

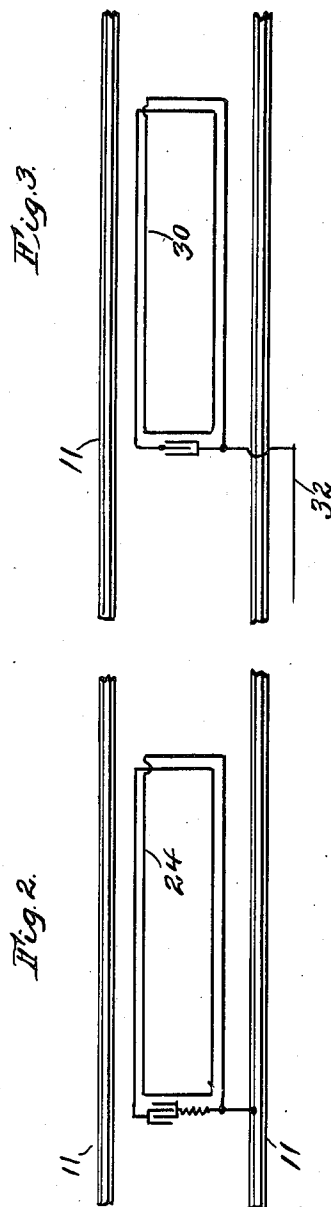
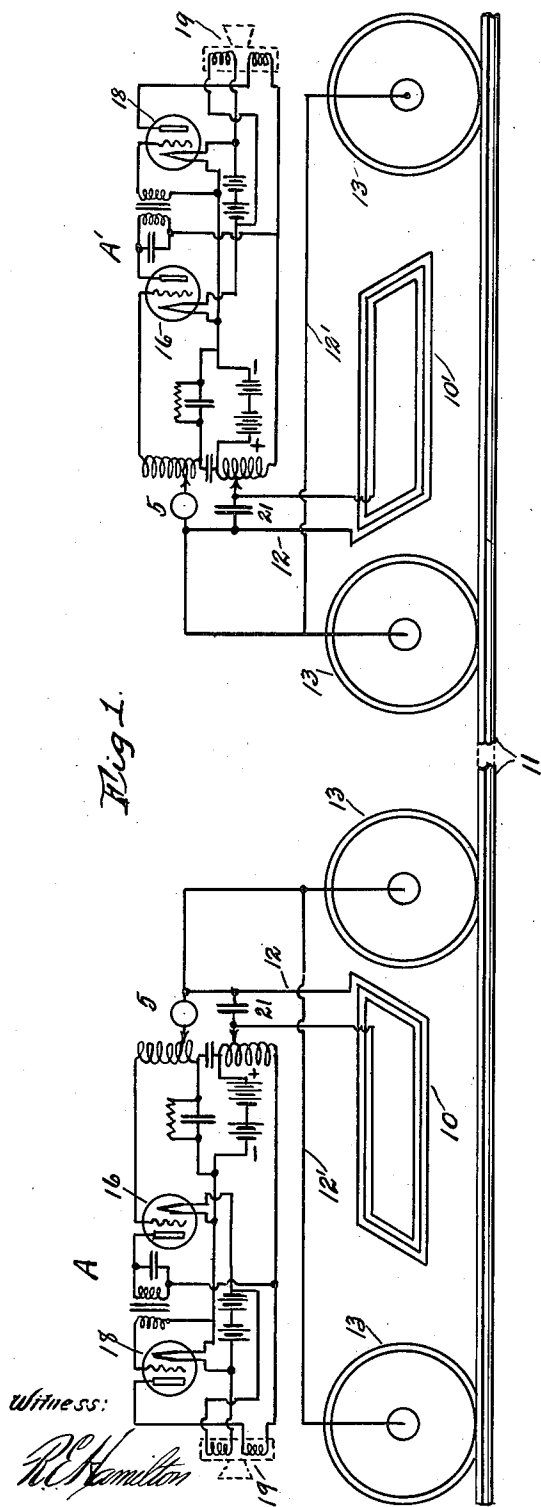
Feb. 19, 1924.

1,484,049

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ELECTRIC HIGH FREQUENCY SIGNALING APPARATUS

Filed Aug. 28. 1922



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UNITED STATES PATENT OFFICE.

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ELECTRIC HIGH-FREQUENCY SIGNALING APPARATUS.

Application filed August 28, 1922. Serial No. 584,716.

To all whom it may concern:

Be it known that I, VLADIMIR K. ZWORYKIN, a citizen of the Republic of Russia, and resident of Kansas City, county of Jackson, State of Missouri, have invented a certain new and useful Improvement in Electric High-Frequency Signaling Apparatus, of which the following is a complete specification.

The present invention relates to electrical apparatus for signaling purposes operated by means of high frequency oscillations and particularly adapted for use in train signaling and control systems.

Accordingly, I have devised an electrical signaling system making use of a high frequency oscillator designed both for the generation and transmitting, as well as for the receiving, of continuous or undamped wave radiation as required in the transmission of signals between trains, or between a train and stationary wayside points. In carrying out the invention as between moving trains, a high frequency wave oscillator is provided on each train, whereby the oscillating circuits will be mutually affected through the track rails, upon approach of the two trains within a predetermined distance of each other, with the result that signals will be produced in both circuits on account of beat waves or notes set up therein in response to slight variations in the continuous wave frequencies.

For carrying out the wayside signaling operation, stationary loop antennae are provided which are of such a character as to absorb the energy of the oscillator or train circuit, thus automatically effecting the production of a signal or operation of suitable relays; or, such stationary loop antennas may be in circuit with suitable oscillator apparatus of a signal station whereby the high frequency current of the oscillator circuit of the train may be modulated and thereby caused to influence the signaling instruments or controlling relays of the train circuit.

With these general objects in view, the invention will now be described by reference to the accompanying drawing illustrating one method which I have devised for carrying out the invention in practice, after which those features which I deem to be novel will be particularly set forth and claimed.

In the drawing—

Figure 1 is a diagram illustrating the cir-

cuit arrangement of a signaling system embodying the present invention;

Figure 2 is a plan view showing a wayside absorbing loop antenna designed to influence the train circuit; and

Figure 3 is a similar view showing a wayside loop antenna, designed to be included in the circuit of a signaling station.

Referring now to the drawing in detail, this shows in Figure 1 a continuous wave high frequency oscillatory circuit designated in general by the reference letter A and designed to be installed on the locomotive of a train or other vehicle. The antenna loop of this circuit is suspended beneath the locomotive adjacent to the track 11, and the conductor 12 of the antenna may be placed in circuit with the rails of the track 11, through the wheels 13 of the locomotive, and, if the locomotive is attached to a train, by means of suitable parallel connections 12' with the conductor 12, with the wheels of all the cars of the train. Any well-known oscillatory circuit can be used for this purpose, particularly a circuit generating oscillations having a constant wave length. Referring to the drawing, this circuit is shown as consisting of an oscillatory tube 16 (of which as many may be used as desired) operating at the same time as a detector, and an amplifier tube 18, of which likewise any number may be employed, according to conditions. This circuit arrangement is such as to act both as a means for generating continuous waves of high frequency and also as a receiver, with one or many stages of relatively low frequency amplifications.

The load circuit is represented by the loop 10 coupled with the inductance of the oscillatory circuit A. The current in this last circuit is measured by the thermal ammeter or thermal relay 5. The amplifier 18 is connected to the loud speaker or special relay 19. It is well known that steel rails are poor conductors for short waves, but that oscillations emitted even by comparatively low-power tube oscillators may be readily transmitted through such rails for a distance of a few thousand yards. Accordingly, if a second locomotive be equipped with an oscillatory circuit A', similar to the circuit A above described, and then either or both of the two locomotives carrying the circuits A and A' begin to approach one another, the circuits will exert

no appreciable influence upon each other until after the distance between them has been decreased below a definite predetermined limit. What is known as the heterodyne effect will then take place by virtue of any slight difference occurring in the wave frequencies in the two circuits; this results in the production of beat waves or notes of lower frequency in both circuits, which beat notes are amplified by the low frequency amplifier and thereby rendered audible when transmitted to the loud speaker 19. No real necessity arises for tuning the two oscillatory circuits for different wave lengths because in practice it is found that the short wave oscillator is subject to more or less automatic change in wave length, particularly during the movement of the train; if deemed advisable, however, a condenser 21 may be constructed in such a way that the movement of the trains will produce any desired variation in frequency.

If either locomotive is attached to a train, the conductor 12 is connected in parallel (by means of the connections 12') with the wheels of all the cars of the train, as above explained. By this arrangement it is apparent that the apparatus of one locomotive will at once detect the presence of a whole train which may be approaching within the predetermined distance above referred to; in other words, the length of the train will be immaterial and the warning signal will be given whenever the distance between the locomotive of one train and the last car of the other train is less than said predetermined limit.

The apparatus of neither locomotive will be actuated to produce any signals by the presence of trains on different or parallel tracks, because of there being no electrical connection between the tracks other than through the ground.

Referring now to Figure 2, I propose locating at suitable intervals along the track, or at any points where it may be desired to effect a signal operation, an absorbent loop antenna 24 which may be tuned for the same wave frequency as the circuits A and A' of the trains, and with resistance representing the load of such circuits. With this arrangement it will be understood that when the antenna loop 10, of the train is carried over one of the loops 24, the latter will absorb the energy of the train circuit, just as a wave meter absorbs the energy from an ordinary transmitter. This produces a drop in the current of the train circuit, adapted to be registered by an ammeter or special relay 5 in the locomotive cab. This constitutes an effective means of transmitting signals from any desired wayside points, at very slight cost for the wayside apparatus, the absorbing loops 24 being inexpensive and of a portable character, adapted to be

located temporarily at any point as required in track reconstruction or other emergency work.

Referring now to Figure 3, this illustrates a wayside antenna loop 30, similar to the loop 24 but connected with a conductor 32 representing part of a signal station circuit whereby a suitable oscillatory current, for instance the current from a microphone or other source, may be introduced in the loop 30 for the purpose of modulating the current in the train circuit A whenever the antenna loop 10 passes over the loop 30. Such modulation of the train circuit has the effect of actuating the loud speaker 19 or other instrument in the circuit A for the transmission of signals.

In this connection it may be stated that the signals received by the train circuit may be used in any well known manner for giving either audible or visible signal indications, or for operation through relays to apply the brakes or control the motive power applied to the train, all of which is of mere mechanical practice in the adaptation of the improvements herein to perform the desired functions.

From the foregoing it will be apparent that I have devised a signal system characterized by these features of improvement, viz, the generating of continuous or undamped waves by a train oscillatory circuit for transmitting purposes, and the employment of the same circuit for receiving purposes, whereby the same beat notes (or signals) will be produced in both circuits of two trains approaching each other within a given distance; and the use of the same type of oscillatory circuit for receiving signals in response to the action of an absorbent wayside antenna loop operating to produce a drop in the current of the train circuit, or in response to the action of a signal station loop antenna operating to modulate the train circuit. A signal system having this arrangement and construction and mode of operation is attended by various distinct advantages, such as the fact that no overhead aerial of the usual type is required for transmitting the signals, the track being used for the propagation of the waves, on the so-called guided wave telegraphy principle; that no special characteristic wave length is required for each train, the trains being tuned for the same wave length and the beat or signal notes of audible frequency being produced by the heterodyne action of the oscillatory circuits upon approaching within a predetermined distance of each other as above explained; and the further fact that, by means of extremely simple and inexpensive wayside antenna loop devices, the same train circuits may be influenced to effect the receiving of various signals from outside sources.

While I have illustrated and described what I now deem to constitute the preferred mode of practicing the invention, I desire to reserve the right to make all such changes or modifications as may fairly fall within the scope of the appended claims.

What I claim is that—

1. Electric signaling apparatus comprising two oscillatory circuits emitting continuous waves of high frequency and of approximately the same wave length, said circuits being operative on relative approaching movement within a given predetermined distance to set up slight variations in wave length producing beat waves of lower frequency, and signal emitting means included in each of said circuits for actuation in response to said beat waves.

2. Electric train signaling means comprising, in combination with the track rails, an oscillatory circuit adapted to be carried by a train and having an antenna suspended adjacent said rails and emitting continuous waves of high frequency, said circuit being adapted to be influenced by a similar circuit carried by a relatively approaching train within a given predetermined distance to generate beat waves of lower frequency, and signal emitting means included in said circuit for actuation in response to said beat waves.

3. Electric train signaling means comprising, in combination with the track rails, a heterodyne oscillatory circuit electrically connected to said track rails adapted to be carried by a train and having an antenna loop emitting continuous high frequency waves and adapted to be maintained in continuous inductive relation to said rails.

4. Electric train signaling means comprising, in combination with the track rails, an oscillatory circuit electrically connected to said track rails adapted to be carried by a train and having an antenna suspended adjacent said rails, an absorbent loop antenna located along said track and operative inductively to absorb the energy of said oscillatory circuit, and current-operated means included in said circuit for actuation in response to the inductive action of said absorbent loop.

5. Electric train signaling means comprising, in combination with the track rails, an oscillatory circuit adapted to be carried by a train and having an antenna suspended adjacent said rails, an exciting loop antenna located along said track and operative inductively to modulate the current of said oscillatory circuit, and current-operated means included in said circuit for actuation in response to the inductive action of said antenna.

6. Electric railway signaling apparatus comprising a moving oscillatory circuit emitting continuous waves of high frequency and adapted to receive from a similar circuit continuous wave signals by the heterodyne method, said circuit having an antenna loop adapted for travel adjacent the track rails, in combination with an absorbent loop antenna located along said track rails and operative inductively to absorb the energy of said moving oscillatory circuit.

7. Electric railway signaling apparatus comprising a moving oscillatory circuit emitting continuous waves of high frequency and adapted to receive from a similar circuit continuous wave signals by the heterodyne method, said circuit having an antenna loop adapted for travel adjacent the track rails, in combination with an exciting loop antenna located along said rails and operative inductively to modulate the current of said moving oscillatory circuit.

8. Electric railway signaling apparatus comprising a moving oscillatory circuit emitting continuous waves of high frequency and adapted to receive from a similar circuit continuous wave signals by the heterodyne method, said circuit having an antenna loop adapted for travel adjacent the track rails, in combination with absorbent and exciting loop antennae located at intervals along said rails and operative, respectively, to inductively absorb the energy of said moving oscillatory circuit or to modulate the current of said circuit.

In witness whereof I hereunto affix my signature.

VLADIMIR K. ZWORYKIN.