

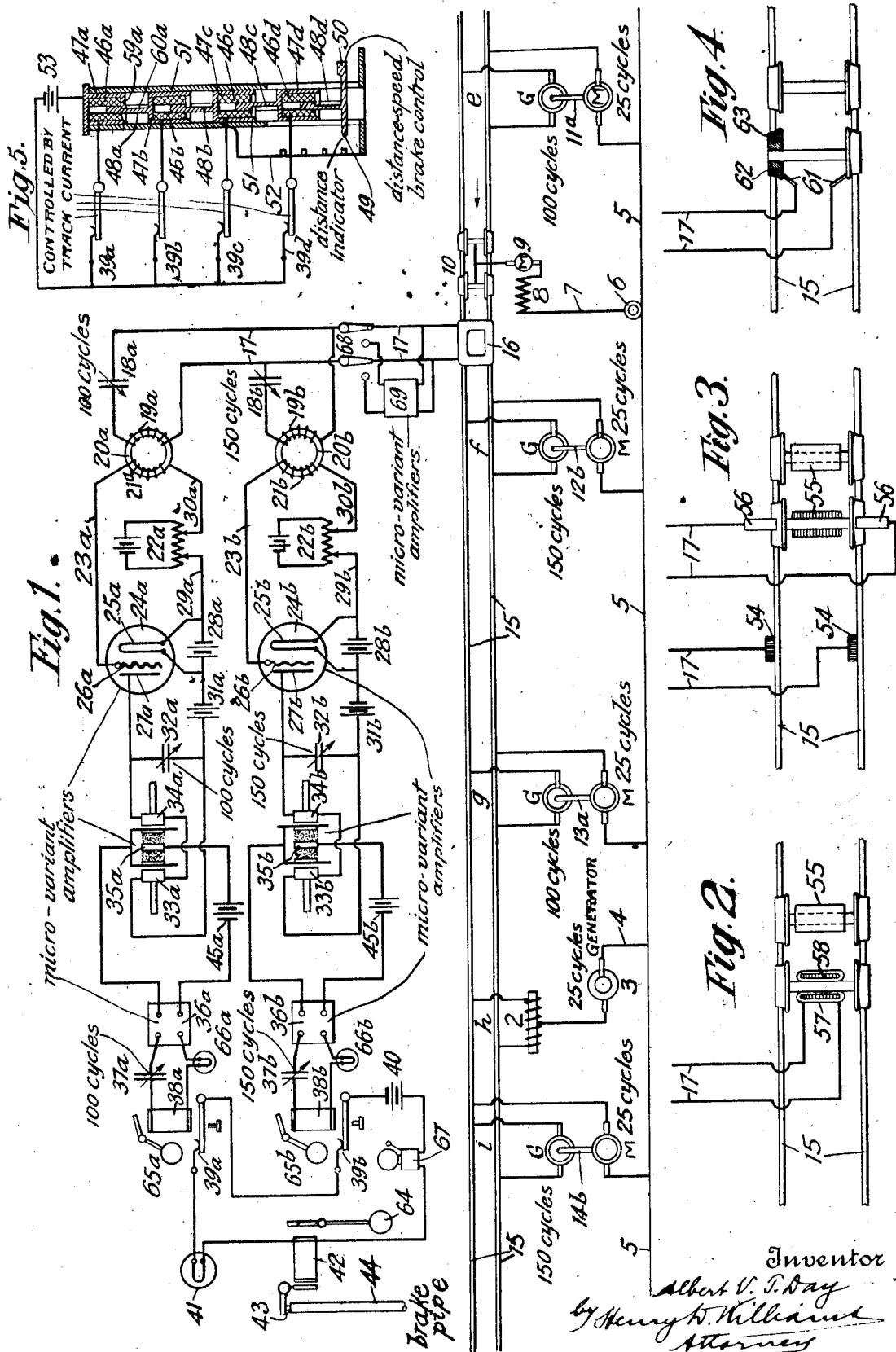
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RAILWAY TRAFFIC CONTROLLING SYSTEM

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RAILWAY-TRAFFIC-CONTROLLING SYSTEM.

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This invention is an automatic traffic-controlling system for railways, designed to control signaling and braking means or equivalent means carried on a railway train or vehicle, in response to control effected from an extraneous point, for example by the presence of a second train or vehicle on the same track in advance. In the accompanying drawings, Figure 1 illustrates one embodiment of the invention, and modifications are shown in Figures 2, 3, 4 and 5.

In the system here shown, an alternating current 25-cycle traction generator 3 is grounded to both track rails 15 through an impedance cross-bond 2, and feeds a transmission line 5 extending along the railway and supplying power to drive the traction motors such as 9 on the train 10, and also power to drive the synchronous rotary converters 11^a, 12^b, 13^a, 14^b whose generator windings are connected across the track rails at intervals and deliver thereto currents of 100 cycles and 150 cycles at alternate successive points. Preferably the various generator windings of the same frequency will be connected to the rails in the same instantaneous sign, i. e. they will all simultaneously deliver positive polarity to the same rail and negative polarity to the opposite rail.

The train 10 moves leftward and carries in front a coil 16 disposed in electro-magnetic inductive relation to the track rails. Currents of 150 and 100 cycles from the two rotary converters ahead, flow rearward through the track rails and the wheels and axles of the train 10, thus inducing in the train coil 16 a composite E. M. F. including components of both frequencies. The terminals of the train coil 16 are connected to the leads 17 across which are bridged the transformer primaries 19^a and 19^b, each in series with a tuning condenser 18^a or 18^b respectively. The secondaries 21^a and 21^b of the transformers are connected respectively in the grid circuits of the audions 24^a and 24^b in series with potentiometers 22^a and 22^b respectively, which are adapted to adjust the mean potentials of the grids 26^a and 26^b for the best amplifying effects. Although the transformers 20^a and 20^b constitute close couplings, the frequencies employed are so low that the grid capacities in series with the transformer secondaries will be small enough to approximate the effects of having the cir-

cuits of these secondaries left open, so that the tuning condensers 18^a and 18^b may be adjusted for very efficient syntonistic resonance with their respective transformer primaries 19^a and 19^b in response to the currents of 100 cycles and 150 cycles respectively.

Since the audion systems are the same for both frequencies, the system for the 100-cycle current may be described as typical. The secondary or plate circuit of the audion 24^a includes the usual battery 31^a in series with the telephonic amplifier magnets 33^a and 34^a which are shunted by the tuning condenser 32^a adjusted for resonance with the magnets in syntonistic response to 100-cycle E. M. F. fluctuations in the plate circuit. The telephonic magnets act simultaneously in opposite directions on their respective diaphragms which carry microphone disc-electrodes spaced on opposite sides of a common middle stationary electrode 35^a so as to form therewith two granular microphone cells which are connected in parallel in the circuit of the battery 45^a including the primary side of a set of amplifiers 36^a adapted to amplify the energy of the 100-cycle current undulations and deliver a 100-cycle current of greater energy to the circuit including the relay magnet 38^a and tuning condenser 37^a adjusted for syntonistic resonance at 100 cycles. Since the vibration of the railway vehicle will tend to move both diaphragms of the telephonic amplifier simultaneously, in the same direction it will increase the microphonic resistance of one cell while simultaneously decreasing the resistance of the parallel cell, so that the joint resistance of both cells in their battery circuit will not be greatly affected by such vibration; whereas the telephonic magnets 33^a and 34^a in response to the 100-cycle current undulations will move their diaphragms simultaneously toward and from their common middle microphone electrode 35^a so as to simultaneously increase and decrease the resistance of both microphone cells to effect their maximum joint-resistance variation in the circuit of the battery 45^a.

When the relay magnets 38^a and 38^b are both simultaneously energized by 100-cycle and 150-cycle currents respectively, they will simultaneously close their respective contacts 39^a and 39^b so as to complete the circuit of the battery 40 including these con-

tacts in series with each other and the signal lamp 41 and magnet 42 controlling the brake valve 43. Manifestly this train-controlling circuit of the battery 40 can only remain thus closed while there is a stretch of clear track in advance of the train 10 sufficient to include the connecting points of at least two of the successive rotary converters which feed the 100-cycle and 150-cycle currents to the track rails at alternatively successive points.

If desired, a movable visual signal may be controlled by the local circuit of the battery 40, for instance such an indicator as 64 actuated by the valve-controlling magnet 42; and an audible signal may also be included in this circuit, as at 67. Also the amplified 100-cycle and 150-cycle currents may directly energize traffic-controlling devices, for example the disc indicators 65^a and 65^b actuated by the magnets 38^a and 38^b respectively, or the signal lamps 66^a and 66^b inserted respectively in the circuits of these magnets.

In lieu of the inductive coil 16, any other suitable scheme may be employed to derive controlling current from the track rails. For instance, as shown in Figure 2, the leads 17 to the train-control apparatus may derive current from a coil 57 wound on a hollow-cylindrical laminated magnetic core 58 surrounding the front axle of the train or car, and the impedance of one or more of the following axles may be increased by similar magnetic cores as at 55, to cause a greater proportion of the track current to flow through the first axle for inducing controlling current in the coil 57. Or, as shown, in Figure 3, the apparatus leads 17 may be connected with contact shoes or brushes 54 bearing on the track rails at points as far as practicable in advance of the front wheels of the train; and as shown in this same figure, the apparatus leads 17 may be connected also with brushes 56 bearing on the treads of the front wheels; and one or more of the foremost axles may be surrounded with the impedance cores 55, to shunt as much current as practicable into the train-control apparatus. Or, as shown in Figure 4, the apparatus leads 17 may receive current from brushes 61 bearing on the front wheel treads 63 which are insulated from the wheel hubs and axle by interposed insulative linings 62 which may also be applied in the wheels of one or more following axles.

For simplicity of representation, the system of Figure 1 has been limited to only two frequencies of train-controlling current, but in lieu thereof, the rotary converters at *e*, *f*, *g* and *i*, could all deliver different frequencies, their sequence being repeated indefinitely throughout successive sections of the track; or a sequence of sources including many more than four successive frequencies could be employed.

When several frequencies are thus employed, they may selectively control as many respective translative devices or relays whose controlled contacts are indicated at 39^a, 39^b, 39^c and 39^d in Figure 5.

In the device of Figure 5, the vertical guide tube 51 has an integral flange at its lower end by which it may be mounted on a suitable base. Into the upper end of this tube is inserted a hollow-cylindrical cup-form magnetic sheath 47^a, with its open end downward, and a solenoid 46^a is secured in the sheath. A solenoid core 48^a slides vertically in the solenoid and is connected at its lower end with the upper closed end of a second magnetic solenoid sheath 47^b which slides in the guide tube 51 and contains the solenoid 46^b fixed within the sheath. A stud 59^a projects radially from the solenoid sheath 47^a into a longitudinal groove 60^a in the core 48^a to limit the withdrawal of the core from the sheath so that it cannot pass beyond the effectual attractive effort of the solenoid 46^a. A core 48^b likewise co-acts with the solenoid 46^b and is likewise limited in its withdrawal movement by a stud projecting from the sheath 47^b, into a groove in the core. The core 48^b carries a depending solenoid sheath 47^c and enclosed solenoid 46^c similarly co-acting with still another core 48^c which likewise suspends still another sheath 47^d and its solenoid 46^d co-acting in the same way with the lowermost core 48^d which carries at its lower end a horizontal crossbar 49, 50, projecting in both directions through opposite longitudinal slots in the guide tube 51.

Thus the solenoid sheaths and cores constitute a vertical chain slidably suspended in the guide tube so as to be shortened by the movement of each core into its solenoid when the solenoid is energized. Therefore, the elevation of the lowest core 48^d and its cross-bar will always be the sum of the movements of the several cores into their respective solenoids, which will always be proportional to the number of solenoids simultaneously energized, providing such movements of the several cores are all equal.

One terminal of each solenoid is grounded on its sheath which makes conductive contact, with the guide tube connected with one pole of the battery 53. The other terminal of each solenoid is connected with the opposite battery pole through a respective one of the contacts 39^a, 39^b, 39^c and 39^d controlled by respective track-current frequencies, so that each solenoid will be energized when its respective current-frequency is received from the track rails, wherefore the elevation of the lowest solenoid core and its cross-bar will be proportionate to the number of track-current frequencies effectually received by a train, so as to vary with the clear distance of track extending in advance of the train.

One end 49 of the cross-bar may co-act with a scale 52 to indicate the clear distance thus determined, and the other end 50 may be employed as the distance-controlled element in any suitable scheme for co-ordinating speed and distance in the automatic control of a warning signal or train-braking or retarding means.

light it. In either event a sufficient measure of controlling energy cannot be transmitted from a short-circuited rail-circuit to apparatus on the train, unless an excessive current be employed in the rail circuit.

Through the agency of the micro-responsive or micro-variant amplifying means, a relatively weak controlling current in the short-circuited rail circuit may efficiently and reliably govern a traffic-controlling apparatus carried on a railway train or vehicle. An amplifying device of this character may have a given factor of amplification which will express the ratio of its output energy to its controlling energy, and when a number of such amplifiers are employed together in sequence, as the amplifiers 24^a and 33^a, 34^a and 36^a, their joint amplifying factor which is the product of their several factors may easily equal 1,000,000.

Manifestly selectivity is not essential in the broad purview of the invention, but when required it may be effected by any suitable means applied at any suitable point in the course of transmission. For example, in the illustrated embodiment the selectivity condensers 18^a and 32^a might be omitted and selectivity could be effected solely in the controlled circuit of the amplifying means 36^a. In this instance, the micro-vibrant amplifiers could readily be made to faithfully reproduce the frequency or other controlling-current characteristics relied upon for selectivity. Or one or more pre-amplifiers of micro-variant character may be located in the box 69 and introduced by the switches 68 into the course of controlling-current transmission from the train coil 16, so as to faithfully reproduce and amplify all components of the composite E. M. F. derived from the rail circuit, before selectively dissociating the traffic-controlling effects of these several components. Manifestly, even if an ordinary circuit closing relay could be made safely responsive to an exceedingly minute current, yet it could not reproduce in its controlled circuit the characteristics thereof which must be relied on for selectivity.

With regard for the effect of a selectivity expedient such as resonance in the transmission of two given currents of respective given frequencies, the ratio of the transmission-efficiency for the preferred current to the transmission-efficiency for the rejected current, may be termed the modulus of selectivity or the selective modulus. In the employment of successive selective means in sequence as in the illustrated embodiment, their resultant or joint selective modulus, which is the product of their several moduli, may readily be made equal to 1,000,000, or more, depending on the relation of frequencies and the characteristics of the selec-

The functions of the amplifying means of this invention must not be confounded with the functions of ordinary circuit-closing relays which serve merely to close and open a local circuit in response to the rise and fall of a controlling current and which are not amplifying devices in the proper sense designating apparatus for producing an amplified current which varies with the strength of a controlling current. The amplifying means employed in the present invention are in the nature of telephonic amplifiers, which repeat minute currents and current undulations with a given factor of amplification so that the repeated current of greater power will derive its characteristics from the controlling current. Since this is accomplished by a micro-variable influence of the amplifying means on the amplified current in a sensitive response to all minute variations in the controlling current, the means thus qualified may be termed generically micro-responsive or micro-variant amplifiers. The comparative action of the micro-variant amplifiers and other relays or translating means not thus qualified, must be understood in order to appreciate the philosophy of the present invention and its relation to the art.

It may be safely stated as a generality that all means of deriving current from track rails short-circuited by a railway train or vehicle, for controlling apparatus on the train or vehicle, are essentially inefficient in energy transmission. But all electro-translative devices which embody the safety function in a protective system, must be controlled by sufficient energy to insure very great certainty of action. For instance, a warning indicator or a relay which is moved to a fixed "clear" position by controlling current, must be actuated by some very positive retractive force to move from "clear" position when that controlling current is discontinued or reduced by a given margin, else the device might stick and remain "clear" when it should move to perform a protective function essential to safety. Therefore the controlling current which actuates the device must have sufficient energy to overcome this very positive retractive force while moving the device to its "clear" position and there retaining it. If the device is a signal lamp to be directly actuated by energy derived from the track rails, obviously it must receive a very considerable amount of energy to effectually

tive means. Hence the frequencies of the traffic-controlling currents may be chosen in such relation to one another and to the frequency of traction current and other foreign currents, that any given traffic-controlling current may be enormously amplified in its ultimate application to the traffic-controlling device which it governs, without applying to that particular device any appreciable measure of any current foreign to its proper control; and this remains not only a mathematical possibility but a wholly feasible undertaking even when the said foreign current vastly exceeds the proper controlling current both in the rail circuit and in the train coil or equivalent derivative circuit. Since the selective modulus of the selectivity means associated with each amplifying device may greatly exceed the amplifying factor of that device, the current foreign to any particular traffic-controlling device may be successively diminished while the proper traffic-controlling current is repeatedly amplified in transmission through successive amplifying devices, so that foreign currents may be sifted out to any desired extent.

In virtue of the foregoing characteristics of the apparatus, the traffic-controlling means on the train or vehicle can be controlled with superlative reliability by a current in the track rails of no greater strength than would ordinarily be required to control a relay directly included in series in the rail circuit. Indeed, by employing amplifying means having a sufficient factor of amplification, the control may be effected with a current in the rails having only a minute fraction of the strength necessary for the direct actuation of an ordinary relay, thus effecting a very great economy in rail-circuit power.

Although the traffic-controlling means on the train or vehicle may be thus governed by a relatively minute controlling current in the rail circuit, it must be understood that this practice does not involve any hazard of false actuation by that measure of controlling current which, theoretically, must be transmitted to the controlled train or vehicle from an adjacent track-source even when the intervening rails are shunted by a preceeding train. The amplifying means may be designed for a certain amplifying factor which will remain constant so long as the amplifiers are maintained in statu quo and which cannot in any event be spontaneously or accidentally increased. Hence the strength of the amplified controlling current which ultimately actuates the governing member of the traffic-controlling means, will be subject to corresponding strength modulations in response to every current-strength variation in the rails, so that when the rail-circuit current is reduced to a given percentage by presence of a preceeding train

the said amplified actuating current will be correspondingly reduced. Therefore the traffic-controlling device may be adjusted to assume its warning or danger or retarding function in response to any given percentage decrement of controlling current in the rail circuit which may be determined by considerations of safety or prescribed by engineering conventions. Obviously the percentage decrement in current strength in the rail circuit effected by short-circuiting action of a train or vehicle, will be the same whether a weak or a strong source of current be employed to feed the rails.

The amplifying means may be of any suitable micro-responsive or micro-variant species, many of which are familiar in telephony. For instance, any number and species of such generic means may be included in amplifying sequence in the amplifier boxes 36^a and 36^b of the illustrated embodiment, and any suitable selectivity means may be employed therewith. Various species of micro-responsive amplifiers can be made exceedingly rugged and durable, but it should be noted that the most delicate species could be employed without any hazard of dangerous failure, so long as the traffic-controlling means is selectively responsive solely to a certain current characteristic which can be delivered by the amplifying means only when derived from the rail circuit. For example, if a very delicate microphonic amplifier were excited by mechanical vibrations to deliver current to the traffic-controlling means, there would be no effective correspondence between this false current and the proper controlling current in the rails.

Manifestly, all the track sources of a given frequency could be omitted from the system of Figure 1 together with all the train apparatus responsive to that frequency, and the remaining train apparatus responsive to current from the remaining track sources would still be operative to show a clear track extending in advance of the train as far as the first track source ahead of the train position. The invention in its broad aspect is not limited to the employment of controlling currents of different characters.

Many different adaptations of the invention may be developed in accordance with the technique of the art, and still other embodiments may be inventively devised, all within the principles, spirit and scope of the following claims.

I claim:

1. A railway traffic-controlling system of the character in which the track rails communicate controlling current to the governing means, comprising apparatus on a moving train continuously governed by traffic conditions ahead to impose a permissible

speed indication or limit which is a function of the clear headway.

2. A railway signaling system comprising track rails, means for supplying alternating signaling current thereto at intervals, adjacent sources differing in frequency, a vehicle, a circuit thereon receiving signaling currents from the currents thus supplied to the rails, means on the vehicle for amplifying the currents received in said circuit, devices on the vehicle, one for each frequency, means for supplying to each device current from said amplifying means of one only of said frequencies, and vehicle governing means on the vehicle controlled by said devices.

3. In a railway signal system, a traffic rail adapted to carry currents of different frequencies, signal circuits in a railway car each responsive to one of said currents of different frequencies, means for interconnecting said signal circuits with a main signal circuit, means associated with each of said signal circuits and including a reactive circuit tuned to the frequency to which the corresponding signal circuit is responsive to permit the passage only of the current of said last frequency, and a frequency-responsive relay in each of said signal circuits.

4. In a railway signal system, a transmission circuit adapted to carry currents of different frequencies, signal circuits in a railway car each responsive to one of said currents of different frequencies, means for interconnecting said signal circuits with said main signal circuit, means associated with each of said signal circuits and including a reactive circuit tuned to the frequency to which the corresponding signal circuit is responsive to permit the passage only of the current of said last frequency, means for intensifying the effects of said currents in each of said signal circuits, and a device in each of said signal circuits selectively responsive to current of the corresponding frequency.

5. In a railway locomotive, a signal circuit, means for communicating currents of different frequencies from a main track circuit to said signal circuit, means in said signal circuit responsive to one frequency for indicating a track condition, and means in said circuit responsive to another frequency for controlling other traffic controlling means.

6. In a railway signal system, in combination, a plurality of circuits for carrying currents of different frequencies, indicating devices, one responsive to each of said currents, means actuated by the presence of a train for affecting one of said circuits, and other means similarly actuated for affecting other said circuits.

7. In an automatic train control or cab signalling system, in combination: a rail-

way vehicle; a stationary conductor extending along the path of movement of the vehicle; traffic controlled means for supplying a periodic signaling current to said conductor; a coil on the vehicle arranged in inductive relation with said conductor; a circuit on the vehicle including said coil and tuned to the frequency of said signaling current; an electrical amplifying device included in said circuit; a relay effected only by current of the frequency of said signaling current and controlled by the current supplied from said amplifying device; and train control apparatus on the vehicle controlled by said relay.

8. In a railway signal system, a traffic rail circuit adapted to carry currents of different frequencies, signal circuits in a railway car each responsive to one of said currents of different frequencies, means for interconnecting said signal circuits with said main signal circuit, means associated with each of said signal circuits and including a reactive circuit tuned to the frequency to which the corresponding signal circuit is responsive to permit the passage only of the current of said last frequency, frequency-responsive devices each associated with one of said signal circuits and auxiliary circuits for operating indicating devices and for controlling the further movement of said car, said circuits being controlled by said devices.

9. In a railway signal system, a transmission circuit normally carrying currents at different frequencies, signal circuits in a car each of which is adapted to respond to one of said frequencies, means for communicating said currents from said main circuit to said signal circuits, and means affected by a train preceding said car for preventing said communication of current.

10. In a railway signal system, in combination, a plurality of circuits for carrying currents of different frequencies, indicating devices, one responsive to each of said currents, means actuated by the presence of a train for affecting one of said circuits, and other means similarly actuated for affecting other said circuits.

11. In combination, a stretch of railway track, railway vehicles thereon, a plurality of sources of signaling current differing in frequency, means for supplying to each vehicle a variable number of said currents depending upon the distance between the vehicle and the next vehicle ahead, and speed governing apparatus on said vehicle responsive to the number of currents supplied thereto.

12. In combination, a stretch of railway track, a plurality of sources of current differing in frequency connected in rotation to the track, railway vehicles, resonant means on a vehicle receiving said currents from

said track rails, there being one such means for each frequency of signaling current, and vehicle-governing apparatus on the vehicle responsive to the number of such means energized at a time.

13. In combination, a stretch of railway track, means for supplying alternating signaling currents thereto, the adjacent sources differing in frequency, devices on a vehicle selectively responsive to said currents of different frequencies, and vehicle governing means on the vehicle controlled by said devices.

14. In combination, a stretch of railway track, means for supplying alternating signaling current thereto, adjacent sources differing in frequency, devices on a vehicle selectively responsive to said currents of different frequencies, speed responsive apparatus on said vehicle, and vehicle governing means on the vehicle controlled jointly by said devices and said apparatus.

15. A railway signaling system comprising electrically continuous track rails, means for supplying alternating signaling current thereto at intervals, adjacent sources differing in frequency, a vehicle, a circuit thereon receiving signaling currents from the currents thus supplied to the rails, means on the vehicle for amplifying the currents received in said circuit, devices on the vehicle supplied with currents from said amplifying means and selectively responsive to the currents of different frequencies supplied to the track rails, and vehicle governing means on the vehicle controlled by said devices.

16. The method of controlling railway traffic which consists in producing in the track rails currents of different frequencies, employing said rail currents to control amplifying means carried on a railway vehicle and selectively responsive to each frequency, and employing the output energy of said amplifying means to govern traffic-controlling means on the vehicle.

17. The method of controlling railway traffic which consists in producing in the track rails currents of different frequencies, employing said rail currents to energize respectively tuned circuits controlling the input to amplifying means carried on a railway vehicle, and employing the output energy of said amplifying means to govern traffic-controlling means on said vehicle.

18. The method of governing railway traffic which consists in producing in the track rails a flow of current having a periodic variation, deriving therefrom E. M. F. available on a railway vehicle, and employing said E. M. F. on the vehicle jointly with the speed of the vehicle to govern traffic-controlling means carried on the vehicle.

19. The method of governing railway traffic which consists in producing in the

track rails currents of different frequencies, deriving therefrom respective E. M. F. fluctuations available on a railway vehicle; and controlling the movement of the vehicle jointly by said E. M. F. fluctuations and speed-responsive means governed by the speed of the vehicle.

20. A railway traffic governing system comprising track rails, means for supplying alternating signaling current thereto, a vehicle, a circuit on said vehicle receiving energy from the rails and tuned to resonance at the frequency of the signaling current, a second circuit on said vehicle including a local source of current, an amplifier on the vehicle for causing variations of the current in said second circuit corresponding to variations of the potential in the first circuit, and vehicle governing means controlled by the current in said second circuit.

21. Railway traffic controlling apparatus, comprising track rails supplied at times with an alternating signaling current, a vehicle, a circuit on said vehicle including a coil in inductive relation to a track rail and a capacity device for at least partially balancing the inductive reactance of the circuit, amplifying means controlled by said circuit, and governing means on the vehicle controlled by said amplifying means.

22. Railway traffic controlling apparatus comprising track rails supplied at times with an alternating signaling current, a vehicle, a circuit on said vehicle including a coil in inductive relation to a track rail and a capacity device for reducing the reactance of said circuit, amplifying means controlled by said circuit, and governing means on the vehicle controlled by said amplifying means.

23. In an automatic train control or cab signaling system, in combination: a railway vehicle; a stationary conductor extending along the path of movement of the vehicle; traffic controlled means for supplying a periodic signaling current to said conductor; a coil on the vehicle arranged in inductive relation with said conductor; a circuit on the vehicle including said coil and a capacity device for reducing the reactance of the circuit, an electrical amplifying device included in said circuit; a relay affected only by current of the frequency of said signaling current and controlled by the current supplied from said amplifying device; and train control apparatus on the vehicle controlled by said relay.

24. In a railway signaling system, in combination: a railway track; means nullified by the presence of a train on a predetermined portion of the track for normally supplying periodic signaling current to the track rails of the track for a predetermined distance in the rear; a vehicle adapted to travel over the track; a circuit on the vehicle having a portion thereof disposed

in inductive relation to the track rails and including a capacity device for reducing the reactance of the circuit; a relay on the vehicle responsive only to current of the frequency of said signaling current; and traffic protecting means on the vehicle governed by said relay.

25. A normally active impulse transmitting system for automatic cab signaling or train control systems comprising a trackway circuit normally energized with periodic current of a predetermined frequency, a train carried circuit arranged in inductive relation with the trackway circuit and including a capacity device for reducing the reactance of the circuit, an amplifying device responsive to the flow of current in a train carried circuit, and a normally energized relay governed by the current supplied from said amplifying device and affected only by current of said predetermined frequency.

26. In combination, a railway track, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving alternating potentials due to said currents in the track, two amplifiers on said vehicle controlled respectively by the two potentials induced in said receiving means, and speed governing apparatus for said vehicle controlled jointly by said amplifiers.

27. In combination, a railway vehicle, two electron tube amplifiers thereon each having a heated filament and a grid and a plate, a grid circuit and a plate circuit for each amplifier, governing apparatus for the vehicle controlled jointly by said two plate circuits, and means located partly on the vehicle and partly in the trackway for supplying alternating voltages to said two grid circuits, respectively.

28. In combination, a railway vehicle, two electron tube amplifiers thereon each having a heated filament and a grid and a plate, a grid circuit for each amplifier, means located partly on the vehicle and partly in the trackway for supplying one alternating potential to the grid circuit for one amplifier and another alternating potential to the grid circuit for the other amplifier, a plate circuit for each amplifier including a source of direct current, and apparatus controlled jointly by said two plate circuits and responsive to variations in the strength of the currents flowing therein for governing the vehicle.

29. In combination, a railway vehicle, two electron tube amplifiers thereon each having a heated filament and a grid and a plate, means located partly on the vehicle and partly in the trackway for creating an alternating potential between the filament and grid of one amplifier and an alternating potential between the filament and grid of the other amplifier, a plate circuit for each amplifier including a source of direct current,

and apparatus controlled jointly by said two plate circuits and responsive to variations in the strength of the currents flowing therein for governing the vehicle.

30. In combination, a railway vehicle, two electron tube amplifiers thereon each having a heated filament and a grid and a plate, means located partly on the vehicle and partly in the trackway for creating an alternating potential between the filament and grid of one amplifier and an alternating potential between the filament and grid of the other amplifier, a plate circuit for each amplifier including a source of direct current, two windings associated with said two plate circuits respectively and each receiving alternating potential due to the potential applied to the grid and filament of the corresponding amplifier but of increased strength, and governing apparatus for said vehicle controlled jointly by said two windings.

31. In combination, a railway track, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving alternating potentials due to said currents in the track, two amplifiers on said vehicle controlled respectively by the two potentials induced in said receiving means, two windings on the vehicle associated with said two amplifiers respectively and each receiving an alternating potential due to the potential applied to the corresponding amplifier but of increased strength, and apparatus controlled jointly by said two windings for governing the vehicle.

32. In combination, a railway track, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving alternating potentials due to said currents in the track, two amplifiers on said vehicle controlled respectively by the two potentials induced in said receiving means, two windings on the vehicle associated with said two amplifiers respectively and each receiving an alternating potential due to the potential applied to the corresponding amplifier but of increased strength, and brake governing apparatus on the vehicle controlled jointly by said two windings and by the speed of the vehicle.

33. In combination, a railway track, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving alternating potentials due to said currents in the track, two amplifiers on said vehicle controlled respectively by the two potentials induced in said receiving means, and brake apparatus on the vehicle controlled jointly by said two amplifiers and by the speed of the vehicle.

34. In combination, a railway vehicle, two

- electron tube amplifiers thereon each having a heated filament and a grid and a plate, means located partly on the vehicle and partly in the trackway for creating an alternating potential between the filament and grid of one amplifier and an alternating potential between the filament and grid of the other amplifier, a plate circuit for each amplifier including a source of direct current, two windings associated with said two plate circuits respectively and each receiving alternating potential due to the potentials applied to the grid and filament of the associated amplifier but of increased strength and brake governing apparatus on the vehicle controlled jointly by said two windings and by the speed of the vehicle.
35. The method of governing railway traffic which consists in supplying two alternating currents to the track rails, creating corresponding voltages on a vehicle by induction, amplifying said voltages, and controlling a vehicle governing mechanism by said amplified voltages.
36. The method of governing railway traffic which consists in supplying two alternating currents to the track rails, creating corresponding voltages on a vehicle by induction, amplifying each induced voltage separately, and controlling a unitary vehicle governing mechanism jointly by said amplified voltages.
37. The method of governing railway traffic which consists in supplying two alternating currents to the track rails, creating corresponding voltages on a vehicle by induction, and governing the vehicle by said induced voltages and by the speed of the vehicle.
38. A normally active impulse transmitting system for automatic cab signaling or train control systems comprising a trackway circuit normally energized with periodic current of a predetermined frequency, a train carried circuit arranged in inductive relation with the trackway circuit and tuned to the frequency of the current therein, an amplifying device responsive to the flow of current in a train carried circuit, and a normally energized relay governed by the current supplied from said amplifying device and affected only by current of said predetermined frequency.
39. A railway signaling system comprising track rails, means for impressing thereon signaling currents of two frequencies, and signaling means controlled by energy received from said track rails and selectively responsive to said two frequencies to give two distinct indications according as one or both frequencies are present and a third indication in the absence of current of either frequency.
40. A railway signaling system comprising track rails, means for impressing thereon signaling currents of two frequencies, and signaling means controlled by energy received from said track rails and selectively responsive to said two frequencies to give a plurality of indications.
41. A railway signaling system comprising track rails, means for impressing thereon signaling currents differing in frequency, and signaling means controlled by energy received from said track rails and selectively responsive to said frequencies to give a plurality of indications.
42. A railway signaling system comprising track rails, means for impressing thereon signaling currents of two frequencies, a railway vehicle, two relays thereon controlled by energy received from the track rails and selectively responsive to said two frequencies, and signaling apparatus on said vehicle controlled by said relays.
43. A railway signaling system comprising track rails, means for impressing thereon signaling currents of two frequencies, two circuits controlled by energy in said rails and resonant respectively to said two frequencies, and signaling means controlled by said circuits.
44. A railway signaling system comprising track rails, means for impressing alternating signaling current thereon, a railway vehicle, a circuit thereon arranged to receive energy from the track rails, a second circuit on the vehicle resonant to current of said signaling frequency, a current amplifying device interposed between said two resonant circuits, and vehicle governing means controlled by said second resonant circuit.
45. A railway signaling system comprising track rails, means for impressing alternating signaling current thereon, a railway vehicle, a circuit thereon arranged to receive energy from the track rails, a vacuum tube amplifier on the vehicle comprising a filament continuously energized from a source of direct current, a plate, and a grid interposed between the filament and the plate, means for connecting said filament and said grid with said circuit so that alternating currents in the circuit produce an alternating difference of potential between the filament and the grid, a second circuit connected with said filament and said plate and resonant to current of said signaling frequency, and vehicle governing means controlled by said second circuit.
46. A railway signaling system comprising track rails, means for impressing alternating signaling current thereon, a railway vehicle, a circuit thereon arranged to receive energy from the track rails and resonant to current of said signaling frequency, vehicle governing means on said vehicle, and amplifying means on the vehicle between said resonant circuit and said governing means for enabling the governing means

to be controlled by weak currents received in the resonant circuit from the track rails.

47. Railway traffic controlling apparatus comprising track rails, a source of alternating signaling current connected thereto, a railway vehicle provided with an electron tube amplifier having a heated filament and a grid and a plate, a grid circuit for said amplifier, a circuit on said vehicle inductively related to a track rail for supplying voltage to said grid circuit of the same frequency as that of the alternating signaling current in the track rails, a plate circuit for said amplifier including a source of direct current, and means associated with said plate circuit and responsive to variations in the strength of the current flowing therein for governing said vehicle.

48. Railway traffic controlling apparatus comprising track rails, a source of alternating signaling current connected thereto, a railway vehicle provided with an electron tube amplifier having a heated filament and a grid and a plate, a grid circuit for said amplifier, means including a winding in inductive relation to a track rail for energizing said grid circuit, a plate circuit for said amplifier including a source of direct current, and means associated with said plate circuit and responsive to variations in the strength of the current flowing therein for governing said vehicle.

49. Railway traffic controlling apparatus comprising track rails, means for supplying alternating signaling current to said rails, a vehicle, a circuit on said vehicle tuned to the frequency of said signaling current and including a winding in inductive relation to a track rail, an electron tube amplifier on said vehicle, a grid circuit for said amplifier energized by said tuned circuit, a plate circuit for said amplifier including a source of direct current, and means associated with said plate circuit and responsive to variations in the strength of the current flowing therein for governing said vehicle.

50. Railway traffic controlling apparatus comprising track rails, a source of alternating signaling current connected thereto, a railway vehicle provided with an electron tube amplifier having a heated filament and a grid and a plate, a grid circuit for said amplifier, means including a winding in inductive relation to a track rail for energizing said grid circuit, a plate circuit for said amplifier including a source of direct current, and means associated with said plate circuit and responsive to variations in the strength of the current flowing therein for controlling the brakes of said vehicle.

51. In combination, a railway vehicle, an electron tube amplifier thereon having a heated filament and a grid and a plate, a plate circuit for said amplifier including a source of direct current, means controlled

by said plate circuit for governing said vehicle, and means located partly on the vehicle and partly in the trackway for creating an alternating difference of potential between the filament and grid of said amplifier.

52. In combination, a railway vehicle, an electron tube amplifier thereon having a heated filament and a grid and a plate, a plate circuit for said amplifier including a source of direct current, means controlled by said plate circuit for governing said vehicle, a grid circuit for said amplifier, and means located in the trackway and controlled by traffic conditions in advance of the vehicle for creating an alternating difference of potential in said grid circuit.

53. Railway traffic controlling apparatus comprising track rails, means for impressing thereon two alternating signaling currents, a vehicle provided with means for inductively receiving voltages due to said currents, amplifying means on said vehicle controlled by the voltages impressed on said receiving means, and speed governing apparatus on said vehicle controlled by said amplifying means.

54. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, and apparatus on said vehicle controlled by said voltages for automatically governing the speed of the vehicle.

55. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, and apparatus controlled by said voltages for governing the brakes of said vehicle.

56. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, and apparatus controlled jointly by the speed of the vehicle and by said voltages for governing said vehicle.

57. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, two windings on said vehicle supplied with currents corresponding to said induced voltages, and apparatus controlled jointly by said windings for governing the vehicle.

58. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, two windings on said vehicle supplied with cur-

rents corresponding to said induced voltages, and governing apparatus on said vehicle controlled jointly by said windings and by the speed of the vehicle.

5 59. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, two
10 windings on said vehicle, means interposed between said receiving means and said windings for supplying the windings with alternating potentials corresponding to said induced potentials but of greater amplitude, and apparatus controlled by said windings
15 for governing the vehicle.

60. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, amplifying means on said vehicle
20 controlled by the voltages impressed on said receiving means, two windings located on said vehicle and supplied by said amplifying means with alternating potentials corresponding to the voltages impressed on said receiving means but of greater amplitude, and apparatus controlled jointly by said
25 windings for governing the vehicle.

61. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, amplifying means on said vehicle controlled by the voltages impressed on said receiving means, two windings located on said vehicle and supplied by said amplifying means with alternating potentials corresponding to the voltages impressed on said receiving means but of greater amplitude, and brake governing apparatus on the vehicle controlled jointly by said two windings and by the
30 speed of the vehicle.

62. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, amplifying means on said vehicle controlled by the voltages impressed on said receiving means, two windings located on said vehicle, means interposed between said amplifying means and said windings for supplying the windings with alternating potentials corresponding to the voltages impressed on said receiving means but of greater amplitude, and apparatus controlled jointly by
35 said windings for governing the vehicle.

63. Railway traffic controlling apparatus comprising track rails, means for impressing two alternating signaling currents thereon, a vehicle provided with means for inductively receiving voltages due to said currents, am-

plifying means on said vehicle controlled by the voltages impressed on said receiving means, two windings located on said vehicle, means interposed between said amplifying means and said windings for supplying the windings with alternating potentials corresponding to the voltages impressed on said receiving means but of greater amplitude, and brake governing apparatus on said vehicle controlled jointly by said two windings and by the speed of the vehicle.

64. In combination, a railway vehicle, an electron tube amplifier thereon having a heated filament and a grid and a plate, means located partly on the vehicle and partly in the trackway for creating an alternating difference of potential between the filament and grid of said amplifier, a plate circuit for said amplifier including a source of direct current and a winding, and governing apparatus for said vehicle controlled by said winding.

65. In combination, a railway vehicle, an electron tube amplifier thereon having a heated filament and a grid and a plate, means located partly on the vehicle and partly in the trackway for creating an alternating difference of potential between the filament and grid of said amplifier, a plate circuit for said amplifier including a source of direct current and a winding, and brake governing apparatus on the vehicle controlled jointly by said winding and by the speed of the vehicle.

66. Railway traffic controlling apparatus comprising track rails, a source of alternating signaling current connected across said rails, a second trackway circuit including a second source of alternating signaling current, and vehicle carried traffic governing means inductively controlled by the joint action of said trackway currents.

67. In a railway signal system, a traffic rail circuit adapted to carry currents of difference frequencies, signal circuits in a railway car each responsive to one of said currents of different frequencies, means for inter-connecting said signal circuits with said traffic rail circuit, means associated with each of said signal circuits and including a reactive circuit tuned to the frequency to which the corresponding signal circuit is responsive to permit the passage only of the current of said last frequency, and means affected by a train preceding said car for varying the current in said circuit.

68. In a railway signal system, a main track circuit normally carrying signaling current, a signal circuit in a railway car, means affected by a preceding train for varying said signaling current, means for communicating said signaling current variations from said main circuit to said second signal circuit, and a signal indicating device responsive to said current variations.

69. In a railway signal system, a transmission circuit adapted to carry signal operating currents of different frequencies, signal circuits in a railway car, each of which is adapted to respond to one of said frequencies, means for communicating said currents from said main circuit to said signal circuits, and a relay in each of said signal circuits responsive to current having the associated frequency. 10

In testimony whereof I have affixed my signature.

ALBERT V. T. DAY.