L. V. LEWIS.

RAILWAY TRAFFIC CONTROLLING SYSTEM.

APPLICATION FILED DEC. 31, 1920.

1,423,862.

Patented July 25, 1922.

4 SHEETS—SHEET 1.

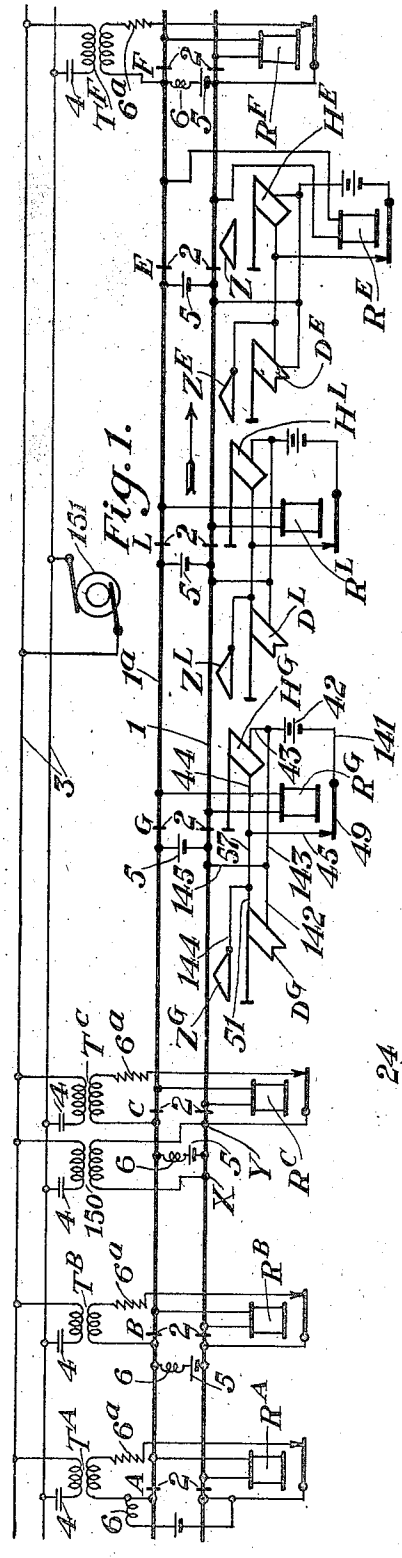


Fig. 1.

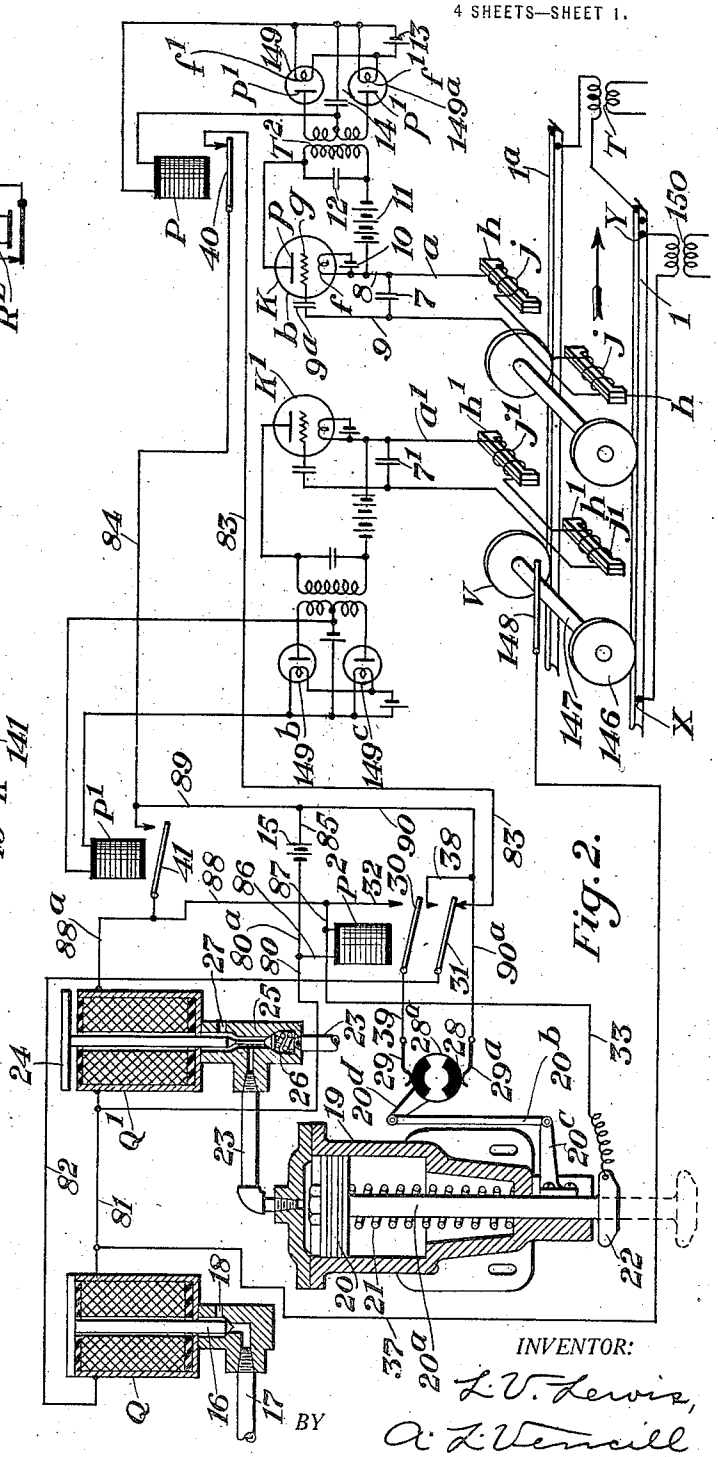


Fig. 2.

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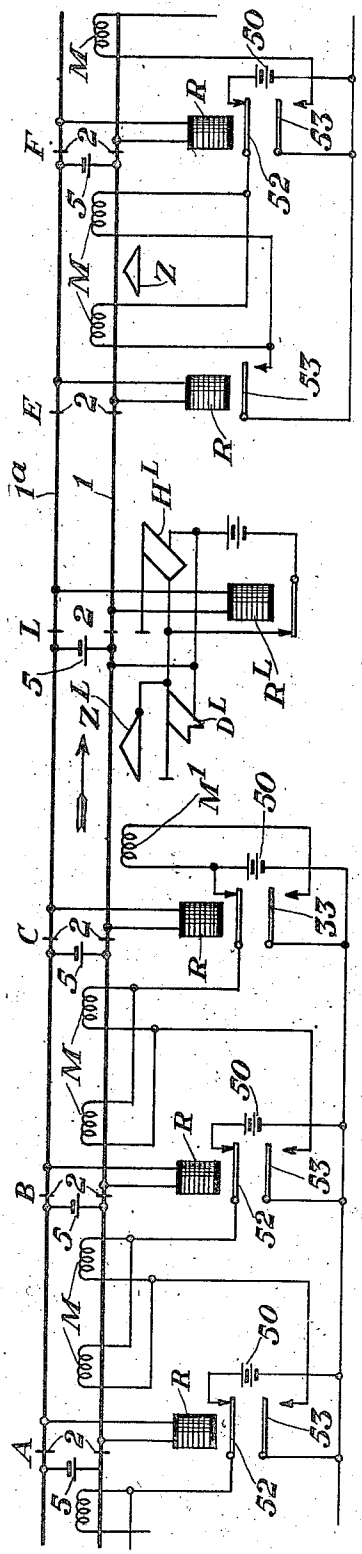


Fig. 6.

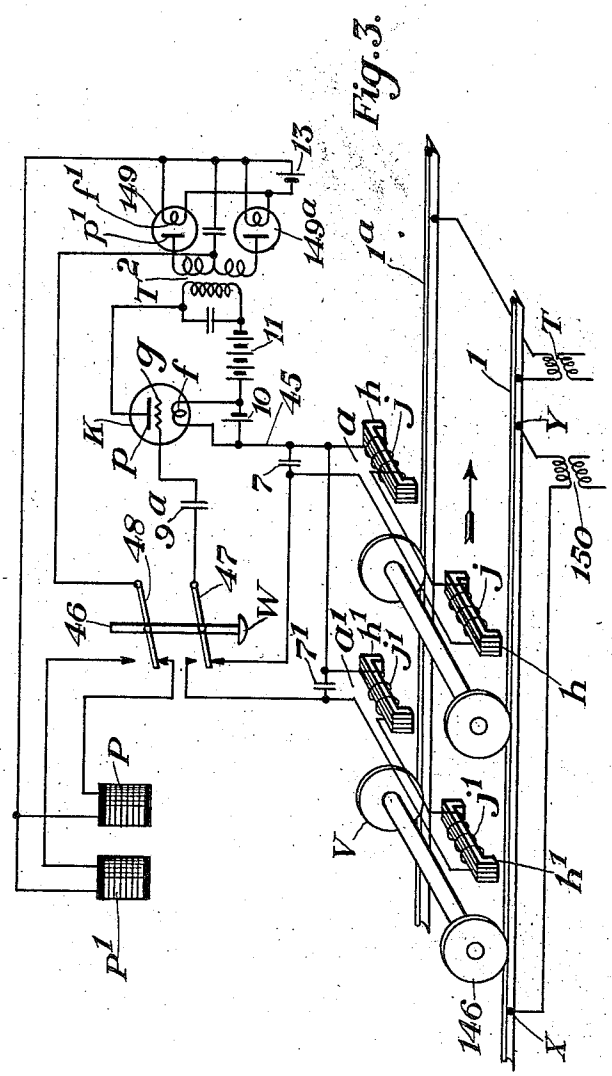


Fig. 3.

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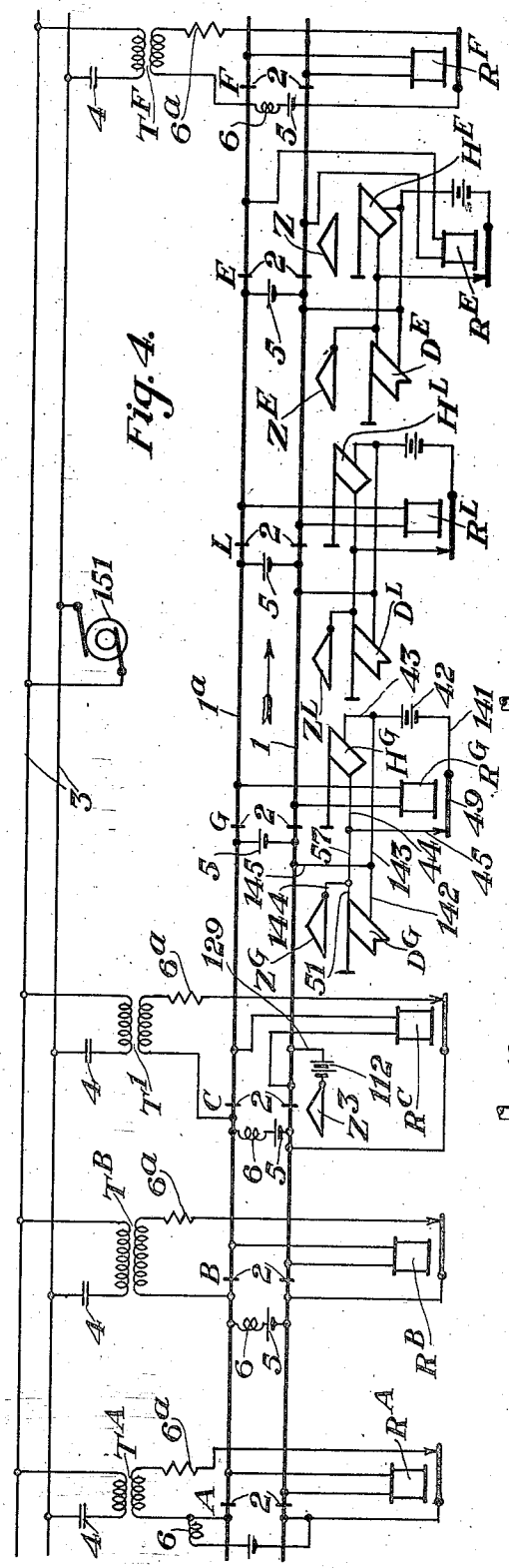


Fig. 4.

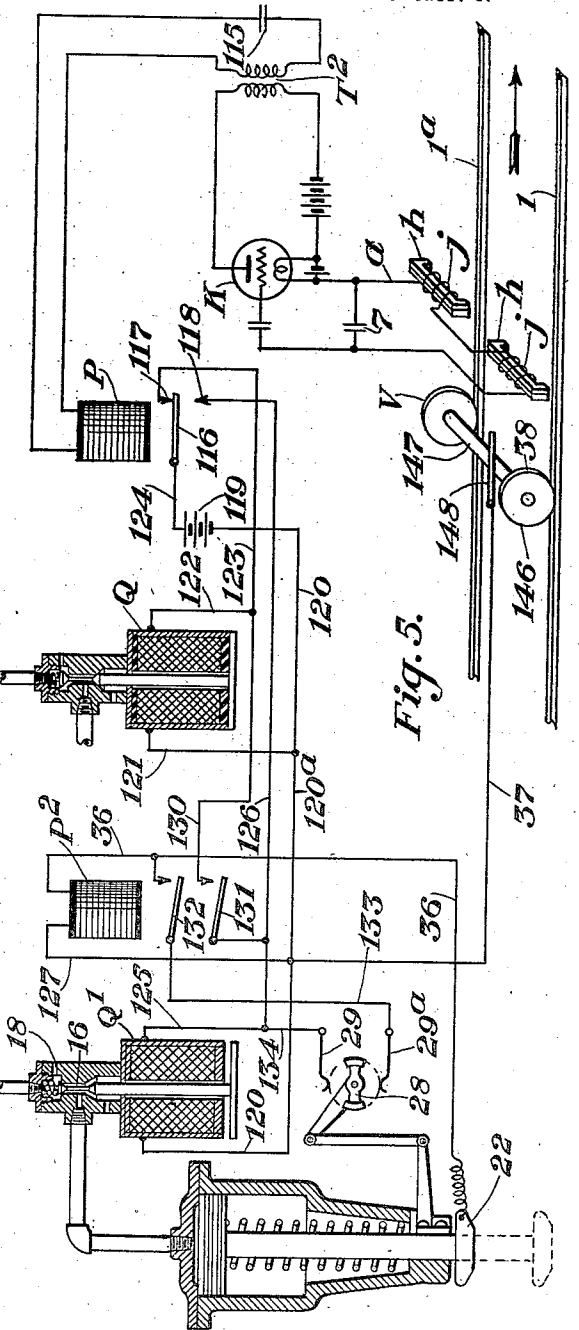


Fig. 5.

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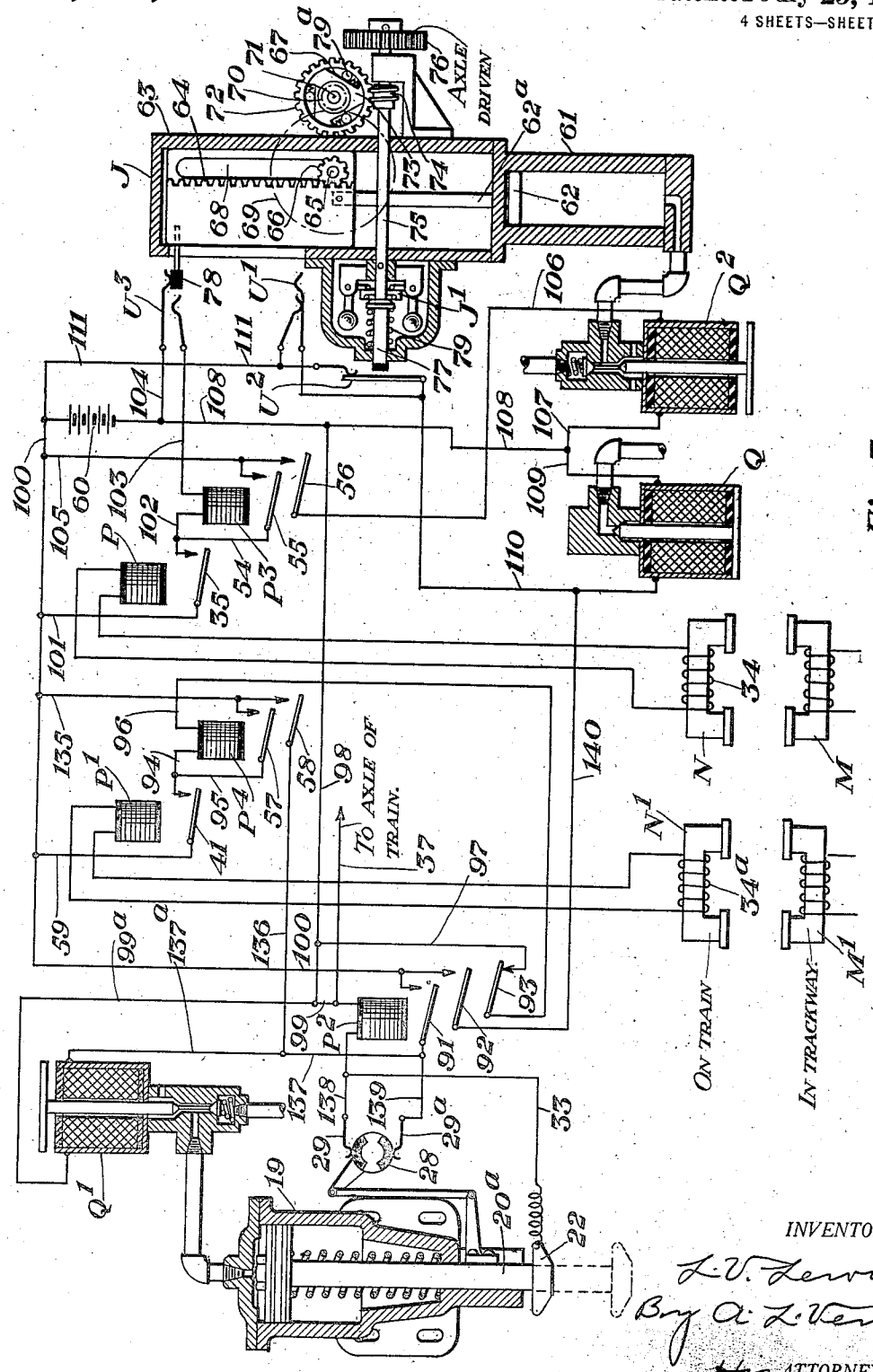


Fig. 7.

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UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING SYSTEM.

1,423,862. Specification of Letters Patent. Patented July 25, 1922.

Continuation of application Serial No. 230,424, filed April 24, 1918. This application filed December 31, 1920. Serial No. 434,319.

To all whom it may concern:

Be it known that I, LLOYD V. LEWIS, a citizen of the United States, residing at Edgewood Borough, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway-Traffic-Controlling Systems, of which the following is a specification.

My invention relates to railway traffic controlling systems, and particularly to systems of the character in which a car or train is provided with traffic governing means which operate to retard the car or train or to otherwise govern the same unless such governing means is affected either continuously or periodically by suitable means in the trackway responsive to traffic conditions in advance. Such control I term "positive" control, and the territory or portion of trackway which is provided with means for thus affecting the train apparatus is hereinafter termed "positive control territory". One condition encountered in connection with systems of this character is the probability that a car or train provided with such governing means must at times travel over a portion of trackway not equipped for affecting the train carried means in this manner, which portion of trackway is termed "non-positive control territory". One object of my invention is the provision of means for changing the condition of the traffic governing means so that the car or train may proceed through non-positive control territory, and for again restoring such governing means to its normal condition when the car or train again enters positive control territory. Another object of my invention is the provision of traffic governing means of this character which may be utilized in connection with trackway apparatus in the non-positive control territory to govern the car or train in accordance with traffic conditions therein, the car or train being free, however, to proceed through this territory without the co-operation of any trackway means.

The present application is a continuation of my co-pending application filed April 24, 1918, Serial No. 230424, for railway traffic controlling systems.

I will describe several forms of systems and apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing a stretch of railway track having applied thereto one form of trackway apparatus embodying my invention. Fig. 2 is a view, partly diagrammatic, showing one form of vehicle-carried apparatus embodying my invention and which may be used in conjunction with the trackway apparatus shown in Fig. 1. Fig. 3 is a view showing a modification of part of the vehicle-carried apparatus shown in Fig. 2 and also embodying my invention. Fig. 4 is a diagrammatic view showing a modified form of trackway apparatus embodying my invention. Fig. 5 is a view showing a modified form of vehicle-carried apparatus embodying my invention which may be used in conjunction with the trackway apparatus shown in Fig. 4. Fig. 6 is a view showing another modification of the trackway apparatus shown in Fig. 1 and also embodying my invention. Fig. 7 is a view, partly diagrammatic, showing one form of train-carried apparatus embodying my invention which may be used in conjunction with the trackway apparatus shown in Fig. 6.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the reference characters 1 and 1^a designate the track rails of a railway over which traffic normally moves in the direction indicated by the arrow, and which rails are divided into block sections A—B, B—C, etc., by insulated joints 2.

The block sections A—B, B—C and E—F, are each supplied with, or have impressed upon the rails thereof, an alternating signaling current. The part of the railway to which such signaling current is supplied is the "positive control territory," whereas the sections C—G, G—L and L—E, which are not supplied with such current, constitute the "non-positive control territory." 151 is a generator of alternating signaling current having a suitable frequency such as 90 cycles per second, and the terminals of which are connected to transmission mains 3. This signaling current is at times supplied to the rails of each section in the positive control

territory by a transformer designated by the reference character T with a letter exponent corresponding to the location, the primary of which transformer is connected with the transmission mains and the secondary with the track rails adjacent the exit end of the section. Current thus supplied to the track I will hereinafter term the "signaling current," and this signaling current co-operates with governing means carried on a car or train as explained hereinafter. The primary circuit of each transformer T includes a condenser 4 the purpose of which is to tune the transformer to resonance at the frequency of the signaling current when a train is at the other or entrance end of the section. The supply of current from each transformer T to the corresponding block section is controlled by means of a relay connected across the rails of the section in advance and at the entrance end thereof, each relay being designated by the reference character R with an exponent corresponding to the location. The relay R for each section is energized by means of a battery 5 connected across the track rails at the exit end of the same section. Included in series with the battery 5 is an impedance coil 6 which limits the flow of the signaling current from the adjacent transformer T through the battery 5 to a negligible value. A resistance 6^a is included in the secondary circuit of each transformer T to prevent such secondary from acting as a short circuit for the adjacent battery 5.

In so far as positive control territory is concerned, it will be evident that when a section is unoccupied and the rails thereof are intact, the relay R for such section will be energized so that signaling current will be supplied to the rails of the section next in the rear. When, however, a section is occupied, current from battery 5 will be shunted and the corresponding relay R de-energized, so that the contact of such relay will be opened to break the circuit of adjacent transformer T and thus to prevent the supply of signaling current to the preceding section.

In order to render the governing means upon the railway car or train ineffective to retard the same in the absence of signaling current while the car or train is passing through the non-positive control territory, I provide means for supplying a "cut-out current" to the trackway at the entrance to the non-positive control territory. In this instance, I supply the "cut-out current" by means of a transformer 150, the primary of which is connected across the transmission mains 3 through a condenser 4, while the secondary is connected to rail 1 at points X and Y, respectively, at the exit end of section B—C. The condenser in the primary circuit tunes the transformer to resonance at the signaling frequency. At the point E, that is, at the exit end of the non-positive control territory, I have provided a ramp rail Z, which is designed to restore the governing means of the car or train to such condition that it is under the control of the signaling current, as will be hereinafter described.

The non-positive control territory C—E is provided with signals, and also with ramps for intermittent control of a car or train passing through this territory as hereinafter explained. I will hereinafter refer to the car or train as a "train," it being understood that this term includes a single car or a plurality of cars coupled to move as a unit.

Referring now to Fig. 2, I have here shown diagrammatically a train V, which is equipped with apparatus adapted to be controlled by the currents supplied to the track rails in Fig. 1, a portion of the train carried apparatus being controlled by the "signaling current" for governing the speed and progress of the train through the positive control territory, while another portion of this apparatus is controlled by the "cut-out current" to render the governing means ineffective while the train is traversing the non-positive control territory. As here shown, the control of the governing means is effected by a circuit a which includes two coils j, j wound on two soft iron cores h, h respectively. These cores are mounted on the train in advance of the forward axle and above the two track rails H and H′ respectively, and are disposed transversely with respect to the rails. Each core is preferably U-shaped as shown, and is mounted with its legs pointing downwardly. When these cores are over rails which are carrying alternating current, part of the magnetic lines of force which surround each rail will pass through the corresponding core and so will induce in the coil on such core an alternating current of the same frequency as that in the rail. The two coils j are so connected in circuit a that the currents created in this circuit by currents flowing in opposite directions in the two rails at a given instant are additive, so that current in the rails from transformer T, that is, the signaling current, creates an alternating current of the same frequency in circuit a. This current in circuit a is employed to control a relay P, but inasmuch as the current in circuit a is too feeble to actuate a relay of rugged construction, I interpose between the circuit and the relay suitable amplifying means, which, as here shown, is in the form of an electron relay K. This relay comprises a vacuum bulb enclosing a filament f, a plate p, and a grid g interposed between the filament and the plate. Circuit a includes a condenser 7, the circuit being tuned to resonance at current of the frequency supplied by the transform-

ers T. The terminals of condenser 7 are connected with filament f and grid g by wires 8 and 9 respectively, so that alternating current in circuit a creates an alternating difference of potential between the grid and the filament. A blocking condenser 9^a is preferably interposed between condenser 7 and grid g as shown. The filament f is constantly heated by a battery 10. The plate circuit of relay K includes a battery 11 and the primary of a transformer T^2, the primary circuit being tuned to resonance at current of the signaling frequency by a condenser 12. Owing to the variation in the liberation of electrons from the heated filament and the grid, the current from battery 11 is correspondingly varied, which latter variation represents a much greater energy value than the current in the circuit a.

Relay P is preferably of a direct current type, hence rectifying means are interposed between transformer T^2 and this relay, comprising two rectifier bulbs 149 and 149^a. The terminals of the secondary of transformer T^2 are connected respectively to the plates p' of these bulbs, while the filaments f' are connected together and are energized by a battery 13. Relay P is connected between the middle point of the secondary of transformer T^2 and the circuit of the filament f', a condenser 14 being connected across the terminals of the relay to steady the flow of rectified current. It will be apparent from this construction that the rectifiers 149, 149^a permit unidirectional flow of current only from the transformer T^2, thus providing direct current for the energization of the relay P.

Relay P controls the supply of current to a magnet Q, which in turn controls a brake application valve 16. The circuit for this magnet Q is from battery 15 through wires 80^a, 80, and 81, magnet Q, wire 82, lower point of contact 31 of a relay P^2, wire 83, contact 40 of relay P, wires 84, 89 and 85 to battery 15. When magnet Q is energized it holds valve 16 in the closed position, thereby preventing the exhaust of fluid pressure from a brake control pipe 17 and so preventing an automatic application of the brakes. When, however, magnet Q is de-energized, it allows valve 16 to open, whereupon the fluid pressure in pipe 17 flows out to atmosphere through a port 18, thus causing an application of the brakes.

In order to remove the brake magnet Q from control by relay P while the train is passing through non-positive control territory, I provide suitable apparatus on the train which is controlled by the cut-out current supplied to rail 1 by transformer 150. This apparatus comprises a circuit a' carried on the train and including two coils j', j' wound on cores h', h' respectively. These cores and coils are similar to cores h and coils j, but are preferably mounted in the rear of the foremost axle of the train. The windings j' are so connected in circuit a' that the currents induced in these windings by currents flowing in the same direction in the two track rails at a given instant are additive. When, then, the train occupies such position that cores h' are between points X and Y, current will be induced in circuit a' due to the cut-out current applied to rail 1 by transformer 150. The reasons why coil j' over rail 1 will receive such current is apparent from the drawing, and it will also be apparent why the other coil j' receives such current when it is considered that part of the current from transformer 150 will flow from rail 1 to rail 1^a through the forward axle or axles, thence along rail 1 to the rear axle or axles and back to rail 1.

The cut-out current thus induced in circuit a' controls a direct current relay P' through the medium of an amplifying device K' and rectifying devices 149^b, 149^c, which are similar to the corresponding devices between circuit a and relay P.

The signaling current flowing from transformers T cannot create current in circuit a', because most of this current is shunted by the forward wheels and axles of the train and so does not reach cores h', and the small proportion which does pass through the rails under these cores induces currents in coils j' which oppose each other and so are neutralized.

Relay P', when energized, causes energization of a magnet Q' and also of relay P^2. The circuit for magnet Q' is from battery 15 through wires 80^a and 80, magnet Q', wire 88^a, contact 41 of relay P', and wires 89 and 85 to battery 15. Relay P^2 is a stick relay, the pick-up circuit of which is from battery 15 through wires 80^a and 86, relay P^2, wires 87 and 88, contact 41 of relay P' and wires 89 and 85 to battery 15. The holding circuit will be traced later.

Magnet Q' controls a mechanical device comprising a cylinder 19 in which moves a piston 20. Attached to the piston is a rod 20^a whose lower end projects beyond cylinder 19 and is provided with a contact shoe 22. Rod 20^a is encircled by a helical spring 21 which tends to retract the rod 20^a and a contact shoe 22 to the position shown in full lines in the drawing. The rod may, however, be moved to a projected position to lower the shoe 22 to the position indicated by dash lines, by means of air pressure, which is conveyed to the cylinder 19 from a supply reservoir (not shown) through a supply pipe 23. The supply of air to cylinder 19 is controlled by a valve 25 which in turn is governed by the armature 24 of magnet Q'. When this magnet is de-energized, valve 25 is held in the position shown by a spring 26, and cylinder 19 is then open to

atmosphere through an exhaust port 27, so that the shoe 22 occupies its upper or retracted position. When magnet Q′ is energized, however, valve 25 is reversed so that air pressure from the supply pipe 23 is then admitted to the cylinder 19 to project the piston 20 and shoe 22 downwardly against the action of the coil spring 21. The piston rod 20^a carries an arm 20^c to which one end of a link 20^b is pivotally connected. The other end of this link is pivotally connected to a crank 20^d which is attached to a rotary switch member 28. This member is provided with diametrically opposite contact segments 28^a which are electrically connected as shown. Bearing on the periphery of the switch member 28, at diametrically opposite points, are contact brushes 29, 29^a which are electrically connected by means of the segments 28^a when the rod 20^a is in its projected position but not when in retracted position.

As stated hereinbefore, when relay P′ is energized it causes energization of magnet Q′ and relay P^2. Magnet Q′ then reverses valve 24 to admit fluid pressure to cylinder 19 to move contact shoe 22 to its projected position, which movement causes the bridging of contacts 29, 29 thereby closing the holding circuit for relay P^2 which circuit is from battery 15, through wires 80 and 86, relay P^2, wires 87 and 32, contact 30, wire 39, contacts 29—28^a—29^a, and wires 90^a, 90 and 85 to battery 15. When relay P^2 is energized, magnet Q′ is energized independently of relay P′, the circuit for magnet Q′ then being from battery 15 through wires 80^a and 80, magnet Q′, wires 88^a, 88 and 32, contact 30 of relay P^2, wire 39, contact 29—28^a—29^a, wires 90^a, 90 and 85 to battery 15. It will be seen, therefore, that when relay P′ has once been energized, relay P^2 remains energized and contact shoe 22 remains in its projected position even after relay P′ becomes de-energized, that is, after the train passes beyond the portion of track to which the cut-out current is supplied.

When contact shoe 22 is in its projected position, brake application magnet Q is energized independently of relay P, the circuit for magnet Q then being from battery 15, through wires 80^a, 80 and 81, magnet Q, wire 82, upper point of contact 31 of relay P^2 and wires 38, 90 and 85 to battery 15.

The operation of the apparatus shown in Figs. 1 and 2 and thus far described, is as follows:

When section B—C is unoccupied, a train equipped with the apparatus shown in Fig. 2 may proceed through section A—B without retardation, because the rails of the latter section are supplied with signaling current so that relay P is energized and magnet Q is consequently held energized to keep brake valve 16 closed. If, however, section B—C is occupied, the rails of section A—B will not be supplied with current from generator 151 owing to the de-energization of relay R^B for section B—C, hence relay P will be de-energized when the train enters section A—B and this will effect a de-energization of brake magnet Q to cause an application of the brakes and consequent retardation of the train. Similarly, the train may pass through section B—C without retardation if section C—D is unoccupied, but not if the latter section is occupied. When the train reaches point X in section B—C, cut-out current will be induced in circuit a' so that relay P′ will become energized. Relay P^2 and magnet Q′ then become energized, so that shoe 22 is moved to the projected position and remains there. Thus the train may proceed through section C—G at unrestricted speed, even through the rails of such section are not supplied with signaling current, and may continue through non-positive control territory of any desired length, although in this instance such territory comprises only the stretch of track C—E.

As the train passes point E in Fig. 1, the contact shoe 22 will be partially raised by ramp rail Z, and this movement of the shoe 22 and of rod 20^a will cause switch member 28 to be turned to such position as to break the electrical connection between brushes 29, 29^a. This opens the holding circuit for relay P^2, and the consequent opening of relay P^2 opens the auxiliary circuit for magnet Q, so that this magnet is now controlled only by relay P. Track section E—F, is, however, supplied with signaling current provided that the section next in advance is unoccupied, so that relay P becomes energized before relay P^2 becomes de-energized. Thus the train is again placed under the control of the signaling current supplied by transformers T, and may proceed in accordance with traffic conditions through positive control territory.

Referring again to Fig. 1, as stated hereinbefore, the non-positive control territory C—E is provided with means for the intermittent control of trains in accordance with traffic conditions therein. As here shown, this is accomplished by signals and ramps. Each section of this territory, and section E—F, is provided with a home signal located at the entrance end of the section and designated by the reference character H with an exponent corresponding to the location, each of which signals is controlled by the track relay at the same location. The circuit for home signal H—G, for example, is from a battery 42, through wire 43, operating mechanism of signal H^G, wires 44 and 45, contact 49 of track relay R^D, and wire 141 to battery 42. Signal H^G indicates proceed or stop, therefore, according as section G—L is unoccupied or occupied.

Each section of non-positive control territory is also provided with a distant signal which is designated by the reference character D with the same exponent as that of the corresponding home signal, each of which distant signals is located at least at maximum braking distance in the rear of the entrance end of the section. Each distant signal is controlled by the track relay for the section whose condition the signal indicates. The circuit for distant signal D^G, for example, is from battery 42, through wires 143 and 142, operating mechanism of signal D^G, wires 51, 57 and 45, contact 49 of track relay R^D, and wire 141 to battery 42. Each distant signal, therefore, indicates proceed or caution according as the corresponding section is unoccupied or occupied.

Each section of the non-positive control territory, as well as section E—F of the positive control territory, is provided with a ramp which is located adjacent the corresponding distant signal, each of which ramps is designated by the reference character Z, with a suitable exponent. Each of these ramps co-operates with the train-carried contact shoe 22 shown in Fig. 2, and the supply of current to each ramp is controlled by the track relay for the corresponding section. For example, when a shoe 22 is on ramp Z^G and relay R^G is closed, and auxiliary circuit for relay P^2 is closed, which circuit is as follows: from trackway battery 42, through wires 143 and 145, rail 1, wheel 146, axle 147, contact 148, wires 37, 81, 80^a, 80 and 86, winding of relay P^2, wire 33, shoe 22, ramp Z^G, wires 144, 57 and 45, track relay contact 49, and wire 141 to battery 42. A corresponding circuit is closed as the train passes over each of the other ramps, provided that such ramp is energized due to the track relay for the corresponding section being closed.

The operation of the intermittent control apparatus shown in Figs. 1 and 2, is as follows:

As the train passes location C, the train-carried relay P^2 becomes closed, thereby removing the brake application magnet Q from control by relay P. As the train passes ramp Z^G, relay P^2 remains closed if this ramp is energized, even though the train-carried holding circuit for this relay is momentarily opened due to the elevation of contact shoe 22, which, in turn, opens the bridge between fingers 29 and 29^a. Under this condition it follows that the train can proceed into section G—L without retardation. If, however, track relay R^G is open when the train reaches ramp Z^G, so that this ramp is de-energized, then the auxiliary circuit including trackway battery 42 will be open, so that the elevation of contact shoe 22 will cause the train-carried relay P^2 to become de-energized. The opening of relay P^2 will open the circuit for brake application magnet Q, so that the train will be brought to a stop. The operation of the intermittent control apparatus as the train passes through section G—L, and L—E will be understood from the foregoing without further explanation.

Fig. 3 shows a modified form of part of the train-carried apparatus shown in Fig. 2, using but a single amplifier K and but a single set of rectifying apparatus for energizing both of the relays P and P′. The two circuits a and a' are provided, as in Fig. 2, these circuits including condensers 7 and 7′ respectively. One terminal of each of these condensers is connected with filament f of the electron relay K, but the grid g is connected with the remaining terminal of condenser 7 or 7′ according as a switch W is in one position or the other, and this switch also connects relay P or relay P′ with the rectifying bulbs, 149, 149^a. Switch W comprises an operating rod 46 which controls a pair of spaced contacts 47 and 48, contact 47 being adapted to connect circuit a or a' to the grid of amplifier K, while contact 48 connects either relay P or P′ to rectifier bulbs 149, 149^a according to the position of the switch W. When switch W is in normal position, as shown, circuit a is connected to amplifier K and relay P is connected to the rectifying bulbs. When the train is passing over that portion of the rail 1 to which the cut-out current is applied, it is necessary that the driver of the train raise switch W to the reverse position, thereby connecting circuit a' to amplifier K and relay P′ to the rectifying bulbs, thus permitting energization of relay P′ to render the cut-out means effective. The important feature of the apparatus shown in Fig. 3 is that it requires manual co-operation to energize the cut-out relay P^2, and hence it insures that the driver of the train will be aware that he is leaving positive control territory.

In Figs. 4 and 5 I have shown another form of train control apparatus, together with a modification of the means for rendering the positive control or governing apparatus ineffective through non-positive control territory. Referring to Fig. 4 the trackway apparatus here shown is identical to that shown in Fig. 1 in so far as concerns the supply of alternating signaling current to the track rails. In this embodiment of my invention, however, I employ an energized ramp rail Z^3 located at or near the entrance end of section C—G to render the positive control means on the train ineffective, instead of the transformer 150 which is provided for that purpose in Fig. 1. This ramp forms one terminal of a partial circuit including a battery 112, and the rail 1 of section C—G constitutes the

remaining terminal of the circuit. A de-energized ramp Z is located at the entrance end of section E—F for restoring the positive control means to its effective condition as in Figs. 1 and 2.

Referring to Fig. 5, the vehicle-carried apparatus comprises a circuit a arranged to collect energy due to the signaling current in the track rails as in Fig. 2 and the current induced in this circuit is utilized to energize an alternating current relay P through the medium of an amplifier K and a transformer T^2. In this instance, the relay P being of the alternating current type, the means shown in Fig. 2 for rectifying the current is not employed, the relay being connected directly to the secondary of the transformer T^2. The secondary circuit of this transformer is tuned to resonance at signaling current frequency by means of a condenser 115. When relay P is energized, its contact 116 engages contact point 117, whereby current from a battery 119 will energize brake magnet Q through the following circuit: from battery 119, through wires 120 and 121, magnet Q, wires 122 and 123, contact point 117, relay contact 116, and wire 124 to battery 119. However, when relay P is de-energized, contact 116 is dropped to de-energize magnet Q, the contact then engaging contact point 118 to energize the cut-out magnet Q′. The circuit for magnet Q′ is from battery 119, through wires 120 and 120^a, magnet Q′, wires 125 and 126, contact point 118, contact 116, and wire 124 to battery 119. In this embodiment of my invention I have provided means similar to that shown in Fig. 2 for permitting the train to pass through non-positive control territory without retardation due to the absence of signaling current. That is, I have provided fluid pressure actuated means for projecting the shoe 22, said means being controlled by magnet Q′.

It will be manifest from the foregoing description that in operation the train is continuously controlled, when in the positive control territory, by the presence or absence of the signaling current in the track rails. When, however, the train enters section C—G, relay P will be de-energized and will drop its contact 116 to energize cut-out magnet Q′. Shoe 22 will then be moved to its projected position in the path of the ramp rail Z^3 and the switch member 28 will close. The circuit for brake magnet Q is now opened at contact 117, but a brake application does not occur, because the shoe 22 immediately engages the energized ramp rail Z^3 to complete an energizing circuit from the trackway battery 112 to the stick relay P^2, this circuit being as follows: from battery 112, through ramp rail Z^3, shoe 22, wire 36, relay P^2, wires 127 and 37, contact 148, axle 147, wheel 38, rail 1, and wire 129, to battery 112. When relay P^2 is thus energized, magnet Q becomes energized to prevent the application of the brakes through the following circuit: from battery 119, through wires 120 and 121, magnet Q, wires 122 and 130, relay contact 131, wire 126, contact point 118, contact 116, and wire 124 to battery 119. Thus magnet Q is maintained energized after leaving the positive control territory, and contact shoe 22 will be held in its projected position. The train may then proceed at unrestricted speed through the non-positive control territory, except for the influence of the intermittent control ramps as hereinafter explained. When the train again enters the positive control territory at location E, the shoe 22 will engage the dead ramp rail Z by which it will be partially retracted to open the switch member 28 and so to de-energize relay P^2. Cut-out magnet Q′ will then be de-energized to permit the complete retraction of the shoe, because contact 116—118 of relay P is now open. The de-energization of relay P^2 again places magnet Q under the control of relay P, and thus again places the train under the control of the signaling current in the track rails.

The non-positive control territory in Fig. 4 is provided with signals, and also with intermittent control ramps which co-operate with the train carried apparatus of Fig. 5 in substantially the same manner as the ramps of Fig. 1 co-operate with the train carried apparatus of Fig. 2. That is, when the train passes over one of these ramps, relay P^2 will be kept energized if the ramp is energized, and the train may proceed without retardation; if the ramp is not energized, however, the opening of contact 29—28—29^a due to the elevation of shoe 22 will permit relay P^2 to become de-energized, so that valve 16 will open and will cause a brake application. The train will then be brought to a stop before entering the occupied section.

In Figs. 6 and 7 I have shown another system in which different means are employed for accomplishing the positive control of trains. In Fig. 6, as in Fig. 1, sections A—B, B—C, and E—F constitute positive control territory, while sections C—L and L—E constitute non-positive control territory. Each of the sections in the positive control territory is provided with two trackway magnets M, M arranged in longitudinal alignment and preferably located between the track rails 1 and 1^a. The magnets M of each section are connected in multiple and are energized by a battery 50, the circuit being controlled by a back contact 53 of the track relay R for the same section and by a front contact 52 of the track relay for the section next in advance. The magnets M in any one section are, therefore, energized only when a train occupies the section

and the next section in advance is unoccupied.

To actuate that portion of the train-carried apparatus which renders the positive control means ineffective through the non-positive control territory, I provide at location C a track magnet M' similar in construction to the magnets M but preferably located upon the outer side of one of the track rails so as to be out of alignment with the magnets M. This magnet M' is energized by the adjacent battery 50 through a back contact 33 of relay R for section C—L.

To again render the positive control means on the train effective when the train enters positive control territory, section E—F is provided with a ramp rail Z arranged at one side of the track rails and in advance of the first magnet M of that section.

In Fig. 7 is shown one form of train-carried apparatus which may be used in conjunction with the trackway apparatus shown in Fig. 6. This apparatus comprises a clearing magnet N and a cut-out magnet N', which are so mounted on the train as to have their poles disposed in confronting relation to the poles of the track magnets M and M' respectively. Hence, as a train magnet passes over an energized track magnet, a current impulse is induced in a circuit including a coil 34 or 34^a surrounding the vehicle magnet, as will be understood. Such an impulse in the clearing magnet N energizes a relay P which in turn closes its contact 35 to complete a pick-up circuit for a stick relay P^3, this pick-up circuit being from battery 60, through wire 100 and 101, contact 35, wire 102, relay P^3, wire 103, circuit controller U^3, wire 104, to battery 60. The holding circuit for relay P^3 is from battery 60 through wires 100 and 105, contact 55 of relay P^3, wires 54 and 102, relay P^3, wire 103, circuit controller U^3 and wire 104 to battery 60. A contact 56 of relay P^3 controls the supply of current from battery 60 to a magnet Q^2, through the following circuit: from battery 60, wires 100 and 105, contact 56, wire 106, magnet Q^2, wires 107 and 108, to battery 60. Magnet Q^2 controls the supply of fluid pressure to a cylinder 61 so that this cylinder is connected with a source of fluid pressure or with atmosphere according as magnet Q^2 is energized or de-energized. A brake magnet Q, similar to that shown in Fig. 2 is connected to battery 60 through circuit controllers U' and U^2 and is normally energized to prevent application of the brakes. The circuit for magnet Q is as follows: from battery 60, through wires 108, and 109, magnet Q, wire 110, circuit controllers U' and U^2 in multiple, wire 111 to battery 60. Circuit controllers U' and U^3 are operated by a run-down device J which is geared to an axle of the train, while circuit controller U^2 is operated by a centrifugal device J'. The run-down device J includes cylinder 61 in which is mounted a piston 62 having a piston rod 62^a extending into a casing 63. Slidably mounted in the casing 63 is a rack bar 64 which is connected to the piston rod 62^a. The rack bar 64 is operatively connected to a shaft 65 by means of a pinion 66 keyed to the shaft and meshing with the toothed surface of the rack bar. The shaft 65 extends through a slot 68 in the rack bar 64 and is keyed to a gear 69 which meshes with a pinion 70 keyed to a shaft 71. On shaft 71 is also mounted a ratchet clutch 73, comprising a spider 67 fastened to shaft 71 and a ring gear 72 which is free to turn on shaft 71 except that its motion in one direction is prevented by the wedging action of rollers 79^a located between spider 67 and the inner face of gear 72. The gear 72 meshes with a worm 74 secured to a shaft 75, and this shaft carried a gear 76 which is connected to an axle of the train. It will be seen from this construction that upward movement of the rack bar is unimpeded, while downward movement thereof is permitted only in accordance with the progress of the train along the track.

Secured to the upper end of the rack bar 64 is an insulated arm 78 which is engage able with the controllers U' and U^3 when the bar is in its highest and lowest positions respectively.

The centrifugal device J' is arranged upon one end of the shaft 75, and actuates a rod 77 which opens the circuit controller U^2 against the action of a spring 79 when the speed of the train exceeds a certain value.

When the train approaches a track magnet, M, the run-down device J is at or near its lowest position, so that circuit controller U^3 is closed. Then as magnet N passes over magnet M, if the latter is energized a momentary current will be induced in the circuit of relay P, which will cause momentary energization of this relay. The consequent closure of contact 35 will close the pick-up circuit for relay P^3, and the latter relay will then remain closed, due to its holding circuit, as long as circuit controller U^3 remains closed. Relay P^3, by the closing of contact 56, will energize clearing magnet Q^2, whereby fluid pressure is admitted to cylinder 61 to move the rack bar 64 to its uppermost position. When rack bar reaches this position, arm 78 will open circuit controller U^3 which opens the holding circuit of relay P^3. Relay P^3 then opens, and so de-energizes magnet Q^2, which permits the fluid pressure in cylinder 61 to exhaust to atmosphere, thus allowing rack bar 64 to descend under the influence of gravity. The downward movement, however, is limited by the rotation of the train axle, hence the

train may proceed at unretarded speed for a predetermined distance, that is, for the distance required for arm 78 to reach contact U'. This distance is somewhat greater than the distance from one magnet M to the next magnet M in advance. If, therefore, the train should proceed at high speed and should fail to receive an impulse from a track magnet before the rack bar 64 reaches its lower position, circuit controller U' will be opened to de-energize magnet Q and so to apply the brakes. It will be apparent, therefore, that to permit the train to proceed at unretarded speed and to prevent the application of the brakes by the descent of rack bar 64, it is necessary that magnet M should receive impulses at predetermined intervals somewhat less than the interval required for the rack bar to run down. However, assuming that a magnet M is de-energized, and that rack bar 64 is permitted to move to its lower position wherein the arm 78 opens the circuit controller U', the train may still proceed at a low speed without an application of the brakes because of circuit controller U^2. This controller is in multiple with controller U', hence brake magnet Q will de-energized only when both of the circuit controllers are open. Circuit controller U^2 is opened only when the speed of the train exceeds a safe low speed determined by the resisting action of the spring 79 upon the centrifugal device. The train may, of course, resume normal speed upon reaching the next energized track magnet M.

The cut-out magnet N' controls cut-out apparatus which is similar to that shown in Fig. 2. This apparatus comprises a shoe 22 which is adapted to be projected by means of fluid pressure in the cylinder 19, controlled by a magnet Q', and a switch member 28 operated by the rod 20^a for controlling a circuit through the contact of a stick relay P^2. Relay P^2 is controlled by a stick relay P^4 which is in turn controlled by relay P'.

When relay P' is momentary energized, due to the train passing over the trackway magnet M', it energizes relay P^4 through the following circuit: from battery 60 through wires 100 and 59, contact 41 of relay P', wire 94, relay P^4, wire 96, back contact 93 of relay P^2, wires 97, 98 and 108 to battery 60. Relay P^4 remains energized due to its holding circuit, which is from battery 60 through wires 100 and 135, contact 57, wires 95 and 94, relay P^4, wire 96, back contact 93, wires 97, 98 and 108, to battery 60. Magnet Q' then becomes energized through the following circuit: from battery 60 through wires 100 and 135, contact 58, wires 136 and 137^a, magnet Q', wires 99^a 98 and 108, to battery 60. When contact shoe 22 is moved to its projected position, due to the energization of magnet Q', a branch circuit is closed in multiple with magnet Q' through wires 137 and 139, contact 29^a—28—29, wire 138, relay P^2, wire 99 to wire 98, thus energizing relay P^2. When relay P^2 picks up, it remains energized by virtue of a circuit from battery 60 through wire 100, contact 91, wire 139, contact 29^a—28—29, wire 138, relay P^2, wires 99, 98 and 108, to battery 60. The closing of relay P^2 opens the circuit of relay P^4 at contact 93. Magnet Q' remains energized, however, because of a branch circuit from wire 100 through contact 91, wires 137 and 137^a, magnet Q', and wire 99^a to wire 98. Brake magnet Q then remains energized irrespective of the position of circuit controllers U' and U^2, by virtue of a circuit from battery 60 through wire 100, contact 92, wire 140, magnet Q, wires 109 and 108, to battery 60.

The operation of the apparatus thus far referred to in Figs. 6 and 7 is as follows:

Assuming that section B—C of Fig. 6 is occupied, the relay R for that section will be de-energized and so will open the circuit of the track magnets M in section A—B. I will now assume that a train equipped with the apparatus of Fig. 7 enters section A—B at high speed. Since the first track magnet M of this section is de-energized, magnet N will not receive an impulse therefrom, hence the run-down device J will open contact U' and so will de-energize the brake magnet Q, thus causing an application of the brakes which will reduce the speed of the train to a low value. If, then, the train in section B—C passes out of that section, the track magnets M of section A—B will become energized, so that as the train passes the second magnet M of that section, relay P will be momentarily energized, thereby causing the run down device J to be restored to its initial position, and so permitting the train to resume full speed. The operation of the apparatus during the passage of the train through section B—C is the same as during its passage through section A—B. As the train enters section C—L and the magnet N' passes over the track magnet M', relay P' will be momentarily energized to cause energization of relay P^4 and magnet Q', whereby the shoe 22 will be projected and relay P^2 will be energized, thus rendering contacts U' and U^2 ineffective to cause de-energization of the brake magnet Q. As the positive control means is now ineffective to retard the train, the train may proceed through the non-positive control territory at unrestricted speed, except for the influence of the intermittent control ramps as hereinafter explained. When, however, the train enters section E—F, which is in the first section of another positive control territory, the shoe 22 will engage the ramp rail Z whereby the run down device J will be

restored to its control of the brake magnet Q by the de-energization of relay P^2. It will be noted, however, that a track magnet M is interposed between the entrance end of the section E—F and the ramp Z so that if the section to the right of E—F is unoccupied the train may proceed at full speed after passing the ramp.

The non-positive control territory in Fig. 6 is provided with signals, and also with an intermittent control ramp Z^L which co-operates with the train-carried apparatus of Fig. 7 in substantially the same way that the corresponding ramp of Fig. 1 co-operates with the train-carried apparatus of Fig. 2. The auxiliary circuit for relay P^2 in Fig. 7 is not completed in the drawing for the reason that the wheels and axle of the train are not illustrated, but it is understood that the wire 37 of this view is connected with a contact corresponding to contact 148 of Fig. 2 and engaging an axle of the vehicle. When the train passes over the intermittent control ramp Z^L, relay P^2 will be kept energized if the ramp is energized, so that the train may proceed at full speed without retardation; if the ramp is not energized, however, the opening of contact 29—28—29^a, due to the elevation of shoe 22 will permit relay P^2 to become de-energized, in which event the train will be brought to a stop or to the predetermined low speed before entering section L—E.

Although I have herein shown and described only a few forms of railway traffic controlling systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Railway traffic controlling apparatus comprising governing means on a train arranged normally to retard the train except when affected by energy received from the trackway, a portion of track equipped with means for supplying energy to the train and a portion of track not so equipped, electrical means adjacent the entrance end of the unequipped portion of the track for rendering said governing means ineffective to retard the train while the latter is passing through the unequipped portion of track, and mechanical means adjacent the exit end of said unequipped portion of track for restoring said governing means to its control of the train.

2. Railway traffic controlling apparatus comprising territory equipped with traffic controlling means and territory not equipped with such means, governing means on a train arranged normally to retard the train except when affected by said trackway means, mechanical and electrical means on the train operated by said traffic controlling means at the entrance end of the unequipped territory for rendering said governing means ineffective to retard the train while passing through the unequipped territory, and means in the trackway adjacent the exit end of said unequipped territory for restoring said governing means to its normal condition.

3. Railway traffic controlling apparatus comprising positive control territory and non-positive control territory, means for connecting a source of cut-out current with two points on one of the rails of the track adjacent the entrance end of the non-positive control territory, a railway train, means thereon arranged normally to retard the train except when affected by energy received from the trackway in the positive control territory, and means on said train responsive to said cut-out current to render said governing means ineffective to retard the train while the latter is passing through the non-positive control territory.

4. In combination, a railway track having positive control territory and non-positive control territory, means for supplying traffic controlling current to the rails of the positive control territory and means for supplying a cut-out current to the track adjacent the junction of the two territories, a train, a traffic controlling relay on the train responsive to the traffic controlling current in the rails, a cut-out relay on the train responsive to said cut-out current, vehicle governing means on the train, means for normally controlling said train governing means by said traffic controlling relay, a member on the train normally held in retracted position, means controlled by the cut-out relay when energized for moving said member to a projected position, a stick relay, a pick-up circuit for said stick relay closed when said cut-out relay is energized, a stick circuit for said stick relay closed when said member occupies its projected position, means controlled by said stick relay when energized for rendering said traffic controlling relay ineffective to control the train governing means, and means located in the trackway for mechanically moving said member out of its projected position thereby de-energizing the stick relay and restoring the train governing means to control by the traffic controlling relay.

5. In combination, a railway track having positive control territory and non-positive control territory, means for supplying traffic controlling current to the rails of the positive control territory and means for supplying a cut-out current to the track adjacent the junctions of the two territories, a train, a traffic controlling relay on the train responsive to the traffic controlling current in

the rails, a cut-out relay on the train responsive to said cut-out current, governing means on the train, means for normally controlling said train governing means by said traffic controlling relay, a member on the train normally held in retracted position, means controlled by the cut-out relay when energized for moving said member to a projected position, a stick relay, a pick-up circuit for said stick relay closed when said cut-out relay is energized, a stick circuit for said relay closed when said member occupies its projected position, means controlled by said stick relay when energized for rendering said traffic controlling relay ineffective to control the train governing means, ramp rails located in the trackway in the non-positive control territory and adapted to engage said train-carried member when the latter is in its projected position, means controlled by traffic conditions for energizing said ramp rails, an auxiliary circuit for said stick relay including said train-carried member and closed when said member engages an energized ramp rail whereby said stick relay then remains closed even though its first-mentioned stick circuit is open.

6. In combination, a railway track having positive control territory and non-positive control territory, a railway train, train-governing means thereon, a relay on the train for controlling said governing means, means associated with the said positive control territory for controlling said relay under clear traffic conditions to prevent operation of said governing means to retard the train, a member on the train normally held in retracted position, means on the train, for moving said member to a projected position, means located in the trackway for causing operation of said last-mentioned means as the train passes from the positive control territory into the non-positive control territory, means controlled by said member when in projected position for removing said train governing means from control by said relay, and means located in the trackway for mechanically moving said member towards its retracted retarded position as the train passes from non-positive control territory into positive control territory to thereby restore said relay to its control of the train governing means.

7. Railway traffic controlling apparatus comprising governing means on a train arranged to retard the train except when affected by traffic controlled means in the trackway, positive control territory equipped with such traffic controlled means and non-positive control territory not so equipped, means for rendering said governing means ineffective to retard the train while traversing non-positive control territory, and means in the trackway of the non-positive control territory for controlling the progress of the train therethrough in accordance with traffic conditions.

8. Railway traffic controlling apparatus comprising governing means on a train arranged to retard the train except when affected by traffic controlled means in the trackway, positive control territory equipped with such traffic controlled means and non-positive control territory not so equipped, and means in the trackway of the non-positive control territory for preventing retardation of the train in the absence of said traffic controlled means and for controlling the progress of the train by said governing means in accordance with traffic conditions in such territory.

9. Railway traffic controlling apparatus comprising positive control territory equipped with means for supplying traffic controlling energy to trains, non-positive control territory not equipped with such means, governing means on a train arranged normally to retard the train in the absence of said energy, a movable member on the train normally occupying a retracted position, means for moving said member to a projected position when the train enters non-positive control territory, means controlled by said member when in projected position for rendering said governing means ineffective to retard the train in the absence of trackway energy, and means located in the trackway for restoring said member to its retracted position when the train enters positive control territory.

10. Railway traffic controlling apparatus comprising positive control territory equipped with means for supplying traffic controlling energy to trains, non-positive control territory not equipped with such means, governing means on a train arranged normally to retard the train in the absence of said energy, a movable member on the train normally occupying a retracted position, means for moving said member to a projected position when the train enters non-positive control territory, means controlled by said member when in projected position for rendering said governing means ineffective to retard the train in the absence of trackway energy, devices located at intervals in said non-positive control territory and controlled by traffic conditions therein and arranged for co-operation with said train-carried member to govern the train, and means located in the trackway for restoring said member to its retracted position when the train enters positive control territory.

11. Railway traffic controlling apparatus comprising positive control territory equipped with means for supplying traffic controlling energy to trains, non-positive control territory not equipped with such means, governing means on a train arranged

normally to retard the train in the absence of said traffic controlling energy, means located adjacent the entrance end of said non-positive control territory for conditioning said governing means to permit the train to proceed through such territory without retardation, devices located at intervals in said non-positive control territory and arranged to co-act with said governing means to control the progress of the train through such territory in accordance with traffic conditions therein, and means for restoring said governing means to normal condition when the train enters positive control territory.

12. Railway traffic controlling apparatus comprising positive control territory equipped with means for supplying traffic controlling energy to trains, non-positive control territory not equipped with such means, governing means on a train arranged normally to retard the train in the absence of said traffic controlling energy, a device on the train arranged to be influenced by suitable trackway means, trackway means located at the entrance to said non-positive control territory for co-action with said device to render said governing means ineffective to retard the train in the absence of traffic controlling energy, other trackway means located in said non-positive control territory for co-action with said device to control said governing means in accordance with traffic conditions, and means for restoring said governing means to normal condition when the train enters positive controlling territory.

In testimony whereof I affix my signature.

LLOYD V. LEWIS.