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WIRELESS TRAIN CONTROL

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Fig. 1.

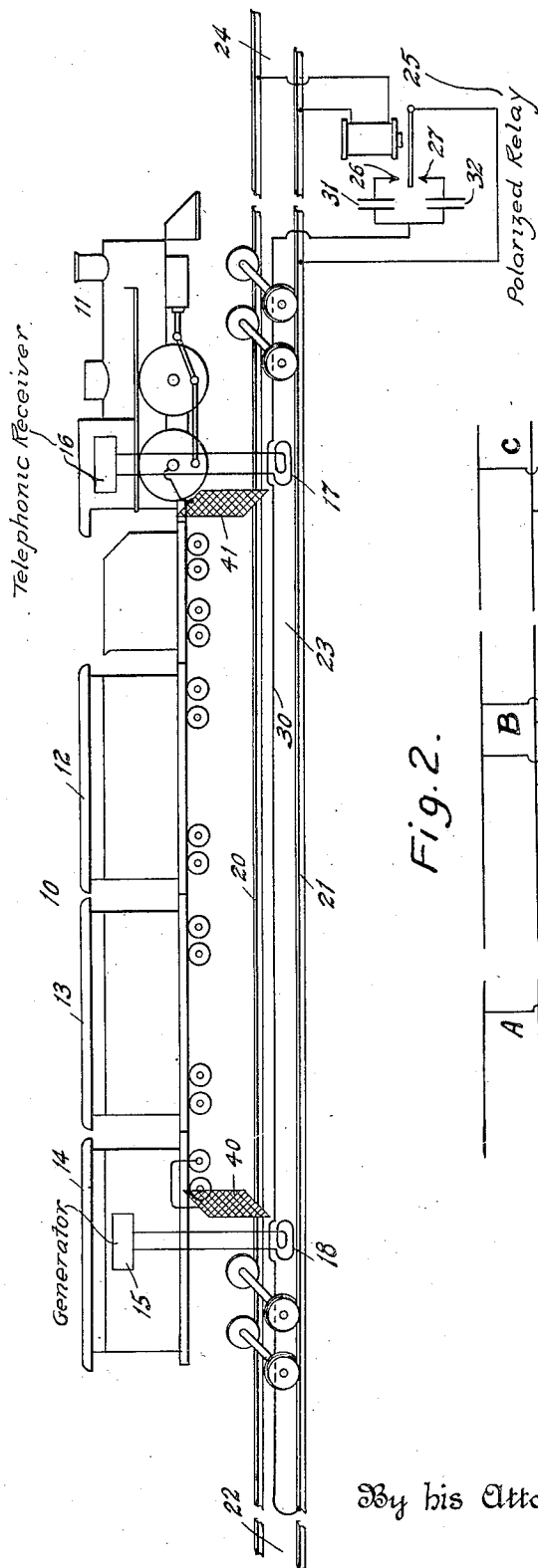
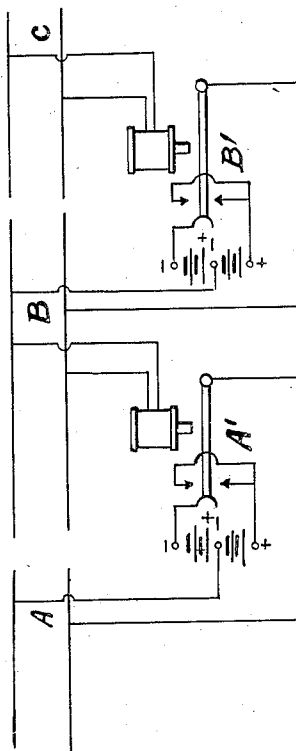


Fig. 2.



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WIRELESS TRAIN CONTROL

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This invention relates to improvements in systems of train control and more particularly to a system of signalling for the control of a train employing radiant energy or so-called Hertzian waves.

In its broader aspect the invention comprises a system of guided wave radio signalling whereby the engineer or other operator of the train may be made aware of conditions in advance of the train, so that the train need not be placed in jeopardy by approaching too closely to another train in advance thereof.

More particularly, the invention comprises a sending station or transmitter positioned in one portion of a train and adapted to emit radiant oscillations or so-called Hertzian waves; a receiving station positioned in another portion of the train, responsive to the oscillations emitted by the sending station; and a stationary means on the roadbed forming a loop which serves as a guide for the radiant oscillations between the sending station and the receiving station on a given train and which may have its electrical characteristics or constants varied by means of a signal relay.

In the present application the term train is intended to include a single movable body which may be articulated in a well known manner so as to go around curves or which may comprise a line of vehicles drawn by an engine or other self propelled vehicle, as is customary in the railroad art.

The signal relay referred to is employed in the prior art to control semaphore block signals and is itself controlled in a well known manner by train conditions existing in the two blocks in advance of the semaphore signals controlled thereby. In the prior art it is usual to employ for this purpose a polarized relay whose armature is operated in one direction when there are no trains in the two blocks mentioned, at which time a clear signal is indicated by the semaphores; and in the other direction when there is a train in the second block in advance at which time a caution signal is displayed by the semaphores. The relay is entirely de-energized when there is a train in the next

block in advance, the winding of the relay being short circuited by the wheels and axles of the train.

In the practice of the present invention a loop is provided extending substantially the length of each block. This loop may be formed of a conductor extending substantially the length of each block which, in combination with one of the track relays of the roadbed, to which it is connected at one end of the block, forms a closed oscillatory circuit or loop. The signal relay referred to above and controlled by traffic conditions in the blocks in advance of the respective block is arranged to control a desired one of the electrical constants of the loop. For example, the inductance of the loop may be varied in the different positions of the relay armature or the capacitance characteristic may be varied thereby. Either or both of the characteristics of the loop may be varied in the manner described according to train traffic conditions in advance of the respective block, and the frequency of oscillations to which the loop will resonate most easily may be varied accordingly.

A sending station is provided on each train which is to be protected by the system of the present invention. The sending station is preferably positioned in a portion of the train remote from the engineer or other person to whom the indications are to be given. Usually the sending station is to be positioned at the rear end of the train, but if the train happens to be longer than any block, it will be necessary to position the sending station in some portion of the train spaced apart from the observer by a distance less than the length of a block.

A receiving station is provided preferably near the engineer or operator of the train, and is so controlled by the sending station in combination with the loop that varying characteristics of the loop will modify the signals in the receiving station according to the road traffic conditions.

Since a block is always longer than the distance between the sending station and receiving station of a train, the high frequency oscillations emitted by the sender will cause

the loop associated with the block in which the train is positioned to oscillate, and the receiving station will respond to the oscillations.

8 The response may be indicated in any desired manner, as for example, by producing a tone in a telephone receiver. The quality of the tone or response will be determined by the electrical characteristics of the loop which
10 depend upon the train traffic conditions in blocks in advance of the train. Thus the engineer of the train will be advised whether there is another train in the block immediately in advance, in which case the signal
15 relay winding will be short circuited and the armature thereof will be in neutral position and little or no response will be given by the receiving station; or whether there is a train only in the second block in advance, in which
20 case a different quality of response will be given by the receiving station; or whether there is no train in the next block in advance in which case a third quality of response will be given.

25 In the drawing there is shown one embodiment of the invention in which the railroad roadbed is divided into blocks, and a train provided with a sending station and a receiving station.

30 Figure 1 shows my important wireless train control system.

Figure 2 shows one type of block relay control circuit.

Referring to the drawing, a train 10, which
35 may comprise an engine 11, and trailing bodies 12, 13, 14, is provided with a sending station 15 positioned in one of the trailing bodies, such as the body 14, for example. The train is shown in diagrammatic form, the
40 forward wheels and axles and the rear wheels and axles thereof being shown separated therefrom for the purpose of more clearly illustrating the features of the invention. It is understood, however, that all
45 of the train wheels co-operate in the same manner with the roadbed. The sending station 15, which is adapted to emit high frequency radiant oscillations, includes a loop 18 carried by the respective body 14 in a position
50 immediately above the level of the roadbed.

Similarly, the engine 11 is provided with a receiving station 16 which includes a loop 17 carried immediately above the level of
55 the roadbed.

The roadbed comprises a pair of track rails 20, 21 of conventional form upon which the train wheels move. The roadbed is divided by insulated fish plates (not shown)
60 into a plurality of successive blocks such as 22, 23, 24. Each of these blocks is provided at or near the point at which a train normally enters with a signal relay 25 which may take the form of a polarized direct current
65 relay operated by the so-called track

current. The control of such track signal relays is well known in the art and a detailed description thereof is unnecessary in the present application.

As is well known, it is customary to cause
70 the movement of the armature of such a signal relay in one direction, for example, to close contact 26, when there is no train in either the block to which the relay winding is connected, or in the block in advance thereof.
75 When, however, there is a train in the block in advance thereof but no train in the block to which the relay winding is connected, in the present instance the block designated 24, the direction of current through the winding
80 is reversed and the relay armature is caused to take up an opposite position, for example, to close contact 27. When, however, there is a train in the block to which the relay winding is connected, in the present
85 instance block 24, the relay is short circuited and its armature takes a neutral position, as for example, that shown in the drawing. It is understood that the relay armature may control terminals, in addition to those shown,
90 for closing the circuits governing the action of the usual semaphore signals placed near the entrance of the block to which the relay winding is connected, in a well known manner, as illustrated in Figure 2.
95

Thus as the train enters block B the magnet of relay A₁ is short circuited and the armature assumes the neutral position and when
100 the train leaves this block and enters block C the armature of relay B₁ is moved into neutral position causing the reversal of the current flowing through the rails of block B and the magnet of relay A₁ and causing
105 the armature of said relay to assume the upper position closing contact 26. When the armature of relay B₁ is caused to go to the upper position by the train entering the next block D (not shown), the current flowing
110 through the rails of block B is again reversed as may be seen from the diagram and the armature of relay A₁ is moved to the lower position closing contact 27 of Fig. 1. Thus
115 each relay armature in addition makes the contacts necessary to change the characteristics of the signaling loop as illustrated in Fig. 1. It is to be understood that any appropriate means may be used to operate the relay, that shown being merely for purpose
120 of illustration and forming no part of the present invention per se.

Each block is provided with a conductor
30 extending substantially the length thereof, which in combination with one of the track rails 21 or with a separate conductor, forms a loop or closed oscillatory circuit for
125 the respective block. This loop acts as a guide for the electro-magnetic waves emitted by the sending station 15, to control the receiving station 16. The loop so formed may also include one of the condensers 31 or 32
130

according to the position of the armature of the relay 25 and thus the electrical constants of the loop, and the frequency to which the closed oscillatory circuit formed thereby will most easily resonate, may be varied.

It is understood that the apparatus shown for each block may be duplicated for the other blocks of the roadbed.

In the operation of the system of the present invention the sender 15 through its loop 18 emits oscillations which cause oscillatory electro-motive forces to be set up in the loop including the conductor 30.

It will first be assumed that there is a train in the next block 24 in advance of the train 10, so that the winding of the relay 25 will be short circuited and the armature thereof will be in the neutral position as shown in the drawing. Little or no current will therefore flow in the loop including the conductor 30 and there will be little or no response in the receiving system 16. The engineer will therefore be warned of danger and will bring his train to a stop.

If, however, there is no train in the block 24, but there is a train in the block in advance thereof, that is to say, conditions prevail which require caution on the part of the engineer of the train 10, the relay 25 will be operated in a direction to close the contact 26. The condenser 31 will then be included in the circuit of the loop associated with block 23. The condenser 31 is of such capacity that a limited oscillatory current or one of predetermined frequency will be permitted to flow in the associated loop, and thus a response of a predetermined and easily recognized character will be produced by the receiver 16. The oscillations in the loop are forced oscillations. If, however, there is no train in either of the two blocks in advance of the train 10 the relay 25 will be operated in such a direction as to close the circuit to contact 27 and the condenser 32 will be connected in the circuit of the loop of the block 23. The condenser 32 is of such capacity as to produce a different response in the loop to the oscillations impressed thereon by the loop 18. There will thus be produced in the loop 17 carried by the engine 11 electro-motive forces of corresponding character and the receiving station 16 will be actuated to produce a signal indicating that conditions ahead are clear, and that the engineer may proceed.

Thus it will be seen that I have provided a system, in which both the sending station and receiving station involved in producing a signal are positioned on the same train, thereby rendering it possible to maintain the system in good working order with a minimum of expense. Furthermore, the loops 18 and 17 carried by the train may be spaced apart from the conductor 30 and thus the need for auxiliary contact shoes or other contact making devices is obviated.

The sending and receiving stations are shielded from direct action on each other by shields such as grids or gauze sheets 40 and 41 respectively, grounded to a convenient truck axle as shown.

The system of my invention provides a signal for the engineer of the train so long as clear conditions prevail, and when conditions requiring caution or danger conditions occur the signal will be reduced or eliminated. Thus failure of the sending station will tend to cause the engineer to exercise caution and such failure will not put the train in jeopardy. It will also be seen that the system may be readily employed in conjunction with ordinary block signalling systems of the prior art without interfering with or modifying the operation thereof.

Illustrative apparatus has been shown for the purpose of specifying one way in which the invention may be practiced, but it is expressly understood that the scope of the invention is not to be limited thereby, reference being had to the appended claims for that purpose.

What is claimed is:

1. In a train control system, a train having a sender near one end for emitting high frequency waves, and a receiver near the other end for receiving the high frequency waves, a roadbed for the train divided into blocks, guiding means for the high frequency waves extending along substantially the length of each block, and means controlled by train traffic conditions in blocks in advance of a given block to vary the electrical constants of the respective guiding means.

2. In a train control system the combination with a road bed having an electrical circuit extending longitudinally thereof, a polarized relay arranged to vary the electrical condition of said circuit from a normal condition to any one of a plurality of other conditions as a result of traffic conditions along said road bed, means carried by a train for producing electrical oscillations in said circuit, and telephonic receiving means carried by said train and arranged to be controlled as a result of the action of said oscillations in said circuit.

3. In combination, a train, a continuous conductive loop circuit, a radio frequency sending loop attached to the train, and a radio frequency receiving loop attached to the train and cooperating with the loop circuit.

4. In combination, a train, a loop circuit having means for changing its characteristics included therein, a sending loop and a receiving loop both attached to the train and shielding means between said loops.

5. In combination, a train, a radio frequency sending loop attached to the train, a radio frequency receiving loop attached to the train some distance from the sending loop and means whereby the oscillations pro-

duced by the sending loop are received in the receiving loop, the radio frequency characteristics of said means being controlled by a traffic regulating arrangement.

6. In combination, a train, a sending loop attached to the train, a receiving loop attached to the train some distance from the sending loop and conductive means whereby the oscillations produced by the sending loop are received in the receiving loop, said means being controlled by a traffic regulating arrangement for changing the radio frequency characteristics of the conductive means for different conditions of traffic.

7. Means for controlling traffic consisting of a series of blocks, radiant energy conductive means extending over each block, radiant energy sending means on a traffic element, and radiant energy receiving means on the element whereby the condition of traffic is indicated by the type of transmission obtained between the sending means and the receiving means.

8. Means for controlling traffic consisting of a series of blocks, radiant energy conductive means extending over each block, radiant energy sending means on a traffic element, and radiant energy receiving means on the element, whereby the condition of traffic is indicated by the type of transmission obtained between the sending means and the receiving means over the radiant energy responsive means.

9. Means for controlling traffic consisting of a series of blocks, variable radiant energy conductive means extending over each block, radiant energy sending means on a traffic element, and radiant energy receiving means on the element, whereby the condition of traffic is indicated by the type of transmission obtained between the sending means and the receiving means.

10. Means for controlling traffic consisting of a series of blocks, variable radiant energy conductive means extending over each block, radiant energy sending means on a traffic element, and radiant energy receiving means on the element, whereby the condition of traffic is indicated by the type of transmission obtained between the sending means and the receiving means over the radiant energy responsive means.

11. Means for controlling traffic consisting of a series of blocks, variable radiant energy conductive means extending over each block, radiant energy sending means on a traffic element, and radiant energy receiving means on the element, and means to vary the characteristics of the responsive means to any one of several stages according to the traffic condition.

12. Means for controlling traffic consisting of a series of blocks, variable radiant energy conductive means extending over each block, radiant energy sending means on a traffic

element, and radiant energy receiving means on the element, and means to vary the characteristics of the responsive means to any one of three stages according to the traffic conditions.

13. In combination, movable members and stationary means, several radio frequency wave devices attached to the movable members for cooperating with conductive devices attached to the stationary means, the wave devices being separated longitudinally from each other and conductively insulated from the conductive devices.

14. In combination, movable members and stationary means, several wave devices attached to the movable members for cooperating with conductive devices attached to the stationary means, the wave responsive devices being separated longitudinally from each other and conductively insulated from the wave conductive devices whereby waves produced in one device do not directly affect another like device.

15. In combination, movable members and stationary means, several wave devices attached to the movable members for cooperating with conductive devices attached to the stationary means, the wave responsive devices being separated longitudinally from each other and conductively insulated from the wave conductive devices whereby waves produced in one device do not directly affect another like device and grounded shields between the devices on the members.

16. In combination, two movable loop antennae, and a stationary loop the characteristics of which are adapted to be varied in accordance with traffic conditions in inductive relation thereto, the antennae being so arranged that they will affect each other through the stationary loop only.

17. In a train control system, means for sending Hertzian waves located on a train, and means for receiving the waves located on the train whereby the condition of traffic is indicated by the characteristics of the reception had.

18. In a train control system, means for sending Hertzian waves, located on the train, means for receiving the waves on the train, and means for conductively associating the sending and receiving means according to traffic conditions.

In testimony whereof I hereunto affix my signature.

JOHN HAYS HAMMOND, JR.