No. 828,322. PATENTED AUG. 14, 1906.

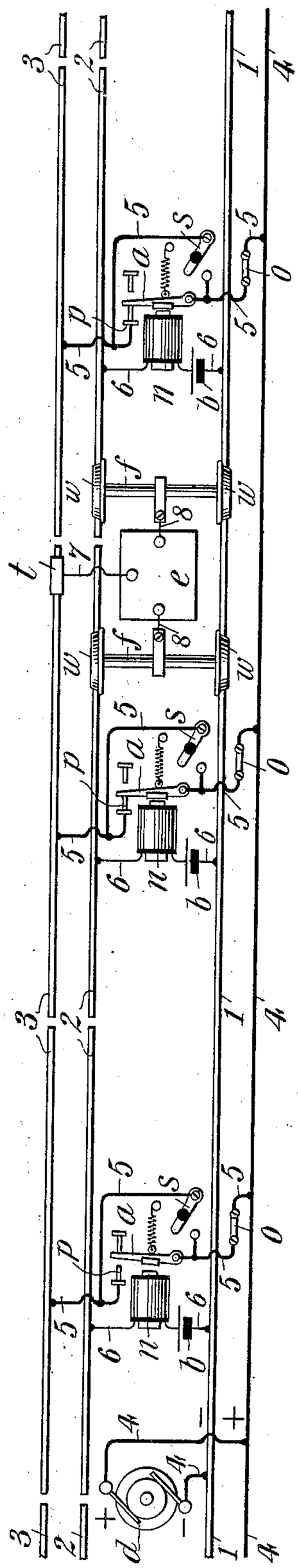
C. J. KINTNER.

ELECTRIC RAILWAY.

APPLICATION FILED DEC. 5, 1903. RENEWED JAN. 11, 1906.

5 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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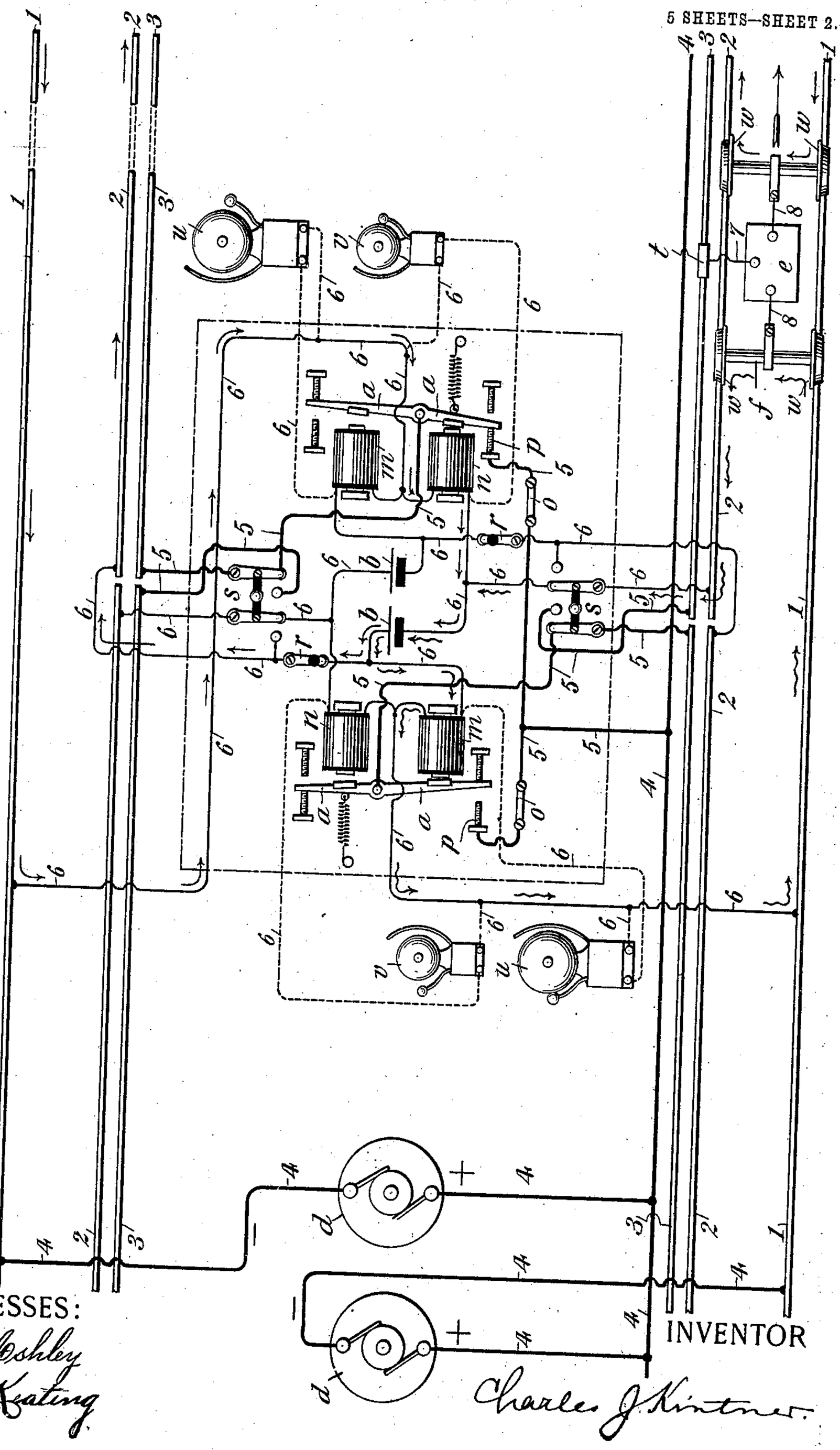
5 SHEETS—SHEET 2.

Fig. 2.



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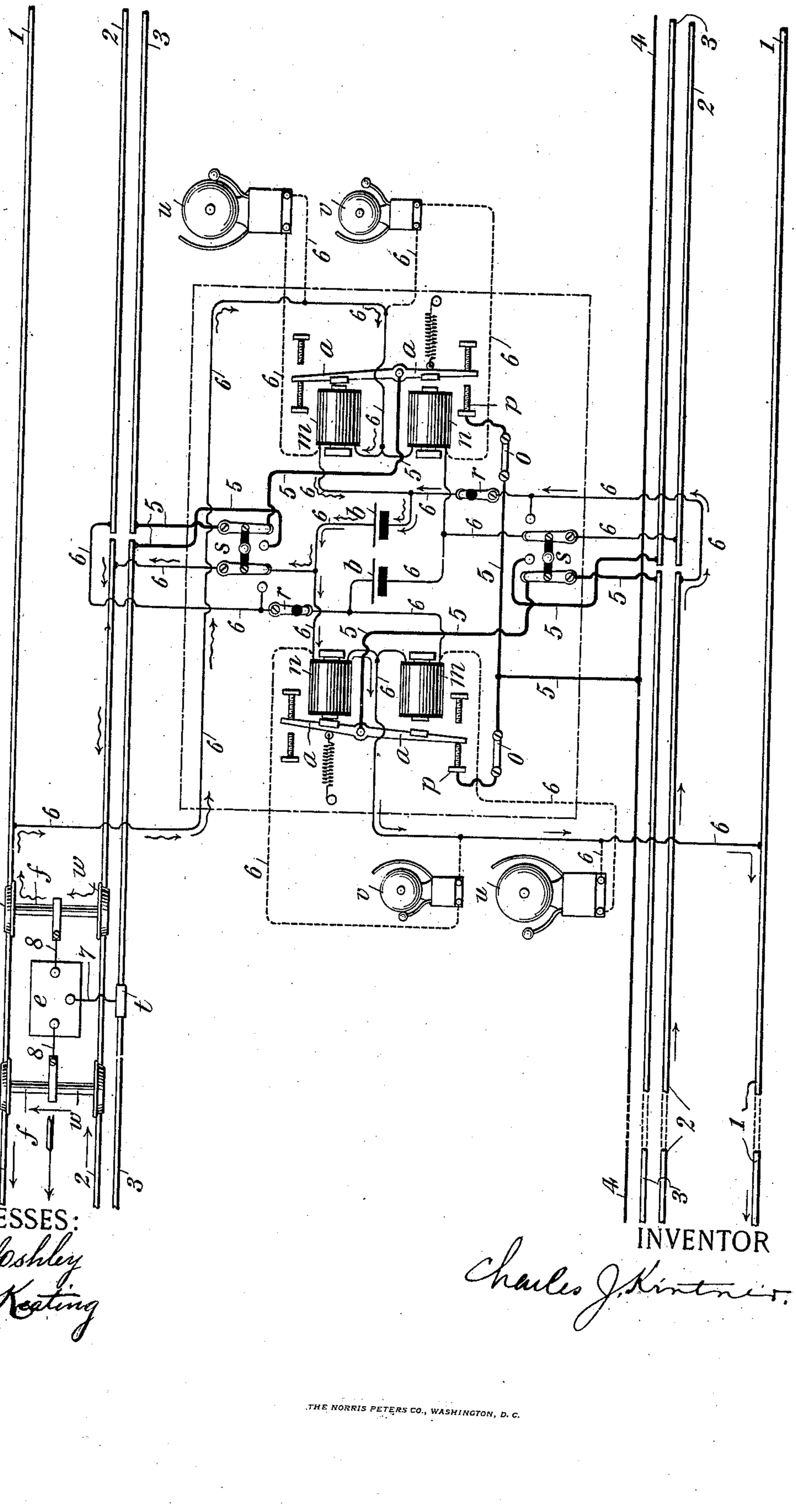
5 SHEETS—SHEET 3.

Fig. 3.



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5 SHEETS—SHEET 4.

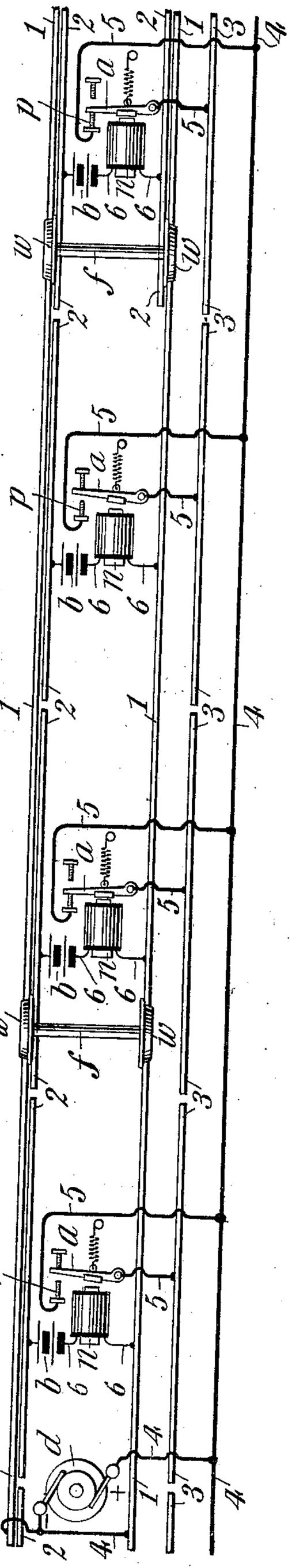

Fig. 4.

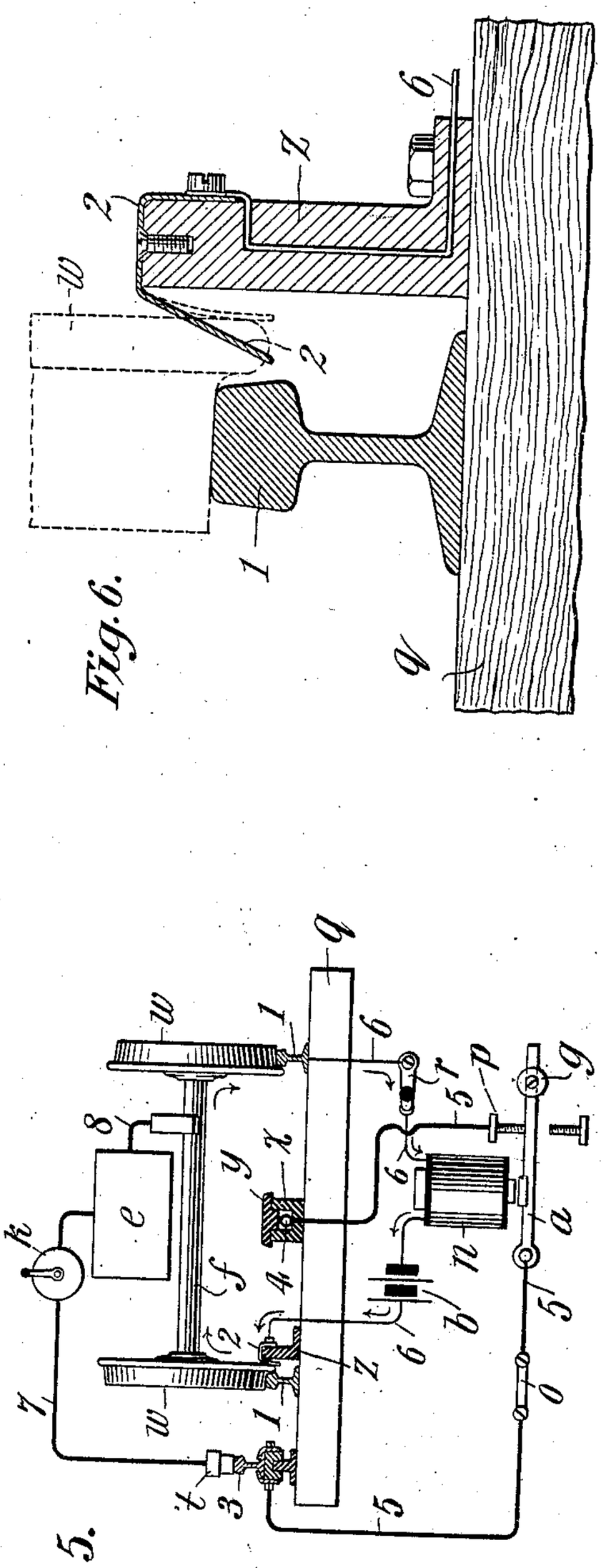

Fig. 6.

Fig. 5.

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5 SHEETS—SHEET 5.

Fig. 7.

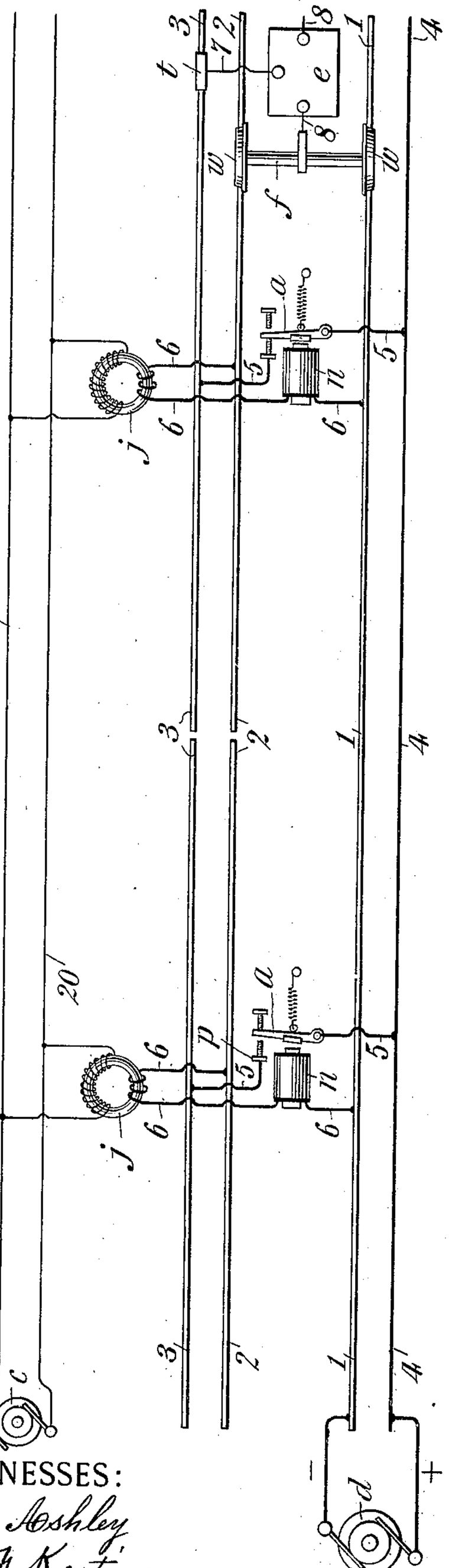

Fig. 9.

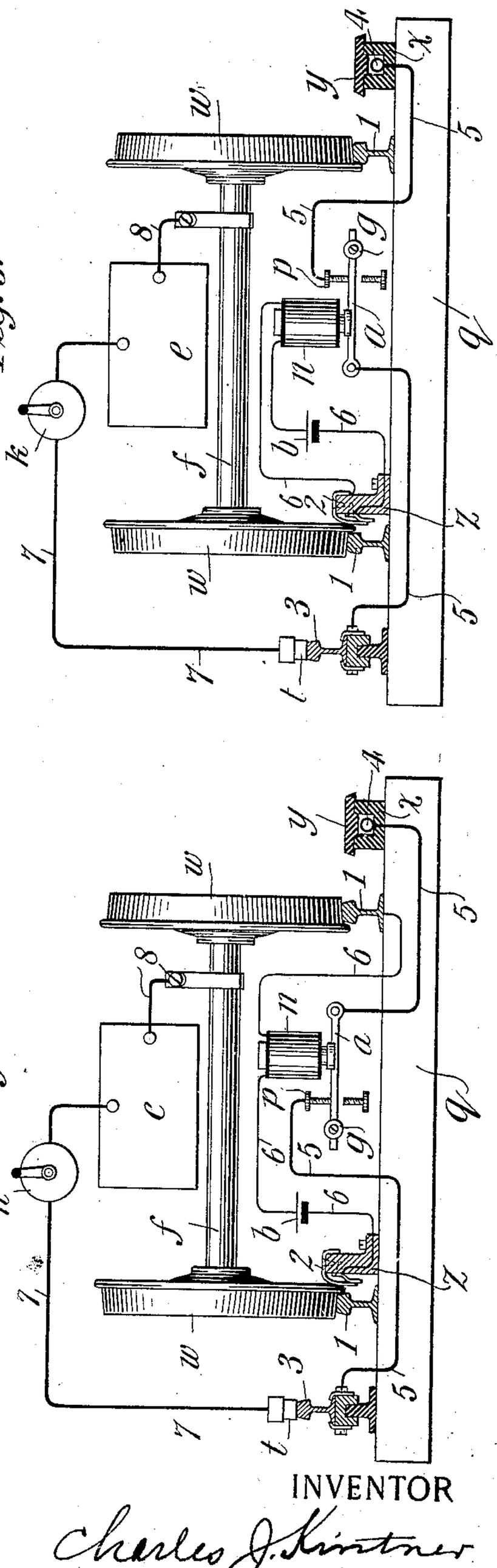

Fig. 8.

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ELECTRIC RAILWAY.

No. 828,322. Specification of Letters Patent. Patented Aug. 14, 1906.

Application filed December 5, 1903. Renewed January 11, 1906. Serial No. 295,573.

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 to improvements in electric railways of the sectional-conductor or third-rail type, and particularly to such systems as utilized the tram or track rails and the wheels or the wheels and axles of the cars for closing the circuit to the switch-controlling electromagnets which effect the connection of the sectional conductors to and the disconnection of the same from the current feeder or main as cars pass over the route, and will be fully understood by referring to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a single-track railway, illustrating my improvement in its simplest form, a power-house dynamo being shown and a car as seen traveling in either direction. Figs. 2 and 3, when placed end to end with Fig. 2 on the left, illustrate diagrammatically a double-track system of electric railways with my invention applied thereto and my arrangement of safety appliances as combined therewith, together with alarm-bells, switches, and circuit connections for effecting the desired results, two power-house dynamos being shown, one for each track, and two cars, one upon the lower track moving from left to right and one upon the upper track moving from right to left. Fig. 4 is a diagrammatic view of a modified form of the invention in which yielding supplemental track-rails are used in place of the tram or service-track rails for effecting the operation of the switches, there being shown in this view two single pairs of wheels and their connecting-axles for independent cars at different parts of the roadway without the trolley-shoes and circuit connections to the motors from the sectional third rails, as shown in the other views of the drawings. Fig. 5 is an enlarged cross-sectional view of Fig. 4, taken through the roadway, illustrating in section also the high-potential-current feeder and its inclosing conduit and in elevational view one of the switching-magnets and circuit connections and the motor and controller on the car. Fig. 6 is an enlarged detail sectional view taken through one of the tram or track rails and the parallel stringer which supports the contacting sectional track-rail, which is also shown in sectional view, a car-wheel and its manner of operation upon the sectional contacting track-rail being illustrated in dotted lines. Fig. 7 is a diagrammatic view similar to Fig. 1 of a modified form of the invention, illustrating the manner of operating the switches through the agency of currents primarily established by a generator at the power-house, which is wholly independent of or disconnected from the power-house generator. Figs. 8 and 9 are enlarged cross-sectional views taken through the roadway similar to Fig. 5 and illustrating still further modified forms of the switch-controlling rails or devices and their circuit connections.

An electric-railway system of the sectional-third-rail type has heretofore been devised in which both of the track-rails were divided into sections insulated from each other and double or duplex sectional third rails equal in length to such sectional track-rails were utilized in connection with an alternating-current power-house generator connected to two current-feeders or mains extending wholly over the route, to which were connected in turn, in multiple-arc relation, the primaries of converters the secondary circuits of which were of relatively low resistance and included switching-electromagnets, the opposite ends of such secondaries being connected directly to the pairs of sectional tram or track rails and the armatures of the switching-magnets included in open circuit between the current-feeders and the pairs of sectional third rails. It has also been proposed to divide both tram or track rails into parallel sections and to connect the opposite ends thereof, respectively, with switching-electromagnets and the secondary coils of converters, the primaries of which were connected in multiple-arc relation with a high-potential circuit controlled or operated directly by the power-house generator the armatures of the switching-magnets being so arranged as to connect the sectional third rails to the current feeder or main when a car was passing over the route, the wheels and axles of said cars short-circuiting the low-voltage currents passing through the switching-magnets and the sectional track-rails. In both instances, however, it is to be noted that the currents which control the operation of the switches are made directly dependent upon the operation of the power-house generators or upon secondary currents

generated thereby, so that when the peak of the load is reached and a large number of cars are traveling over the route the switches are rendered proportionately inoperative. It has also been proposed to divide both tram or track rails into pairs of insulated sections and to include between such parallel sectional track-rails switching-electromagnets which are actuated or operated by low-voltage batteries carried one upon each car and so arranged that the circuit was closed from the batteries through the switching-magnets and the wheels and axles as the car passed from section to section, as disclosed in United States Patent to Hicks, No. 419,673, granted January 21, 1890. Such an arrangement necessarily contemplates the use of a large number of batteries—namely, one for each car. It also necessitates the dividing of the track-rails into short sections not exceeding the length of the car, or rather the distance between any pair of trucks. A sectional-third-rail system has also been devised in which one of the track-rails is electrically continuous throughout its length and the other track-rail divided into sections corresponding in length with sectional third rails located between the track-rails, switching-electromagnets being located in pairs in switch-boxes at the ends of each section and a battery carried by each car so connected with the tram-wheels that when a car is standing upon a section the circuit is closed through the wheels and axles, the sectional track-rail, and the corresponding switching-magnet, the current from the battery returning by the wheels and axles resting upon the continuous track-rail. Such a system necessitates the use of a portable battery upon each car or train and the use of two sets of switching devices in each switch-box in order to enable cars to travel in opposite directions or to back from one section to another, while with my improvement by locating the batteries beside the track, one for each section, I am enabled to utilize a single switch for each section, no matter in which direction a car may be traveling. It has also been proposed to locate sectional third rails between the track-rails and to combine therewith pairs of sectional conducting-rails electrically connected with switching-electromagnets and batteries located beside the track, one for each section, all so arranged that through the agency of a duplex or double switch controlling trolley the sectional third rails are successively connected to and disconnected from the current feeder or main as a car passes over the route, as disclosed in patent to Wheless, No. 468,164, granted February 2, 1892.

My invention has for its objects—

First, to furnish a local stationary source of electrical energy for each section of the system and to include the same in circuit with the track-rails or track-circuit-closing devices and a switching-magnet, so arranged that when a car is passing over the route a relatively low voltage circuit is closed through the switching-magnet and the armature thereof caused to connect that particular sectional conductor or third rail directly to the current feeder or main so long as any pair of car-wheels of the train rests or stands upon the section, it being understood that each section is provided with an independent relatively low voltage generator, which is wholly disconnected from or out of control of the power-house generator or the source of power which drives it. In other words, the principal or essential feature of my invention lies in the use of relatively low voltage currents with sectional track-rails or track-circuit-closing devices, and in such manner that the operation of the switching-magnets is always the same under all conditions of load and usage, a condition which is not possible with existing types of sectional-third-rail systems where the low-voltage generators are connected to or made dependent upon the current generated by the power-house generator.

Second, the provision of safety appliances whereby when a car is passing over a given section the next section in the rear is made wholly inoperative, so that a following car will stop when it enters thereon for lack of working current.

Third, to combine switching devices with the low-voltage generators and safety appliances, whereby any sectional third rail may either be wholly cut out of circuit or any two adjoining sectional third rails may be joined in series relation and the corresponding adjoining sectional tram or track rails or track-circuit-closing devices connected in like series relation, so that the two united sections will operate from the switching devices located at the opposite ends of such single section.

Fourth, to combine alarm mechanism with the before-mentioned switching or safety apparatus or both, whereby both the public and the officials are warned as to the fact that any sectional third rail is alive, said alarms being actuated by the relatively low voltage generators and in such manner as to be wholly independent of the working current utilized to drive the motors and furnish lights for the cars and adapted also to give audible indication of the condition of the switch and safety batteries.

Referring now to the drawings in detail, in all of which like numerals and letters of reference represent like or equivalent parts wherever used, and first to Fig. 1, 1 represents a tram or track rail extending over the route and electrically continuous throughout its length, said track-rail being connected directly to the negative pole of a power-house dynamo *d*, the positive pole of which is connected directly to an insulated current feeder

or main 4, parallel with the roadway. 2 2 2 are sectional tram or track rails insulated from each other at their adjoining ends, and 3 3 3 are sectional third rails or conductors of the usual type insulated from each other at their adjoining ends and supported upon insulators in any well-known manner. 5 5 5 are normally open branch circuits designed to connect the sectional third rails or conductors 3 directly to the current feeder or main 4. These branch feeders are shown in Fig. 1 as connected, preferably, at or near the middle of each of the sectional third rails or conductors 3 3 3, 6 6 6 being low-resistance conductors included in circuit between the continuous track-rail 1 and the center of the sectional tram or track rails 2 2 2, *n n n* being switching-electromagnets and *b b b* low-voltage electrical generators, preferably single-cell storage or primary batteries having the necessary ampere-hour capacity to meet the requirements of relatively long usage. *a a a* are switching armature-levers included in the normally open branch circuits 5 5 5 and provided with the usual retractile springs, and *p p p* are the front contacts therefor. *s s s* are manual switches for connecting the sectional third rails 3 3 3 directly to the current feeder or main when it is desired to leave them in permanent connection therewith. *o o o* are fuses or equivalent automatic cut-out devices for disconnecting the sectional third rails or conductors for an undue flow of current to the motors on the cars. *w w w w* represent the wheels, and *f f* the axles of a car, and *e* an electric motor connected through the controller by conductor 7 directly to a current-collector or trolley-shoe *t*, adapted to contact with the sectional third rails 3 in the usual manner. 8 8 are return-conductors from the motor to the axles *f f*, wheels *w w*, and continuous tram or track rail 1 connected to the negative pole of the power-house generator *d*.

The operation is as follows: The car is shown in Fig. 1 as passing in either direction with the wheels *w w* upon two adjoining sectional track-rails 2 2 and with the current-collector or trolley-shoe *t* upon the middle sectional third rail. Consequently current is flowing from the battery *b* of the middle section through the magnet *n*, conductor 6, sectional track-rail 2, wheel *w*, axle *f*, wheel *w*, continuous tram or track rail 1 to the negative pole, so that the magnet is energized and the switching-lever *a* is drawn into its forward position, thereby connecting the positive pole of the power-house dynamo *d* and feeder 4 with the middle of the central sectional third rail 3, so that current is flowing through the current-collector or trolley-shoe *t*, conductor 7, to the controller of the motor *e*, thence by the return-conductor 8, axle *f*, wheel *w*, continuous track-rail 1 to the negative pole of the power-house dynamo, so that the car may move in either direction. At the same time circuit is closed through the other pair of wheels *w w* and axle *f* from the battery *b* of the extreme right-hand section through the switching-magnet *n* of that section, and its switching-armature *a* is held in its forward position, so that that particular third rail is made alive for the time being, and upon the supposition that the car is traveling from right to left it will be disconnected from the current-feeder as soon as the last pair of wheels *w w* leave the sectional track-rail 2 on the right; but this will occur only after the current-collector or trolley-shoe *t* has left the right-hand sectional third rail 3, so that although this sectional third rail has current-potential there will be no arcing, in view of the fact that the sectional third rail upon which it is now resting has a like current-potential. As the wheels *w w* leave the left-hand end of the right-hand track-rail 2, therefore, the magnet *n* of that section will be demagnetized and the switch will be opened and no arcing will occur at any point, it being obvious that the low-voltage switching battery *b* will not cause damaging arcing. Should it be desirable at any time to repair a switch or to restore a battery it is only necessary to connect that particular sectional third rail with the current-feeder directly by the switch *s* and leave it thus connected until the repair is effected. In the event of an abnormal flow of current through any sectional third rail from short-circuiting or otherwise on the car the corresponding fuse or cut-out *o* will be blown.

Referring now to Figs. 2 and 3, I will describe in detail my invention as applied to double tracks and as combined with safety appliances for preventing rear-end collisions, together with means in the nature of switches for varying the lengths of the sections, also as combined with alarm-bells for indicating the fact that any particular sectional third rail or conductor is alive on either track. In these two figures of the drawings, 1 1, as before, represent the continuous tram or track rails on the outside, and 2 2 the sectional tram or track rails on the inside, 3 3 being the sectional third rails, as before. In this instance each track is provided with an independent dynamo *d*, having its positive pole connected to a common current feeder or main 4, with the branch feeders 5 5 running from each track to the open contacts of duplex switches *s s*. Two cars like that shown in Fig. 1 are shown in these figures of the drawings, the lower car passing upon the lower track from left to right in the direction of the large arrow and the upper car upon the upper track from right to left in the direction of the large arrow. *n n* are the switching-magnets, as before, and *m m* are safety-magnets, *u u* being low-toned tap-bells adapted to be included

in the circuit of the respective batteries *b b*, and *v v* high-toned tap-bells located at the opposite ends of the sections and adapted similarly to be included in the battery-circuits, as will be more particularly described in connection with the description of the mode of operation. The tap-bells *u u* are in multiple-arc relation with the safety-magnets *m m* and the tap-bells *v v* in like multiple-arc relation with the switching-magnets *n n*. It is to be noted that the armature-levers *a a* of the switching-magnets are centrally pivoted and that the arms under control of the switching-magnets *n n* are shorter than the arms under control of the safety-magnets *m m* for a purpose to be hereinafter described. All of the magnets, switches, and batteries for each section are inclosed in water-tight switch-boxes located in this instance at or near the ends of the adjoining sections, outlines of said switch-boxes being shown in broken dotted lines and the circuits of the alarm-bells being shown in fine dotted lines, the tailless arrows representing the circuits from the batteries to the switching-magnets in operation and the wavy arrows representing the corresponding circuits from the batteries in the safety-magnets.

With this brief description I will now refer to the mode of operation and first to the car upon the upper track, which is seen traveling from right to left in the direction of the large arrow. As the car stands upon the middle section (there being three sections shown) a circuit is closed from the left-hand battery *b* in Fig. 2, by way of the tailless arrows through the switch *r*, branch conductor 6, sectional track-rail 2, front wheels *w*, and axle *f* of the car, continuous tram-rail 1 to the left, down by conductor 6 to the right, through switching-magnet *n* in the lower right-hand corner of the switch-box in Fig. 2, to the negative pole of said battery, thereby causing the short-armed switching armature-lever to be drawn into its forward position against the influence of the retractile spring, so that a working circuit is now closed from the right-hand power-house generator *d* on the left by current-feeder 4, branch feeder 5, right-hand fuse *o*, contact-point *p*, armature-lever *a*, branch feeder 5, right-hand branch of the duplex switch *s* at the top of the switch-box to the central sectional third rail 3, current-collector or trolley-shoe *t*, motor *e*, return-conductors 8, axles *f*, wheels *w w*, to the continuous track-rail 1, and thence to the negative pole of the before-mentioned power-house generator, so that the motor on the car is receiving working current, which is moving the same from right to left, as shown. At the same time a branch circuit is closed, as shown by the waved arrows, from the right-hand battery *b* in the right-hand switch-box in Fig. 3, upward through conductor 6, left-hand half of the duplex switch *s*, sectional track-rail 2, through the rear wheels *w w*, axle *f*, continuous track-rail 1, downward by conductor 6 to the right, thence to the left, upward through the safety-magnet *m*, thence to the left and downward to the negative pole of said battery, causing said magnet to energize the armature upon the long arm of the switching armature-lever *a*, and therefore aid the armature-spring at the other end of said armature-lever to prevent any forward movement of the switching-lever in the event of a car entering the extreme section on the right in the rear of the car in Fig. 3, it being understood that should a car so enter the circuit would be closed from the left-hand battery *b* in the right-hand switch-box through the wheels and axles of that car, track-rails 2 and 1, conductor 6, and the switching-magnet *n* in the lower right-hand corner of the box; but as the safety-magnet and the armature-spring act in the same direction this tendency of the switch to operate will be overcome, and this condition will continue so long as the two cars stand upon the sections of track in the order named or until the rear wheels of the car upon the central section shall pass out of that section to the next section in advance. At the same time that the circuit was closed from the left-hand battery *b* of the switch-box in Fig. 2 a multiple-arc branch circuit was closed through the high-toned tap-bell *v*, located outside of said box and to the right thereof, so that this bell is ringing continuously, giving warning to the public that that particular sectional third rail is alive. At the same time a multiple-arc branch circuit was closed through the low-toned tap-bell *u* on the right of the switch-box in Fig. 3, giving a continuous warning to a motorman following that there is a car upon the section preceding. Each of the tap-bells is provided with a parabolic reflector, as shown, designed to concentrate the sound in the proper direction—that is to say, the reflectors behind the low-toned tap-bells will throw the sound toward approaching cars from the rear, while the reflector behind the high-toned tap-bells will throw the sound in the same direction, giving warning to the public of the fact that the sectional conductor between the bell and where the sound is audible is alive.

Upon tracing the circuits for the lower car upon the central section of the lower track through the left-hand battery *b* in the switch-box, Fig. 2, and the right-hand battery *b* in the switch-box, Fig. 3, it will be seen that the sectional third rail of the central section for the lower track is alive and is connected with the current-feeder, receiving its current from the extreme left-hand power-house generator, the return-circuit from that generator being to the lower track-rail, while the return-circuit from the right-hand generator runs to the upper track-rail.

Should it be desired to lengthen any sec-

tion of the system, it is only necessary to turn the switch *s* from the position shown into contact with the other pair of contacts adjacent thereto, this being effected in connection with the upper track by turning the lower points of the switch from right to left into contact with the exposed contacts and the lower switch from left to right into contact with the like exposed contacts, at the same time rupturing the circuits 6 by opening the switches *r* in both switch-boxes. To illustrate, suppose it is desired to connect the two sections on the left in Fig. 2 of the upper track in series relation it is only necessary to turn the duplex switch *s* from right to left with the points thereof into contact with the exposed contacts shown and to at the same time interrupt the circuit 6 at the switch *r*, in which event it will be apparent that the sectional track-rails 3 3 are connected in series relation for those two sections, and the sectional third rails are likewise connected in series, so that the two batteries and two sets of magnets at the ends of the now single section will act as before. The tap-bells *u v* being combined with the system in such manner as to be operated by the batteries *b b* at both ends of each section not only give the warnings, as hereinbefore referred to, to the public and to the officials of the road that the particular sections with which they are connected are alive, but serve the additional function of indicating when the batteries have reached a point of discharge at which they should necessarily be recharged or replaced, it being well known in the art of railway-signaling that as single batteries run down or become polarized the signaling tap-bells located in circuit therewith will vary their rate of signal-taps.

Referring now to Figs. 4, 5, and 6, I will describe a modified form of the invention in which both of the tram or track rails are electrically continuous throughout the length of a predetermined portion of the road and connected directly to the negative pole of the power-house dynamo *d*, as is usually the case, the positive pole thereof being connected to the current-feeder 4, which is preferably inclosed in an insulated conduit *x*, having a removable cover *y* and located either between the track-rails or to one side thereof, as preferred. 5 5 5 are normally open branch feeders, and *n n n n* the switching-magnets, provided with switching armature-levers *a a a a*, adapted to close the working circuit on their forward movement at the contact-points *p p p p*. In this form of the invention instead of dividing one of the track-rails into insulated sections I provide a supplemental set of yielding sectional track-rails 2 2 2 equal in length to the sectional third rails 3 3 3 and made, preferably, of thin steel secured to the upper edge of insulating-stringers *z*, treated in any preferred manner, which stringers are secured directly to the ties *q* by bolts or otherwise, the arrangement being such that the inner edges of the yielding sectional track-rails shall lie always well out of contact with the adjacent tram or service rail 1, while their other edges are connected by an insulated conductor 6, extending through the stringer *z* to the positive pole of the battery *b*, the negative pole of said battery being connected to the switching-magnet *n* through conductor 6, switch *r* to one of the tram or service rails 1, as clearly illustrated in Figs. 5 and 6. The switching-magnets in this form are preferably arranged, as shown in Fig. 5, with their lower poles turned downward and the switching armature-levers provided with adjustable weights *g* for normally holding them in their open positions. In place of using the track-rail for the return-circuit I may utilize a second set of yielding supplemental sectional track-rails, as illustrated at the right-hand section in Fig. 4, the duplicate sectional yielding track-rails being, as will be understood on examination of Fig. 6, so arranged that their yielding edges are adjacent to the inner edges of the tram or track rails 1 1, so that the flanges of the wheels *w w* will close the circuit of the battery *b* through the wheels and axles and actuate the switch.

The operation of the form of the invention as shown in Fig. 4 will be clearly understood on examination of Fig. 5, it being apparent that when a car is standing upon or passing over any section its corresponding switching-magnet *n* will be energized by virtue of a current flowing from the battery *b* through the conductor 6, yielding supplemental sectional track-rail 2, wheels *w w*, and axles *f f* of the car to the other track-rail 1, by conductor 6, switch *r*, through the magnet to the negative pole, thus causing the armature *a* to be lifted with its weight *g*, so that a branch circuit is closed from the feeder 4 by the branch feeder 5, contact *p*, switch armature-lever *a*, fuse *o* to the sectional third rail 3, by the trolley-shoe or current-collector *t*, conductor 7, controller *k*, motor *e*, conductor 8 to the wheels and axles of the car, through both tram or service rails 1, as will be apparent on inspection of Fig. 4, to the negative pole of the power-house generator *d*. A further modification of this form of the invention which would prevent any possibility of the circuit being closed to the switching-batteries *b* by the laying of a crow-bar or other conductor upon the sectional track-rails and continuous track-rail or upon the supplemental track-rail, as shown in Fig. 4, might be used, and I regard the same as coming within the scope of my claims as hereinafter made, in which the opposite poles of the battery *b*, including the switching-magnet *n*, might be connected one—say the negative pole—to the yielding sectional supplemental track-rail in

the manner shown in Fig. 6 and the other pole thereof connected to a second yielding sectional track-rail secured to the inner face of the stringer *z* and underneath the yielding edge of the supplemental sectional track-rail 2, which is acted upon by the flanges of the car-wheels, the arrangement being such that when any one of the car-wheels enters a section the two yielding sectional track-rails are forced into and maintained in contact with each other as long as any car-wheel is standing upon or passing over a section. Such an arrangement I should consider as the preferred form on surface roads across the country where the public might carelessly close the circuit by laying a conductor upon the continuous track-rails and any one of the sectional track-rails when the invention is constructed and used in the manner illustrated in Figs. 1 to 4, inclusive. Such an arrangement also protects the inner flexible rail from the weather and from the presence of ice or other insulating substances.

In Fig. 7 I have illustrated diagrammatically a modification of the invention in which the switches are controlled by an alternating-current generator *c*, wholly independent of or disconnected from the power-house generator *d*. This alternating-current generator is connected directly in a circuit 20, extending over the line, and at intervals along the line corresponding to the lengths of the sectional tram-rails 2 2 are located converters *j j*, having the primaries thereof connected in multiple with the circuit 20. The secondaries of said converters are connected at their opposite ends, respectively, through the low-resistance conductors 6 6 with the sectional track-rails 2 2 and the continuous track-rail 1 and include the switching-magnets *n*. 5 5 are the normally open branch circuits, as before connected directly to the current feeder or main 4 on one side and to the sectional third rails 3 3 on the other side, *a a* being switching armature-levers included in said circuits. A car is shown upon the extreme right-hand side of the drawings, and the operation will be apparent, it being obvious that when the wheels *w w* are standing upon the extreme right-hand section the low-voltage circuit from the converter *j* will be closed through the low-resistance conductor 6, thereby energizing the switching-magnet *n*, so that the switching armature-lever *a* is drawn forward and the current-feeder 4 connected directly in circuit with the sectional third rail 3, so that working current is furnished to the current collector or trolley *t* and motor *e* through the return-conductor 8, axle *f*, wheel *w*, and continuous track-rail 1 to the power-house generator. While such a system is capable of practical operation, owing to the fact that the currents operating the switches are generated by a source of electrical energy—in this instance an alternating-current generator *c*, which is wholly independent of or disconnected from the power-house generator *d*—it is not the preferred form, but is illustrated here as one which is entirely practical.

In Figs. 8 and 9 I have illustrated modified forms of track-circuit-closing devices or track-circuit-closing rails as coming within the terms of my invention and as used in connection with a system of sectional third rails. Referring first to Fig. 8, *q q* represent the ties, as before, supporting the track-rails 1 1, *w w* the wheels, and *f* the axle, of a car, *e* being an electric motor, and *k* a controller carried thereby. 7 is a conductor running from the controller to the current-collector or trolley-shoe *t*, resting upon the third-rail 3, which is supported upon insulators in the usual way by the ties *q*. 8 is the return-conductor connected to the motor *e* and axle *f*, and hence to the wheels *w* and track-rails 1 1. *n* is the switching-magnet, *a* the switching-lever, and *b* the switching-battery. 2 constitutes a normally dead track-rail, similar to the like track-rail illustrated in Fig. 5, equal in length to the sectional third rail or conductor 3, said track-rail having normally no electrical connection whatever otherwise than as acted upon by the flanges of the wheel when brought into contact with a second sectional track-rail located beneath the former and secured directly to the stringer *z*, the arrangement being such that when no car is upon the section the lower edge of the upper track-rail will rest against the adjacent lateral flange of the tram-rail 1, so as to constitute a housing or protection for the conducting track-rail beneath it, which track-rail is connected directly to the low-resistance conductor 6, and hence to the battery *b*. When a car is standing upon a section, as illustrated in Fig. 8, the flanges of the wheels *w w* on the left pass between the tram-rail 1 and the yielding track-rail 2, forcing it, as shown, into electrical connection with the inner or protected track-rail, thereby closing a circuit as follows: from the battery *b* through the low-resistance conductor 6, switching-magnet *n*, right-hand track-rail 1, right-hand wheel *w*, axle *f*, left-hand wheel *w*, flange of wheel, upper yielding circuit-closing rail *w*, lower yielding circuit-closing rail, conductor 6 to the negative pole, thus causing the switching armature-lever *a* to be drawn into its upper position, so that the circuit is closed directly from the feeder 4, branch circuit 5, armature-lever *a*, contact-point *p*, branch circuit 5 to the sectional third rail 3, by current-collector or trolley-shoe *t*, conductor 7, to the controller *k* and motor *e*, and by the return-circuit 8, axle *f*, wheels *w w*, and rails 1 1 to the power-house dynamo. Referring now to Fig. 9, the only essential difference between the arrangement of circuits and that disclosed in Fig. 8 is found in the fact that

both of the yielding track-rails or circuit-closing devices 2 are connected directly to the low-resistance conductors 6, so that when a car is standing upon any particular section, as shown, the circuit is closed directly from the battery *b* by the conductor 6, through the magnet *n*, conductor 6, and through the yielding edges of the two yielding track-circuit-closing rails 2 2, the flanges of the wheels in this instance acting mechanically only to bring the yielding circuit-closing rails into electrical contact with each other.

I do not limit my invention to the modified forms thereof illustrated in the accompanying drawings and hereinbefore described, as obviously a number of the features thereof might be materially departed from and still come within the scope of my claims hereinafter enumerated. To illustrate, the novel types of yielding circuit-closing rails shown in Figs. 5, 6, 8, and 9 might be utilized in connection with sectional third-rail systems of electric railways generally, many of the features of my invention being generic, particularly those with relation to the use of such sectional track rails or circuit-closing devices and of the use of the same in combination with electrical generators for controlling the switches which effect the connection of sectional third rails to and disconnection of the same from a power-house generator, whether the same be through the agency of local batteries located at points along the line or through the agency of local currents primarily generated by a generator which is independent of or disconnected from the power-house generator, one of the important features of my invention residing in the controlling of the switches by electrical currents, which shall be locally constant for each switch, and I wish it understood that my claims are to be construed as of the most generic nature in these particulars.

No claim is made in the present application to an electric-railway system having a current-feeder or main, a series of sectional third rails, a series of sectional track-rails, a continuous track-rail connected to the power-house generator, and switching devices included in circuit between the sectional track-rails and the continuous track-rail with electrical generators located at intervals along the road nor to the combination of sectional track-rails, sectional third rails, a power-house generator connected to a current-feeder, and circuit connections between the sectional track-rails with local switch-controlling generators when combined with safety mechanism for preventing rear-end collisions, as these features are claimed in an original application filed by me in the United States Patent Office October 13, 1903, and bearing Serial No. 176,930.

I am aware that it has heretofore been proposed to operate or control electric railway-signals by utilizing one of the track-rails and a flexible supplemental conducting-rail closely adjacent thereto in connection with a signal-battery and an electric circuit connected to the track-rail and such flexible rail, as disclosed in British Patent No. 2,169 of 1889 and in United States Patent to Means, No. 273,377; also, that it has heretofore been proposed to operate or control electric railway-signals by utilizing both of the track-rails and a pair of rigid supplemental conducting-rails yieldingly supported at their ends and connected together electrically and to one or more electrical circuits, including one or more signals, as disclosed in United States Patent to Thaler, No. 491,387. In all of the before-mentioned patents, however, it is proposed to utilize the tread-surfaces of the car-wheels for effecting electrical connection between the track rail or rails and the supplemental rail or rails. While such an arrangement would be operative, it is open to the objection that with many existing types of rails the head of the rail is practically the same width as the tread-surface of the car-wheels, so that oftentimes such an arrangement would be impractical, and I make no claim hereinafter to this feature *per se*, my claims in this particular being limited specifically to the utilization of the flanges of the wheels between the track-rail and the yielding supplemental conducting-rail. I am also aware that it is old to mechanically close an electrical circuit to and through an electric motor on board of an electrically-propelled car through the action of the flanges of the car-wheels and yieldingly-supported conducting-rails, as disclosed in German Patent No. 103,246, September 28, 1898.

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

1. An electric-railway system embracing a current-feeder and a power-house generator connected thereto; a series of sectional conductors or third rails; normally open branch feeders and switches for closing the circuit between the current-feeder and the sectional conductors; in combination with switch-controlling electromagnets included in circuit with local electrical generators beside the track; together with track-circuit-closing devices controlled by the wheels of a car or train upon the track, said electrical generators being wholly out of control of or disconnected from the power-house generator when in operation.

2. An electric-railway system embracing a current feeder or main and a power-house generator connected thereto; sectional conductors or third rails; electrical batteries located at intervals along the route and connected in circuit with switch-controlling electromagnets and track-circuit-closing devices,

the arrangement being such that the presence of the wheels of a car upon any section will cause the third rail or conductor of that section to be electrically connected to the current feeder or main when said car is passing over the section, no matter in which direction it may be traveling.

3. An electric-railway system embracing a current-feeder and a power-house generator included in circuit therewith and with one or more of the tram or service rails; sectional conductors or third rails and a local battery for each sectional conductor or third rail; in combination with switching devices made operative by the wheels of a car and circuits and circuit connections whereby a car standing upon or passing over any section will maintain the corresponding sectional conductor or third rail connected to the feeder, whether the power-house generator be operating or not.

4. An electric-railway system embracing a current-feeder and a power-house generator connected thereto and to a return-circuit; a series of sectional conductors or third rails and switches for connecting the same to and disconnecting them from the feeder; in combination with local batteries located beside the roadway and included in circuit with switch-controlling electromagnets and track-circuit-closing devices; together with additional local batteries and safety devices included in circuit therewith and with the track-circuit-closing devices whereby the sectional conductors or third rails are connected to and disconnected from the feeder as a car passes over the route and rear-end collisions are avoided.

5. An electric railway of the sectional third-rail type provided with local batteries located at intervals along the roadway; switch-controlling electromagnets and track-circuit connections for making the sectional third rails alive as a car passes over the road; in combination with alarm mechanism for indicating when any sectional third rail is alive.

6. An electric-railway system of the sectional third-rail type embracing a current-feeder and switches for connecting the same to and disconnecting it from the sectional third rails in sequence; in combination with a local electrical generator for each switch, and alarm mechanism for indicating when any sectional third rail is alive.

7. An electric railway of the sectional third-rail type embracing a current-feeder; sectional third rails and switches for connecting the same to and disconnecting them from the feeder in sequence; a local battery for each switch and sectional track-circuit-closing devices for actuating the switches; together with an alarm connected in circuit with each local battery and adapted to indicate when any section is alive and also to indicate the condition of the battery.

8. An electric-railway system embracing a current feeder or main; sectional conductors or third rails; normally open circuit connections between the same and the feeder; switches for closing said normally open circuit connections, and local electrical generators wholly independent of or disconnected from the power-house generator and included in circuit with switch-controlling electromagnets; in combination with track-circuit-closing rails having contact with the wheels of the cars as they pass thereover and adapted to close successively the circuits of the switch-controlling magnets, the arrangement being such that the presence of a car upon any section of the track causes the corresponding sectional conductor to be maintained in connection with the current feeder or main during the time that said car is passing thereover in either direction, whether the power-house generator be in operation or not.

9. In a double-track system of electric railways a power-house generator for each track, each having its negative pole connected to a continuous track-rail and its positive pole to a feeder; sectional third rails and switches and circuit connections for each track included in circuit with local batteries; in combination with safety devices for preventing rear-end collisions; said safety devices being included in circuit with additional local batteries and the track-rails, the arrangement being such that the switching-batteries and the safety-batteries normally oppose each other through the track-rails and tend to restore electrical equilibrium after cars have passed over the route, the balance being disturbed for each section by the presence of a car thereon and the switching and safety mechanisms actuated concurrently.

10. In an electric-railway system a current feeder or main and a power-house generator included in circuit therewith and with one or both of the track-rails; sectional conductors or third rails; switches for connecting the same to and disconnecting them from the feeder; local batteries, one for each section, included in circuit with a switch-controlling electromagnet and two track-circuit rails, one of which conceals or protects the other; in combination with means carried by or moving with each car for continuously closing the circuit between the track-circuit rails so long as a car stands upon or is moving over a section.

11. A sectional system of electric railways embracing a current-feeder; sectional conductors or third rails; independent local batteries located beside the track and switches for connecting the sectional conductors to and disconnecting them from the feeder; in combination with track-circuit-closing devices actuated by the wheels of a car on any section to close the local circuit to its corre-

sponding switch-magnet and a cut-out for each sectional conductor or third rail adapted to automatically disconnect the same from the feeder for an abnormal flow of current therethrough.

12. In a system of electric railways a current feeder or main; sectional conductors and switching devices for connecting the same to and disconnecting them from the feeder or main; local electrical generators included in circuit with the switching devices and with sectional track-circuit-closing rails; in combination with means for cutting out any third-rail switch and simultaneously connecting the adjoining third rails and track-circuit-closing rails respectively in series relation so that two sections may be joined together and act as one.

13. A track-circuit-closing device consisting of a flexible rail adapted to make frictional contact with the wheels of a car; in combination with a switch-controlling magnet connected thereto and to a return-circuit including a source of electrical energy, the arrangement being such that the switch-magnet is energized by the presence of the car-wheels between the flexible rail and one of the tram or service rails as the car stands upon or passes over the route.

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

CHARLES J. KINTNER.

Witnesses:

M. TURNER,

M. F. KEATING.