No. 748,620. PATENTED JAN. 5, 1904.

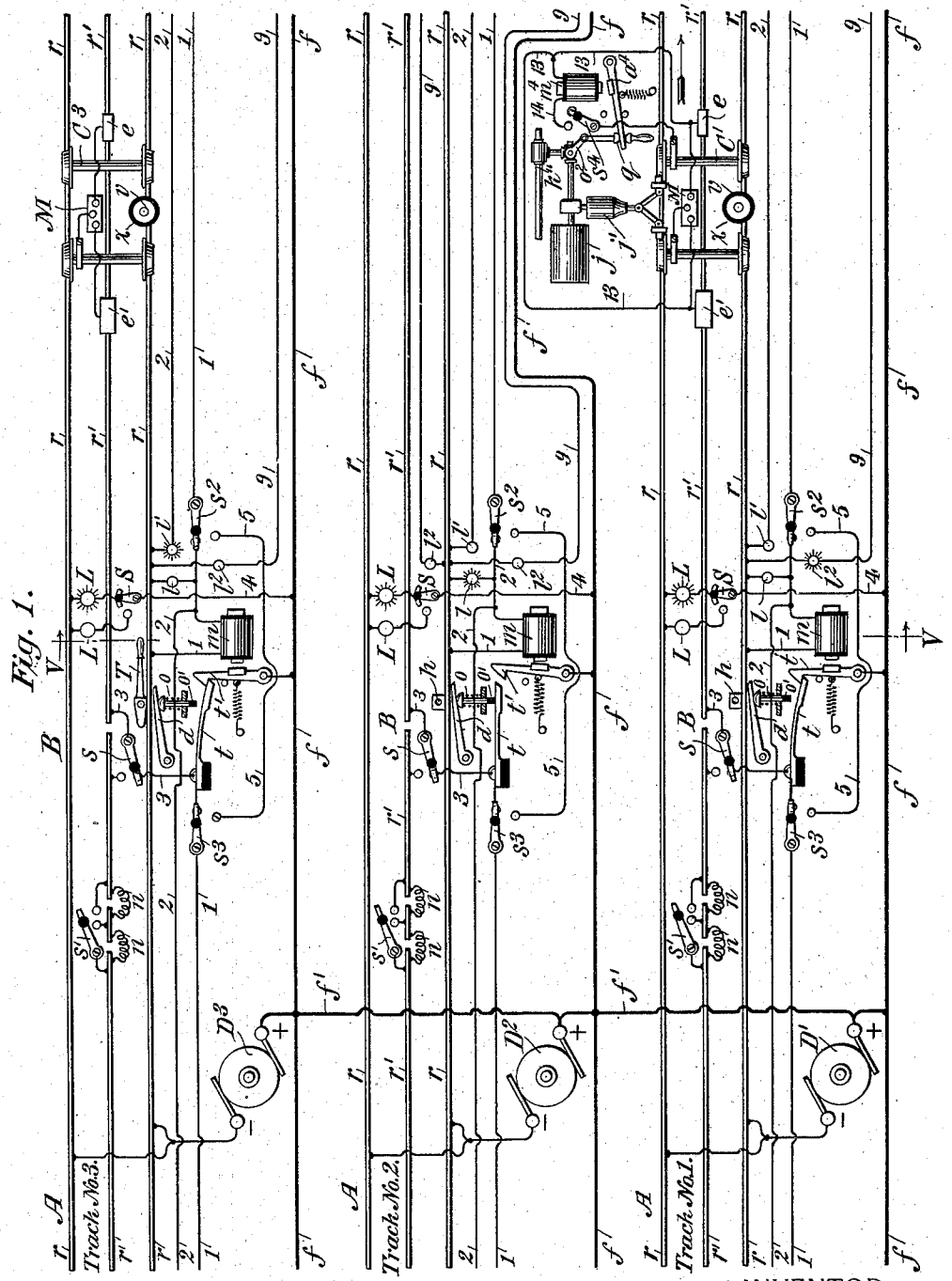
C. J. KINTNER.

ELECTRIC RAILWAY.

APPLICATION FILED MAR. 10, 1902. RENEWED MAY 22, 1903.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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NO MODEL. 6 SHEETS—SHEET 2.

Fig. 1a

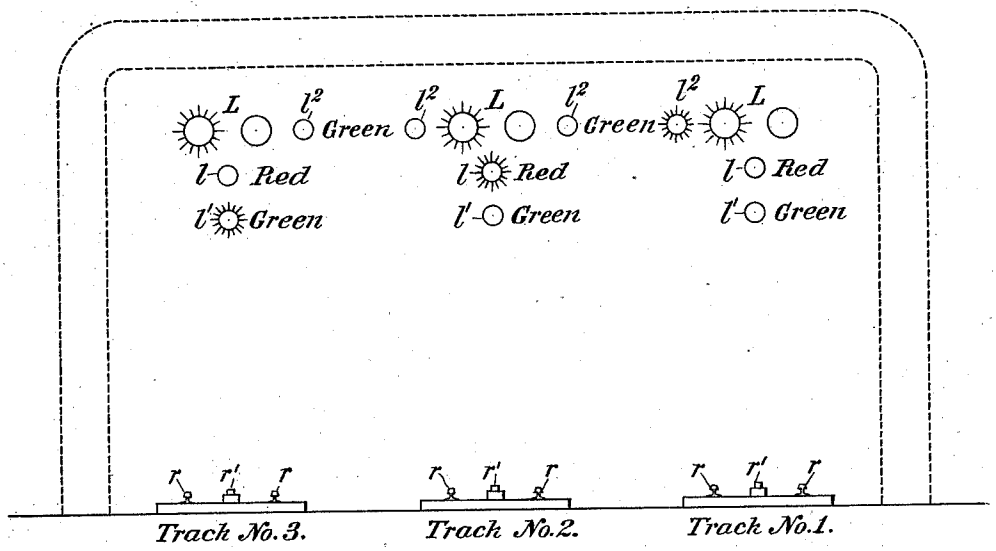
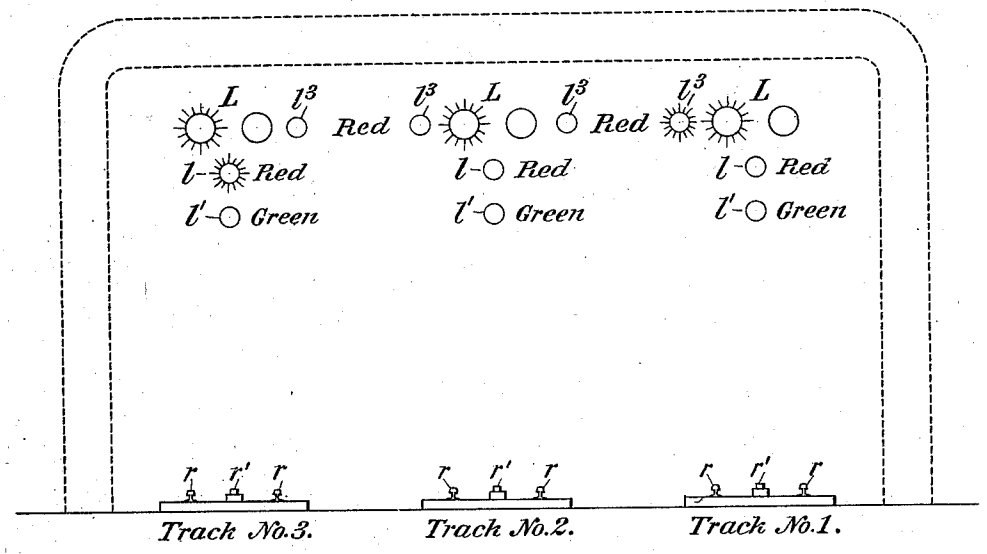


Fig. 2a



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NO MODEL. 6 SHEETS—SHEET 3.

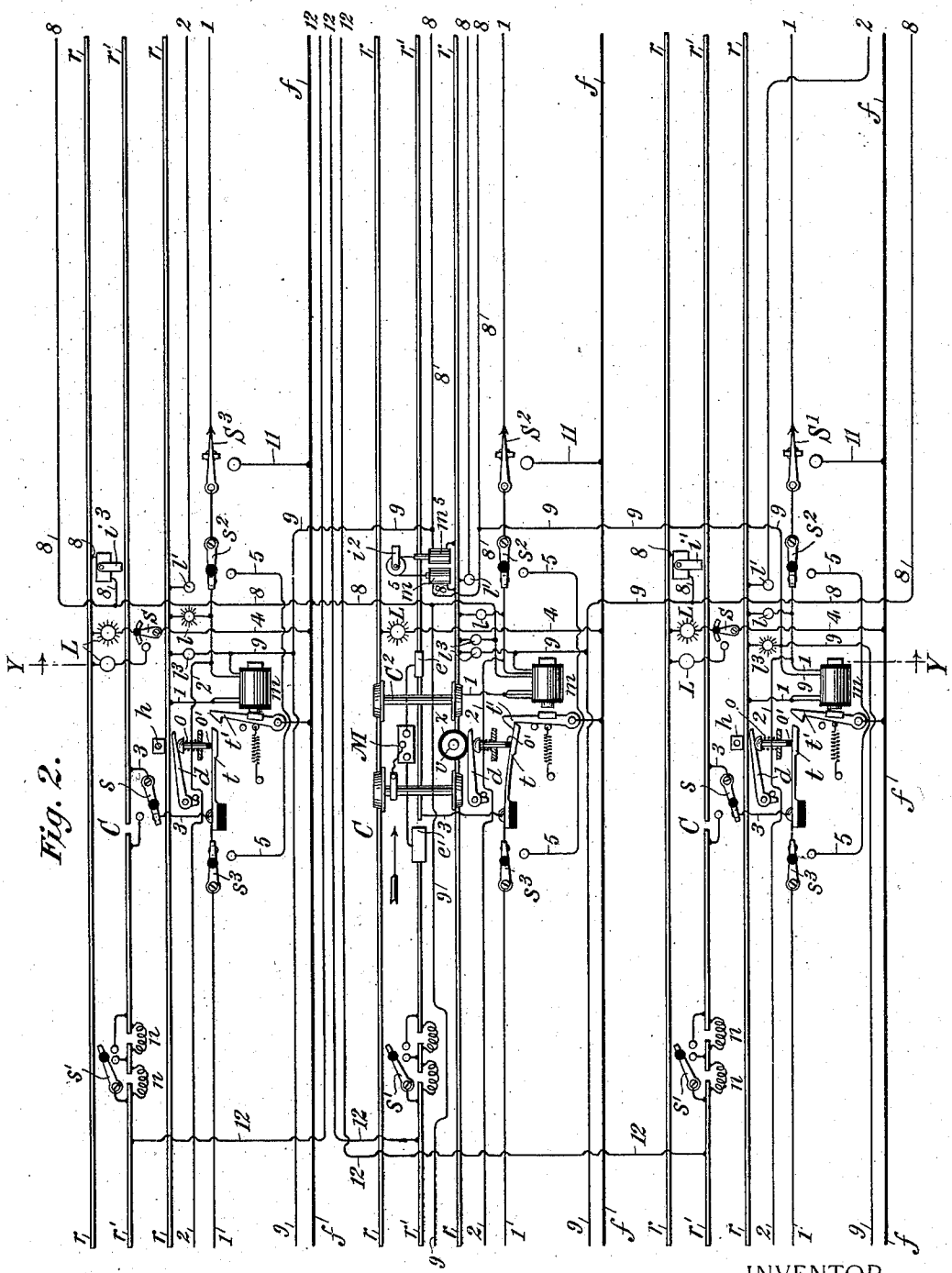

Fig. 2.

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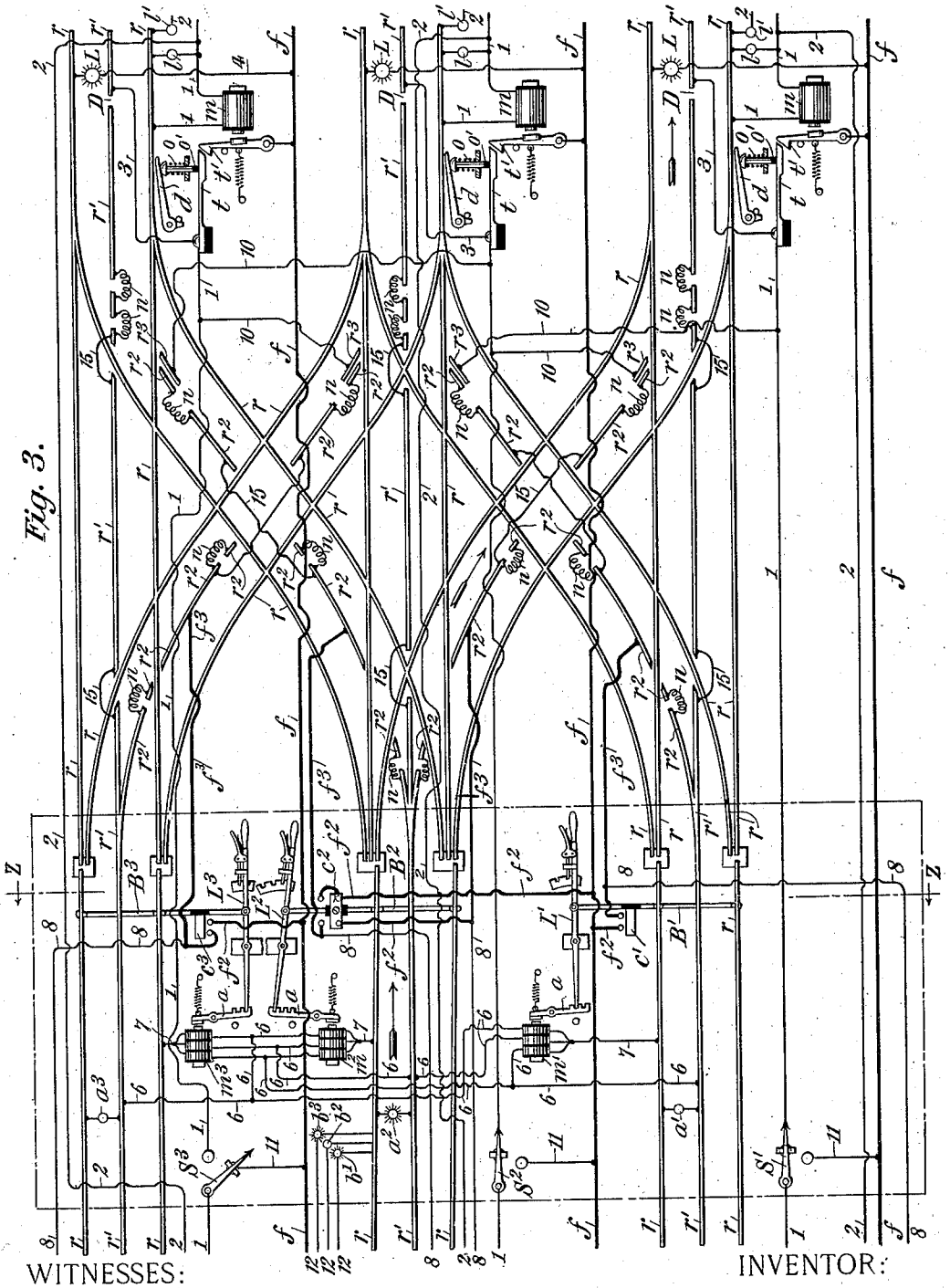
NO MODEL. 6 SHEETS—SHEET 4.

Fig. 3.



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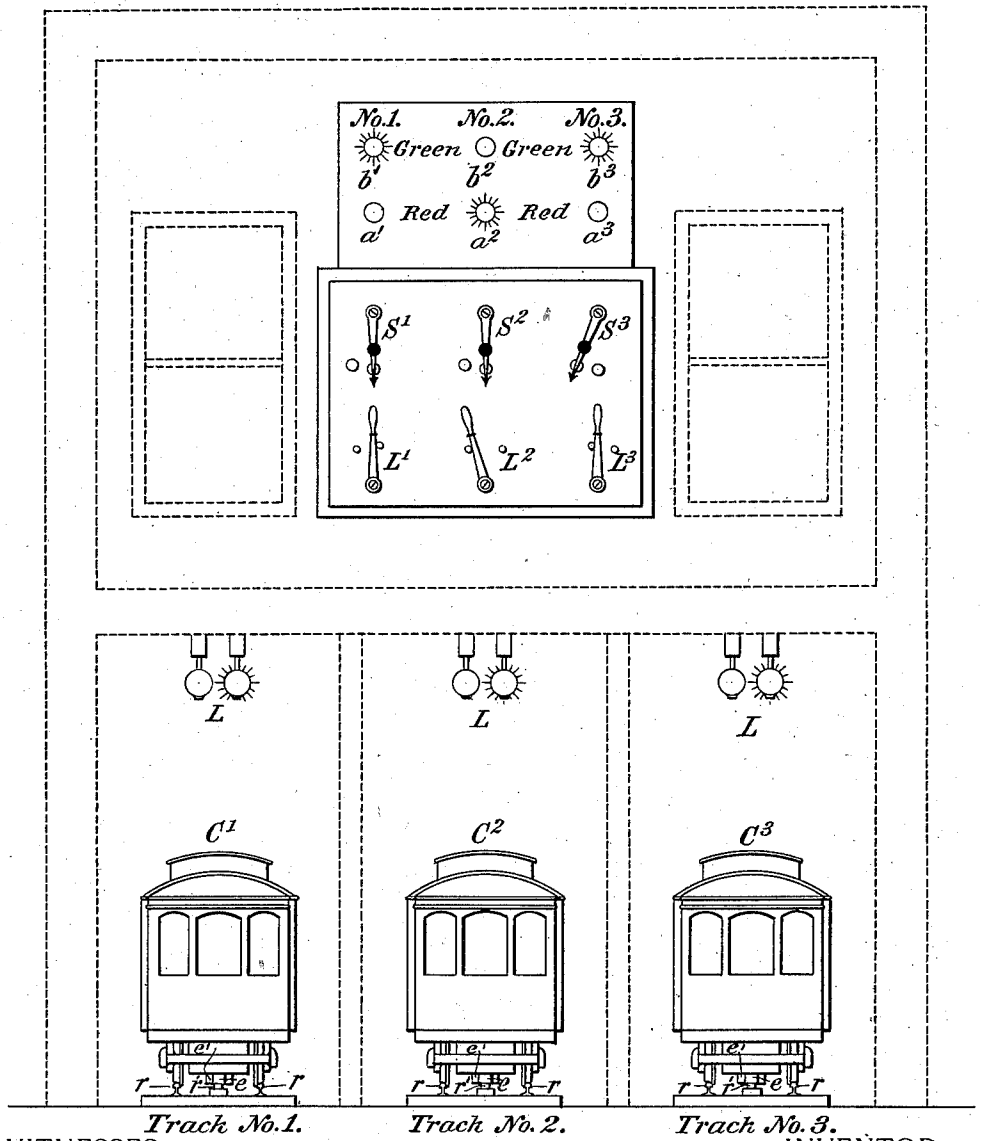
NO MODEL. 6 SHEETS—SHEET 5.

Fig. 4.



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NO MODEL. 6 SHEETS—SHEET 6.

Fig. 5.

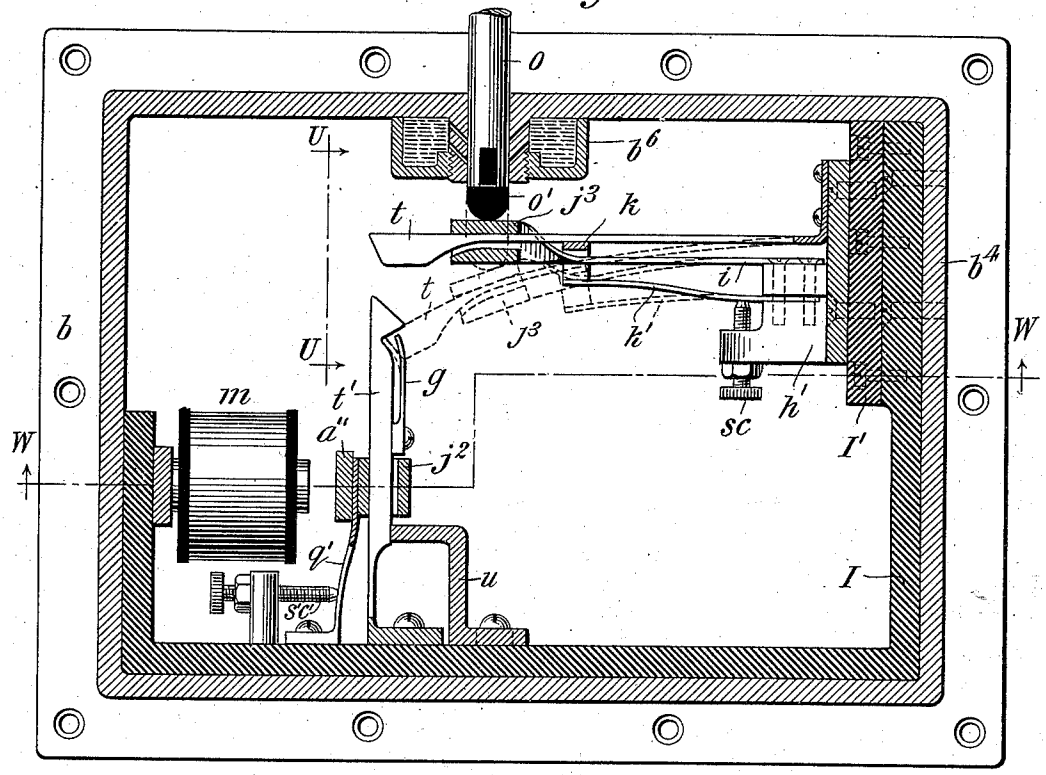


Fig. 6.

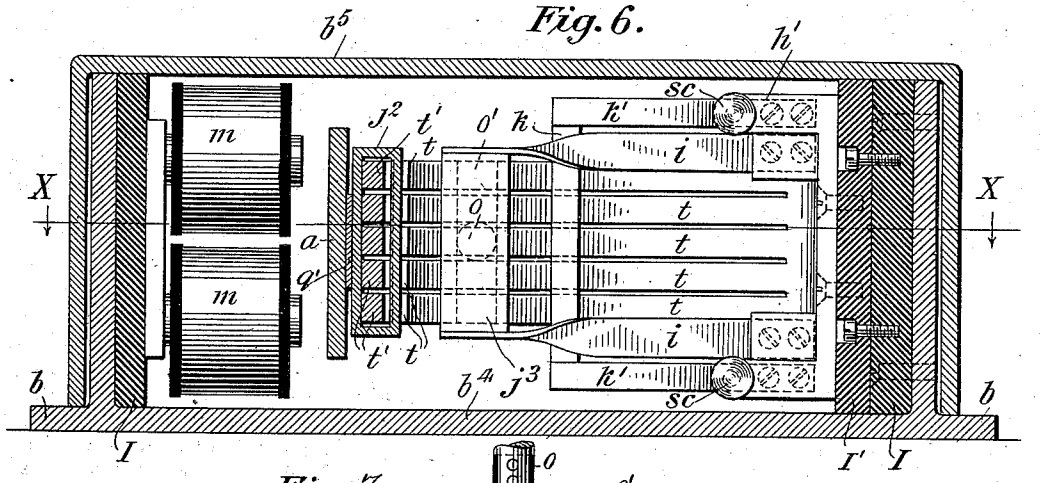
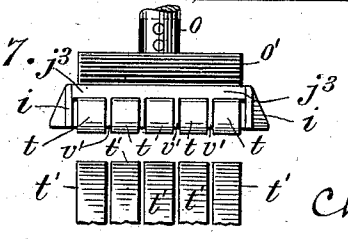


Fig. 7.



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No. 748,620. Patented January 5, 1904.

UNITED STATES PATENT OFFICE.

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

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 748,620, dated January 5, 1904.

Application filed March 10, 1902. Renewed May 22, 1903. Serial No. 158,379. (No model.)

To all whom it may concern:

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

My invention is directed particularly to improvements in safety systems of electric railways, and has for its objects, first, to provide means for avoiding disastrous collisions between cars or trains at switches where it is found necessary to transfer the same from one track to another; second, to provide means for enabling a station master, switchman, lineman, track walker, or any authorized person to flag or stop a car or train at any point where it may be deemed necessary; third, to provide means in connection with an electric railway embracing a current feeder or main, sectional conductors normally disconnected therefrom, and switching mechanism for connecting them to and disconnecting them from the current feeder or main, with means whereby any two or more of the sectional conductors may be connected together in series relation and the switching mechanism therefor cut out of circuit, so that the two or more sectional conductors thus connected become, in effect, a single sectional conductor, with switching mechanism located at its opposite ends, and the arrangement such that the system operates as effectually with the switch thus cut out as before, such an arrangement also making it possible to vary the length of the sectional conductors according to the requirements of the service; fourth, to provide means in connection with a sectional system of electric railways whereby arcing is avoided at the terminals of the switches thereof and at the ends of the sectional conductors, together with means for disconnecting the before-mentioned means from the sectional conductors, so as to avoid the stalling of a car or train at or near the end of any sectional conductor; fifth, to provide an electric railway embracing two or more lines of tracks and working conductors therefor with a system of switching sectional working conductors normally disconnected from the current feeder or main and circuit connections so arranged that said switching working conductors are only connected to the current feeder or feeders when a rail-switch has been set for the purpose of transferring a car or train from one track to another; sixth, to combine in a safety system of electric railways a system of signals all operatively so related to the working conductors of the system that motormen and employees generally are made aware of conditions which give preliminary or cautionary and danger warnings, together with the nature thereof, so that all possibility of accidents is reduced to a minimum; seventh, to provide a novel form of switch-closing trolley, carried by each car or train and adapted to mechanically actuate the switches for connecting the sectional conductors to the current feeder or main, said trolley being provided with an elastic or yielding tire for preventing damage to those parts of the switches with which it comes into mechanical contact as the car or train passes by the same; eighth, to provide a novel form of switch for connecting the sectional third rails or conductors to the current feeder or main adapted to convey currents of enormous quantity and potential and without danger of serious arcing, the same being so constructed and arranged that it possesses a delicacy of operation, making it possible to release the terminals with a minimum utilization of electrical energy, and therefore further increasing the safety of the system.

For a full and clear understanding of the invention, such as will enable others skilled in the art to construct and use the same, reference is had to the following specification and accompanying drawings, the essential features of novelty being particularly pointed out in the claims at the end of the specification.

Figures 1, 2, and 3 are diagrammatic views illustrating a system of three tracks of an electric railway embodying the essential features of my invention, it being necessary for the purpose of clearly understanding the same that said drawings be placed end to end and read from left to right. Fig. 1ª is a sectional view taken through the road-bed on the line V V, Fig. 1, illustrating the three tracks and a sectional third rail or conductor for each track and the disposition of the various signals in connection with the system

at that point as seen looking in the direction of the arrows from left to right, the dotted lines illustrating a tunnel in which the system is supposed to be located. Fig. 2^a is a similar view taken on the line Y Y, Fig. 2, and as seen looking thereat from left to right in the direction of the arrows, this view being similar in all respects to Fig. 1^a except that additional danger-signals are shown here in connection with that part of a section embracing a switchman's house where cars are switched from one track to another, as shown in broken lines in plan view in Fig. 3. Fig. 4 is a sectional view taken through the switchman's house and the tracks on the line Z Z, Fig. 3, and as seen looking thereat from right to left in the direction of the arrows, the disposition of the switchboard-signals in said house and of the rail and stop switches, together with a car on each track, and the permanent signals at the end of a section being illustrated in elevational view, the outline of the switchman's house, the windows thereof, and the tunnel being shown in dotted lines. Fig. 5 is a sectional view taken through Fig. 6 on the line X X and as seen looking thereat in the direction of the arrows from the top toward the bottom of the drawings, the same being an interior view illustrating my novel form of switch. Fig. 6 is a sectional view taken through Fig. 5 on the broken line W W and as seen looking thereat in the direction of the arrows from the bottom toward the top of the drawings. Fig. 7 is a detail view illustrating the disconnected adjoining ends of the switching-terminals and as seen looking thereat in the direction of the arrows from left to right from a point of view illustrated by a broken line U U in Fig. 5.

Referring now to the drawings in detail, in all of which like letters and numerals of reference represent like or equivalent parts wherever used, and first to Figs. 1 to 3, there are shown three tracks—"No. 1," "No. 2," "No. 3"—embracing each a line of tram-rails $r\ r$ and a line of sectional third rails or conductors $r'\ r'$. $f\ f\ f$ are insulated current feeders or mains extending over the entire route. $D'\ D^2\ D^3$ are power-house generators having their positive poles connected in multiple arc relation with the three feeders $f\ f\ f$ by a cross-feeder f' and their negative poles to the tram-rails $r\ r\ r\ r\ r\ r$. I have illustrated in these figures of the drawings three sections of a safety system of electric railways, as follows: AB, BC, CD, the power-house generators, being located within the limits of the section AB upon the supposition that said system extends indefinitely in opposite directions from A A A on the left and from D D D on the right. Each of the current-feeders f is connected by short branch conductors to conducting locking-terminals $t'\ t'\ t'$ in the switch-boxes, additional yielding conducting-terminals t being electrically connected by branch conductors 3 and switches $s\ s$ to the sectional third rails or conductors r'. 1 1 are releasing and safety circuits or conductors running from the terminals t to the rear and each to its own releasing-electromagnet m, said conductors being finally connected directly to the tram-rails $r\ r$. Each of the terminals t' is provided with a locking hook or shoulder at its free end and a releasing-armature, as shown. o is a switch-operating pin located in the path of a horizontally-pivoted lever d, said pin being surrounded by a strong spiral spring adapted to hold the switch-lever d closely adjacent to the surface of the tram-rail r and insulated at its lower end, as shown at o'. $l\ l\ l$ are signaling-lamps located preferably in multiple-arc relation to the magnets m, and L L are permanently-glowing lamps connected in branch circuits 4 between the feeders f and tram-rails r, there being two of these lamps at the end of each section of the system, one of which is always in circuit, as shown. S is a switch adapted to place either one or both of said lamps in circuit, as desired, the function of these lamps being to give a continuous indication in tunnels or at night of the commencement and ending of successive third rails or conductors or, in other words, to indicate the presence of the several switches of the system. 2 2 2 are additional safety conductors running in each instance to the distant ends of the next adjacent sectional conductor in the rear and including in circuit additional lamps l', said lamps being preferably of green color to give what is termed a "cautionary" indication, while the lamps l, located in the circuit-releasing conductors 1, are preferably red for the purpose of indicating "danger." 5 5 5 are normally open shunt-circuits around the switching mechanism, and $n\ n\ n$ are resistances connecting short sectional rails or conductors at or near the ends of the sectional third rails or conductors for reducing the arcing effect at the terminals in the switch-boxes. $s\ s'\ s^2\ s^3$ are switches for varying the current relations in the switch-boxes and upon the sectional third rails or conductors. $C'\ C^2\ C^3$ are cars located, respectively, upon tracks No. 1, No. 2, No. 3, the cars $C'\ C^3$ being located in section BC upon their respective tracks and car C^2 just leaving said section and entering section CD upon track No. 2. M represents the motor on board of each car and $e\ e'$ two trolley-shoes or current-collectors electrically connected thereto, the trolley-shoe e' being relatively much broader than e for a purpose which will be disclosed later on.

I have shown upon car C' a complete automatic brake mechanism which is controlled electrically, the same consisting of the usual air-brake mechanism having a local air-reservoir j connected by a train-pipe k'' to the source of air-supply, (not shown,) j' being the brake-cylinder, the piston of which is connected directly to the brakes, as shown. o^2 is an operating-valve connected to an op-

erating-lever q, and a^4 is an armature-lever adapted when held in its forward position by an electromagnet m^4, included in a multiple branch 13 14 of the motor-circuit, to maintain the brakes in open or inoperative position, s^4 being a switch in the branch 14 for releasing the brakes by hand. It will be understood that the cars C^2 C^3 are provided each with such an automatic brake system, the same not being illustrated in order not to unnecessarily complicate the drawings. It will also be noted that the distance between the non-arcing resistances n n and the end of each sectional conductor to the right is greater than the length of the car or train traveling over the route. In other words, this distance should be such that when the front current-collector or shoe e reaches the brake at the end of the sectional third rail or conductor the rear current-collector or shoe e' shall be located within the section, so as to include the resistances n n in circuit, and thereby lower the current flow in the same manner as has been disclosed in previous Letters Patent granted to me by the United States Patent Office on the 13th day of May, 1902, and numbered 700,127, the improvement in this respect making it possible to run multiple-unit trains of relatively great length over the system without damaging arcing at the terminals in the switch-boxes, as will be described more particularly in connection with the description of the mode of operation.

Referring now to Fig. 3, I will describe my safety interlocking system of rail-switches and switching sectional working conductors for effecting the transfer of a car or train from one of a number of tracks to any other and also my novel system of signals as connected therewith. L' L^2 L^3 represent rail-switching levers of the usual type connected directly to the switch-rails by links B' B^2 B^3 and adapted to move the rails in the usual manner. a a a represent locking armature-levers having their armatures in the magnetic field of electromagnets m' m^2 m^3, each having three coils so interconnected by conductors 6 and 7 to the particular third rails of the tracks No. 1, No. 2, and No. 3 and their corresponding sectional third rails r' r' r' that when any one of said sectional third rails is made alive all of said electromagnets will be energized and the armature-levers drawn into their forward positions in such manner as to lock the levers L' L^2 L^3. c' c^2 c^3 are contact-plates carried by and insulated from the switching-links B' B^2 B^3 and adapted to contact, respectively, with stationary contacts located in their paths and connected to short branch feeders f^2 f^3 f^2 f^3 f^2 f^3, the branch feeders f^3 being connected, respectively, to switching sectional working conductors r^2 r^2 r^2—one for each track—the same being a continuation in each instance of the third rails or conductors r', but, as is obvious on inspection of the drawings, all normally disconnected from any of the current feeders or mains at the switching contact-plates c' c^2 c^3. These switching sectional working conductors are broken or interrupted at the points where they cross the tram-rails and are provided at their outgoing ends with short sections connected by resistances n, arranged for the purpose of preventing abnormal arcing, as do the corresponding resistances in the third-rail sections r'. These switching sectional working conductors are further united together directly by insulated buried bonds or cables 15 15, where they cross the tracks, as is apparent on inspection of the drawings. At the extreme outgoing end of each switching sectional working conductor and parallel therewith is located a short sectional conductor r^3 sufficiently distant from the corresponding sectional working conductor to be out of contact with the front current-collector or shoe e. These working conductors r^3 are connected in turn to branch conductors 10 10 10, running directly to the releasing-circuits 1 in each instance. Returning now to the branch feeders f^3, there is connected to the same at a point near the stationary contacts for the movable contact-plate c' a branch conductor 8, in each instance running to the rear, said branch conductors running, respectively, to semaphore-controlling magnets adapted to operate semaphores i' i^2 i^3, (see Fig. 2,) two of such magnets being shown at m^5 at the commencement of section CD, said circuits branching still farther by conductors 9 to lamps or signals l^3 at the same points and to individual coils of the releasing-magnets m m m, and also still farther, as may be traced, to the beginning of section BC to cautionary lamps l^2 l^2 l^2. The several signaling-lamps and their relative dispositions upon these circuits are clearly illustrated in Figs. 1^a and 2^a of the drawings, their arrangement or location being such that a motorman on entering a section is given an especial indication of the condition of the track for at least two sections in advance and an especial indication of the nature of the danger, if danger there be, which his car is approaching. a' a^2 a^3 are red danger lamps located in the switchman's house and included directly in circuit between the third rails or conductors r' and tram-rails r of all of the tracks on section CD. (See Figs. 3 and 4.) b' b^2 b^3 are cautionary lamps, preferably of green color, also located in the switchman's house and having a similar relation to the sectional third rails or conductors of section BC that the lamps a' a^2 a^3 do to section CD. (See Figs. 2, 3, and 4.) In other words, these lamps b' b^2 b^3 are included directly in circuits 12, running from the ends of the sectional conductors r' r' r' of the section BC to the tram-rails r at the switchman's house, the arrangement of all of these lamps a' a^2 a^3 b' b^2 b^3 being such as to give to the switchman in his house a correct warning of the electrical condition of each of the tracks in section CD or BC, as will be more particu-

larly described in connection with the mode of operation. S' S^2 S^3 are stop-switches, also located in the switchman's house and upon a switchboard convenient to the switchman and conveniently located with relation to the switching-levers L' L^2 L^3, all as clearly illustrated in Fig. 4. These stop-switches S' S^2 S^3 are connected directly normally in circuit with releasing or safety circuits 1 1 1, and are adapted when turned, as shown at S^3, Fig. 3, to connect the current feeder or main *f* through a branch feeder 11 directly to the releasing and signaling conductors running to the rear, so that the switchman may stop any car or train on either track. Similar switches S' S^2 S^3 may be located in the releasing-circuits 1 at various points in the route for the purpose of enabling any authorized person to flag and stop any train; but when so located they should preferably be under lock and key and accessible only to authorized employees. I have shown three such switches at the beginning of section CD, Fig. 2, any one of which may be obviously turned into operative connection with its corresponding feeder *f* through the branch conductor 11, and thereby signal and stop an advancing car. T (see Fig. 1) is a portable switch-operating lever adapted to be carried on each car, said lever having a pin on its lower side adapted to be inserted in a hole or opening *h* in a metallic block secured directly to the ties and with its upper face flush with the tram-rails *r*, the arrangement being such that when the operating-lever is placed horizontally with the pin in the opening *h*, in the manner shown in Fig. 1, the motorman may take hold of the handle thereof and move it outward, so that the short arm of the lever bears against the switching-lever *d*, forcing the operating-pin *o* downward and locking the terminals *t t'* together in the switch-box, provided, of course, that the locking-terminal *t'* is not held in its forward position by the releasing-magnet *m* at the time the operation is effected. This operating-lever is designed for use by the motorman in the event of his having run past the danger-signal *l* and entered upon a dead section, it being necessary in that event to use manual means to effect the necessary connection of the sectional conductor to the current feeder or main.

I will now describe the mode of operation. The switchman is supposed to be in his switch-house looking from one of the windows thereof (see Fig. 4) in the direction from which the cars are approaching. Three cars C' C^2 C^3 are seen upon the tracks—the cars C' C^3 upon tracks No. 1 and No. 3 are approaching the middle of section BC, (see Fig. 1,) while car C^2 has just entered section CD of track No. 2. (See Fig. 2.) As cars C' C^3 passed the switch-boxes at the entrance of section BC the yielding tire *x* of the switch-operating trolley *v* of each car acted upon the switching-levers *d*, moving them laterally in such manner as to cause the operating-pins *o o* to lock the yielding terminals *t* into electrical connection with the locking-terminals *t'*, so that the sectional conductors *r'* for those two cars were made alive by current flowing from the current-feeders *f*, locking and yielding terminals *t' t*, conductors 3, and switches *s*. As car C^2 entered section CD of track No. 2 the sectional third rail of that track for that section was made alive in the same manner from the current-feeder *f*. The releasing-circuits 1, connected to the terminals *t* and extending to the rear, were simultaneously made alive, so that a danger-signal *l* was displayed upon track No. 2 at the entrance of section BC, the releasing-magnet *m* was energized, and the locking-terminal *t'* held in its forward position, as shown. A still further circuit was closed to the rear through a multiple-arc conductor 2 to the commencement of section A, (not shown,) where circuit was closed through a cautionary signal or green lamp, thus giving to the motorman of any car coming upon track No. 2 an indication at that point that a car C^2 is two sections in advance, and an indication at the commencement of section BC in the nature of a red light or danger-signal *l*, showing that car C^2 was one section in advance. Similar danger-signals are located at the entrance of section A, (not shown,) but in circuit with releasing-circuits 1, connected to the terminals *t*, so that the sectional conductor over which each car is traveling is made alive and danger and cautionary signals displayed at the commencement of the first and second sectional conductors in the rear, respectively, thereby giving in each instance to following cars, first, a cautionary signal; second, a danger-signal, and, third, precluding the possibility of a car proceeding farther, owing to the fact that when it passes its danger-signal no current will be received from its sectional conductor, because the locking-terminal *t'* is held in its forward position. It will be obvious also upon inspection of the diagrammatic view of car C' at the lower right-hand end of Fig. 1 that when a car passes a switch where the locking-terminal *t'* is held in its forward position the brakes will be automatically applied, for the reason that the magnet m^4 will be demagnetized, and consequently permit the release of the armature-lever a^4 and open the cock o^2. Suppose that before car C^2 on track No. 2 entered section CD the switchman had orders from the train despatcher to transfer said car from track No. 2 to track No. 1 and also to transfer car C^3 from track No. 3 to track No. 2 and that cars C' C^3 at the time he received orders were on section AB, so that at that time there was no cautionary signal displayed on his switchboard. (See Fig. 4.) Suppose at the same time that car C^2 is just entering section BC. Consequently there would have been displayed at that time on the switchboard a green light b^2, (see Fig. 2,) for the reason

that when the sectional third rail on section BC was made alive a circuit was closed from conductor 12 to lamp b^2 on his switchboard. Hence he had ample time to turn the switch into the position shown. But suppose that after he had thus turned the switch and the cars assumed the positions shown in the drawings two green lights b' b^3 appeared upon his switchboard, as is apparent if circuits 12 be traced from sectional conductors r' for sections BC on tracks No. 1 and No. 3 and upon inspection of Fig. 4. Consequently before car C^2 will have passed from track No. 2 to track No. 1 car C^3 will have advanced too far to be safely switched, so that it is necessary for him to stop car C^3. This he does by turning the switch S^3 to the left, as shown in Figs. 3 and 4, and hence a circuit is closed from feeder f of track No. 3 (see Fig. 3) by branch conductor 11, switch S^3, releasing-circuit 1 to releasing-electromagnet m, and to earth or return, and also through the danger-lamp l at the entrance of section CD, track No. 3, thus holding the locking-terminal t' in its forward position, displaying a danger-signal l, at the same time closing a branch current through conductor 2 to the entrance of section BC and displaying a cautionary signal or green lamp l' also at that point, so that as car C^3 advances its motorman observed before it passed the entrance of section BC said cautionary signal 1'. As it advances still farther the motorman will observe a danger-signal at the entrance of section CD. Therefore it rests with him to apply his brakes and stop his car before it reaches the switch s' near the end of section BC. His car must therefore remain in this position until the signals are all restored to "safety." When the rail-switch lever L^2 was placed in the position shown in Figs. 3 and 4, branch-feeder circuits were closed from the feeder f of track No. 2 by branch feeders f^2 f^3, contact-plate c^2 to the right to the switching sectional working conductors r^2, so that the same were made alive preparatory to the movement of the car from track No. 2 to track No. 1. At the same time a circuit was closed through branch conductor 8 to the rear through the left-hand controlling-solenoid m^5 of the semaphore i^2 to earth, thus turning the semaphore-arm to the right, indicating to the motorman of car C^2 that his car is to be switched from track No. 2 to track No. 1. A further branch is closed at the same time from conductor 8 by conductor 9 downward in multiple through a red danger-lamp l^3 at the entrance of section CD upon track No. 1 and also through one coil of the two-coil magnet m to earth, thus holding the locking-terminal t' for track No. 1 at the entrance of section CD in its forward or inoperative position and displaying a red or danger signal at that point to the motorman of car C'. A still further multiple-arc branch is closed by conductor 9 to the rear on track No. 1 to the commencement of section BC through a green lamp l^2 at the point, thus giving to the motorman on car C' as the car entered section BC a cautionary signal of a peculiar nature, the danger-signal for car C' at the entrance of section CD, located on the left of the permanently-glowing lamp L, showing the motorman of car C' that a car upon track No. 2 is about to be switched upon track No. 1. The peculiar location of this danger-signal l^3 is indicated in Fig. 2^a, the same being to the left of the permanent-glowing lamp L, while the usual red danger-signal l and green cautionary signal l' for the section for direct traffic are located directly below said lamp. As the car C^2 advances, therefore, the front current collector or shoe e passes upon the switching sectional working conductors r^2 before the rear current collector or shoe e' leaves the short sectional conductor r^2, connected to the sectional conductor r' of track No. 2, so that there is no break in the circuit. These two current collectors or shoes, respectively, bridge the spaces in passing over the short sectional working conductors r^2, and in like manner bridge the space from the extreme advance end of the switching sectional working conductors r^2 to the sectional conductor r' of section D of track No. 1, thus maintaining the continuity of current in passing from one track to another. As the rear current collector or shoe e' passes off the short sectional working conductor r^2 it bridges the space between said sectional working conductor and the short working conductor r^3, conveying current therefrom by a branch conductor 10 to the releasing-circuit 1 of track No. 2, section CD, of the switch at the entrance of that section, thereby releasing the locking-terminal t' and restoring the switch, the sectional conductors, and all of the signals electrically connected therewith to their normally dead conditions. Consequently the danger-lamp a^2 in the switchman's house is extinguished and gives warning to the switchman that car C^2 has been safely transferred to track No. 1. As the sectional conductor r' is now dead, the locking-magnets m' m^2 m^3 are all demagnetized, for the reason that the energizing-coils connected to the sectional conductor r' of section CD, track No. 2, are without current. Therefore the switchman may now restore the switch-lever L^2 to its normal position and may set the switch-lever L^3 for the purpose of transferring car C^3 from track No. 3 to track No. 2. When car C^2 enters section D of track No. 1, the terminals t' and t are automatically connected by the operating-trolley v in the manner already described in connection with the movement of cars C' and C^3, so that the sectional conductor r' of that section is made alive. Consequently the releasing-circuit 1 of track No. 1, section CD, is still conveying current to the releasing-electromagnet m, so that the locking-terminal t' at the entrance of section CD, track No. 1, is still held in its forward position, the danger-signal l displayed at that point, and the

cautionary signal l' displayed at the entrance of section BC, track No. 1. Consequently car C' cannot advance until car C^2 passes out of section D on the extreme right and restores the terminals t t' to their normal or operative positions at the entrance of that section. The switchman having turned the switch-lever S^3 to its left position (see Figs. 3 and 4) may now return it to its normal position. Consequently the danger-signal l at the entrance of section CD and the cautionary signal l' at the entrance of section BC, track No. 3, are restored to "safety," the locking terminal t' at the entrance of section CD is restored to operative position, and the motorman upon car C^3 may now cause his car to advance. Suppose the rail-switch L^3 be now operated for conveying car C^3 from track No. 3 to track No. 2, thus placing the contact-plate c^3 into operative relation with the feeder f of that track and turning the tram-rails in the proper position to transfer the car. Upon tracing the circuits from the feeder f of track No. 3 to branch feeders f^2 f^3 f^2 f^3 to the right it will be apparent that the switching sectional working conductors r^2 for track No. 3 have been made alive, so that car C^3 may now advance and will be transferred from track No. 3 to track No. 2, and upon tracing the circuits by conductor 8 from contact-plate c^3, which has been moved forward it will be found that the semaphore i^3 at the entrance of section CD is displayed to the view of the motorman entering that section, so that he is given warning that his car is to be transferred from track No. 3 to track No. 2. At the same time current is conveyed downward by branch conductor 8 and branch conductor 9 to a red light or danger-signal l^3 at the entrance of section CD, track No. 2, through one of the multiple coils of the releasing-magnet m at that point and through conductor 9 to the rear to the entrance of section BC, track No. 2, to a green or cautionary lamp l^2 at that point, thus giving to the motorman of an incoming car on track No. 2 at the entrance of section BC indication that there is danger ahead, and at the entrance of section CD of track No. 2 a red light l^3 to the left of the permanently-glowing lamp L, (see Fig. 2^a,) indicating the nature of the danger, showing to the motorman that a car is to be switched from track No. 3 to track No. 2, the disposition of all of these special red-light signals being clearly illustrated in Fig. 2^a. In the same manner when a car is to be switched from track No. 1 to track No. 2 the switch-lever L' is turned with the contact-plate c' in contact with the stationary contacts in the path thereof, so that the branch feeder f^3 is made alive. Consequently the switching sectional working conductors r^2 from track No. 1 to track No. 2 are given current potential, the semaphore i' being controlled in the same manner as was the semaphore i^3 of track No. 3 and the danger and cautionary signals l^3 and l^2 displayed, so as to give warning to the motorman of the car on track No. 1 that his car is to be switched to track No. 2. The disposition of the branch conductors 10 and the working conductors r^3 for releasing all of the signals and terminals is obvious in view of what has been said in connection with the like parts with relation to track No. 2 and track No. 3. It will also be apparent, in view of what has been said concerning the display of the red-signal lamp a^2 when car C^2 entered section CD of track No. 2, that in like manner the corresponding red-lamp signals a' a^3 will be displayed whenever the sectional conductors r' of section CD for tracks No. 1 or No. 3 are made alive. In other words, if there are three cars traveling over the three tracks upon section CD then all of the red lights a' a^2 a^3 will be glowing in the switchman's house and all of the locking armature-levers a a a will be held in their locked positions, so that the switch-levers L' L^2 L^3 cannot be disturbed. In like manner when three cars are passing over tracks No. 1, No. 2, and No. 3 of section BC all three of the green lights b' b^2 b^3 will be displayed. Therefore the signaling-lamps a' a^2 a^3 b' b^2 b^3 in the switchman's house give to the switchman a correct indication of the condition of the three tracks for two sections in front of him, and he is enabled to control the movements of all cars upon those two sections at any time, both as to the matter of transferring said cars from any one track to another or as to the matter of stopping any or all of the cars before they reach the section embracing the switching-levers L' L^2 L^3. It is apparent, therefore, that this system may be so arranged that in a multiple system of tracks any car may be transferred to any other track, it only being necessary to provide these switching-stations at such intervals as the nature of the traffic may demand.

I will now describe the manner of connecting any adjacent pair of sectional conductors in series relation with each other, so as to shunt out the switching mechanism at their adjacent ends and to make the two sections, in effect, one sectional conductor, thereby making it possible to repair any switch in the event of its becoming damaged without interfering with the traffic. Suppose, for instance, it is desired to make the sectional conductors r' of sections BC and CD, track No. 1, a single section. It is only necessary to move the free end of the switch s, Fig. 2, to the other stationary contact in its path, interrupting the circuit 3, thereby uniting the two sectional conductors in series. At the same time the switch s' is placed upon its stationary contacts, so as to shunt the resistances n n and give to the now lengthened sectional conductor r', between the points B and D, the same resistance throughout. A further change is necessitated, however, to make the apparatus operative for this increased length of section in order that the releasing-circuits may operate therefor. This

is effected by moving the free ends of the switches s^2 s^3 into contact with the stationary contacts of the shunt-circuit 5 around the switch-box. Consequently the entire switching mechanism, in so far as its electrical functions are concerned, is now cut out and the two sectional conductors r' r' made continuous, while the releasing-conductors from the point B on the left to the point D on the extreme right are united in one continuous circuit, so that the danger-signal l at the point B is now the danger-signal for the terminals t t' at the point D on the extreme right, and the cautionary signal l' at the beginning of section AB, which signal is not shown, is now made the cautionary signal for the lengthened section, which may now be known as "section BD." For the purpose of giving a special indication to motormen of the fact that any switch has been cut out the switch S at that point should be turned, so that both of the permanent-signal lamps L will glow, thereby giving a double or duplex signal, which warns motormen of the fact that they need not look for cautionary or danger signals at that point so long as both of the permanent signals are displayed. In like manner any number of sectional releasing-conductors may be connected together in series and the releasing-circuits thereof connected in like series relation, the duplex signals LL being displayed at each switch, it being obvious that when the switch-levers d are operated by the switch-operating trolley v at the points where such switches are cut out there will be no circuit connection effected to any part of the system, the terminals t and the branch conductors 3 being interrupted at the switches s s^3 and the switching-magnets m and lamps l cut out of circuit at the switch s^2.

Referring now to the means for preventing abnormal arcing at the ends of the sectional third rails or conductors and at the terminals in the switch-boxes, the same consisting of resistances n n, inserted in series relation in the manner shown and in the manner disclosed in my before-mentioned applications, I will describe how I prevent a train from becoming stalled between the switch s' and the ends of the adjacent sections. It will be apparent that should a train come to a standstill between these points it cannot receive current enough to advance, owing to the resistance offered by the resistances n n. I therefore provide switches s', so arranged that when they are closed they will shunt the resistances n n, thereby affording to the motors on the short sectional conductors near the ends of the sections sufficient current to enable the motorman to back his car or train up until he has passed beyond the resistanee in the rear a sufficient distance to enable him when the switch s' is again restored to its open position to obtain sufficient headway to run by momentum over the short section between the resistances n n and adjoining ends of the sectional conductors, it being understood, of course, that the motorman should not cause his car to advance from one section to another while the switch s' is closed, for the reason that if the working current is being used to any great extent through the motors damaging arcing would occur at the ends of the sectional third rails or conductors and at the terminals in the switch-boxes. By backing the car or train up a sufficient distance and restoring the switch s' to its normal or open position the system may be operated in such a manner as to avoid any possibility of abnormal arcing.

I will now describe in detail the especial form of switch particularly adapted for use in connection with my novel safety system of electric railways, which is illustrated in Figs. 5, 6, and 7 on a practical working scale. In existing systems of electric railways using sectional third rails or conductors it has not been found feasible to utilize metallic terminals for the switches, owing to the fact that when the circuit is interrupted at the ends of the sectional conductors abnormal arcing occurs, which invariably fuses the switching-terminals, and also to the fact that where enormous currents were conveyed through the terminals it was not found feasible to provide metallic terminals which would successfully convey the current from the feeders to the sectional third rails or conductors. My invention embraces in this respect metallic terminals, preferably of copper, having sufficient current-carrying capacity in practice to carry many hundreds or even thousands of amperes. b^4 represents a metallic switch-box secured in the present instance with the base directly to one of the rail-ties, and b^5 is a metallic cover therefor. I represents an insulating medium or lining secured directly to the inner surface of the box by screws or otherwise, and I' a second insulating medium to which a stationary terminal h', of copper and of very large current-carrying capacity, is secured by screws, as shown. t represents the yielding terminal consisting of a copper bar slitted longitudinally into a number of metallic fingers, having the free ends thereof cut away at an angle, as shown, and the solid or united end thereof secured directly to the stationary terminal h' by screws, brazing, or otherwise, so as to make the best electrical contact. j^3 is a metallic collar which surrounds the free ends of the finger-like terminals t and is provided with downwardly-extending spacing-fingers v', adapted to maintain the finger-like ends of the terminals at equal distances from each other. This collar j^3 is carried by a pair of yielding arms i, secured at one end directly to the stationary terminal h' and one surface thereof resting directly upon the top of the finger-like terminals t t, maintaining them all in alinement with each other when pressed downward, its under portion being curved, as shown, so that when the fingers are depressed said curved

portion will bear upward against the under surface of the fingers and make good electrical contact between them and the yielding arms *i i*, thereby giving an increased conductivity to the entire terminal. *k' k'* are conducting spring-arms secured at one end directly to the fixed terminal *h'* and having at their free ends a conducting cross-bar *k*, adapted to bear upward against the under surfaces of the finger-like terminals *t t*, adjusting-screws *sc sc* being provided on both sides, as shown, for the purpose of regulating the yielding action of these arms and the entire arrangement such that the cross-bar *k* and spring-arms *k'* give further conductivity to the structure of the yielding terminal. The locking-terminal is in like manner composed of a copper bar slitted so that there is a similar number of yielding fingers *t'*, which, however, are provided with a locking-shoulder at their upper ends, the shoulder having a definite inclination with relation to the upper surface of the yielding terminals *t* when depressed. *g g* are conducting-springs, one for each of the fingers of the terminal *t'*, the free ends of said springs being adapted to bear directly against the inclined end of the fingers *t* when the terminals are locked together. j^2 is a collar similar to j^3, surrounding the terminals *t'* and carried by a yielding spring-arm *q'* in the path of an adjustment-screw *s' c'* for regulating the pressure. *a* is an armature secured to the collar j^2 in the magnetic field of the releasing-magnet *m*. *u* is a back-stop of conducting material for the locking-terminal *t'*. It will be noticed that there is considerable space between the rear inner face of the collar j^2 and extreme right-hand face of the locking-terminal *t'* and that the other inner face of the collar is held firmly against the locking-terminal by the spring-arm *q'* and adjustment-screw *s' c'* and that all are held against the back-stop *u*. This is for an especial purpose, as will be described in connection with the description of the mode of operation. *o* is an operating-pin, and *o'* an insulating-bearing secured at the end thereof and resting against the upper surface of the collar j^3. b^6 is an oil-box provided with the necessary supply of oil and having ducts for conveying the oil to the operating-pin *o*, so as to continuously lubricate the same. The operation of this switch is as follows: The switch-operating trolley *v* (illustrated in Figs. 1, 2, and 3) moves the pin inward under the influence of the lever *d* and causes the collar j^3 to press all of the yielding finger-terminals *t* laterally into locked position, as shown in dotted lines. The locking-fingers of the terminals *t'* finally spring into position and force the free ends of the springs *g* against the inclined end faces of the spring-fingers *t*, thus giving good surface contact between the locking-shoulders of the terminals *t'*, the upper face of the terminals *t*, and the inclined faces of the terminals *t* and springs *g*. The pressure of the spring-arm *q'* by reason of the adjustment-screw *s' c'* is sufficient to hold the two terminals together. The tendency of the terminals, however, is to separate, owing to the inclination of the locking-surfaces between the terminals *t* and *t'* and to the action of the springs *g* against the inclined faces of the terminals *t*; but the pressure of the spring *q'* is sufficient to overcome this. Consequently when the releasing-magnet *m* is magnetized its first action is to move the collar j^2 forward and cause the same to give a sharp blow upon the rear face of the terminals *t'*, thus allowing the inclined action of the locking-faces and the pressing action of the springs *g* to aid in the separation of the terminals, the free terminals being pressed upward by the united spring action of the terminals themselves, the yielding arms *i*, and adjustable spring-arms *k'*. Furthermore, I avoid any possibility of damaging arcing, owing to the fact that the circuit is interrupted simultaneously at a number of places between the spring finger-terminals *t* and *t'*, which terminals are held apart by the spacing-fingers *v'*. Like spacing-fingers might be utilized in the collar j^2, if desired, to hold the terminals *t'* apart.

I do not limit my invention to the especial details of construction and arrangement of circuits hereinbefore described and illustrated in the accompanying drawings, as the same may be materially departed from and still come within the scope of my claims hereinafter made. I have shown three power-house generators D D' D^2 and three current-feeders *f f f*, the latter illustrated in heavy lines, one for each line of rails, and this arrangement I deem preferable in order that each line of rails of the system may not be dependent in any sense upon a single feeder, although, if preferred, a single feeder may be used to supply the current to all of three or more lines of rails of a system substantially like that illustrated in the accompanying drawings and described in the foregoing specification, such matters coming within the skill of those versed in the art; nor do I limit my invention to the use of electric lamps as signals, as obviously either visual signals, as semaphores, or audible signals may be substituted for a number of signals illustrated in the accompanying drawings, or semaphores may be combined therewith. In fact, for day service, where the system is located in the open air, I should prefer to use semaphores combined with lamps, as disclosed in my before-mentioned prior applications filed in the United States Patent Office; nor do I limit a number of the features of my invention to their application with a sectional system of electric railways, as obviously the same may be applied in connection with third-rail systems of electric railways generally or in connection with underrunning trolley systems, my invention being generic in many respects and particularly with respect to the feature of switching sectional

working conductors for enabling the movement of a car from one line of rails to one or more parallel lines of rails, in which such sectional working conductors are dead at all times, except when a switch has been set to bring them into service.

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

1. A safety system of electric railways embracing two or more parallel lines of tram-rails, one or more current feeders or mains, and one or more switching sectional working conductors for conveying current to the motors on the cars when being transferred from one track to another; in combination with rail-switches for moving the switch-rails as required and electrical connections whereby when a rail-switch is set so that the switch-rails will transfer a car from one line of tram-rails to another the sectional working conductors are made alive; said working conductors being always without current potential when the switch-rails are in alinement with their direct lines of tram-rails, substantially as described.

2. A safety system of electric railways embracing two or more parallel lines of tram-rails; one or more current feeders or mains and one or more switching sectional working conductors for conveying current to the motors on the cars when being transferred from one track to another; in combination with rail-switches for moving the switch-rails as required and electrical connections whereby when a rail-switch is set so that the switch-rails will transfer a car from one line of tram-rails to another, the sectional working conductors are made alive; together with interlocking means for locking the rail-switches so that they cannot be disturbed after a car on any track has reached a certain point adjacent to the rail-switches, substantially as described.

3. A safety system of electric railways embracing two or more parallel lines of tram-rails, one or more current feeders or mains and a sectional third rail or conductor for each line of tram-rails normally disconnected from the current feeder or feeders; in combination with circuits and circuit connections for connecting said sectional conductors to the current feeder or main and disconnecting them therefrom, and rail-switches for each line of tram-rails; together with electromagnetic interlocking devices connected in circuit with said sectional third rails or conductors and in such manner that when any one of said sectional conductors is made alive the rail-switches for all of the tracks are automatically locked and held locked until said sectional conductor is disconnected from the current feeder or main, substantially as described.

4. A safety system of electric railways embracing two or more parallel lines of tram-rails, one or more current feeders or mains and a sectional third rail or conductor for each line of tram-rails normally disconnected from the current feeder or feeders; rail-switches for each line of tram-rails; switching sectional working conductors for supplying current to the motors on board the cars when being transferred from one line of rails to another, all of said sectional conductors being normally without current potential; in combination with circuits and circuit connections for connecting said sectional and switching working conductors to the current feeder or main and disconnecting them therefrom; together with electromagnetic interlocking devices connected in circuit with the first-named sectional conductors and in such manner that when any one of the said sectional conductors is made alive the rail-switches for all of the tracks are automatically locked and held locked until said sectional conductor is disconnected from the current feeder or main, substantially as described.

5. A safety system of electric railways embracing one or more current feeders or mains and two or more lines of tram-rails; switching working conductors for each line of tram-rails for conveying current to the motors on board the cars when being switched from one line of rails to another; rail-switches for each line of tram-rails, circuit connections between the rail-switches and the switching working conductors and the current feeder or main for giving to the working conductors current potential when a switch has been set to transfer a car from one line of tram-rails to another; in combination with a current collector or shoe carried by a car and branch circuits or conductors at the outgoing ends of the switching working conductors whereby after a car or train has been transferred from one track to another the circuits will all be restored to their normal conditions, substantially as described.

6. A safety system of electric railways embracing a current feeder or main, a series of sectional third rails or conductors normally disconnected therefrom and switching mechanism for connecting said sectional conductors to and disconnecting them from the current feeder or main; in combination with safety-circuits permanently connected in circuit with the sectional working conductors, each sectional or safety circuit including a danger-signal at a point somewhat remote from the point where it is connected to the sectional working conductor and a cautionary signal located at a point still more remote therefrom, the arrangement being such that when any sectional conductor is connected to the current feeder or main by its corresponding switch a danger-signal is displayed at one point and a cautionary signal at another point still more remote, substantially as described.

7. A safety system of electric railways embracing a current feeder or main and a series

of sectional third rails or conductors normally disconnected therefrom; switching mechanism for connecting said sectional conductors to and disconnecting them from the current feeder or main; releasing-circuits connected permanently in circuit with the sectional third rails or conductors and including the releasing-electromagnets of the switches; in combination with danger and cautionary signals included in said releasing-circuits; together with permanent signals located at the ends of adjoining sectional third rails or conductors, substantially as described.

8. A safety system of electric railways embracing a current feeder or main, a series of sectional third rails or conductors normally disconnected therefrom and switching mechanism for connecting said sectional conductors to the current feeder or main and disconnecting them therefrom; in combination with duplex signals located at the adjoining ends of said sectional third rails or conductors; together with manual switches for placing either or both of said signals in circuit with the current feeder or main, substantially as described.

9. A safety system of electric railways embracing two or more parallel lines of tram-rails; one or more current feeders or mains, a series of sectional third rails or conductors for each line of tram-rails; rail-switches for effecting the tranfer of a car or train from any line of tram-rails to another; in combination with danger and cautionary signals for each sectional third rail or conductor and additional danger or cautionary signals relatively so located to the first-named danger and cautionary signals that the special nature of the signal is indicated to motormen as they approach the switches, substantially as described.

10. A safety system of electric railways embracing two or more parallel lines of tram-rails, rail-switches for effecting the transfer of a car or train from any line of tram-rails to another and electrical circuits and circuit connections between the rail-switches and the current feeder or main and a semaphore or signal for each track adapted to give to a motorman an indication of the fact that his car is to be transferred from the track over which it is traveling to another track and to indicate to him on which of the tracks it is to be transferred, substantially as described.

11. A system of electric railways embracing a current feeder or main and a series of sectional third rails or conductors; in combination with switching mechanism for connecting said sectional rails or conductors to and disconnecting them from the current feeder or main; together with switching means for connecting two or more of said sectional conductors in series and simultaneously disconnecting them from the switching mechanism, substantially as described.

12. A system of electric railways embracing a current feeder or main, a series of sectional third rails or conductors and switching mechanism for connecting said sectional conductors to and disconnecting them from the current feeder or main; said switching mechanism embracing safety and releasing circuits and electromagnets; in combination with switches for connecting two or more of said sectional third rails or conductors in series relation and additional switches and shunts, one for each sectional third-rail switch, the arrangement being such that when all of the switches are placed in their shunt relation to the sectional third-rail switches, said third-rail switches are rendered inoperative and the adjoining sectional third rails or conductors are made operative as a single section, substantially as described.

13. A safety system of electric railways embracing a current feeder or main; a series of sectional third rails or conductors provided with non-arcing resistances connected in series relation between adjoining short sectional conductors near the outgoing end of each sectional third rail or conductor, the last sectional third rail or conductor near the end being of sufficient length to permit a car or train of indefinite length to be located thereon; said car or train being provided with two or more current collectors or shoes, one at each end thereof; together with means as a switch for shunting the resistances out of circuit, substantially as described.

14. A safety system of electric railways embracing a current feeder or main and a series of sectional third rails or conductors normally disconnected therefrom; in combination with switching mechanism for automatically connecting said sectional third rails or conductors to and disconnecting them from the current feeder or main as a car or train passes by or over the route; together with manual switching mechanism located beside the track and operatively connected to the switching mechanism of any sectional third rail or conductor in such manner that any authorized person may render said switching mechanism temporarily inoperative so as to cause a car or train to stop when it reaches that particular sectional third rail or conductor, substantially as described.

15. A safety system of electric railways embracing a current feeder or main and a sectional third rail or conductor adapted to be electrically connected thereto; switching mechanism for connecting said sectional third rail or conductor to and disconnecting it from the current feeder or main and a manual switch connected in circuit with said switching mechanism and located at some point beside the track, the arrangement being such that an authorized person may temporarily prevent the sectional third rail or conductor from being connected to the current feeder or main and thereby cause a car or train to stop when its current-collector enters upon said sectional third rail or conductor, substantially as described.

16. A safety system of electric railways embracing a current feeder or main and a sectional third rail or conductor adapted to be electrically connected thereto; switching mechanism for connecting said sectional third rail or conductor to and disconnecting it from the current feeder or main and a manual switch connected in circuit with said switching mechanism and located at some point beside the track; in combination with a car or train provided with a propelling electric motor, a current collector or shoe for conveying current from the service or working conductor to and through the motor; together with electromagnetically-controlled brake mechanism included in the same circuit, the arrangement being such that an authorized person may prevent the sectional third rail or conductor from being connected to the current feeder or main, deprive the motor of current and automatically apply the brakes, substantially as described.

17. A safety system of electric railways embracing a current feeder or main; a sectional third rail or conductor and switching mechanism for connecting said sectional third rail or conductor to and disconnecting it from the current feeder or main; a manual switch located beside the track and operatively connected in circuit with said switching mechanism; signaling mechanism included in circuit with the switching mechanism, the arrangement being such that an authorized person may prevent the sectional third rail or conductor from being connected to the current feeder or main and display or give a warning signal, substantially as described.

18. A safety system of electric railways embracing two or more parallel lines of tram-rails; one or more current feeders or mains and a series of sectional third rails or conductors for each track normally disconnected therefrom; switching mechanism for connecting said sectional third rails or conductors to and disconnecting them from the current feeders or mains; in combination with rail-switches for each line of rails and stop-switches therefor operatively connected with the switching mechanism of the sectional third rails or conductors in such manner as to enable a switchman to stop any car on any track; together with signaling mechanism for indicating to a switchman in a switch-house the electrical condition of the sectional third rails or conductors adjacent to said switch-house, the rail-switch levers, stop-switches and signalling mechanism being all so located in the switch-house as to be readily observed by him, substantially as described.

19. In a system of electric railways a current feeder or main and a series of sectional third rails or conductors normally disconnected therefrom; switching mechanism for connecting said sectional conductors to and disconnecting them from the current feeder or main, said switching mechanism consisting of yielding interlocking terminals and levers for actuating the same; in combination with a mechanically-controlled trolley carried by a car, said trolley being provided with an elastic or yielding tire, substantially as described.

20. A safety system of electric railways embracing a current feeder or main; a series of sectional third rails or conductors normally disconnected therefrom and a switch for each sectional third rail or conductor embracing yielding metallic terminals having interlocking parts, the free ends of said terminals being slitted as shown and the locking part of one of the terminals so constructed with relation to the other that the tendency of the terminals when locked is to separate; in combination with adjustable yielding releasing means adapted to hold the terminals together, substantially as described.

21. In a safety system of electric railways of the sectional-third-rail type, a switch for connecting the circuit between any sectional third rail or conductor and the current feeder or main of the system, consisting of two yielding terminals, the ends of which are provided with locking means and yielding springs g, g, relatively so disposed that when held together the normal tendency is for them to separate; in combination with yielding means for maintaining the terminals in contact, said yielding means being attached to an armature located in the field of a releasing-electromagnet and a collar which surrounds the releasing-terminal, the arrangement being such that when the armature is drawn forward it gives to the releasing-terminal a sudden blow and permits the forces acting upon the interlocked faces of the two terminals to further aid in the separation thereof, substantially as described.

22. A safety system of electric railways embracing two or more parallel lines of tram-rails, one or more current feeders or mains and a sectional third rail or conductor for each line of tram-rails; in combination with a series of switching sectional working conductors for each line of tram-rails bonded together by bonds or cables where they intersect the tram-rails; together with a car or train having one or more electric motors and two or more current collectors or shoes so located with relation to each other that the circuit is never wholly interrupted through the motor when a car is passing from one track to another, substantially as described.

23. In an electric-railway system a switch consisting of two yielding terminals, the free ends of which are adapted to be locked together by an interlocking ledge or shoulder upon one of them; in combination with adjustable yielding means for maintaining the two terminals in locked relation, the angular relation of the two contacting ends of the terminals being such that they will not remain in locked position without the aid of the before-mentioned adjustable yielding means, subtantially as described.

24. In an electric-railway system a switch

consisting of two yielding terminals, the free ends of which are adapted to be locked together by an interlocking ledge or shoulder upon one of them; in combination with means for forcing the ends of the terminals into locked relation; together with adjustable yielding means for maintaining the two terminals in locked relation, the angular relation of the two contacting ends of the terminals being such that they will not remain in locked position without the aid of the before-mentioned adjustable yielding means, substantially as described.

25. In an electric-railway system a switch adapted to convey currents of large quantity, consisting of two yielding terminals the free ends of which are adapted to be locked together by an interlocking ledge or shoulder upon one of them, said locking-shoulder having an angular relation to the end of the other terminal such that when the two terminals are interlocked there is normally a tendency for them to separate; in combination with a releasing-electromagnet and an armature therefor operatively connected with means for releasing the interlocked terminals, together with adjustable yielding means for maintaining said terminals in locked position; substantially as described.

26. In an electric-railway system a switch adapted to convey currents of large quantity, consisting of two yielding terminals the free ends of which are adapted to be locked together by an interlocking ledge or shoulder upon one of them, said locking-shoulder having an angular relation to the end of the other terminal such that when the two terminals are interlocked there is normally a tendency for them to separate; in combination with means for forcing said terminals into their interlocked position; together with releasing means which normally maintains the interlocked terminals in their locked position and an electromagnet having an armature connected to the releasing means, the arrangement being such that the releasing means, when acted upon by the electromagnet, gives to the locking-terminal a preliminary blow whereby the terminals are caused to separate under their own yielding action and the joint action of the electromagnet, substantially as described.

27. In an electric-railway system a switch adapted to convey currents of large quantity, consisting of two yielding metallic terminals, one of which is composed of fingers separated from each other and the other is provided with an interlocking ledge or shoulder at its free end having an angular relation to the free ends of the fingers, such that when the two terminals are interlocked there is normally a tendency for them to separate, substantially as described.

28. In an electric-railway system a switch adapted to convey currents of large quantity, consisting of two yielding metallic terminals, one of which is composed of fingers separated from each other and the other is provided with an interlocking ledge or shoulder at its free end having an angular relation to the free ends of the fingers, such that when the two terminals are interlocked there is normally a tendency for them to separate; in combination with means for simultaneously forcing all of the free ends of the fingers into interlocked position with the shoulder of the other terminal, substantially as described.

29. In an electric-railway system a switch adapted to convey currents of large quantity, consisting of two yielding metallic terminals, one of which is composed of fingers separated from each other and the other is provided with an interlocking ledge or shoulder at its free end having an angular relation to the free ends of the fingers, such that when the two terminals are interlocked there is normally a tendency for them to separate; in combination with means for simultaneously forcing all of the free ends of the fingers into interlocked position with the shoulder of the other terminal; together with adjustable yielding means for holding the terminals in their interlocked position, substantially as described.

30. An electric-railway system embracing a current feeder or main; a series of sectional third rails or conductors and switching devices for connecting said sectional conductors to and disconnecting them from the current feeder or main as a car or train passes over the route; in combination with means located at the adjoining ends of the sectional conductors for connecting said conductors together in series relation and temporarily disconnecting any one or all of the switching devices from their respective sectional conductors, substantially as described.

31. An electric-railway system embracing a current feeder or main; a series of sectional third rails or conductors, and switching devices for connecting said sectional conductors to and disconnecting them from the current feeder or main as a car or train passes over the route; in combination with means for cutting out of circuit any one of the switching devices and connecting the adjoining ends of the sectional conductors adjacent thereto in series relation with each other, the arrangement being such that any two sections, when so connected, will operate as one and be operatively connected to and disconnected from the current-feeder by the next adjacent switching device in the rear, substantially as described.

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

CHARLES J. KINTNER.

Witnesses:

JAMES P. J. MORRIS,

M. F. KEATING.