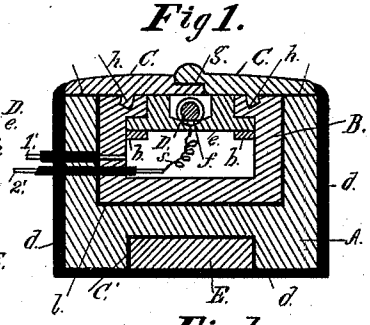


Fig 5.

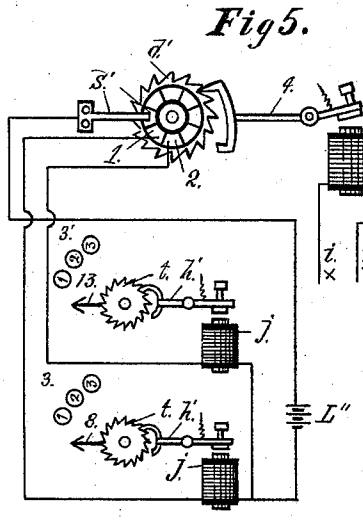


Fig 6.

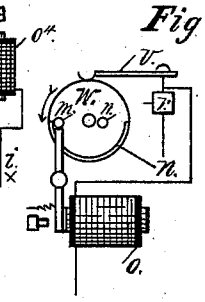
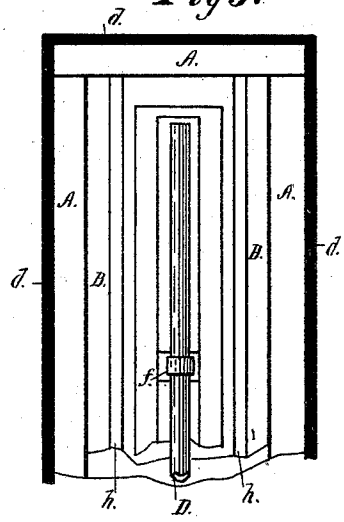


Fig 3.



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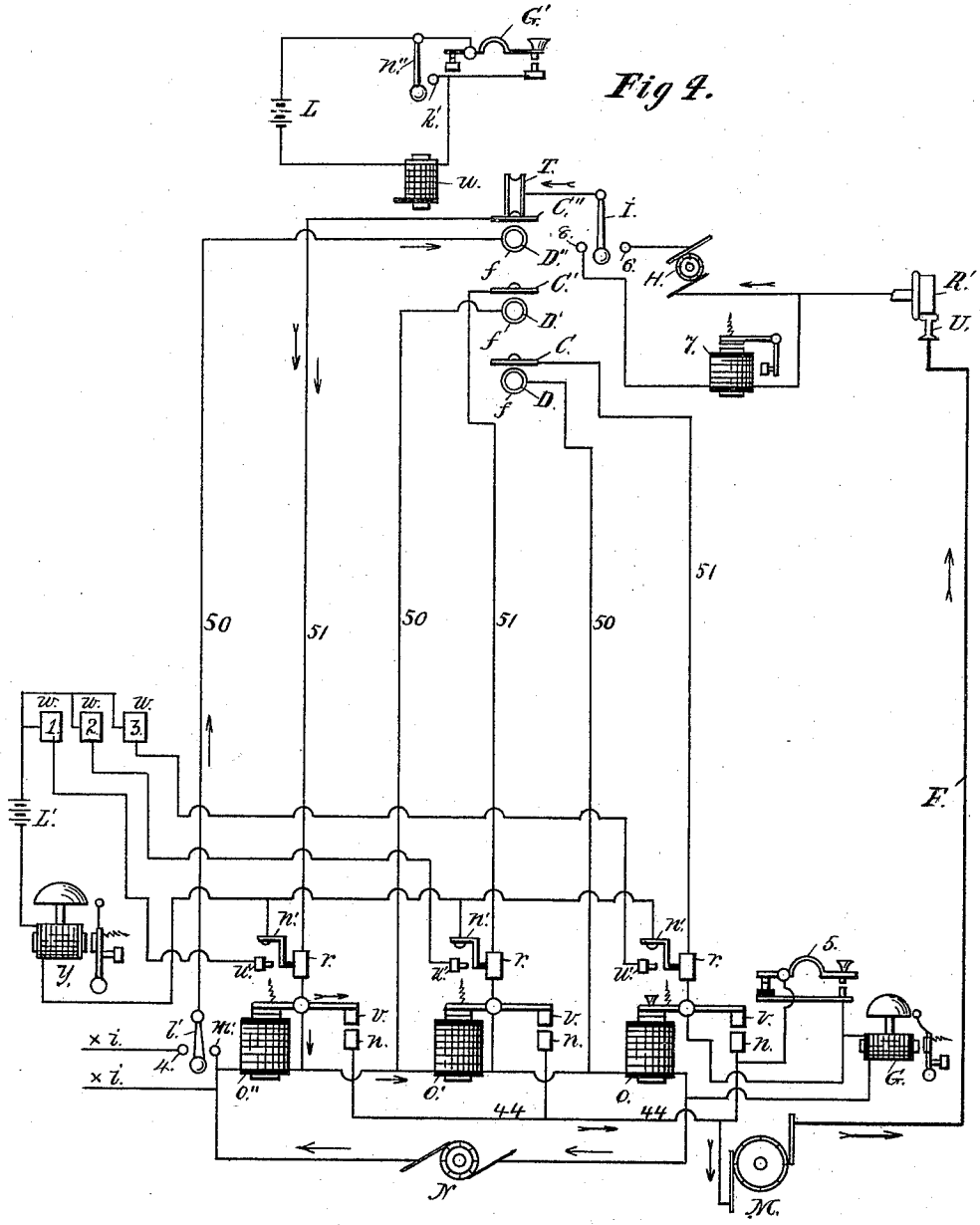
(No Model.) 4 Sheets—Sheet 2.

J. H. GUEST.

CLOSED CONDUIT ELECTRIC RAILWAY.

No. 537,414. Patented Apr. 9, 1895.

Fig 4.



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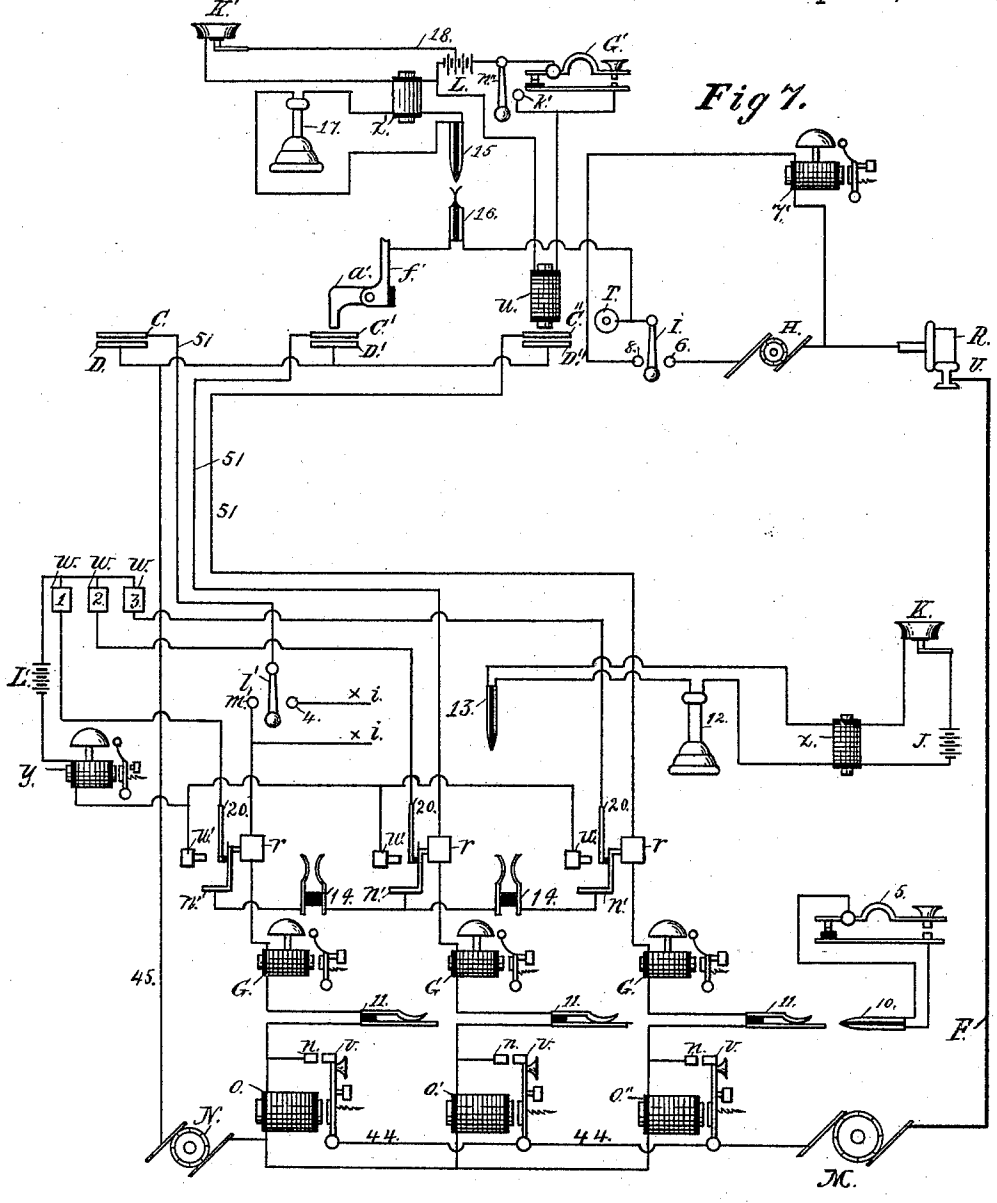
CLOSED CONDUIT ELECTRIC RAILWAY.

No. 537,414. Patented Apr. 9, 1895.

Fig 7.



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4 Sheets—Sheet 4.

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CLOSED CONDUIT ELECTRIC RAILWAY.

No. 537,414. Patented Apr. 9, 1895.

Fig 9.

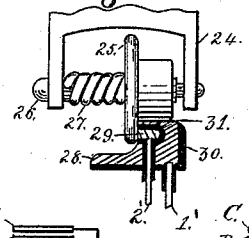

Fig 8.

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UNITED STATES PATENT OFFICE.

JOHN H. GUEST, OF BROOKLYN, NEW YORK.

CLOSED-CONDUIT ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 537,414, dated April 9, 1895.

Application filed February 17, 1893. Serial No. 462,676. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. GUEST, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improved Electric Railway, of which the following is a specification.

My invention relates to electric railway systems wherein the motive power is obtained through a moving contact or connection with a contact conductor suitably joined with a stationary source of electricity.

The object of my invention is to produce an effective and convenient system without the use either of overhead wires or conductors, or of slotted conduits, and one which shall be free from the objections of leakage and of danger to life and property incident to those systems wherein a charged contact conductor, or one which is liable to be accidentally charged by contact, is placed on the surface of the street or in position to be touched by persons, animals, or foreign objects. In my invention the contact conductor is placed on the street surface but mere contact of electric conducting bodies therewith cannot result in charging the same as in some other systems.

A further object of my invention is to provide for the automatic announcement at the central station, of any damage or derangement of the system, and to locate the square or block where the trouble exists.

Another object is to make all the electric switches employed in charging the sections of the contact conductor readily accessible for repair and inspection, and to avoid the necessity of placing them underground where they are more liable to derangement.

My invention also permits the car conductor to telegraph or telephone from his car, at any point, to the central station and to receive answers and directions therefrom.

By suitable adjuncts to the system as hereinafter described, the time each car leaves the stable may be automatically announced, and also, if desired, the time when it reaches the terminus, and its location along the route can be known at any time.

Other advantages and functions of the system will be apparent from the subjoined description taken in connection with the accompanying drawings.

In carrying out my invention I divide the contact or surface conductor from which the car takes off current by a suitable revolving or rubbing contact, into sections insulated from one another and of greater or less length as convenience may dictate. In large cities, or where traffic is heavy, they may be no more than a single block long. From each of these sections I run a separate feed wire to a common point preferably in or near the power station or source and there locate suitable electric switch-devices whereby each feeder wire may be connected to the bus-bar supply conductor or other charged conductor which is kept charged by the power dynamo or dynamos of the system. The said switch devices which are thus massed in convenient location for inspection and repair and in a situation where they will not be liable to damage, are closed automatically by the car when it reaches each section. One of the important features of operating my invention consists in operating said switch devices by an electro-magnet or magnets whose controlling circuits are over the power feeder wires and by a return circuit independent and separate from the feeder wires and from the power return.

The switch controlling magnet or magnets located as above described and controlling the separate feeders extending from the power source to the sections, may be controlled by the car in any desired manner, but the preferable way is to employ magnetizable circuit closing devices at the several sections acting by the magnetism of a device moving with the vehicle. By so actuating them they may be inclosed in water tight boxes or receptacles, and the use of exposed conducting surfaces or contact conductors for actuating them may be also avoided.

I prefer to employ in this part of the system a sectional closed conduit or chamber in which is a magnetizable conductor adapted to be moved or lifted by an electro-magnet carried by the car for the purpose of closing a circuit of the switch magnet for the feeder of the corresponding section. The chamber containing said conductor may be completely sealed and the conductor be made to close circuit upon the inner or unexposed surface of the contact conductor section, thus utiliz-

ing the feeder wires in the operation as already explained, the movable magnetizable conductor being connected to the independent return.

The magnetizable conductor may be of any desired construction as, for instance, of loose sheets of iron or of flexible iron cable. I prefer to use the latter. Inasmuch as in my system, the said conductor only carries the current for controlling the switch magnets, it may be light, while moreover the objections incident to its use, if it be made to carry the working or motive power current as has been before proposed, are reduced.

An electro-magnet or magnets carried by the car serve to lift and hold said conductor in contact with the working conductor, thereby keeping the switch electro-magnet for the feeder of the corresponding section in condition for keeping the feeder connection intact so long as the car is on the section. When the car leaves the section the magnetizable conductor breaks a circuit of said magnet and the switch at the central station or other convenient point disconnects the feeder of the contact conductor from the motive current source.

In my invention the magnet on the car is arranged to drop the iron conductor before the working contact leaves the contact conductor, so that the sparking or flashing is practically all transferred to the electro-magnetic switch instead of being either upon the working contact of the car or upon the interior of the sectional closed conduit, as would be the case if the magnetizable conductor were used to carry the working current of the system. The break between the iron conductor and the contact conductor is only a break of the current necessary to operate the switch magnet and the flashing and burning are therefore small. In this system the switch magnets may be worked on either normally closed or normally open circuit.

Having described the general principles of my invention, I will proceed to describe the same more in detail in connection with the accompanying drawings, and to more particularly set forth other features of the system not yet explained.

In the accompanying drawings:—Figure 1, is a cross section through one of the sections of closed conduit which I prefer to employ. Fig. 2, is a longitudinal vertical section at the abutting ends of said sections, and shows in elevation the carriage upon which the traveling contacts that move over the working conductor are suspended as well as the magnets for operating on the magnetizable conductor to control the action of the electro-magnetic switches as hereinafter described. Fig. 3, is a plan of one end of a section with the lid removed. Fig. 4, is a diagram of a system containing my invention. Fig. 5, is a diagram for a form of register or recorder that may be used for showing when each car leaves the station. Fig. 6, shows a preferred construction of electro-magnetic switch for governing the connections of the several feeders with the source of power. Fig. 7, is a diagram of a modified arrangement of circuits and apparatus adapted for carrying out my invention. Fig. 8, illustrates a modification wherein a single electro-magnet is employed for operating the switches of a number of feeder wires, and the switch is so organized that rear end collisions are prevented by blocking the following train through its inability to obtain power from the feeder of sections at the rear of the train ahead. Fig. 9, shows a device that may be used on a car for controlling the circuits of the switch magnet or magnets which connect the feeders to the bus-bar source of supply and disconnect it therefrom as the car passes on and off the sections.

I will first proceed to describe the form of sectional closed conduit that I prefer to use and also the construction of the current collecting contact and magnetic devices upon the vehicle adapted to operate upon the magnetizable circuit closer within said conduit.

A, is a wooden trough or boxing closed at its ends as shown in Figs. 2 and 3, and containing an iron box or trough B, also closed at its ends and preferably coated with insulating material as seen at 1.

E, is a stringer of iron or wood fastened to the ties for holding the boxing A, in position. The whole may be surrounded as indicated at *d*, with waterproof or insulating material.

D, is a magnetic conductor extending preferably the whole length of the section and supported in a tray *e*, preferably of insulating material, and immediately beneath a cap C, of conducting material. The conductor D, may be of a number of iron strands or plates loosely assembled as well understood in the art and adapted to be lifted from its tray or seat against the under surface of the cap C. Connection with the conductor D, is made by a strip or collar *f*, to which is joined a flexible conductor *s*, which is joined with a conductor 2′, leading through the side of the boxing or casing and properly sealed or insulated at the point where it passes the casings A, B.

The cap C, closes the top of the conduit water-tight being properly packed at its edges, but is in electrical connection with the iron trough B, and is held down in place thereon by tongues engaging grooves *h*, or by other suitable means. The cap C, is preferably made of two parts lapped together and packed at *g*, to prevent the entrance of moisture. The cap C, is the working or contact conductor upon which moves the rolling or rubbing contact carried by the car.

The connection between the working contact C, and the electro-magnetic switch before referred to and to be presently described is made over a feeder wire which enters the section by conductor 1′, (see Fig. 1,) through a suitable packing or insulation and is joined to the iron trough B, and so with the cap C.

Cap C, is preferably made of phosphor-bronze or other conducting non-magnetic material and has a slight projection extending longitudinally over it and forming a rail upon which a contact wheel may be guided.

The several sections may be insulated from one another, as indicated in Fig. 2, by the insulation *d*, and the space may be also packed as indicated with stone or other material.

The working contacts carried by the vehicle consist of the trolley wheels T, attached to springs *k*, that are secured to a carriage which, as indicated at *a*, is suspended from a lazy-tongs *i'*, hung from the bottom of the car or vehicle or from the truck a part of which is indicated at *b'*, by a pivotal support *j'*. By this device the trolley and the magnets mounted on the carriage may accommodate themselves to the movement of the car.

It will be noticed that the pivotal support for the lazy-tongs has its axis parallel to the line of travel while the axis of the connecting pivots is transverse to the line of travel. By thus putting the axes of suspension and of connection at right angles to one another, I provide not only for the up and down movements of the car but also for a rocking movement longitudinally and for a swaying or rocking movement laterally.

Magnets *u*, *u*, are mounted on the carriage between the trolley wheels T. The magnets may be horse-shoe magnets each part *u*, forming a pole thereof, or a series of magnets may be employed for the purpose. These magnets being mounted between the trolley wheels T, it will be seen that whichever way the vehicle moves the magnet which is employed, as before described, for lifting the magnetizable circuit closer D, so as to make contact with C, will drop the same before the collector T, may leave the section of conductor C. The springs *k*, permit the wheels T, to roll easily over the cap C, suitable stops as indicated limiting the upward movement of the trolley. A brush *g'*, may be mounted on the carriage in advance of the trolley wheel to clean the surface of cap C. There is also mounted upon the carriage, and in electrical connection with the parts with which the wheels T, are connected, a contact *a'*, which may be operated by a person on the car through a rod *f'*, working in a suitable guide *e'*, for the purpose of making connection with the working conductor C, of one section while the contacts T, are engaged with the section next to the rear. The purpose of this will be described in connection with diagram Fig. 7.

Referring to Fig. 4, I have indicated three sections of working conductor C, C', C'', each with its appropriate section of magnetizable circuit closer D, D', D''. The dynamo which supplies the working currents for driving the car is indicated at M, and is connected at one pole with the bus-bar or supply conductor 44, from which connection is made at the proper times by contacts *v*, *n*, with the feeder wires leading as indicated to the several working or contact conductors C, C', C''. The other pole of the main dynamo M, connects with the conductor F, joined as shown to the rail U, with which latter the car wheel indicated at R', makes connection in the ordinary way.

H, typifies the propelling motor of the car in the circuit between the collector T, and the car wheel R', in the ordinary manner. In this circuit, on the car, is included an electric switch I, having the two contacts 6, 8, by one of which the circuit on the car is completed through the motor H, and by the other of which the circuit is completed through a relay bell or other signal receiving device, the electro-magnet of which is indicated at 7, and which magnet is of high resistance so as to prevent undue flow of current from the dynamo M, when the magnet is in use. The contacts *v*, *n*, are normally open and are controlled by the electro-magnets *o*, *o'*, *o''*, the said magnets corresponding respectively to the sections C, C', C''. The magnets *o*, *o'*, *o''*, are on normally closed circuit, as indicated, with a generator N, of any suitable character which keeps the said magnets normally charged thereby keeping the contacts *v*, *n*, open. A short circuit for each magnet is completed over the feeder wire 51 joined to a working contact section C, C', C'', and a return wire 50 formed as shown by a connection from the circuit closer D, D', D''. In the case of D'', the return is completed through switch *l'*, when turned to contact *m'*. When D'' and C'', are in contact, *o''*, will lose its power and will remain out of action so long as the magnet *u*, on the vehicle maintains the connection of D'', and C'', so that as will be obvious the dynamo M, will supply current for driving the motor over the feeder connected to the sections of contact conductor C''. When the car passes off said section, the magnet *u*, will first drop the conductor D'', and then the magnet *o''*, will break the connection of the dynamo M with the feeder of C'', as already explained. At the same time the magnet in advance on the vehicle will complete the connection for the next section C', by drawing D', into contact with C', and thereby causing the armature of magnet *o'*, to close the connection at *v*, *n*, of the feeder of the working or contact section C'.

In the system as thus arranged it is obvious that the switch controlling magnets for the several feeders are on normally closed circuit and connection for the feeder is made by short circuiting them, but, as indicated in Fig. 7, each magnet may be operated on a normally open circuit and a common return wire used for the several sections D, D', D'', of magnetizable conductor. The magnets *u*, may be energized by battery L, carried on the vehicle, as indicated in the diagram Fig. 4. In the circuit of said battery is a switch *n''*, which normally closes the circuit of magnet *u*, by contact *k'*, but when open, shunts the circuit

into the key G′. As will be obvious, by operating the key the circuit closer which operates upon the magnets *o*, *o′*, *o″*, will be caused to make and break circuit, and a signal may be thereby sent to the central station from any section of the system. The signal may be received by the magnets *o*, or preferably by an independent bell magnet, one of which is indicated at G, Fig. 4 in the connection with magnet *o*, at the part of the connection which constitutes the short circuit for operating said magnet.

Communication may be had from the central station with the car by means of a key 5 Fig. 4, placed as indicated in the circuit of the feeder wire and adapted to control the circuit of the dynamo M, over said feeder and through the magnets 7, which the conductor or other person places in circuit by means of switch I, as already explained. A separate key might be used for each feeder wire, but preferably it would be used in connection with a jack-knife switch 10 and 11, whereby it might be inserted into the circuit of each feeder as shown in Fig. 7.

In each feeder wire is a fusible plug *r*, adapted to fuse on abnormal current through the circuit. This fuse operates as a circuit controller by reason of the attachment to it of a spring *n′*, which is attached or connected to the fuse at one end and has a bias tending to draw it toward a contact stop, its tendency being, however, restrained by the fuse. The spring is adapted on the blowing of the fuse to fly against a stop *w′*, which stop and spring are connected as shown to the circuit of a battery L′, used in connection with any suitable electric annunciator comprising the usual shutters or indicators *w*, *w*, *w*, and an alarm bell *y*, thereby calling attention to the trouble and locating the section.

It will be obvious that in operating the key 5, Fig. 4, the shunt around the key should be opened which may be done by holding the contacts *v*, *n*, open.

In place of the electro-magnet switch already described, I may use a device such as indicated in Fig. 6, comprising a wheel W, having two stops *m*, *n*, that engage with the armature lever of the magnet *o*, and hold said wheel in the two positions respectively where the spring *v*, will bear on an insulating part of the periphery of the wheel and open a conducting portion of the periphery *n*.

For the purpose of registering or recording automatically the dispatch of cars from any station and keeping track of their movements, I may use the devices to be now described which may be applied to one or more of the sections of working conductor or may be applied only to the section nearest the station from which the car starts and to the terminal section. These devices are located at a central or common station and may be operated as follows:

A switch *l′* Fig. 4, normally makes connection with *m′*, to complete the normal short circuit for the magnet *o″*, which, in this case, it will be supposed is the one controlling the section nearest the starting point. When the switch *l′*, is turned to contact 4, it shunts into the controlling circuit of magnet *o″*, an electro-magnet o^4 Fig. 5, the connecting wires being indicated at *x*, *i*. When the car runs out upon the first section D″, the magnet o^4, will be operated because it is in the circuit closed by contact of E″ and C″, and its armature lever 4, will operate the escapement attached to it and the escape wheel *d′*, controlled thereby will be allowed to rotate one step and actuate a commutator or circuit changer of the usual construction having a circuit closing finger S′.

The several sections of the commutator are connected as shown individually to magnets *j*, which latter are energized by the battery L″, and serve individually, by their armature levers, *h*, *h′*, to actuate the wheel *t* of a register or counter having a pointer which moves over number spaces or divisions of a dial. Through the first closure of circuit of the battery L″, the first register magnet connected with segment 1, of the commutator will be actuated, and the index hand 8, thereof will point to the first number on its scale thereby indicating the first car out. The next car out would obviously operate the index 13, of the next dial. If there be as many indexes as cars and they be rotated in succession, it is obvious that each index will keep tally of the number of trips of each car, always supposing that there are as many dials as there are cars on the line.

It is obvious that a single dial might be used at the car station and a record taken from that dial to show the number of cars sent out, or if a register be connected to the final section of the system also then the differences at any time between the registrations of the two dials would show the number of cars on the line.

In the modification shown in Fig. 7, the several circuit closers D, D′, D″, are connected to a common wire 45, leading from generator N, and the switch magnets *o*, *o′*, *o″*, are in the normally open feeder circuits 51 leading respectively to the contact sections C, C′, C″. Said magnets will each remain excited while the cars are on a section and complete the connection of said feeder wire with the bus-bar or supply conductor 44, joined to the power generator M. Obviously when the car passes off the section and the magnetizable circuit closer breaks the circuit then the corresponding switch magnet will disconnect the feeder wire of that section. The key 5, may be introduced into any feeder wire circuit for the purpose of communicating with the car by means of the jack-knife switch 10, 11. The signal sent by this key may be received on a bell, the electro-magnet of which is indicated at 7′. In this diagram I have shown how a telephone may be used for communicating between the central office and the car.

On the car the telephone receiver is indicated at 17, the induction coil at z', and the transmitter at K', the wire 18, serving to take off the current of a part of the battery L, for oral communication. A jack-knife switch 15, 16, puts the telephone onto a circuit of the car which leads as shown from the switch I, to the contact a', adapted to be operated by rod f', as already described, and thereby brought into connection with the surface section of conductor. In this system when the car conductor sends a signal, to the central station he should have both trolley wheels on one of the sections C, and depress the contact a', onto the next section.

It will be obvious that a car conductor might ring up the central station on any bell G, by operating his key G', and thereby causing the contacts n, v, to make and break the circuit of the generator N, through the electro-magnetic bell G, and the central station may answer through employing the current of generator M, the circuit over the feeder being kept closed for the purpose by pressing the armature of the switch magnet so as to keep the contacts n, v, closed.

The telephone transmitter K, induction coil Z, battery J, and telephone receiver 12, may be used at the central office for communicating with the car. For this purpose the jack-knife switch 13, 14, may be employed, the jaws of the switch 14, being placed in connections between the springs n', of the several fuses or safety plugs. The fuse is modified by insulating the springs n', from the local circuits as shown and allowing them to operate upon supplemental springs 20, which connect to the local annunciator circuit and are pressed back either by springs n', or by their own spring action onto the contacts u', for the purpose of operating the annunciator when the fuse blows.

As will be obvious, when the contact a', makes connection with one section as C', and the collector T, makes connection with the succeeding section, then the insertion of the plug 13, into the jaws 14, between the springs n', connected onto the feeders leading to said sections respectively, will place the telephone or other apparatus connected to 13, in circuit over said feeders as a metallic circuit and through any telephone or other apparatus connected onto the circuit by the jack-knife switch 15, 16. Hence oral or other communication may be had in both directions over the feeder wire circuits independently of the power circuit wire F. As the jaws 14, are normally open, the jack-knife switch will not interfere with the normal operation of the devices in feeding motive power current or in automatically announcing the defective section.

I do not limit myself to any particular construction of electro-magnetic switch for controlling the connection of the several feeder wires at a common point with the source of electric energy for driving the car. Nor do I limit myself to any special devices for controlling the circuits of said electro-magnet when the car passes onto and off the section, but I prefer to employ an electro-magnetic device as described wherein the force of magnetism is used to close the circuit at the section and to thereby cause the electro-magnetic switch to operate as described to connect the feeder of that section with the bus-bar or similar source of electrical energy.

As shown in the diagram Fig. 8, the electro-magnetic switches may be combined in a single device and operated by a single electro-magnet. This device as will presently appear also has the advantage that each car may control the connection of the feeder wires of sections behind it. The electro-magnet o, or o', has its armature provided with an escapement or propelling device whereby a ratchet or other propelling wheel t', may be moved step by step. 32, is a disk which is stationary and 33, is a contact adapted to be moved by the wheel t', over the disk. As will be well understood by electricians, it is not material which is made the stationary and which the movable element of the apparatus. The wheel t', being moved step by step by the action of the magnet, one step when the armature is drawn to the magnet and one when it is released, the arm 33, will be thereby caused to rest first on an insulation space 22 of the disk 32, as indicated, or on a conducting space v. The several conducting spaces v, connect severally with the feeder wires and the contact arm 33, connects with the power generator. The spring n, moves with the contact arm 33, but is so mounted thereon as to be insulated from it as at 21. The spring arm n, holds circuit for the magnet o, by which the switch is operated, since it bears on a disk or ring which is divided into segments which are connected integral with the several segments v, as indicated. The divisions between the segments coincide with the center of the insulating spaces 22. When the armature of the magnet o, is drawn up it causes the arm 33, to make contact with a conducting section of the disk 32, and the circuit of the generator M, is thereby closed over the feeder over which the magnet o, was energized. The armature is held up by the circuit through the magnet o, until the circuit is broken at the section which is for the time being taking the power current from generator M. When the armature falls back the spring n, is carried to the next section of the disk 32, and the arm 33, moves onto an insulating space 22, corresponding to such section. As will be understood, therefore, the arms 33, normally rest on insulation 22, that is to say, when there is no current on the magnet o.

Each disk may be made to operate upon as many sections as desired, but for the sake of illustration only six sections are shown. The switch at the right of the drawings is sup-

posed to have been operated by the passage of the car over two sections connected therewith.

Whatever the number of sections controlled by each magnet or combined in each switch, it will be obvious that the following train must wait for current should it be ahead of time until the train ahead has gone over as many sections as the magnet operates upon, or in other words until the rotary switch has been moved step by step to bring the contact spring *n*, back to connect with the segment which is joined to the feeder wire of the first section that is engaged by the following train at which point it is left by the train ahead when the train ahead passes onto the section connected with the first feeder of the next switch.

In the diagram but two of the feeders for each switch are shown, the four intermediate feeders of the switch at the right being omitted. As will be obvious the rotary switch here operates to connect and disconnect the feeders in succession from the main generator and the adjunct circuit closer and breaker *n*, acts to connect said feeders in succession to the switch operating magnet. At every complete rotation of the rotary switch the last action of the magnet *o*, brings the switch into position to repeat the operation by connecting the first of the feeders to the dynamo M, when the magnet is again excited and so on through the cycle of feeders joined to the switch.

The controlling circuits for the switch devices might be controlled by the car as it passes onto and off each section by a device such as is indicated in Fig. 9, where the contact rail or working conductor of a modified shape is shown in cross section at 28. This rail 28, is to be laid in sections, as before described, and in the side of it is embedded a longitudinal conductor 29, insulated at 31, from the main rail 28. The rail or bar 29, plays the same part as the flexible or magnetic conductor D, already described. Wheel 25, is a current collecting wheel borne in a frame 24, and having its flange arranged to engage with the bar or rail 29, as indicated, thereby completing the connection from 29, to 28, the said parts 29 and 28, being connected respectively with the insulated wires or connections 1′, 2′, as already explained in the description of Figs. 1, 2 and other figures. A spring 27, presses the wheel 25, sidewise into contact with the bar 29. The circuit will remain closed between 1′, and 2′, so long as the collector wheel is on any given section and the operation will be as already explained, the said sections being connected and disconnected by the electro-magnetic switches either operated by separate magnets or combined in one device and operated by a suitable magnet.

The special arrangement of step-by-step switch and sections of working conductor connected with said switch and thrown into circuit consecutively through the operation of the magnet controlling the step-by-step mechanism is not herein claimed but forms the subject of claim in another application for patent filed by me July 6, 1893, Serial No. 479,742.

What I claim as my invention is—

1. The combination, substantially as described, in an electric railway system, of a sectional contact conductor, a series of feeder wires leading from said sections to a common point, electro-magnetic switch devices for controlling the connection of said feeder wires with the source of energy at such point, and a controlling circuit for said switches formed in part over the feeder wires and in part over a conductor or return wire common to said switches and independent of the feeder wires and of the return for the working or power currents.

2. In an electric railway system, the combination substantially as described, of a sectional contact conductor, feed wires connecting said sections with electro-magnetic switches massed or located at a common point and adapted to connect said feeders with a source of power, a magnetizable circuit closer contained in a sealed chamber on the road-bed for each section, and controlling the circuits of the switch controlling magnet or magnets, and an electro-magnet carried by the car for operating said magnetizable circuit closer, as and for the purpose described.

3. In an electric railway system, the combination substantially as described, of a closed conduit having surface or contact conductors normally disconnected from the sources of working or power current, magnetizable circuit closers within said conduit, and electro-magnetic switches controlled by the same for connecting the surface conductor with the source of working or power current.

4. The combination, substantially as described, in an electric railway system, of a sectional surface conductor, a magnetizable contact contained in a sealed chamber, and adapted to make connection with said surface conductor, wires or conductors normally connecting the sections of surface conductor with electro-magnetic switches controlling the connections of the feeders with the source of power, a contact carried by the vehicle and traveling on the surface conductor, and a magnet placed in advance of said contact for operating upon the said magnetizable circuit closer whereby the electro-magnetic switch may be opened before the traveling contact leaves the section.

5. In an electric railway system, the combination substantially as described, of a closed conduit having a surface conductor and an interior magnetic circuit closer, a magnet or magnets carried by the vehicle for lifting the latter into contact with the surface conductor, and electro-magnetic switches on a circuit thus closed for completing the connections of

the surface conductor with the working or power current source.

6. In an electric railway system, the combination, substantially as described, of a working or contact conductor divided into sections insulated from one another, separate power feeder wires connecting the same with a central station, a circuit closer in each feeder at the central station responding to abnormal current on said feeder, and a local annunciator connected with said circuit closer, as and for the purpose described.

7. The combination, in an electric railway system, of a sectional contact or working conductor divided into sections insulated from one another, separate power feeder wires connecting said sections individually with the central station, and an electric recorder or register for one or more of said sections locally governed at the central station by power current flowing over the feeder wire, as and for the purpose described.

8. The combination, substantially as described, in an electric railway system having contact conductors divided into sections insulated from one another and each connected with the central station by an independent feeder, a plurality of electric registers corresponding in number to the number of cars sent out over the line, an electro-magnet in a circuit completed over one of said feeders, and a commutator or circuit closer governed thereby for completing the connections of the register magnets in succession.

9. In an electric railway system, the combination substantially as described, with a contact conductor divided into sections insulated from one another and each connected with the central station over a separate feeder wire, a means at the central office for telephoning or telegraphing over each of said feeder wires, and means upon the car for signaling to the central office, as and for the purpose described.

10. In an electric railway system, the combination, substantially as described, of a sectional closed conduit, a magnetizable conductor therein, feeder wires connecting the sections and also the magnetizable conductors with a central station, an electro-magnet for operating on the magnetizable conductor, and a key or circuit closer on the car for operating the said magnet so as to make and break at pleasure a circuit over the feeder wires whereby the conductor may communicate with the central station.

11. In an electric railway system, the combination, substantially as described, with a sectional contact conductor the sections of which are insulated from one another, separate feeder wires connecting the same with the central station, signaling apparatus on a circuit in the car, and an electric switch for shifting the circuit on the car from the motor to and through the signaling device.

12. The combination in an electric railway system, of a sectional closed conduit having a surface or contact conductor divided into sections connected with the central station over independent feeders, a magnetizable circuit closer in each section of closed conduit, an electro-magnet on the car for operating the same, a key or circuit closer in the circuit of said magnet, a signal bell in the circuit on the car connected with the trolley or moving contact carried by the car, a signal device and switch for connecting the same into the circuit between the movable contact and the return, an independent return from the several magnetizable contacts to the central station, and a signal at the central station in the circuit completed over said common return for responding to the signal sent from the car.

13. In a sectional closed conduit, the combination, substantially as described, of the iron box or trough B, closed at its ends and surrounded by an insulating trough A, a flexible magnetizable conductor D, supported in an insulating tray in said iron trough, the cap or cover C, of conducting material closing the top of the iron trough and sealing the same, a feeder wire or conductor connected to the iron trough, and a return wire or connection joined to the flexible conductor.

14. The combination, substantially as described, of the working or contact conductor on the road-bed, a carriage supported by the vehicle, a working contact mounted on said carriage, and a lazy-tongs suspension having the axes of its connecting pivots transverse to the line of travel and hung from a pivotal support whose axis is parallel to the line of travel, as and for the purpose described.

15. The combination with the insulated sections of working conductor and the separate feeder wires therefor, leading each from the central station, of a fusible plug in each feeder at the station, an annunciator on a local circuit, and circuit closers for the several wires and members of said annunciator held in normal position by said fuses while intact.

16. The combination, substantially as described, of a working or contact conductor for electric railways, divided into sections insulated from one another, a feeder wire or circuit for each section extending therefrom to the central station, a fusible plug in each feeder at the central station, a local or auxiliary circuit controlled thereby, and an annunciator or signal device on said local circuit.

17. The combination, substantially as described, of a working or contact conductor for electric railways, divided into sections insulated from one another, a feeder for each section leading therefrom to the central station and containing a safety fuse at said station, and devices controlled by each safety fuse for indicating or announcing the feeder in which abnormal current flows sufficient to blow said fuse.

18. The combination with the insulated sec-

tions of working or contact conductor and their corresponding feed wires, of normally open connections between said feed wires at a central station or station common to them, and means for including a telephone, telegraph or other electric communicating apparatus in said connection, as and for the purpose described.

Signed at Boston, in the county of Suffolk and State of Massachusetts, this 13th day of February, A. D. 1893.

JOHN H. GUEST.

Witnesses:
CHAS. M. REED,
ALICE R. BROWN.