Jan. 14, 1969 L. BROCKMAN 3,422,262

HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

Filed Feb. 1, 1966 Sheet 1 of 2

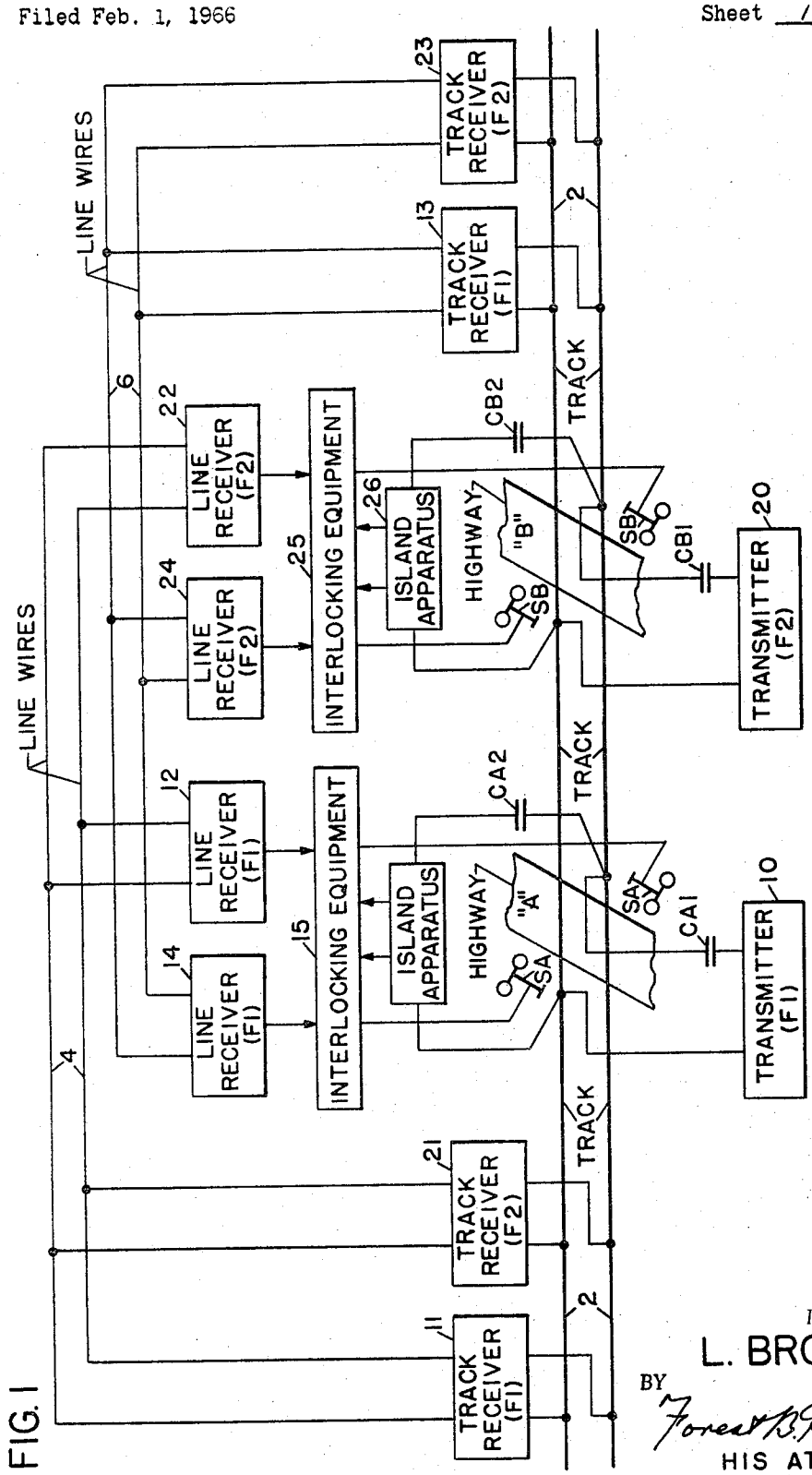


FIG. 1

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FIG. 2 TRACK RECEIVER

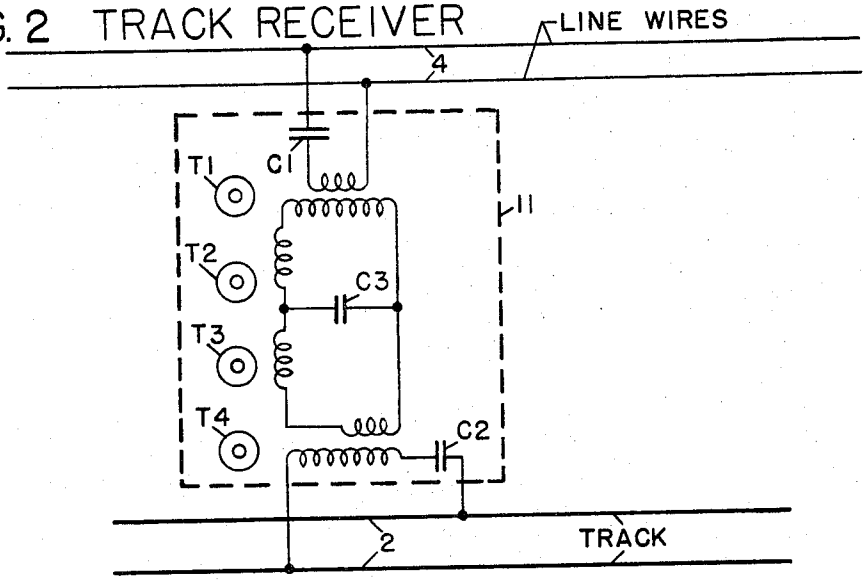
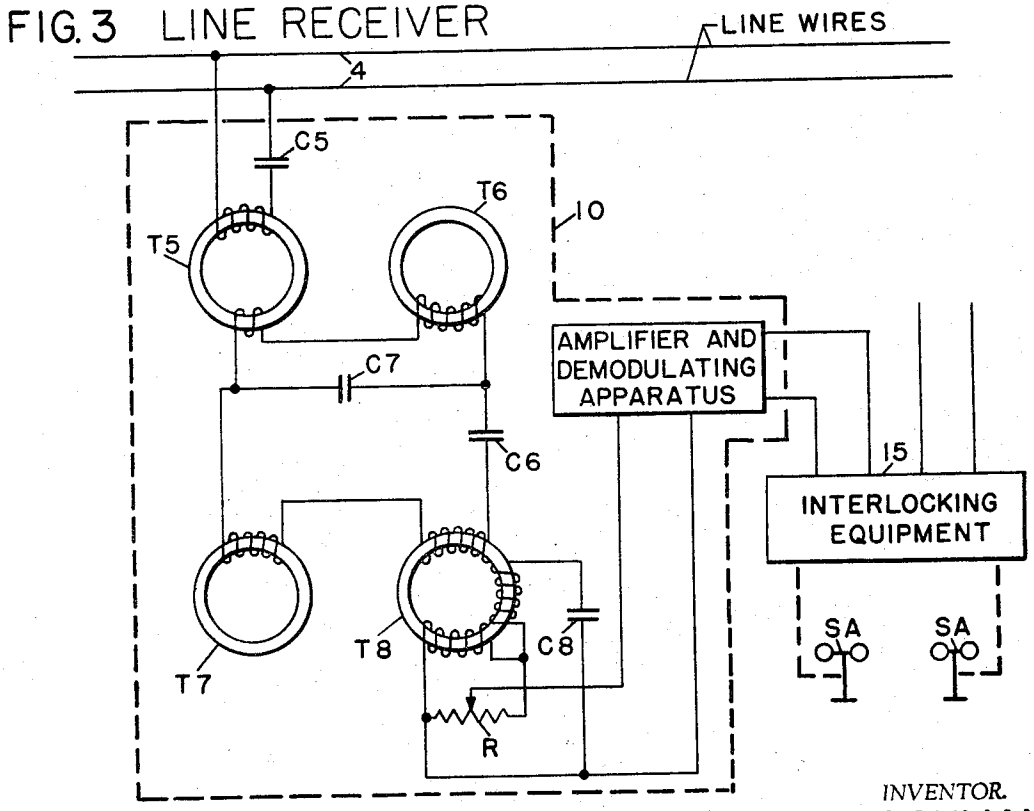


FIG. 3 LINE RECEIVER



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HIGHWAY CROSSING SIGNAL CONTROL SYSTEM

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Int. Cl. B61l *1/02*; B61l *1/12*; B61l *25/00*

ABSTRACT OF THE DISCLOSURE

This disclosure shows overlay high frequency track circuits controlling the crossing warning signals for a plurality of closely located highway level crossings. Both the transmitters and receivers are located at the respective crossings and the frequencies are taken from the track at the remote ends of the approach sections and returned over line wires to the respective receivers in a way to minimize the number of line wires required.

BACKGROUND OF INVENTION

This invention relates generally to railway signaling apparatus, and more particularly pertains to a simplified control system for highway crossing warning devices located at the intersection of a highway and a stretch of railway track.

The recent trend has been to use continuous trackway without insulated joints. To do this in connection with highway crossings has been somewhat expensive because the use of high frequency track circuits has usually resulted in providing a transmitter at the beginning of each approach section with the appropriate receivers at the highway crossing, such as disclosed, for example, in the Patent No. 3,035,167, granted May 15, 1962, to P. H. Luft. This means that the power supply for such a system obtained from the power line running along the railway track will require three power drops, i.e., one at each transmitting location and one at the highway. Also, two frequencies have to be used for each highway crossing so that the two receivers adjacent the crossing can distinguish the direction of train approach.

The present invention proposes a simplified form of system where a single frequency is applied at the highway crossing and is transmitted in each direction away from the highway. At the extreme end of each section, a track receiver responds to such frequency and transfers it to a pair of line wires extending back to the highway crossing. The reception of the frequency over each pair of line wires indicates the absence of an approaching train; but the absence of the frequency on either or both pair of line wires indicates that a train is occupying the corresponding section of track.

This organization of the present invention requires a power drop only at the highway crossing and requires only a single frequency transmitter at the highway crossing. This gives a saving in equipment which is more than enough to pay for the pair of line wires extending from the entrance to each section to the highway crossing.

The above proposed organization is also readily adaptable to the use of an "island section" adjacent the highway to effect the shutting off of the highway crossing warning device after the rear of a train passes the highway section. Such an island track circuit using a particular high frequency different than the above mentioned frequency has

been disclosed in the Patent No. 3,025,393, granted March 13, 1962, to C. R. Crain. Such apparatus for an island section is simple to provide and is compatible with the type of apparatus herein proposed since its frequency is considerably higher than that used for the approach sections above described.

On the other hand, the direction of train movement can be registered and used to operate the crossing mechanism without the use of an island section in the manner disclosed, for example, in the above mentioned Luft Patent No. 3,035,167.

Another feature of the present invention is that such organization is readily adaptable to provide for the control of a member of highway crossings relatively near each other by providing a single frequency transmitter for each of such crossings, each transmitter employing a distinguishable frequency from each of the others. In this connection, the same line wires that would be employed for one highway crossing may thus be used for the second, third, fourth, etc. with only sufficient extension of each pair of line wires to include the approach sections and the added crossings.

Thus, one object of the present invention is to provide a novel organization employing high frequency track circuits in a more economical fashion for the control of highway crossing signals.

Another object of the invention is to provide an organization readily adaptable to a multiplicity of relatively close highway crossings so as to provide adequate warning of approach trains under any conditions.

Another object is to provide a system that is adaptable to use island sections adjacent the highway crossing to give adequate fail-safe directional control for various traffic conditions.

Other objects, purposes and characteristic features of this invention will in part be obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference may be made to the accompanying drawings, in which like reference characters designate corresponding parts throughout the several views, and in which:

FIG. 1 illustrates diagrammatically the general layout of one embodiment of the present invention as applied to a multiple number of highway crossings;

FIG. 2 illustrates a typical track receiver apparatus for connecting the ends of the approach sections to the line circuitry; and

FIG. 3 shows a typical line receiver apparatus for connecting the pair of line wires to the interlocking equipment adjacent the highway crossing.

With reference to FIG. 1 of the accompanying drawing, a stretch of track 2 is illustrated as having two highways A and B crossing the track 2 and located relatively close together such as in the order of four or five hundred feet. The track rails are considered to be effectively continuous rails insofar as electrical characteristics are concerned; but, if desired, they may be successive sections of rails welded together. Each of the highways A and B is provided with suitable highway crossing signals SA and SB suitably oriented for highway traffic control. Other protective apparatus, such as automatic gates or the like, may be used if desired. Although one or any suitable number of highway crossings may be controlled as herein contemplated, it is felt that two will be illustrative of the present invention.

For example, the highway crossing A has associated

therewith a Transmitter **10** which has its output connected across the track rails **2** on opposite sides of the crossing through a Capacitor CA1. This Transmitter **10** transmits a suitable carrier frequency F1 in the audio range modulated by a suitable lower frequency.

This connection of the Transmitter **10** across the track rails **2** at the highway crossing A causes its frequency signal to be transmitted over the track **2** in both directions away from the highway crossing. The length of the usual track circuit approach section can be in the order of 5000 feet. At the outer ends of the approach track sections for such crossing, Track Receivers **11** and **13** are connected. More specifically, the Track Receiver **11** is connected to the track at the west end of the approach to the highway A for receiving an input from the track rails. Its output is connected across the line wires **4** which extend to the highway crossing A.

At the end of the east approach to the highway A, a Track Receiver **13** is connected across the track rails **2** and its output is connected to the line wires **6** which extend to the highway crossing A.

At the highway crossing A, a Line Receiver **12** is connected across the line wires **4**; and another Line Receiver **14** is connected across the line wires **6**. These two Line Receivers then have their output connected to the interlocking equipment **15** which is also illustrated as receiving an input from the island apparatus **16** which is connected across the highway crossing A through a Capacitor CA2 and supplies an output to the interlocking equipment as illustrated in the above mentioned Crain Patent No. 3,025,393. Such series overlay track circuit immediately adjacent the highway crossing is of a suitable higher frequency than F1 and may well be in the order of eight to ten kilocycles. Due to the relatively high frequency and the characteristics of this equipment, its effect is only felt for substantially the width of the crossing connections in the order of two or three hundred feet. The island track circuit acts to operate a repeater relay in the interlocking equipment **15**.

It is to be understood that the frequencies F1, F2, etc. for the transmitters **10**, **20**, etc. are suitably selected to be different frequencies in the audio range, and that these carrier frequencies are suitably modulated at selected lower frequencies. As an example of such carrier frequencies, seven are given in the following table:

Carrier frequency (c.p.s.)	Modulating frequency (c.p.s.)
960	28
1,300	35
1,700	50
2,300	65
3,000	88
3,900	110
4,800	140

Each track receiver, such as **11**, is tuned rather sharply to transfer its particular carrier frequency F1 to the line wires 4 which carry such frequency back to the highway crossing A where it is received by the line receiver **12**. Such line receiver **12** is also tuned rather sharply to its particular carrier frequency F1, and includes suitable amplifying and demodulating apparatus. Such demodulating apparatus provides an output to the interlocking equipment only if the modulating frequency allotted to carrier frequency F1 is present. The same operation is of course true of track receiver **13** and line receiver **14** as controlled over line wires **6**.

The line receivers **12** and **14** normally receive their appropriate modulating frequencies and supply outputs to normally energize their respective output relays within the interlocking equipment **15**. These relays together with the island track circuit repeater relay control the crossing signals SA as shown in the Crain Patent No. 3,025,393. If the island track circuit is not used, then the directional control can be set up as shown in the Luft Patent No. 3,025,167.

The approach of a train in either direction acts to release the line receiver for the corresponding direction and set the signals SA into operation; but the signal control is removed when the train has passed that highway crossing as detected by the island track circuit apparatus. As the train continues such signals continue inactive by reason of the indication of the occupied condition of the leaving section indicated by the release of its line receiver relay. When the train leaves then all apparatus is restored to normal.

With regard to the highway crossing B, a Transmitter **20** is connected across the track rails **2** on opposite sides of the highway B through a Capacitor CB1. Similarly, the island apparatus **26** has a series overlay track circuit connected across the track rails through a Capacitor CB2.

The line wires **4** are extended from crossing A to crossing B, and the line wires **6** are extended a suitable distance to the right to reach the entrance to the approach section for the highway B. The Track Receiver **23** is connected across the track rails **2** with its output connected across the line wires **6**.

At the other side of highway crossing B the approach section extends beyond the highway A. The Track Receiver **21** is connected across the track rails **2** at the appropriate approach point with its output connected to the line wires **4**. The Line Receivers **22** and **24** are connected respectively to the line wires **4** and line wires **6**, and supply their respective outputs to the associated interlocking equipment **25**, which also receives an input from the island apparatus **26**. The interlocking equipment **25** controls the signals SB for the highway B in the usual way described above for highway A.

It is thus evident that the present invention is readily adaptable to multiple highway crossing protection with a minimum of additional line wires. It is also evident that the provision of power need be supplied only at the respective highway crossings.

Each transmitter **10**, **20**, etc. is tuned to its own frequency and presents a high impedance connection with regard to all the other frequencies. Thus, transmitter **10** can send its carrier frequency to track receiver **13** with substantially no effect on such carrier frequency by the transmitter **20**.

Since the island overlay track circuits adjacent the highways extend approximately 150 feet each way, and the highways are assumed to be four or five hundred feet apart, there is no interference between the separate island track circuit apparatus although they may be operating on the same frequency.

The track receiver **11** has been shown diagrammatically in FIG. 2, and such showing may be considered as typical of each of the track receivers used in the system. Such track receiver **11** includes four separate toroid units T1, T2, T3 and T4 shown diagrammatically with the cores at one side. However, such cores are of suitable magnetic material formed in a doughnut shape with the associated coils wound completely around them. The toroid T1 is a transformer having its primary connected through a Capacitor C1 across the line wires **4**. The secondary of this toroid Transformer T1 is connected to a toroid impedance T2 and Capacitor C3 in series. In a similar way, the primary of the toroid Transformer T4 is connected across the track rails **2** through Capacitor C2. The secondary of the toroid Transformer T4 is connected through a toroid impedance T3 to the capacitor C3 in series.

The impedance of the primary winding of Transformer T4 and the Capacitor C2 is very low with respect to the frequency such as F1, for example. Such impedance may be in the order of 1 or 2 ohms. This means that the Frequency F1, for example, does not extend to any great extent in the track rails beyond the point at which the track receiver is connected marking the approach point for the associated highway. The track receiver is also tuned to be highly responsive to the carrier frequency being received and the output of the track receiver is supplied to the line

wires in the most efficient way so that such output will be received by the associated line receiver.

The line receiver **12** has been shown diagrammatically in FIG. 3, and such showing may be considered as typical of each of the line receivers used in the system. Such line receiver **12** includes four separate toroid units **T5**, **T6**, **T7** and **T8** shown diagrammatically with the windings on their respective cores. These cores are doughnut shaped formed of suitable magnetic material with associated coils wound completely around them.

An input connection is made from the line wires **4** through capacitor **C5** to the primary winding of the toroid Transformer **T5**. This connection is tuned to the carrier frequency and to the characteristics of the line circuit. The secondary winding of the toroid Transformer **T5** is connected through the winding of the toroid impedance **T6** across the Capacitor **C7**. The toroid impedance **T7** is connected in series with the primary winding of the toroid Transformer **T8** through capacitor **C6** across the Capacitor **C7**. This circuit is also tuned to the carrier frequency.

The two secondary windings on the toroid Transformer **T8** are connected in series and tuned to the frequency by the Capacitor **C8**. A tap to these windings and an adjustable resistor R supplies the output connection to the associated amplifier and demodulating apparatus which in turn supplies an output assumed to be a suitable relay in the interlocking equipment **15**.

Having described a highway crossing system as one specific embodiment of the present invention, it is to be specifically understood that this form is selected to facilitate the disclosure of the invention rather than to limit the number of forms which it may assume; various modifications and adaptations may be applied to the specific form shown to meet requirements of practice, without in any manner departing from the spirit or scope of the invention.

What I claim is:

1. In a system for controlling a highway crossing warning apparatus located at the intersection of a highway and a stretch of railway track, a frequency transmitter connected across the rails at said highway crossing for transmitting a particular frequency over the rails in both directions away from the highway crossing, a pair of track receivers connected across the rails at separated points, each point being a distance on opposite sides of the highway crossing corresponding to the desired length of an approach section, and each said track receiver being tuned to said particular frequency, a separate pair of line wires extending from each of said points to said highway crossing, each said pair of line wires being connected to its respective track receiver for receiving said particular frequency from it when such frequency is received over said tack rails, a separate line receiver at the highway crossing connected to each pair of line wires and giving an output only if said particular frequency is received over its said line wires, interlocking equipment controlled by outputs of said line receivers to cause said highway warning apparatus to be rendered active when a train is approaching said crossing in either direction and shunts said rails to prevent the flow of said particular frequency from said frequency transmitter to said track receiver on that side of said crossing.

2. In a system according to claim **1** wherein said transmitter frequency is in the audio range and is modulated with a much lower frequency.

3. In a system according to claim **1** wherein each said track receiver is a low impedance shunt across the rails of said track for said particular frequency.

4. In a system according to claim **1** wherein a higher frequency is applied to said rails adjacent said highway crossing to form a short island track circuit adjacent said crossing, and said interlocking equipment is controlled by outputs of said line receivers and said island track circuit.

5. In a system for controlling highway warning apparatus, a stretch of railway track intersected by a plurality of highways at closely adjacent locations, highway warning apparatus for each of said crossing locations, a carrier frequency transmitter for each of said crossing locations having its output connected across the rails at its respective location and said output being of a distinctive frequency for each different location, an approach point for each direction for each crossing location, a track receiver connected across the rails at each said approach point, each pair of track receivers for the approach points of each crossing location being tuned to the frequency corresponding to the frequency of the transmitter for such crossing location and being substantially unresponsive to the frequencies of the transmitters for the other crossing locations, a pair of line wires extending from the outermost approach point in one direction to each of said crossing lcoations and connected to the track receiver at each approach point for the one direction, another pair of line wires extending from the outermost approach point in the opposite direction to each of said crossing locations and connected to the track receiver at each approach point for the opposite direction, a pair of line receivers for each crossing location both being tuned to give an output only when the frequency for that crossing location is received and each of said two receivers being connected to a different one of said pair of line wires, and an interlocking equipment for each crossing location responding to the outputs of the line receivers for that location to render active said warning apparatus for such crossing when a train is approaching said crossing location in either direction and shunts said rails within the approach limits for that crossing location, whereby to control a plurality of highway warning apparatus by means of a single pair of line wires for each direction of approach.

6. In a system according to claim **5** wherein each said different carrier frequency is modulated with a much lower frequency by its transmitter, each such modulating frequencies being different for each transmitter, and wherein each said line receiver supplies an output to its respective interlocking equipment only if it receives its particular carrier frequency modulated by its distinctive modulating frequency.

7. In a system according to claim **5**, wherein each said track receiver is a low impedance shunt for the frequency from its respective transmitter but is ineffective as a shunt for the frequency from any of the other transmitters.

8. In a system according to claim **5** wherein a short island track circuit is formed for each of said crossing locations by applying a frequency substantially higher than any of said distinctive frequencies, and means supplying said interlocking equipment for each crossing location with an output from said island track circuit for its crossing location.

9. The invention according to claim **1** wherein each track receiver comprises,

a tuned input circuit means connected across the rails at one of said separated points,

a tuned output circuit means connected across the line wires extending from that point, and

tuned transfer circuit means inductively coupling the input circuit means to the output circuit means,

said input, output and transfer circuit means each being tuned to said particular frequency, whereby to transfer only said frequency from the rails at said point to the line wires.

10. The invention according to claim **5** wherein each track receiver comprises,

a tuned input circuit means connected across the rails at the associated approach point,

a tuned output circuit means connected across the associated pair of line wires, and

tuned transfer circuit means inductively coupling the input circuit means to the output circuit means,

each of said circuit means being tuned to the distinctive

output frequency of the transmitter connected at the associated crossing location.

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