United States Patent

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[54] **TRACK CIRCUIT PICKUP UNIT**
5 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **246/40,** 246/249
[51] **Int. Cl.** **B61l 21/00**
[50] **Field of Search** ..... 246/39, 34 (CT), 37, 28 (K), 249

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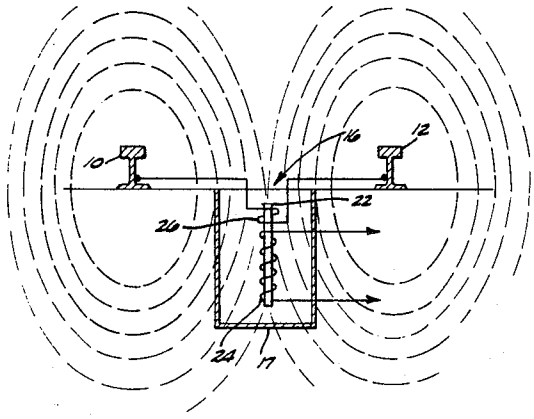
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ABSTRACT: Apparatus is described which detects the presence of a train within a given area. The apparatus includes a sensing unit which comprises an iron core transformer vertically positioned between the rails of a railroad track. A single-loop primary winding is coupled across the track. A secondary winding of the transformer is coupled to a receiver. At least one transmitter is coupled to the track at a predetermined distance from the sensing unit. The receiver detects secondary voltage induced by the track voltage applied to the primary winding. The wheel and axle of the train, when approaching the given area between the selected transmitter and the receiver, from the receiver end causes current to flow in the rails past the sensing unit, which through magnetic flux coupling to the sensing device adds in polarity to the magnetic flux in the core due to the primary winding, thereby increasing the signal induced into the secondary winding. This signal is detected by the receiver. When the train is within the given area between the selected transmitter and the receiver, the wheels and axle act as a shunt to short out any signals from the desired transmitter to the pickup unit.



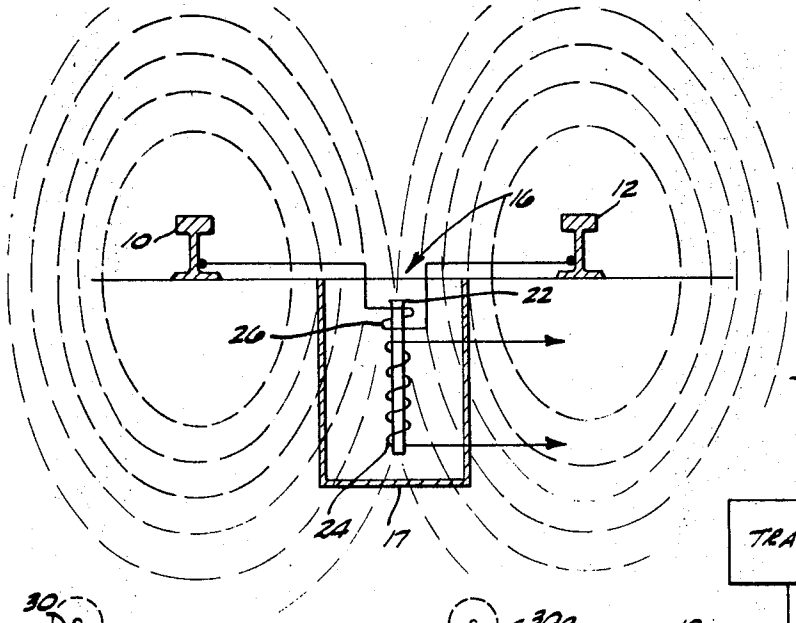


FIG. 1.

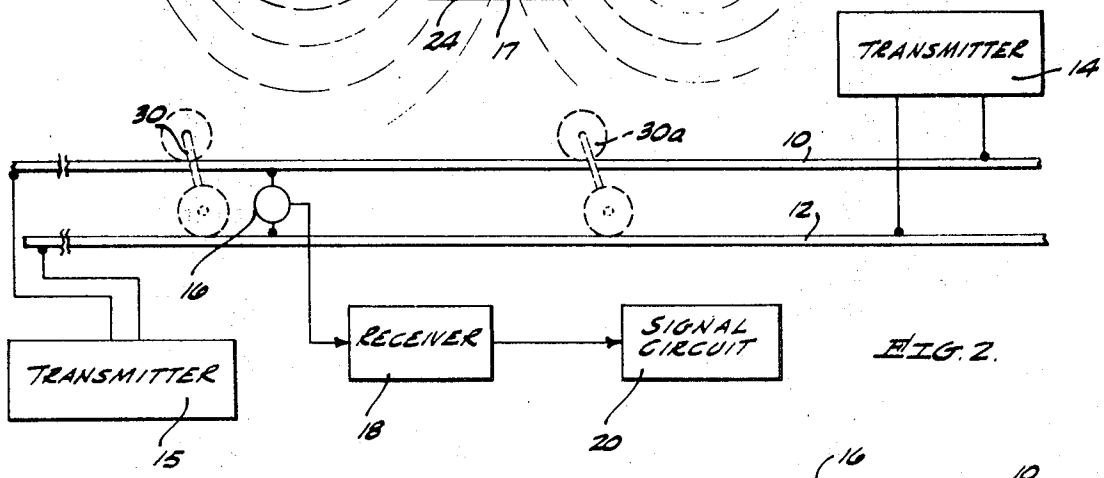
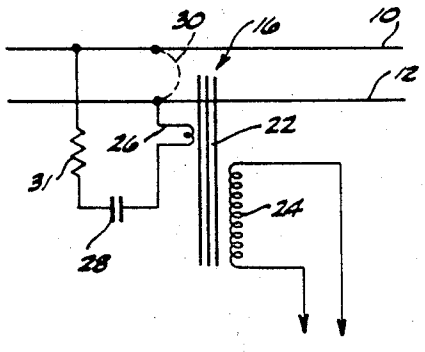


FIG. 2.

FIG. 3.



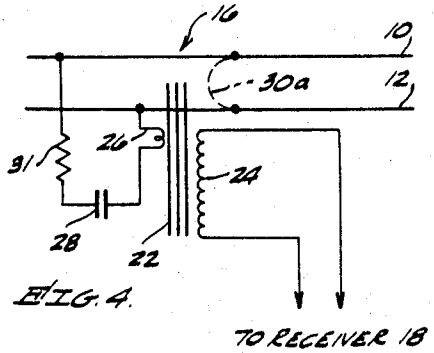


FIG. 4.

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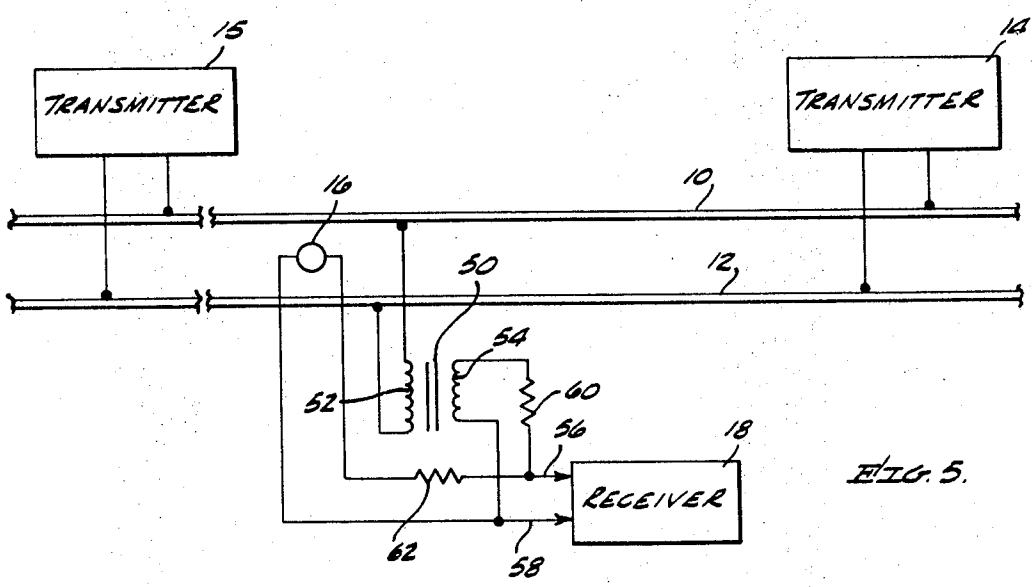


FIG. 5.

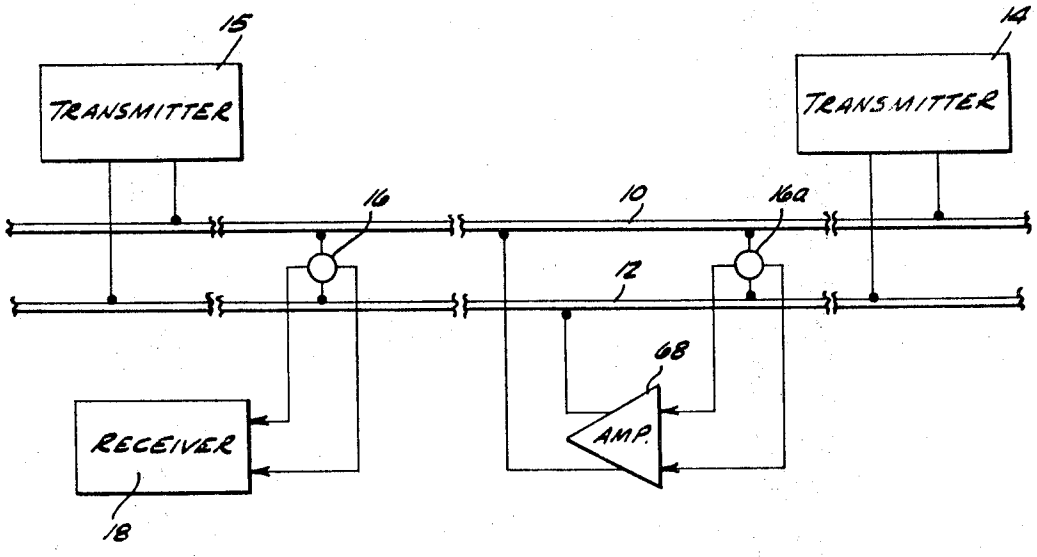


FIG. 6.

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TRACK CIRCUIT PICKUP UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to railroad signalling systems and more particularly to a novel and improved system for indicating the presence of a train within a given area or indicating a broken rail within a given area.

2. Description of the Prior Art

In the prior art track circuit pickup units have been susceptible to damage due to lightening or high voltage potential striking the rails, which in turn develop a current surge. These current surges have heretofore frequently caused damage to the electrical equipment coupled thereto for detection of approaching trains within a given area. Further, in the prior art, in order to detect the presence of a train within a given area and further to detect the direction in which the train is travelling, elaborate and complex electrical systems were required. These prior art complex electrical systems are normally costly and expensive and thus when damage would occur thereto due to the lightening bolts or high voltage potential striking the rails, quite an expense was necessary for the replacement of the equipment so damaged. Thus, a need has arisen for a simple system for detecting the presence of a railroad train on a track and also to provide for the more sensitive detection of a signal from the transmitter in a preferred direction than from the opposite direction, thus providing to a display the data information needed to provide traffic clearance and control and for proper switching operations of railroad trains.

BRIEF DESCRIPTION OF THE INVENTION

Briefly described, the present invention comprises a track circuit pickup unit positioned exactly between a pair of rails of a railroad track. The unit includes a transformer having a vertical extending core normal to the longitudinal axis of the railroad tracks. A primary winding comprising a single loop is wound around the top of the core and detects voltage across the tracks providing a proportional magnetic field in the core. A secondary winding is provided beneath the primary winding on the core and is coupled to a receiver. A transmitter applies a signal to the rails which is applied across the primary winding. In operation, when a signal is sensed in the track circuit primary winding from the preferred transmitter, the current flowing in the rails past the transformer into a shunt, in the form of a train across the rails, will increase the magnetic flux in the core and hence will increase the voltage to the receiver from the secondary winding. This is because the rails and the train shunt appears as a further turn of the primary winding and thus further inductively couples the transmitter to the receiver. After the train has passed the transformer and shorts the track between the preferred transmitter and the receiver, the signal to the receiver from the preferred transmitter will cease and the signal from the transmitter in the opposite direction will be smaller. This is because a signal from the transmitter in the opposite direction from the preferred transmitter, the magnetic lines of flux from the primary voltage, and that from the current flowing in the rails are in opposed directions in the core, thus providing decreased detection sensitivity.

It therefore, becomes one object of this invention to provide a novel and improved track circuit pickup unit.

Another object of this invention is to provide a novel and improved track pickup unit which detects the presence of a railroad train upon a track within a given area.

Another object of this invention is to provide a novel and improved track pickup circuit which detects the presence of a train by changes in induced voltage in the apparatus caused by adding or cancelling magnetic lines of flux.

Another object of this invention is to provide a novel and improved track circuit pickup unit which uses only a single coil mechanically equidistant between the rails of the railroad track.

Another object of this invention is to provide a novel and improved train presence detector which provides a signal with sharp definition when a train enters a given area.

DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages will become more apparent to those skilled in the art when taken into consideration with the following detailed description wherein like reference numerals indicate like and corresponding parts throughout the several views and wherein:

FIG. 1 is a side section view of the preferred embodiment of this invention illustrating partially and schematically the electrical circuit used therewith;

FIG. 2 is a partial electrical schematic drawing and block diagram of the preferred embodiment of this invention illustrating the circuit operation in two different modes;

FIG. 3 is an equivalent circuit of the invention when operating in one of its modes;

FIG. 4 is an equivalent circuit diagram of the invention operating in the second mode;

FIG. 5 is an electrical schematic drawing of a further embodiment of this invention; and

FIG. 6 is a block diagram of this invention using the track circuit pickup unit with a repeater amplifier.

DESCRIPTION OF PREFERRED EMBODIMENTS

Turning now to a more detailed description of this invention, there is shown in FIGS. 1 and 2 a pair of tracks 10 and 12 having a first transmitter 14 coupled thereto for transmitting electrical signals into the tracks 10 and 12. A second transmitter 15 is coupled to the tracks 10 and 12 at a position remote from the transmitter 14. The transmitters 14 and 15 may, for example, be an oscillator which applies an AC signal to the tracks 10 and 12. A pickup unit 16 is positioned between the transmitters 14 and 15 and preferably at a position relatively closer to the transmitter 14. It is this area between the transmitter 14 and the receiver 18 which is the given area to which the presence of a railroad train is to be detected. The pickup unit 16 senses the signals from the tracks 10 and 12 which are then detected by the receiver 18. The receiver detects the presence of a train on the track within the given area and transmits the signals to a signal circuit 20 for the ultimate use thereof.

The pickup unit may be a transformer, as shown in FIGS. 3 and 4, comprising a core 22 which may be comprised of a stack of steel laminations of high permeability material insulated and vacuum varnished and positioned in a vertical position perpendicular to the longitudinal axis of the tracks 10 and 12. Wound around this core and substantially in the middle of the stack of steel laminations there is a secondary winding 24 which may be comprised of a magnetic coil of wire with a high number of turns (approximately 1,900) which ends are connected to the receiver 18, as shown in FIG. 2. Near the top of the stack of laminations 22 there is a single turn primary winding 26 connected directly across the rails 10 and 12. The signal current circulating through the tracks will create a symmetrical magnetic field (shown by the dash lines in FIG. 1) which lines of flux will go through the air permeability and will be collected in the high permeability of the lamination of the core 22, thus establishing a linear magnetic field into the iron core. Variations of flux lines in this magnetic field generates a signal into the secondary winding 24.

The single turn primary winding 26 near the top of the core 22 picks up the voltage between the rails 10 and 12 and the multiturn coil 24 at the center of the lamination stack senses any current circulating in the rails, both of which can develop a secondary signal voltage. The primary winding 26 or the single turn coil circuit contains a capacitor 28 for direct current blocking and a resistor 31 in series with the capacitor 28 for constant input impedance. The pickup unit 16 of the invention detects voltages provided by the transmitter 14 and 15. For one example it is the area between transmitter 14 and pickup

unit **16** where the presence of the train is to be detected. The voltage is sensed by the direction connection of the single turn primary winding **26** to the rails **10** and **12**.

FIG. **5** shows an alternate embodiment wherein the pickup unit **16** only receives its current by induction due to its location within the track bed between rails **10** and **12**. In this embodiment a separate connection to the receiver **18** is provided through a transformer **50** to the tracks **10** and **12** and is coupled to the output winding of the pickup unit **16**. The rails **10** and **12** are coupled directly to the primary winding **52** of the transformer **50**, and the secondary winding **54** is coupled across the input leads **56** and **58** to the receiver **18**. A pair of resistors **60** and **62** are coupled into the circuits, and act as summing or mixing circuit to sum the voltage from the rails **10** and **12** and current through the rails **10** and **12** to a single signal. In some cases when high voltage potentials are applied to the tracks it becomes necessary to isolate the pickup unit **16** from the rails **10** and **12**.

The theory of operation can be derived from the equivalent circuit shown on FIGS. **3** and **4** which shows that the axle and wheels **30** act as an additional turn of wire around the core **22**. In this particular embodiment, it is apparent that a current in the rails from transmitter **14** and through the shunt provided by the wheels and axle **30** is in phase with the current of the primary winding **26**. The voltage across the rails **10** and **12** applied to the primary winding **26** decreases as the wheels and axle **30** approaches the pickup unit **16**, but as the impedance of the rails **10** and **12** decreases, the current in the rails **10** and **12** increases and the corresponding signal induced in the pickup unit **16** increases so that the signal sensed by the receiver **18** is still above the threshold level. When the train is directly over or on the other side of the pickup unit **16** as shown by the reference numeral **30***a* (FIGS. **3** and **4**) all voltages to the pickup unit **16** from transmitter **14** are shorted out. Without voltage across the rails **10** and **12** and with no current flowing past the pickup unit **16**, voltage is no longer induced into the secondary winding **24** and this is then reflected by the receiver **18** receiving no signal.

A unidirectional pickup is provided in accordance with the practice of this invention. For example, the pickup unit **16** senses signals coming from one direction, i.e. transmitter **14** while ignoring or discriminating against signals in a second direction i.e. transmitter **15**. If the single turn coil **26** when viewed from the top is wound in a counterclockwise direction for example, current caused by the voltage between the rails **10** and **12** will flow through the winding from rail **10** for example in a counterclockwise direction, when considering an instantaneous current flow in the AC signals. Again in the same instant, current from transmitter **14** will also flow past the pickup unit **16** through the ballast in the track bed around core **22** in the counterclockwise direction adding to the signal produced from the single turn of wire **26** around core **22**. Current from transmitter **15** would flow in a clockwise direction around core **22** but the current through the turn of wire **26** would still flow counterclockwise around the core thus the two signals would cancel each other.

With reference now to FIG. **6**, there is shown a further embodiment of this invention where the pickup unit **16A** is coupled to a n amplifier **68** which in turn is coupled back to the tracks **10** and **12**. Thus, if a long distance is provided between the transmitter **14** and the pickup unit **16** or if a greater amount of area is to be the given area to which detection of a train is to be determined, the amplifier **68** working in conjunction with the pickup unit **16A** acts as a repeater booster circuit to amplify the signals from the transmitter **14** and send them along to the pickup unit **16** and the reciever **18**.

I claim:

1. In combination with a railroad track including a pair of rails:

a transmitter coupled to said pair of rails of said track and adapted to apply electrical energy to said rails;

a pickup unit positioned between said pair of rails of said track, said pickup unit including a first transformer including a winding being adapted to inductively receive electrical energy from said rails, a second transformer having a first winding being directly coupled to the rails of said track and a second winding being inductively coupled to said first winding and being coupled in parallel with the winding of said first transformer; and

a receiver responsive to said pickup unit and being coupled to the said first and second transformer of said pickup unit.

2. The combination, as defined in claim **1**, and further comprising:

a first resistor coupled in series with one output lead of the second winding of said second transformer; and

a second resistor coupled in series with one output lead of the winding of first transformer of said pickup unit and to the output lead of said winding of said second transformer containing said first resistor.

3. In combination with a railway track including a pair of rails:

a first transmitter coupled to said pair of rails of said track;

a first pickup unit positioned between said pair of rails of said track, said pickup unit including a high permeability core transformer having a pickup winding, said pickup winding being coupled to rails of said track;

a receiver responsive to said pickup unit and being coupled to the pickup winding of the transformer of said first pickup unit;

a second pickup unit positioned between said pair of rails of said track and between said first pickup unit and said first transmitter, said second pickup unit including a high permeability core transformer having a pickup winding, said pickup winding being inductively coupled to the rails of said track; and

a booster amplifier, said booster amplifier being coupled to the pickup winding of said second pickup unit and including a pair of output leads coupled to said rails between said first pickup unit and said second pickup unit.

4. A presence detector used with a railway and including at least a pair of rails comprising:

means for providing a magnetic field around said rails and normal to the longitudinal axis of said rails;

a first inductance means positioned substantially between said rails and said inductance means including a magnetic core having a magnetic axis being normal to the plane of the rails, a first coil coupled to said rails and around said core, and a second coil coupled around said core; and

means coupled to said inductance means to detect changes in magnetic flux created in said rails by the presence of a shunt thereacross.

5. A presence detector, as defined in claim **4**, wherein said first coil comprises a single turn of wire and said second coil comprises a plurality of turns of wire around said core.