May 19, 1925. **1,538,047**

L. V. LEWIS

RAILWAY TRAFFIC CONTROLLING APPARATUS

Original Filed Sept. 11, 1920 2 Sheets-Sheet 1

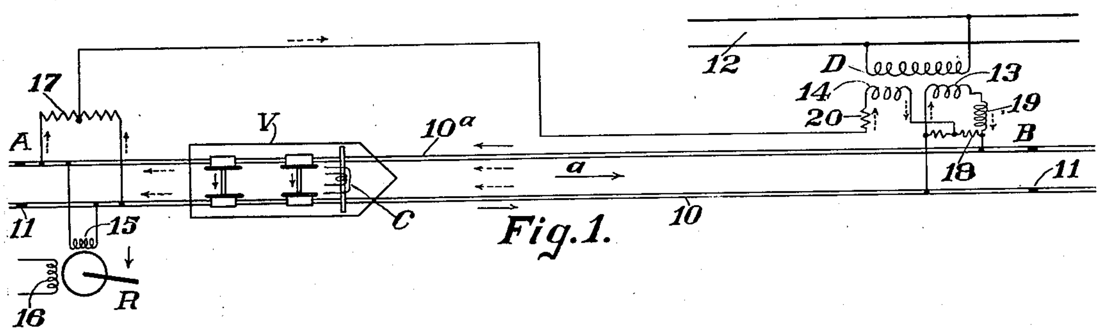

Fig.1.

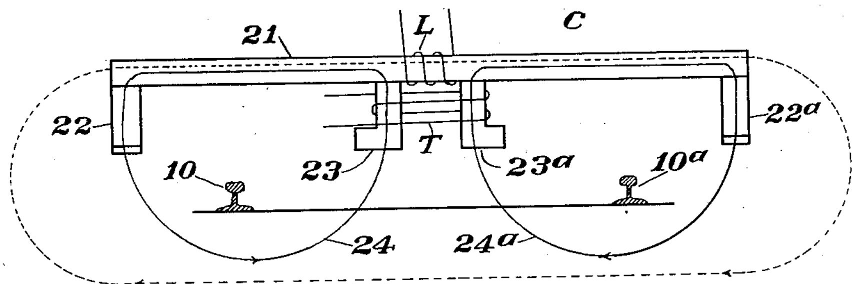

Fig.2.

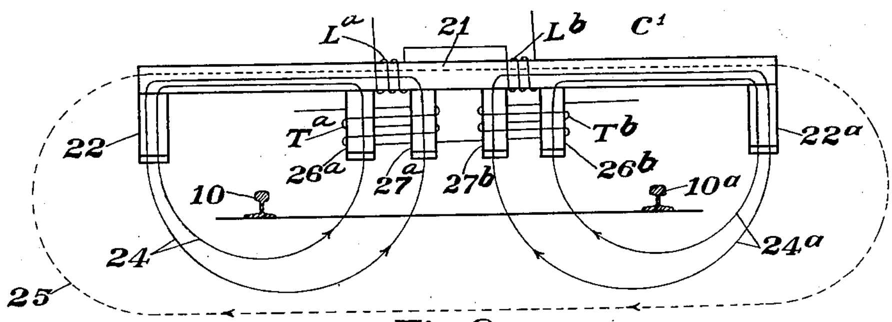

Fig.3.

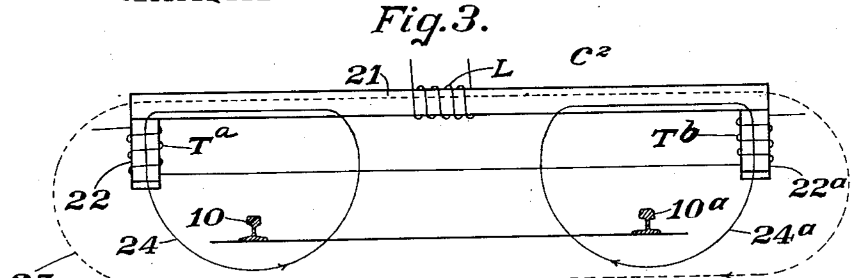

Fig.4.

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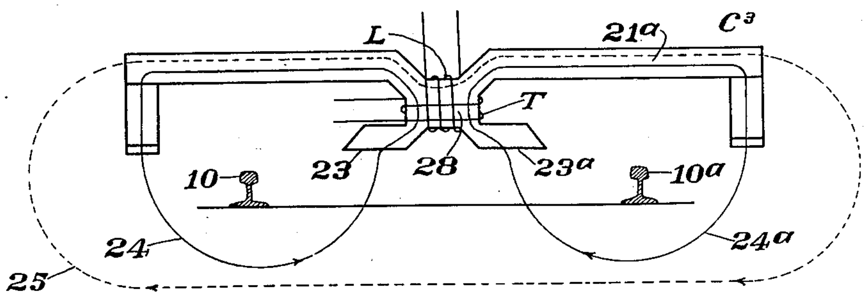

Fig. 5.

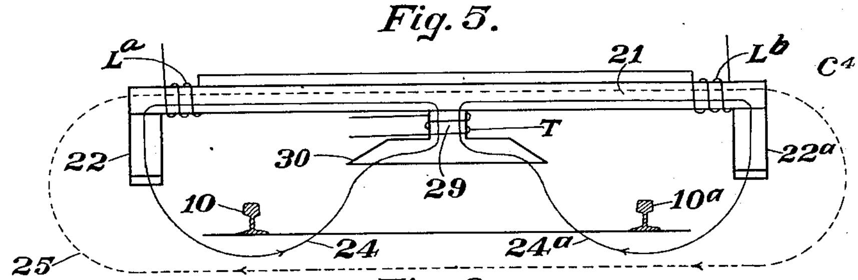

Fig. 6.

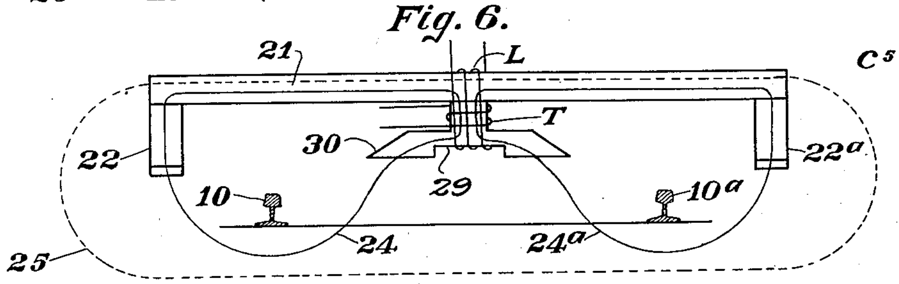

Fig. 7.

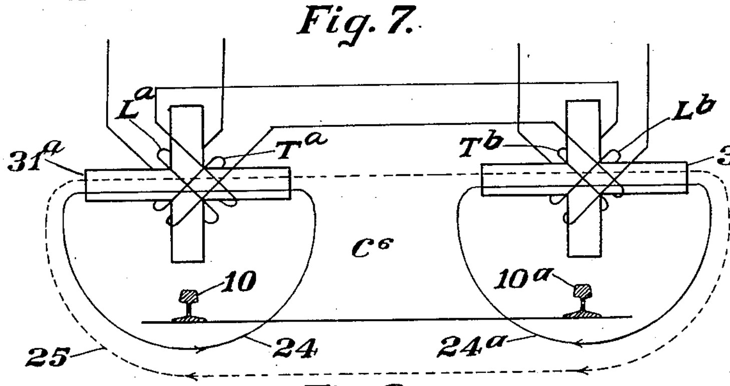

Fig. 8.

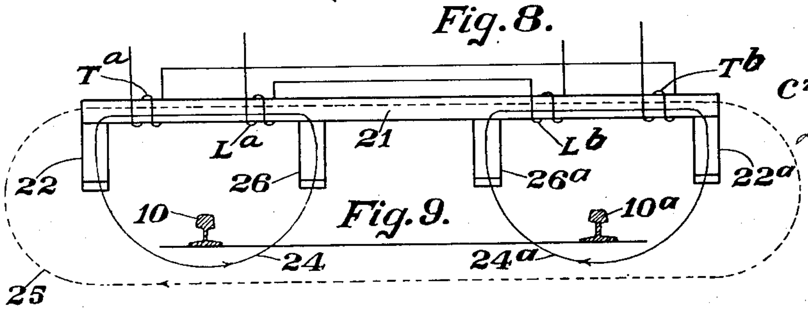

Fig. 9.

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Patented May 19, 1925. **1,538,047**

UNITED STATES PATENT OFFICE.

LLOYD V. LEWIS, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed September 11, 1920, Serial No. 409,705. Renewed May 6, 1922. Serial No. 559,057.

To all whom it may concern:

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

My invention relates to railway traffic controlling apparatus of the type wherein governing means on a vehicle is controlled by energy received from the trackway, and it relates more particularly to the receiving apparatus on the vehicle for picking up such energy from the trackway and transmitting it to the governing means.

I will describe several 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 trackway apparatus with which vehicle carried receiving apparatus embodying my invention is adapted to co-operate. Fig. 2 is a view showing in front elevation one form of vehicle carried receiving apparatus embodying my invention. Figs. 3, 4, 5, 6, 7, 8 and 9 are views similar to Fig. 2 but showing various modified forms of receiving apparatus each embodying my invention.

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

Referring first to Fig. 1, the reference characters 10 and 10^a designate the track rails of a railway over which traffic normally moves towards the right as indicated by the large arrow *a*. These rails are divided by insulated joints 11 to form a series of electrically separated track sections of which only one complete section A—B is shown in the drawing. Located adjacent the exit end of the section A—B is a transformer D the primary of which is connected with a transmission line 12 which is supplied with alternating traffic controlling current from a source not shown in the drawing. The transformer D is provided with two secondary windings 13 and 14, the former of which is connected across the track rails 10 and 10^a to supply track circuit current thereto in the usual manner. This current controls a track relay R having one winding 15 connected across the track rails adjacent the entrance end of the section, and a second winding 16 supplied with alternating current from a suitable source not shown in the drawing. The transformer secondary 14 is connected with the middle points of two resistances 17 and 18, which in turn are connected across the track rails adjacent the entrance and exit ends of the section A—B respectively.

In actual practice, the track relay R for each track section controls the supply of current from the transformer secondaries 13 and 14 to the rails of the section next in the rear, but inasmuch as this control does not enter into my present invention it is omitted from the drawing to simplify the disclosure as much as possible.

It will be seen from the foregoing that the current from secondary 13 flows in opposite directions in the two track rails at any given instant, as indicated by the small arrows in solid lines. This current I will, for convenience, refer to as the "track circuit current." The current from secondary 14, however, flows in the same direction in the two track rails, as indicated by the arrows drawn in dash lines, and this current I will refer to as the "line circuit current" or the "line current." The track circuit current and the line circuit current are displaced in phase by means of a reactance 19 in series with transformer secondary 13, and a resistance 20 in series with secondary 14.

As shown in the drawing, the track section A—B is occupied by a vehicle V which may be, for example, a locomotive. This vehicle, it is understood, is provided with suitable governing means which is controlled by the track and line currents in the rails 10 and 10^a, the control being effected through the medium of receiving apparatus which is designated as a whole by the reference character C. Various forms of receiving apparatus embodying my invention are illustrated in Figs. 2 to 8 respectively, wherein they are designated C to C^7, and any one of these several forms may be employed on the vehicle V for co-operation with the trackway apparatus shown in Fig. 1.

Referring now to Fig. 2, the receiving apparatus in the form here shown comprises a core 21 of magnetizable material, preferably laminated soft iron, which is mounted on the vehicle in front of the forward axle and is disposed transversely with respect to the track rails. The length of this core is somewhat greater than the distance between the track rails, so that the core overhangs the rails on each side of the track. The core 21 is provided with two downwardly projecting arms 22 and 22ª, one at each end; and near the middle of the core are two spaced, downwardly projecting L-shaped arms 23 and 23ª which point in opposite directions. Surrounding the core 21 between the arms 23 and 23ª is a winding L which I will term the "line winding," and surrounding the arms 23, 23ª is a second winding T which I will term the "track winding."

The path of the magnetic flux around each rail due to track circuit current is represented by the solid lines 24 and 24ª, the directions of the lines of force being indicated by the arrow heads applied to these lines. It will be observed that the flux from each rail passes through the track winding T but not through the line winding L, and further that the flux from both rails is in the same direction through winding T. The result of this is, of course, that track circuit current in the rails induces a voltage in the track winding T but not in the line winding L.

Considering now the line current, the path of the magnetic flux around the rails due to this current is indicated by the dash line 25 in Fig. 2. This flux it will be seen, passes through the line winding L, but not through the track winding T, and so it follows that line current in the track rails will induce voltage in the line winding but not in the track winding.

One feature of the structure shown in Fig. 2 is the provision of different magnetic circuits for the two windings, so that each winding will be exposed only to the magnetic field of the current which is intended to induce voltage in the winding.

The two windings L and T are usually employed to control the supply of energy to the two stator windings of a polyphase relay, which in turn controls the vehicle governing means. When this is the case, it is highly important that the apparatus should be so arranged that voltage induced in one winding T or L by the track current cannot serve as a source of excitation for the other winding L or T. Improper operation of this nature is impossible with the structure shown in Fig. 2, because the two windings L and T are in non-inductive relation to each other, even though both windings are mounted on the same mechanical support and are in inductive relation to the track rails.

In a system such as that illustrated in Fig. 1, it is desirable that the value of the line current should be considerably less than the value of the track circuit current, in order to avoid any possibility of false operation of the track relay R by the line current. It is also desirable, however, that the track and line windings in Fig. 2 should be alike, that the apparatus between these windings and the controlling relay should be alike and that currents of the same intensity should be supplied to the two windings of the controlling relay. In order to accomplish this result, it is, of course, necessary to make the reluctance of the magnetic circuit for line current flux lower than the reluctance of the magnetic circuit for track circuit current flux. This may be readily accomplished with the structure shown in Fig. 2 because the structure is a very efficient collecting device for line current due to the fact that the core 21 provides a path through laminated iron for nearly half the total length of the path around the two rails; whereas the structure may be made less efficient for the collection of track circuit current energy by proper design of the arms 23 and 23ª. For example, if the track circuit current is four amperes and the line current is one ampere, the structure may be so designed that the line winding L will receive four times the flux that is received by the track winding T, so that the voltages induced in these windings will be equal.

Referring now to Fig. 3, the apparatus here shown is similar to that shown in Fig. 2 except that the line winding comprises two coils Lª and Lᵇ, and the track winding comprises two coils Tª and Tᵇ. The core 21 is provided with a pair of downwardly projecting arms 26ª and 27ª located on one side of the center of the track and with a second pair of similar arms 26ᵇ and 27ᵇ located on the other side of the center of the track. One of the line coils Lª is mounted on the core 21 between the arms 26ª and 27ª, while the other line coil Lᵇ is mounted on core 21 between the arms 26ᵇ and 27ᵇ. One track coil Tª surrounds the two arms 26ª and 27ª, while the other track coil Tᵇ surrounds the two arms 26ᵇ and 27ᵇ. The paths of the magnetic fluxes due to track and line currents in rails are indicated respectively by the solid lines 24, 24ª and by the dash line 25. In this form of my invention, each line coil is in non-inductive relation to the adjacent track coil, so that neither of these coils can create voltage in the other. Line coil Lª is in inductive relation to track coil Tᵇ, but any voltage induced in one of these coils by the other will be neutralized by an equal and opposite voltage induced by line coil L^b in track coil T^a or by track coil T^a in line coil L^b. Similarly, line coil L^b is in inductive relation to track coil T^a, but any induced voltage due to such relation will be neutralized by the inductive relation of coils L^a and T^b. The net result, then as in Fig. 2, is that current in either winding will produce no voltage at the terminals of the other winding.

In Fig. 4, the line winding L surrounds the core 21 at a point substantially midway between the two track rails, and the track winding comprises two coils T and T^a which are mounted respectively on the two end arms 22 and 22^a. In this arrangement, the two currents are separated by removing the track coils to the greatest possible distance from the line coil. Furthermore, any voltage which is induced in coil T^a by current in winding L will be neutralized by an equal and opposite voltage induced in coil T^b by winding L, and vice versa, so that as in the preceding views current in either winding will produce no voltage at the terminals of the other winding.

Referring now to Fig 5, the magnetizable core, which is here designated 21^a, is provided with a vertically disposed offset portion midway between the two track rails, and this offset portion is provided with two laterally projecting arms 23 and 23^a. The line winding L is wound vertically around the offset portion 28, whereas the track winding T is wound horizontally around this same portion of the core. As indicated by the solid and dash lines, flux due to the track circuit current passes through the track winding T, but not through line winding L, whereas flux due to the line current passes through the line winding L, but not through the track winding T. The two windings L and T are obviously in non-inductive relation to each other, and so it is impossible for current in either winding to create voltage in the other winding.

Referring now to Fig. 6, the line winding comprises two coils L^a and L^b mounted at opposite ends of the core 21, and the track winding T surrounds an arm 29 which projects downwardly from the core at a point between the two track rails. The arm 29 is provided with a shoe 30 to assist in collecting flux from the track circuit current in the rails 10 and 10^a. This structure is highly efficient because the line windings L and L^a are situated at highly advantageous points in the magnetic field. Inasmuch as any voltage induced in coil L^a by current in winding T will be neutralized by an equal and opposite voltage in coil L^b, and vice versa, it is apparent that current in either winding cannot create a voltage at the terminals of the other winding.

In Fig. 7, the track winding T is wound on the arm 29 as in Fig. 6, but the line winding L is located at the middle of the core and surrounds this core as well as the arm 29 and the shoe 30. The arrangement shown in Fig. 7 avoids the possibility of false influence of one winding by the other because the two windings are in non-inductive relation.

Referring now to Fig. 8, the apparatus in the form here shown comprises two cores 31^a and 31^b located above the track rails 10 and 10^a respectively and each formed of laminated soft iron. Each core is in the form of a cross having its arms disposed in horizontal and vertical directions. The core 31^a carries a line coil L^a and a track coil T^a which coils are wound diagonally on the core and are disposed at right angles to each other. The core 31^b is similarly provided with a line coil L^b and a track coil T^b. The two line coils L^a and L^b are so connected that the voltages induced in these coils by flux due to line current assist each other in the circuit including the coils, whereas the track coils T^a and T^b are so connected that the voltages induced therein due to track circuit current assist each other in the circuit including these coils. It follows, therefore, that track circuit current will create no potential in the circuit including the line coils L^a and L^b, and that similarly line current will create no voltage in the circuit including the track coils T^a and T^b. The two coils on each core are, of course, in non-inductive relation to each other and obviously the coils on one core are in non-inductive relation to the coils on the other core. It follows that the structure shown in Fig. 8 has all of the advantages of the structure shown in Fig. 2 except for the efficiency of the magnetic circuit for line coils L^a and L^b.

Referring now to Fig. 9, the core 21 is provided with two end arms 22 and 22^a and two intermediate arms 26 and 26^a, all of which project downwardly from the core. Located between the arms 22 and 26 are a track coil T^a and a line coil L^a, and similarly located between the arms 22^a and 26^a are a track coil T^b and a line coil L^b. The paths for the fluxes due to currents in the track rails will be clearly understood from the drawing. As in the preceding view, the coils are so connected that voltage will be induced in the circuit of the line coils by line current only, and that voltage will be induced in the circuit of the track coil by track circuit current only. Current in either winding can produce no voltage at the terminals of the other winding because, for example, any voltage induced in coil T^a by current in coil L^a will be neutralized by an equal and opposite voltage induced in coil T^b by current in coil L^b.

Although I have herein shown and described only a few forms of receiving 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. Vehicle carried receiving apparatus comprising a track winding and a line winding, and means for mounting said windings so that alternating current flowing in opposite directions in the two track rails will induce voltage in the track winding but not in the line winding, and that alternating current flowing in the same direction in the two rails will induce voltage in the line coil but not in the track coil.

2. Vehicle carried receiving apparatus comprising a magnetizable core mounted transversely with respect to the track rails and provided with two spaced downwardly projecting arms located between the two rails, a line winding surrounding said core between said arms, and a track winding surrounding said two arms.

3. Vehicle carried receiving apparatus comprising a magnetizable core mounted transversely with respect to the track rails, and two windings so mounted on said core that each winding is in inductive relation to the track rails and that said windings are in non-inductive relation to each other.

4. Vehicle carried receiving apparatus comprising a magnetizable core mounted in front of the forward axle and transversely with respect to the track rails, and two coils so mounted on said core as to be in inductive relation to the track rails but in non-inductive relation to each other.

5. Vehicle carried receiving apparatus comprising a magnetizable core mounted transversely with respect to the track rails and extending substantially from rail to rail, a line coil wound on said core so that voltage is induced therein by alternating currents flowing in the same direction in the two rails, an arm projecting from said core in such position as to receive flux due to alternating currents flowing in opposite directions in the two rails, and a track coil wound on said arm.

6. Vehicle carried receiving apparatus comprising a track winding and a line winding mounted in front of the forward axle, and partial circuits of magnetizable material for said windings so arranged that alternating currents flowing in opposite directions in the two rails will induce voltage in the track winding but not in the line winding, and that alternating currents flowing in the same direction in the rails will induce voltage in the line winding but not in the track winding.

7. Vehicle carried receiving apparatus comprising a track coil and a line coil mounted in front of the forward axle, a partial circuit of magnetizable material for said track coil located in the path of the flux surrounding a track rail due to alternating currents flowing in opposite directions in the two rails, and a partial circuit of magnetizable material for said line coil located in the path of the flux surrounding the track rails due to alternating currents flowing in the same directions in the two rails.

8. Vehicle carried receiving apparatus comprising a track coil and a line coil mounted in front of the forward axle, a partial circuit of magnetizable material for said track coil located in the path of the flux surrounding a track rail due to alternating currents flowing in opposite directions in the two rails, and a partial circuit of magnetizable material for said line coil located in the path of the flux surrounding the track rails due to alternating currents flowing in the same directions in the two rails, said circuits being so arranged that the two coils are in non-inductive relation to each other.

9. Vehicle carried receiving apparatus comprising a track coil and a line coil mounted in front of the forward axle, and partial circuits of magnetizable material for said coils so arranged that alternating currents flowing in opposite directions in the two rails will induce voltage in the track coil but not in the line coil, and that alternating currents flowing in the same direction in the rails will induce voltage in the line coil but not in the track coil, said circuits being so arranged that the two coils are in non-inductive relation to each other.

10. Vehicle carried receiving apparatus comprising a magnetizable core mounted in close relation to the track, a track winding mounted on said core in such manner that voltage is induced therein by alternating current flowing in opposite directions in the two rails, a line winding mounted on said core in such manner that voltage is induced therein by alternating current flowing in the same direction in the two rails, the mounting of said windings being such that current in either winding will not produce voltage at the terminals of the other.

11. Vehicle carried receiving apparatus comprising a track winding receiving voltage due to alternating current flowing in opposite directions in the two track rails, a line winding receiving voltage due to alternating current flowing in the same direction in the two rails, and means associated with said windings for preventing current in either winding from producing voltage at the terminals of the other.

12. Vehicle carried receiving apparatus comprising a track winding and a line winding both inductively related to the track rails, and means associated with said windings for facilitating the induction of volt-

ages therein by currents in the rails and preventing current in either winding from producing voltage at the terminals of the other.

13. Vehicle carried receiving apparatus comprising a magnetizable core and two windings mounted thereon in non-inductive relation to each other.

14. Vehicle carried receiving apparatus comprising a magnetizable core mounted in close relation to the track, a track winding mounted on said core in such manner that voltage is induced therein by alternating current flowing in opposite directions in the two rails, a line winding mounted on said core in such manner that voltage is induced therein by alternating current flowing in the same direction in the two rails, said windings being so mounted that they are in non-inductive relation to each other.

15. Vehicle carried receiving apparatus comprising a winding located between the two track rails, and means for causing magnetic flux due to current flowing in the same direction in opposite portions of said rails at a given instant to pass through said winding.

In testimony whereof I affix my signature in presence of two witnesses.

LLOYD V. LEWIS.

Witnesses:

A. Herman Wegner,

A. H. Maranda.