June 29, 1926. 1,590,839

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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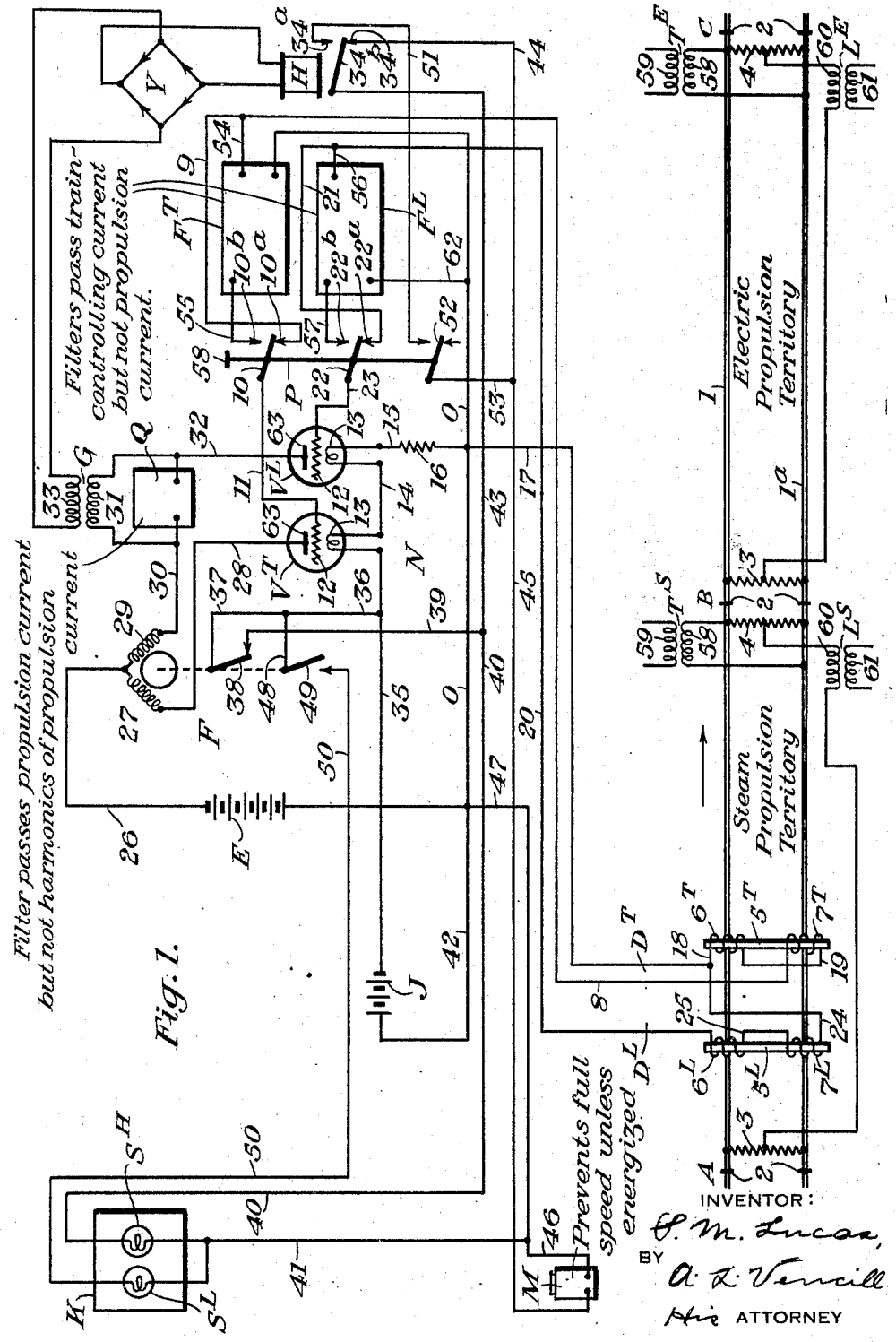


Fig. 1.

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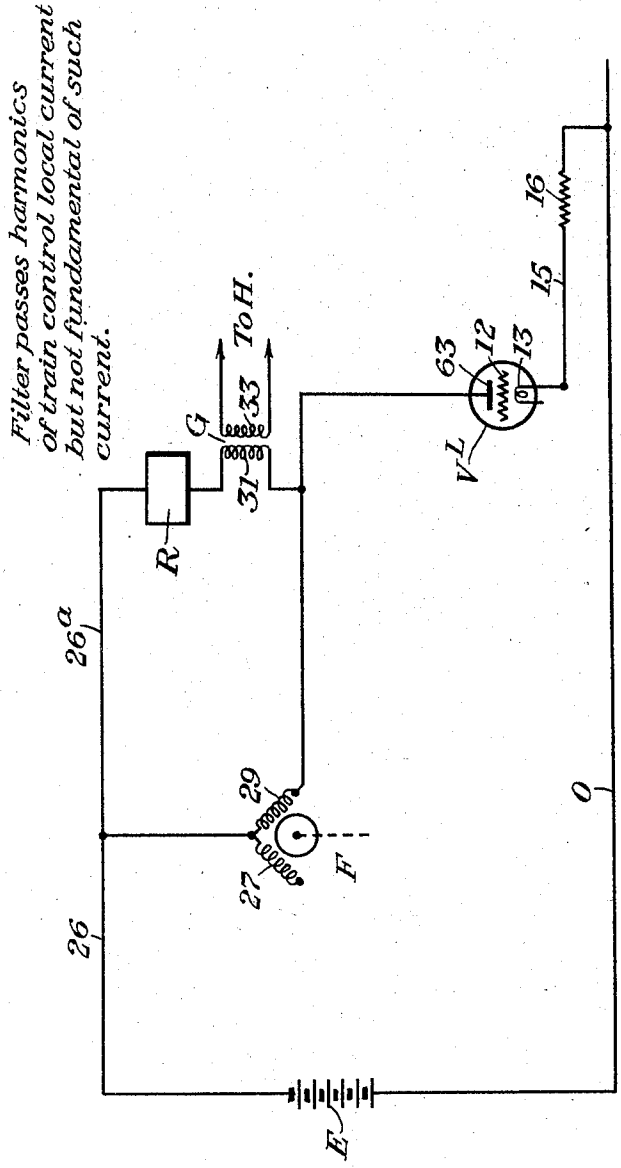


Fig. 2.

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UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed May 21, 1925. Serial No. 31,759.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising train-carried governing mechanism which is controlled by train controlling current in the trackway.

Under some circumstances it has been found desirable to apply train controlling currents of higher values to one part of a railway and of lower values to another part. For example, in the case of a railway having steam propulsion territory and electric propulsion territory, it may be advantageous under some conditions to apply train controlling current of higher values to the trackway of the electric propulsion territory than to the trackway of the steam propulsion territory. A similar condition may exist when two adjoining railways use train controlling currents of different values and a train traverses both railways. Under such conditions, means are provided on the train for changing the condition of the train-carried governing mechanism in accordance with the changes in current values of the trackway controlling currents when the train passes from either territory into the other.

One feature of my invention is the provision, in combination with apparatus of this character, of means for enforcing the operation of such change-over means when the train passes from steam propulsion territory into electric propulsion territory, the penalty for failure of the operation of the change-over means being that the train is prevented from proceeding at full speed in the electric propulsion territory.

I will describe two forms of 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 one form of apparatus embodying my invention. Fig. 2 is a view showing a modification of a portion of the apparatus shown in Fig. 1 and also embodying my invention.

Similar reference characters refer to similar parts in both of the 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 railway includes steam propulsion territory and electric propulsion territory. The track rails are divided by insulated joints 2 into a plurality of track sections, of which only two sections A—B and B—C are shown in the drawings. Section A—B is located in steam propulsion territory and section B—C is located in electric propulsion territory, but it will be understood that in most instances each territory will include more than one track section.

Located adjacent the exit end of each track section is a transformer designated T with a suitable exponent, for supplying track circuit current to the rails of the section. The secondary 58 of each transformer T is connected across the rails of the associated section, so that track circuit current flows through the two rails of the section in series. Each section is also provided with a second transformer designated by the reference character L, with a suitable exponent, for supplying local current to the rails of the section. As here shown, the secondary 60 of each transformer L is connected to the middle points of two resistances 3 and 4, which are connected across the rails adjacent the entrance and exit ends of the section respectively, so that the local current supplied by each transformer L flows through the two rails of the associated section in multiple.

The primaries 59 and 61 of the transformers T and L are supplied with alternating train controlling current from a suitable source which is not shown in the drawing.

In practice, the supply of either or both of the train controlling currents to the track rails of each track section by the track transformers T and the local transformers L, will be controlled by traffic conditions in advance of the section. Such controlling means forms no part of my present invention and is omitted from the drawing for the purpose of simplification.

The steam propulsion territory is occupied by a train designated as a whole by the reference character N, which train is provided with governing mechanism controlled by the train controlling currents in the track rails. As here shown, a magnetizable core 5^T is located in advance of the forward

wheels and axle of the train and is provided with two pick-up coils 6^T and 7^T located in inductive relation with the two track rails 1 and 1^a, respectively. Located at some other suitable point on the train is a second magnetizable core 5^L provided with two pick-up coils 6^L and 7^L which are disposed in inductive relation with the two track rails 1 and 1^a, respectively.

The forward pick-up coils 6^T and 7^T, which I will term the "track" coils, are included in a circuit D^T, which circuit passes from the lower coil 7^T, through wires 8 and 9, contact $10—10^a$ on a change-over switch P, wire 11, grid 12 of a vacuum tube amplifier V^T, filament 13 of the same amplifier, wire 14, filament 13 of a vacuum tube amplifier V^L, wire 15, resistance 16, wires 17 and 18, upper coil 6^T, wire 19, to the lower coil 7^T. The two coils 6^T and 7^T are so wound and connected in this circuit that the alternating voltages induced in these coils by track circuit current in the track rails are additive.

The rear pick-up coils 6^L and 7^L are included in a circuit D^L, which passes from the upper coil 6^L, through wires 20 and 21, contact $22—22^a$ on the change-over switch P, wire 23, grid 12 of vacuum tube amplifier V^L, filament 13 of the same amplifier, wire 15, resistance 16, wires 17 and 24, the lower coil 7^L and wire 25 to the upper coil 6^L. The two coils 6^L and 7^L are so wound and connected in this circuit that the voltages induced therein by currents flowing through the track rails in multiple are additive, and, consequently, voltages are induced in this circuit by the local currents supplied to the track rails by the local transformers L^s.

The track current amplifier V^T is provided with a plate circuit which passes from a battery E, through wire 26, stator winding 27 of an induction motor relay F, wire 28, plate and filament of tube V^T, wire 14, filament 13 of tube V^L, wire 15, resistance 16, and common wire O to battery E. The local current amplifier V^L is provided with a plate circuit which passes from battery E, through wire 26, stator winding 29 of relay F, wire 30, primary 31 of transformer G, wire 32, plate and filament of tube V^L, wire 15, resistance 16, and common wire O to battery E. The relay F controls a cab speed indicator K and also a magnet M. The magnet M in turn controls suitable governing mechanism which prevents full speed of the train unless the magnet is energized. This mechanism forms no part of my present invention and is omitted to simplify the drawings. When relay F is energized, the high speed indicator lamp S^H is lighted, the circuit being from battery J, through wires 35, 36 and 37, contact 38 of relay F, wires 39 and 40, high speed lamp S^H, wires 41, 47 and 42, to battery J. At the same time the magnet M is energized, the circuit being from battery J, through wires 35, 36 and 37, contact 38 of relay F, wires 39 and 43, back contact $34—34^b$ of a relay H, wires 44 and 45, winding of magnet M, and wires 46, 47 and 42 to battery J.

When relay F is de-energized, the circuit for the high speed indicator lamp S^H is open at contact 38, and the circuit for a low speed indicator lamp S^L is closed at contact 49, this circuit being from battery J, through wires 35, 36 and 48, contact 49, wire 50, lamp S^L and wires 41, 47 and 42 to battery J. The circuit for magnet M is also open at contact 38 of relay F.

The relay H is supplied with current from the secondary 33 of transformer G, a rectifier Y preferably being interposed between this relay and the transformer so that the relay may be of the direct current type. The parts are so proportioned that when the train is in steam propulsion territory, as shown in the drawing, the value of the current supplied to relay H is such that the back contact of this relay is closed and its front contact is open.

The circuits which I have described hereinbefore are the circuits which are effective when the train occupies steam propulsion territory. If no means were provided for limiting the amount of current supplied to the grid and filament of the amplifier tubes V when the train occupies electric propulsion territory, these tubes would become over-saturated, so that they would be ineffective to properly control the plate circuits including the stator windings of relay F. For this reason electric filters F^T and F^L are provided for the pick-up circuits D^T and D^L, respectively, which filters are interposed in these circuits by means of the change-over switch P when the train enters electric propulsion territory. Upon entering such territory the engineer reverses switch P, whereupon the circuit D^T becomes open at contact $10—10^a$ and this circuit then passes from wire 8, through wire 54, filter F^T and common wire O to wire 17. The output circuit for filter F^T is then from the filter, through wire 55, contact $10—10^b$, wire 11, grid and filament of amplifier tube V^T, wire 14, filament 13 of tube V^L, wire 15, resistance 16, and common wire O to the filter F^T. Similarly, the circuit D^L hereinbefore traced becomes open at contact $22—22^a$ and filter F^L is connected across wires 20 and 17, through wires 56 and 62. The output circuit of filter F^L then passes from the filter, through wire 57, contact $22—22^b$, wire 23, grid and filament of tube V^L, wire 15 and resistance 16 to wire 17. Each filter F^T and F^L is designed to pass alternating current of train controlling frequency, but not current of the propulsion frequency, and so by means of these filters the tubes V^T and V^L are protected against over-energization or

saturation due to alternating propulsion current.

The filters F^T and F^L, however, materially reduce the efficiency of the energy transmission from the track rails to the amplifying tubes, and hence it is necessary to supply more train controlling current to the track rails in the electric propulsion territory than in the steam propulsion territory. For example, the track circuit current supplied by the track transformer T^S in steam propulsion territory may be 0.4 ampere and the loop current supplied by transformers L^S in the steam propulsion territory may be 0.2 ampere, whereas in the electric propulsion territory the track circuit current supplied by transformers T^E may be 1 ampere and the local current supplied by transformers L^E may also be 1 ampere. It is important, therefore, to insure that the change-over switch P shall be operated to include the filters F^T and F^L in the pick-up circuits when the train enters the electric propulsion territory, because if this is not done, the train-carried mechanism which is set up for the small values of train controlling currents in the steam territory will have a very small factor of safety with respect to the comparatively heavy train controlling currents in the electric propulsion territory. This applies particularly to the track circuit current, because it is essential that when two trains occupy the same track section the forward train should shunt the track circuit current to a sufficient degree to prevent the rear train from receiving enough of this current to effectively energize the track winding 27 of relay F, and if this current is of sufficient value the shunting by the forward train will not be effective. I accordingly arrange the transformer G and relay H so that the increased current in the plate circuit for tube V^L due to the entrance of the train into electric propulsion territory will effectively energize relay H, that is, will cause the front contact 34—34ª of this relay to close and its back contact to open. The circuit for magnet M then passes from battery J, through wires 35, 36 and 37, contact 38 of relay F, wires 39 and 43, front contact 34—34ª of relay H, wire 51, contact 52 on change-over switch P, wires 53 and 45, winding of magnet M, wires 46 and 47, and wire 42 to battery J. Contact 52 is closed only when change-over switch P occupies its electric propulsion territory position, and, consequently, if the engineman fails to operate the switch P on entering electric propulsion territory the circuit for magnet M will be open at contact 52 and so the train cannot proceed at full speed through this territory. Usually the magnet M when de-energized will permit the train to proceed only at a safe low speed, such as 15 miles per hour.

As shown in Fig. 1, a low pass filter Q is interposed in the plate circuit for amplifier tube V^L and is connected across the terminals of the primary 31 of transformer G. This filter is designed to freely transmit current of the propulsion frequency but to offer a high impedance to harmonics of this current. When current is induced in the pick-up circuit D^L due to the local trackway current of one ampere in electric propulsion territory, a large third harmonic of this local current is developed in the plate circuit of tube V^L due to the characteristic of the tube itself. This third harmonic current is almost entirely forced into the primary 31 of transformer G, and so is effective to energize relay H. Any other harmonics of the local current will likewise be forced into transformer G by the impedance of the filter Q and so will assist in the energization of relay H.

When the low pass filter Q is not used, the operation of relay H depends upon the increased current flowing in the plate circuit of tube V^L due to the increased value of local trackway current, assisted to some extent by the third harmonic of this local current. When the filter Q is used, the assistance by the third harmonic is greater. In some instances it may be desirable to utilize the third harmonic alone to energize relay H, in which event the apparatus shown in Fig. 2 may be used.

Referring now to Fig. 2, the plate circuit for tube V^L is provided with a branch around relay winding 29, which branch includes wire 26ª, a filter R, and the primary winding 31 of transformer G. The filter R may be tuned to freely pass the third harmonic of the local current frequency or to pass all harmonics, but to offer a comparatively high reactance to the fundamental of this frequency. It follows that while the tube V^L is energized by local current in steam propulsion territory at which time there is little or no current of the third or other harmonic present in the plate circuit of this tube, relay H will be de-energized, but when the tube V^L becomes over-energized due to the entrance of the train into electric propulsion territory, the consequent relatively large current of the third or other harmonic of the local current frequency will be supplied to transformer G and so will cause energization of relay H.

Although I have herein shown and described only two forms of apparatus 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. In combination, a railway comprising

steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, frequency selecting apparatus on the train, a member on the train for connecting said apparatus with said mechanism while the train is in the electric propulsion territory and for disconnecting the apparatus from the mechanism when the train is in the steam propulsion territory, and means for compelling operation of said member when the train passes from one said territory into the other territory.

2. In combination, a railway comprising steam propulsion territory, and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, frequency selecting apparatus on the train associated with said governing mechanism, a member for affecting the action of said selecting apparatus on said mechanism, and means for compelling operation of said member when the train passes from one said territory into the other territory.

3. In combination, a railway comprising steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, frequency selecting apparatus on the train, a manually operable member on the train for connecting said apparatus with said mechanism while the train is in the electric propulsion territory and for disconnecting the apparatus from the mechanism when the train is in the steam propulsion territory, and means for preventing the train from proceeding at full speed unless said member is operated to disconnect said apparatus from said mechanism when the train passes from steam propulsion territory into electric propulsion territory.

4. In combination, a railway comprising steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, frequency selecting apparatus on the train, a manually operable member on the train for connecting said apparatus with said mechanism while the train is in the electric propulsion territory and for disconnecting the apparatus from the mechanism when the train is in the steam propulsion territory, and means for affecting said governing mechanism unless said member is operated to disconnect said apparatus from said mechanism when the train passes from steam propulsion territory into electric propulsion territory.

5. In combination, a railway comprising a territory supplied with train controlling current of a lower value and a second territory supplied with train controlling current of a higher value, a train carried circuit, means on the train controlled by said currents for supplying energy to said circuit, governing mechanism on the train controlled by the energy in said circuit, apparatus on the train acting to reduce the current in said circuit, a member for affecting the action of said apparatus on said circuit, a transformer the primary of which is included in said circuit, a relay supplied with energy from the secondary of said transformer, and means controlled by said relay for affecting said governing mechanism unless said member is operated when the train passes from one territory into the other.

6. In combination, a railway comprising steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, a train carried circuit, means on the train controlled by said rail currents for supplying energy to said circuit, governing mechanism on the train controlled by the energy in said circuit, apparatus on the train acting to reduce the current in said circuit, a member for affecting the action of said apparatus on said circuit, a transformer the primary of which is included in said circuit, a relay supplied with energy from the secondary of said transformer, a low pass filter associated with said circuit and said transformer for keeping propulsion current but not the harmonics of the propulsion current away from said relay, and means controlled by said relay for affecting said governing mechanism unless said member is operated when the train passes from steam propulsion territory into electric propulsion territory.

7. In combination, a railway comprising steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the

rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, apparatus associated with said mechanism and operating to reduce the current received by said mechanism, a manually operable member on the train for connecting said apparatus with said mechanism while the train is in the electric propulsion territory and for disconnecting the apparatus from the mechanism when the train is in the steam propulsion territory, and means responsive to said current of higher value but not to said current of lower value for compelling operation of said member when the train passes from steam propulsion territory into electric propulsion territory.

8. In combination, a railway comprising steam propulsion territory and electric propulsion territory, means for supplying train controlling current of a lower value to the rails in the steam propulsion territory, means for supplying train controlling current of a higher value to the rails in the electric propulsion territory, train carried governing mechanism controlled by said currents, frequency selecting apparatus on the train, a manually operable member on the train for connecting said apparatus with said mechanism while the train is in the electric propulsion territory and for disconnecting the apparatus from the mechanism when the train is in the steam propulsion territory, and means responsive to said current of higher value but not to said current of lower value for preventing the train from proceeding at full speed unless said member is operated to disconnect said apparatus from said mechanism when the train passes from steam propulsion territory into electric propulsion territory.

In testimony whereof I affix my signature.

SAMUEL M. LUCAS.