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TRAFFIC DETECTING APPARATUS

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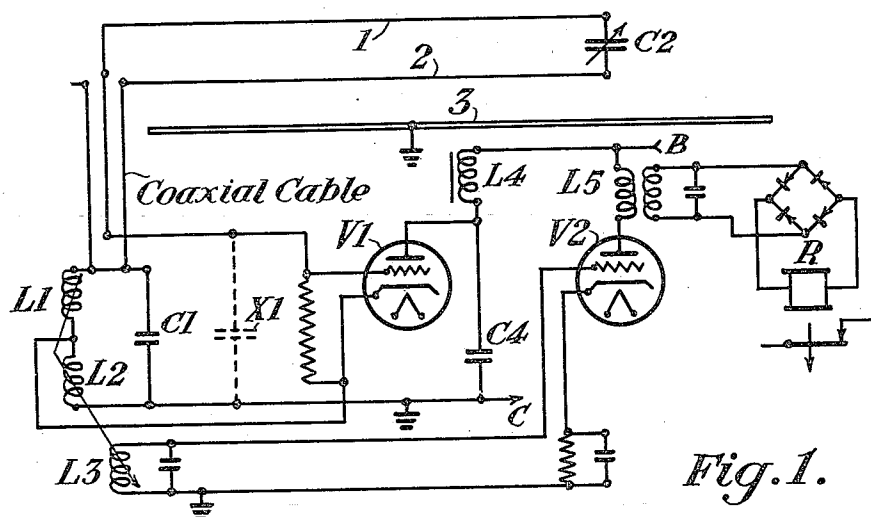


Fig. 1.

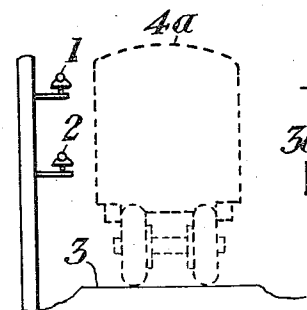


Fig. 2a.

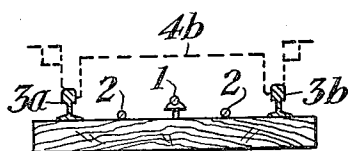


Fig. 2b.

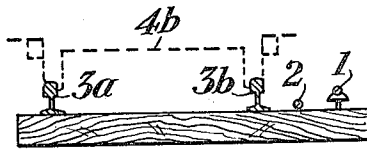


Fig. 2c.

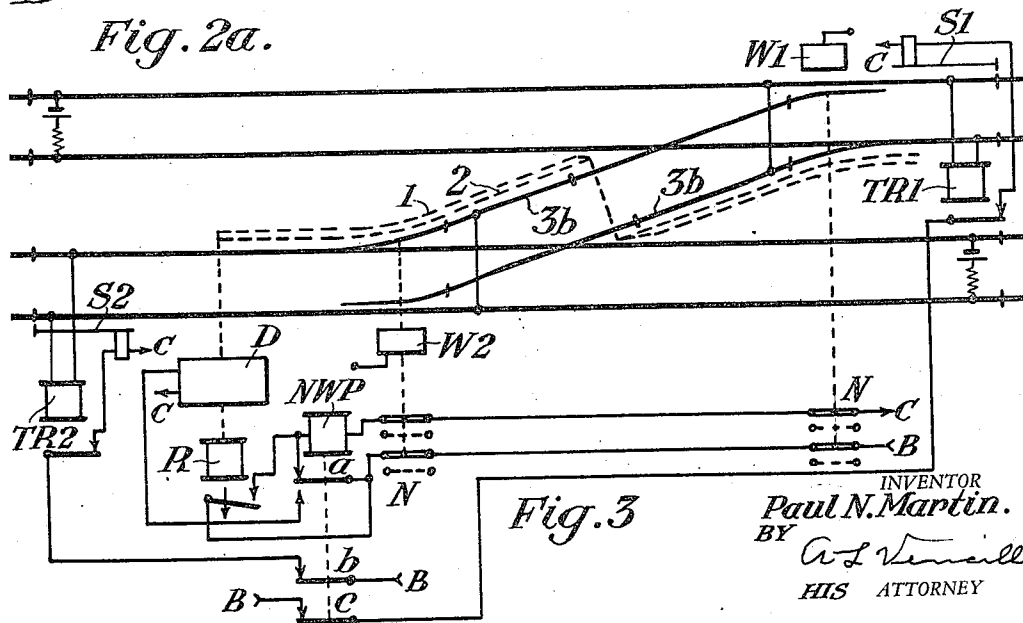


Fig. 3

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TRAFFIC DETECTING APPARATUS

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8 Claims. (Cl. 246—30)

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My invention relates to traffic detecting apparatus, and more particularly, to electronic means for detecting presence of a vehicle in an extended stretch of roadway which does not depend upon physical contact with circuit controlling elements in the roadway, such as highway contactor or railway track circuits.

The principal object of my invention is the provision of improved vehicle detecting means in which the presence of a vehicle at any point in an extended stretch of roadway is detected by its effect upon an alternating electric field of force in the space above the roadway occupied by the vehicle. My invention is particularly applicable to railway vehicles, and may be applied to a railway to supplement or as a substitute for, a track circuit, as for example, to detect the presence of a car in a stretch of track of which the rails have a high contact resistance due to infrequent train movements, or to detect the presence of light weight vehicles, or of highway vehicles or the like having insulated wheels and incapable of shunting the usual track circuits, or to detect the presence of cars on railway crossings or at other locations where the installation of track circuits is impracticable.

I shall describe one form of apparatus embodying my invention and shall then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 shows one form of train-detecting apparatus comprising an electronic oscillator, the circuits for which are so arranged that it is responsive to changes in the electrical capacity to ground of insulated conductors 1 and 2, which extend along a stretch of roadway 3, such as a single track highway or a railway along which vehicles may move, but which restrains them to remain at a substantially constant distance from conductors 1 and 2, the apparatus serving to detect the presence of a vehicle at any point in the stretch by the release of a detector relay R which is normally held energized by current generated by the oscillator. Figs. 2a, 2b and 2c illustrate different ways in which the conductors 1 and 2 may be disposed to render the apparatus more sensitive to the presence of a train. The roadway 3 is illustrated in Fig. 2a as a single track highway occupied by a highway vehicle 4a, and in Figs. 2b and 2c, as a pair of track rails 3a and 3b for guiding the wheels of a railway car or train 4b. Fig. 3 shows a specific application of the apparatus of my invention to the problem of detect-

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ing the presence of a railway car or train on the tracks of a railway crossover.

Similar reference characters refer to similar parts in each of the views, and in lieu of showing the various sources of current for energizing the apparatus, I have shown only their terminals, the positive or supply terminal being identified by the reference character B and the negative or common return terminal by the reference character C, in each instance.

Referring to Fig. 1, the electron tube V1 has its plate to cathode circuit energized over connections from the plate of the tube to terminal B of the local source through a choke coil L4, and from the cathode of the tube to terminal C of the source through an inductance L2. The inductances L1 and L2, in series, are tuned by a capacity C1 to form a tank circuit having one end terminal connected to the plate of tube V1 through a blocking condenser C4, and the other end terminal through conductor 2, an adjustable condenser C2 and conductor 1, to the grid of tube V1, whereby a voltage derived from the tube output may be impressed across the grid-cathode circuit of the tube of the proper value and phase to cause the generation of sustained oscillations of a frequency determined by the circuit constants. Coupled to the inductances L1 and L2 is a tuned inductance or filter L3 by which voltage of the frequency normally generated by tube V1 is supplied to the grid circuit of an amplifier tube V2, the output of which is supplied through a filter L5 selectively responsive to the same frequency, to energize a direct current relay R connected thereto through a rectifier whereby relay R is normally held energized.

The conductors 1 and 2 which extend along the roadway 3 where the detection of the presence of a vehicle is desired may be arranged as shown in Fig. 2a, 2b or 2c, or otherwise, conductor 2 being interposed in the direct path between conductor 1 and the grounded roadway in Fig. 2a or between conductor 1 and the track rails in Figs. 2b and 2c. The arrangement of Fig. 2a may also be applied to detect the intrusion of an object such as a vehicle into an enclosure such as a bridge or a room in which the structure corresponding to the ground 3 completely surrounds the vehicle and the conductors 1 and 2 and is not directly associated with the earth. Although for simplicity, the conductors are represented as wires they may also consist of metallic plates or screens, or a plurality of wires connected in parallel as in-

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indicated by the conductor 2 in Fig. 2b, for example. In view of the fact that the roadway and the lower terminal of coil L2 are both grounded, or at least, have a low impedance to ground, conductor 2, connected to the upper terminal of coil L1, is supplied with the full voltage of the tank circuit, creating an electric field in the space between conductor 2 and the ground 3, the capacity of which is in parallel with condenser C1, and which, it is to be understood, forms a part of and is included in C1 as shown. Likewise, the capacity between conductors 1 and 2 is in parallel with a condenser C2, and is to be understood to be included in C2 as shown, while the capacity between conductor 1 and the ground 3 is indicated as a condenser X1, shown dotted in the drawing. The capacities of C2 and X1 are in series across C1 and so govern the tuning of coils L1 and L2 to some extent, and they also serve as a voltage divider to impress a portion of the voltage across C1 upon the grid of the tube. The grid voltage exceeds the value required to maintain oscillations, only when the capacity X1 is relatively small and its impedance high in comparison with that of C2, and this voltage is zero when X1 and C2 are equal, and is in a direction opposite to that required to maintain oscillations when X1 exceeds C2.

Conductor 2 serves as a shield between conductor 1 and ground and to confine the detecting action to the horizontal portions of these conductors which extend along the roadway 3. The vertical portions representing the lead in wires to the oscillator preferably comprise a coaxial cable in which conductor 1 is wholly surrounded by conductor 2 as shown. Since the oscillating potential difference between conductor 2 and ground is equal to that across condenser C1, it is always greater in magnitude than that between conductor 1 and ground, and it follows that conductor 2 directs the electric field of conductor 1, corresponding to the capacity X1 upwards into the space which a vehicle moving over the grounded roadway would occupy. In any of the views 2a, 2b or 2c, it will be seen that the capacity X1 corresponds to the space containing those dielectric flux lines which emanate from conductor 1 and reach the ground 3 in spite of the shielding effect of conductor 2, and from the configuration it will be apparent that the number of these is normally relatively small, but is greatly augmented in the presence of a large object such as a vehicle. In Fig. 2a, for example, the vehicle 4a provides a low impedance connection through the capacity between the vehicle and the roadway 3 which is relatively close to conductor 1, and so greatly increases the capacity X1, and in Figs. 2b and 2c the vehicle 4a has a low impedance connection to ground through the track rails 3a and 3b, with the same effect.

The presence of a car in the space near conductor 1 also increases the capacity between conductor 1 and ground due to the greater dielectric constant of the materials of the car in comparison with air, in addition to the greater effect of the conducting metal or partially conducting materials in the car as described above.

Normally, the capacity C2 is adjusted somewhat above the critical value at which the output of tube V1, supplied to coil L2 in response to the voltage supplied to the grid circuit of the tube, is sufficient to maintain oscillations, the sensitivity being a maximum when the adjustment is but slightly above the critical value.

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It will be apparent therefore that in response to a predetermined increase in capacity between conductor 1 and ground due to the presence of a vehicle on the protected stretch of track, the generation of oscillations by tube V1 will cease, causing relay R to release. The adjustment of C2 is preferably such that relay R will be released by a relatively large metallic object such as the vehicle 4a or 4b but will not be released by the proximity of persons, or due to the presence of snow or ice.

Furthermore, relay R is energized through tuned circuits comprising coils L5 and L3 and hence is selectively responsive to the normal frequency of the tank circuit including coils L1 and L2. In the presence of a car the capacities C1 and X1 both increase and since these are connected in series across C1, the resultant capacity to which the coils L1 and L2 are tuned is increased so as to shift the resonant frequency of the tank circuit to a value to which the circuits of tube V2 do not respond, thereby releasing relay R. Since the capacity C1 includes that between wire 2 and ground, the wire 2 therefore serves directly as a capacity means for controlling relay R, in addition to its function as a shield as above described.

The blocking condenser C2, which is interposed in the grid-cathode circuit of tube V1 to limit the loss of energy from the tank circuit due to the rectifying action of the tube, is preferably located at the end of conductors 1 and 2 remote from the oscillator lead-in wires, as shown, so that if a short circuit occurs between conductors 1 and 2, the blocking condenser C2 is thereby removed from the grid circuit, and the tank circuit will be incapable of building up the voltages required for oscillations, due to grid rectification in tube V1. An open circuit in conductor 1 or 2 will have the effect of replacing condenser C2 by a capacity less than that of X1, reducing or reversing the grid voltage and thereby stopping oscillations. Relay R is made immune to energization by foreign alternating current, due to battery chargers or the like, by the provision of tuned circuits for the tube V2, selectively responsive to a distinctive frequency.

Referring now to Fig. 3, in this view I have shown two tracks of double track railroad provided with the usual track circuits having the track relays TR1 and TR2, over which train movements are governed by block signals S1 and S2. The tracks are connected by a crossover including the hand throw switches W1 and W2 provided with the usual switch circuit controllers included in the circuit for an indication relay NWP; the energization of which indicates that both crossover switches are locked in their normal position, front contacts b and c of relay NWP being included in the circuits for the signals as indicated on the drawing. Although a crossover is shown, the corresponding arrangement may be used for the protection of main line movements over a single switch, as is obvious.

The train detecting apparatus of my invention is indicated by the reference character D in Fig. 3, with the conductors 1 and 2 arranged as in Fig. 2c and extending the length of the crossover.

To effect a movement over the crossover, the switches W1 and W2 are unlocked by the train crew and are then operated to reverse, releasing relay NWP. The purpose of the detecting apparatus in Fig. 3 is to prevent the clearing of either signals S1 or S2 if a car is left on the crossover within fouling distance of either main track, even

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though the car fails to shunt the track relay TR1 or TR2, due to the high contact resistance of the rails 3. Relay NWP is arranged as a stick relay; and the detecting apparatus D is normally de-energized. When the switches W1 and W2 are restored to normal and locked by the train crew, the detecting apparatus is supplied with current over a connection to terminal B including back contact a of relay NWP and the switch circuit controller contacts N, tube V1 is set into oscillation to create an oscillating electric field in the space above the crossover track, and then the detector relay R becomes energized, provided there are no cars within range of the detector wires 1 and 2. Relay R completes a pick-up circuit for relay NWP which then becomes energized, and by opening its back contact a, deenergizes the detector apparatus and releases relay R.

Although I have herein shown and described only one form 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. Traffic detecting apparatus for indicating the presence of a vehicle in a stretch of track, comprising an electron tube having a plate, grid and cathode; a tank circuit including inductance and capacity having one end terminal connected directly to ground and through a blocking condenser to said plate, a middle terminal connected to said cathode, and its other end terminal ungrounded and capacity-coupled to said grid, whereby said tube is conditioned to generate sustained oscillations of a frequency determined by the constants of said tank circuit, an insulated conductor included in the connection of said ungrounded end terminal to the grid of said tube, said conductor extending the length of said stretch of track and having a capacity to ground which is normally low in comparison with the coupling capacity between the grid and said ungrounded tank circuit terminal but which capacity is increased by the presence of a vehicle in said stretch of track sufficiently to reduce the voltage supplied to the grid to less than that required to sustain oscillations, and a detector relay energized by the oscillations generated by said tube when said stretch of track is unoccupied.

2. Traffic detecting apparatus comprising, an insulated conductor extending the length of a stretch of substantially grounded trackway, an electronic oscillator comprising an electron tube having a plate, grid and cathode, and a tank circuit having one end terminal grounded and connected through a condenser to said plate, a middle terminal connected to said cathode, and the other end terminal connected by said conductor through a second condenser to said grid, the capacity of said second condenser being sufficient relative to the capacity in the space between said conductor and trackway of the electric field between said conductor and ground, to render the tube effective to generate oscillations when said space is wholly unoccupied but not when there is a vehicle in said stretch, a detector relay, and means for maintaining said detector relay energized by the oscillations which are generated by said tube when said stretch is unoccupied.

3. Traffic detecting apparatus comprising, two conductors which extend the length of a stretch of substantially grounded trackway, the relative

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positions of said conductors being such that the first conductor normally has a relatively low capacity to ground due to the shielding effect of the second but has a relatively high capacity to ground when the stretch is occupied by a vehicle, a voltage divider including an adjustable condenser and the capacity to ground of said first conductor in series, connected between said second conductor and ground, an electronic oscillator having a grid circuit and a plate circuit, a detector relay normally energized by current supplied by said plate circuit, means including said plate circuit for normally maintaining a potential difference between said second conductor and ground, and means including said voltage divider for supplying a voltage to the grid circuit of said oscillator which is sufficient to maintain oscillations only when the stretch is not occupied by a vehicle.

4. Traffic detecting apparatus comprising, two insulated wayside conductors which extend the length of a stretch of substantially grounded roadway, so located that the first conductor normally has a relatively low capacity to ground due to the shielding effect of the second conductor, but has a relatively high capacity to ground when the stretch is occupied by a vehicle, an electronic oscillator having its output controlled by a tank circuit comprising an inductance and a capacity which includes that of the space between the second conductor and ground and having its input circuit connected to said first conductor, a detector relay normally energized by current derived from the output of said oscillator, and means including a condenser connected between said two conductors for so adjusting the voltage supplied to said oscillator from said first conductor as to effect the release of said detector relay when a vehicle occupies said stretch.

5. Traffic detecting apparatus comprising, two insulated wayside conductors which extend the length of a stretch of substantially grounded roadway and are connected by an adjustable condenser said conductors being so located that the first normally has a relatively low capacity to ground due to the shielding effect of the second but has a relatively high capacity to ground when the stretch is occupied by a car, an electronic oscillator having its output circuit controlled by a tank circuit connected between said second conductor and ground and having its input circuit connected to said tank circuit over said two conductors and said adjustable condenser in series, a detector relay normally energized by current derived from the output circuit of said oscillator, and means including said adjustable condenser for supplying a voltage to said input circuit sufficient to maintain oscillations only when the stretch is not occupied by a vehicle.

6. Traffic detecting apparatus comprising, two insulated wayside conductors which extend the length of a stretch of substantially grounded trackway, the first of which is at a greater effective distance from the trackway than the second, an electronic oscillator for supplying alternating current to said second conductor to maintain a potential difference between such conductor and the trackway, said oscillator deriving its energization from a potential divider comprising a capacity connection through space from said first conductor to the trackway and a connection through an adjustable condenser to said second conductor, and means comprising a vehicle in said stretch for decreasing the effective distance

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through space between the first conductor and the trackway and thereby decreasing the energization of said oscillator.

7. A system for detecting the intrusion of a movable object in a protected space, comprising a first and a second conductor adjoining said space, a source of electrical energy, means for supplying a voltage from said source to said first conductor to create an electric field of force between said first conductor and ground, means for supplying a voltage from said source to said second conductor, said conductors being so positioned relative to ground and to said space that the potential impressed on the second conductor directs said electric field away from its normal path into said space, and a detector responsive to an increase in the strength of said electric field due to the movement of an object of a predetermined size into said space.

8. A system for detecting the intrusion of a movable object in a protected space, comprising a first and a second conductor adjoining said space, a source of electrical energy, means for supplying a voltage from said source to said first conductor to create an electric field of force between said first conductor and ground, means for supplying a relatively higher voltage from said source to said second conductor, said second conductor being so located between the first con-

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ductor and ground that the potential impressed thereon directs said electric field away from its normal path to ground and concentrates said field in said space, and a detector responsive to an increase in the strength of said electric field due to the movement of an object of a predetermined size into said space.

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