

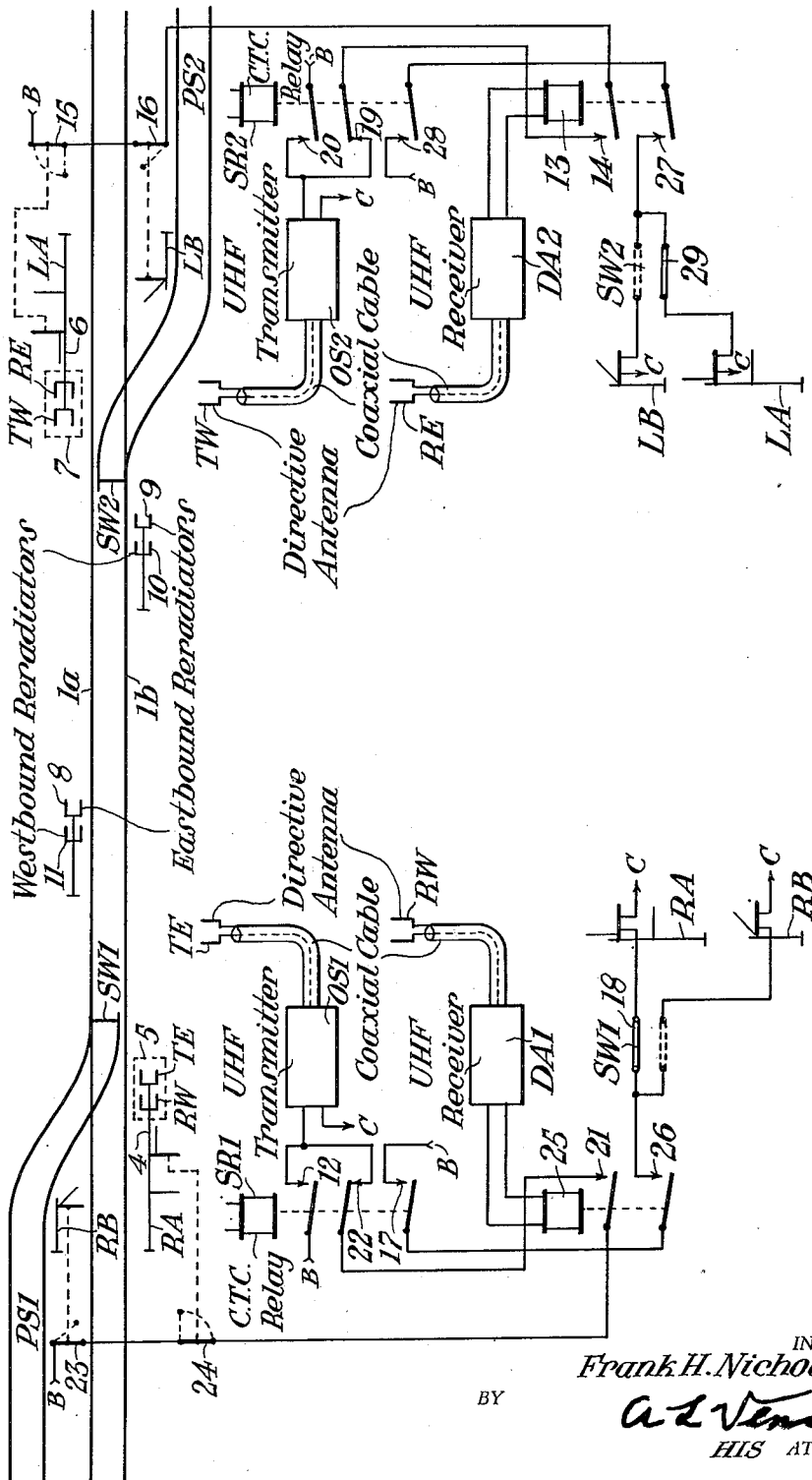
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RAILWAY TRAFFIC CONTROLLING APPARATUS

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RAILWAY TRAFFIC CONTROLLING
APPARATUS

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My invention relates to railway traffic controlling apparatus, and more particularly to apparatus to detect occupancy of a stretch of railway track and to control a signal in response to such detection.

Traffic through a given stretch of railway track is frequently governed by a signal controlled through a track circuit responsive to a train occupying the stretch. On single track railway traffic between two locations, such as adjacent siding locations, is often governed by opposing block signals which may be controlled manually by two operators one at each location or by an operator at a remote office through a centralized traffic control system. Additional safety may be obtained in the control of such block signals by using track circuits including the rails of the stretch, there being several track circuits when the distance between the block signal locations is relatively long. These track circuits require bonding of the rails and insulated rail joints of the usual arrangement. Also line wires are required to carry the control to the opposite ends of the stretch when the stretch is relatively long and more than one track circuit is required.

In view of such circumstances in railway signaling, a feature of my invention is the provision of novel and improved means to detect the train occupancy of a stretch of railway track without use of track circuits.

Another feature of my invention is the provision of novel means to control a block signal according to traffic conditions of the respective block.

Another feature of my invention is the provision of novel means to control opposing block signals of a stretch of single track railway.

Other features, objects and advantages embodying my invention will appear as the specification progresses.

I accomplish the foregoing features, objects and advantages embodying my invention by generating an ultra high frequency current at the end of the stretch or block a train is to enter, radiating such quasi-optical wave substantially along the center line of the track at a height corresponding to the height of railway trains to the exit end of the block, detecting and amplifying the energy received at the exit end of the block to control another oscillator to supply a second ultra high frequency wave which is radiated toward the entrance end where it is detected and amplified to control a block signal. By using quasi-optical waves and directing and beaming them along substantially the center line of the track at a

height corresponding to the height of railway cars, a train or car occupying the stretch will intercept the wave and thereby detect the occupancy of the track. By using two-way control the sending of the return wave can be governed by traffic conditions and other circumstances at the exit end of the block.

Furthermore, the transmitter and receiver of the ultra high frequency current at each end of the block are so arranged that the transmitter and receiver are controlled according to the direction a train is to move through the stretch. This directional control causes the transmitter at the end of the block the train is to enter to supply the original wave which is to be beamed along the track to the exit end where it is received by the receiver and the receiver governs the associated transmitter to supply the return wave which is received at the entrance end of the block to influence the receiver at that point to control the block signal, the block signal being cleared in response to such two-way radiation of the ultra high frequency waves. If a train is to move in the opposite direction through the stretch, the sequence of operating the transmitters and receivers is reversed, and in this way only one transmitter and one receiver is required at each end of the block.

Where curves, grades and similar conditions exist along the stretch, I provide reradiators to direct and beam the high frequency wave along the track.

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

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying my invention when used to detect the occupancy of a stretch of single track railway and for controlling the opposing block signals governing traffic through this stretch.

Referring to the drawing, the reference characters 1a and 1b designate the track rails of a stretch of single track railway between two passing siding locations PS1 and PS2.

Eastbound trains are governed through this stretch of track or block by signals RA and RB, signal RA governing trains on the main track and signal RB governing trains moving from the siding. Similarly, westbound trains are governed through the stretch by signals LA and LB at location PS2. In other words, the signals at location PS1 and the signals at location PS2 serve as opposing block signals for this stretch of track.

The block signals RA, RB, LA, and LB may be of

any one of the standard types, such as semaphore, searchlight, color-light, or position-light signals. These block signals are preferably controlled in part manually and in part according to traffic conditions of the stretch. The manual control may be effected by an operator at each location or by an operator at a remote office through a centralized traffic control system, this latter arrangement being that disclosed in the drawing. The type of centralized traffic control used is immaterial, there being several such systems well-known to the art. It is sufficient for this application to point out that relays SR1 and SR2 at locations PS1 and PS2, respectively, are controlled by an operator at a remote office through a centralized traffic control system, the relays SR1 and SR2 being selectively governed according to different codes delivered to the locations and the arrangement being such that only one relay is energized at a time.

The traffic control of the block signals is such that a signal can be cleared to permit a train to enter the stretch only if the stretch is unoccupied. To detect occupancy of the stretch an ultra high frequency current transmitter and a receiver of such ultra high frequency current are provided at each location PS1 and PS2, a transmitter OS1 and a receiver DA1 being placed at location PS1, and a transmitter OS2 and a receiver DA2 being placed at location PS2.

Transmitters OS1 and OS2 are preferably alike except to supply currents of different frequencies and they are shown conventionally in the drawing since their specific construction forms no part of my invention, and their construction may be of any one of several arrangements. Preferably each transmitter includes an electron tube oscillator supplying current having a wave length of the order of 3 meters or less. That is, microwaves are used and the waves lie in the frequency region of 100 to 3000 megacycles per second. These waves are of a quasi-optical nature and radiation thereof can readily be beamed and the beam intercepted or blocked. Also, such waves are not reflected to any extent by the so-called Heaviside layers but they can be reradiated by elements of proper dimensions with respect to the wave length. The two transmitters supply currents of different frequencies, or as an alternative arrangement the two transmitters may supply a carrier of the same frequency and each transmitter include a generator to generate a modulation current of a frequency individual for that transmitter.

The receivers DA1 and DA2 are also shown conventionally for the sake of simplicity because their specific construction forms no part of my invention and they may be of any one of several arrangements of electron tube amplifier, detector, and demodulator stages. These receivers are arranged for receiver DA1 to be responsive to the energy supplied by transmitter OS2, and for receiver DA2 to be responsive to the energy supplied by transmitter OS1.

The antennas are of the directive type, and any one of several arrangements of directive antennas may be used, among which are the corner reflector, horn, cone, parabolic and Alfred loop types. In the drawing the antennas are illustrated diagrammatically as dipoles having two vertical elements for vertical polarization of the waves. It is to be understood, however, that horizontal polarization can be used. The essential characteristic of the antennas is that the wave is beamed along the track at a height corresponding to the height of

railway cars. At location PS1 antennas TE and RW are connected to transmitter OS1 and receiver DA1, respectively, through connections which preferably include coaxial cables. Antennas TE and RW may be mounted in any convenient manner and as illustrated they are mounted on an arm 4, secured to the mast of signal RA to bring the antennas just above the signal mechanism. The elements of the antennas are of relatively short dimension because of the microwaves used and thus the antennas can be placed at almost any height on the signal mast without interference with the signal mechanisms. In practicing the invention the transmitter apparatus and the receiver apparatus may be housed in a case secured to the signal mast and the antennas carried on such housing, so that the connection of each antenna to its apparatus is reduced to a minimum length. Antenna TE is disposed to beam the wave substantially along the center line of the track toward location PS2 at a height corresponding to the height of railway cars. In order to avoid radiation in the opposite direction, a metallic screen indicated by a dotted rectangle 5 may be mounted on the side of antenna TE remote from location PS2. The receiver antenna RW is disposed to receive a wave beamed along the track from location PS2.

At location PS2, antennas TW and RE are connected to transmitter OS2 and receiver DA2, respectively, through coaxial cables and are mounted on an arm 6 secured to the mast of signal LA. As explained in connection with antennas TE and RW at location PS1, the antennas TW and RE are of relatively small dimensions and can be mounted at almost any suitable height on the signal LA without interference with the signal mechanisms. Also, transmitter OS2 and receiver DA2 may be housed in a case mounted on the signal mast to bring the transmitter and the receiver close to the respective antenna. Antenna TW is disposed to beam the wave along the track toward location PS1 at a height corresponding to the height of railway cars and to avoid radiation in the opposite direction a metallic shield indicated by a dotted rectangle 7 may be used. Receiving antenna RE is disposed to receive a wave radiated from location PS1.

It follows that the microwave energy supplied by transmitter OS1 at location PS1 is beamed along the track from antenna TE to be picked up by antenna RE at location PS2 and influence receiver DA2 when no train occupies the stretch, but that a train moving through the stretch blocks such wave and the wave does not reach the receiving antenna RE. Similarly, microwave energy supplied by transmitter OS2 at location PS2 is beamed along the track from antenna TW to be picked up by antenna RW at location PS1 to influence receiver DA1 when no train occupies the stretch but that a train in the stretch blocks the radiation of such wave. It is to be pointed out that although the antennas at each location are illustrated as mounted on the signal mast, it is apparent that these antennas may be mounted on separate poles if desired.

In case the track between locations PS1 and PS2 includes curves, grades and similar circumstances, and if the distance is relatively long, the wave radiated at antenna TE or TW may not reach the remote receiving antenna. Under such circumstances reradiators are provided at pre-selected points along the stretch. Such reradiators for microwave energy may be of any one of several different forms known to the art and

in the drawing two dipole reradiators 8 and 9 are shown for reradiating the wave radiated from location PS1 to PS2 and two reradiators 10 and 11 are shown for reradiating the wave radiated from location PS2 to location PS1. These reradiators are mounted on suitable poles located along the track just outside of the clearance line of cars and the reradiators of a given direction may be alternately located on the opposite sides of the track and the waves beamed from one reradiator across the track to the next adjacent reradiator, so that any train moving along that portion of the track intercepts the beam.

Normally, that is, when no train is to be dispatched through this stretch of track, both relays SR1 and SR2 are deenergized, both transmitters OS1 and OS2 are inactive, both receivers DA1 and DA2 are uninfluenced and the signals indicate stop. If a train at location PS1 is to move east to location PS2, the operator sends a code through the centralized traffic control system to energize relay SR1. With relay SR1 energized to close front contact 12, the transmitter OS1 is supplied with power from a suitable source of current located at location PS1 and which source of power may be a battery, not shown, but the terminals of which are indicated at B and C. The transmitter OS1 when thus powered becomes active to supply ultra high frequency current to antenna TE from which it is beamed along the track toward location PS2. At location PS2 this wave is picked up by antenna RE and applied to receiver DA2 where it is detected and amplified to energize a relay 13 since the block is unoccupied. With relay 13 picked up to close front contact 14, a circuit is completed to power transmitter OS2, this circuit extending from terminal B of a suitable source of power at location PS2, such as a battery, not shown controller contact 15 operatively associated with signal LA and closed only when that signal indicates stop, controller contact 16 operatively associated with signal LB and closed only when that signal indicates stop, front contact 14 of relay 13, back contact 19 of the opposing centralized traffic control relay SR2, and input side of transmitter OS2 to terminal C of the source of power. When thus powered the transmitter OS2 is active to supply its ultra high frequency current to antenna TW from which the wave is beamed along the track to location PS1. At location PS1 this return wave is picked up by antenna RW and applied to receiver DA1 where the energy is amplified and detected and a relay 25 connected to the output side of receiver DA1 is energized in response thereto. With relay 25 energized to close front contact 26, a signal control circuit is formed from terminal B through front contact 17 of the centralized traffic control relay SR1, front contact 26 of relay 25, contact 18 operatively connected to switch SW1 at location PS1 and moved to the position illustrated by solid lines in the drawing when switch SW1 is set for trains on the main track, and signal RA to terminal C. With signal RA thus energized, that signal is controlled to display its clear indication for permitting the train to move east from location PS1 to location PS2.

In the event the switch SW1 is set for a train to move from the siding, the controller contact 18 is moved to the position illustrated by dotted lines in the drawing, and the signal circuit is made to include signal RB and that signal is governed to display a clear indication for the train on the siding to move east to location PS2.

It is to be pointed out that radiation of the wave from antenna TE to antenna RE is aided and redirected by the reradiators 8 and 9 and radiation of the wave from antenna TW to antenna RW is aided and redirected by the reradiators 10 and 11. Furthermore, it is to be pointed out that a sufficient number of such reradiators will be used to effectively radiate the wave from one location to the other.

Any train occupying the stretch between locations PS1 and PS2 would block the eastbound wave and no return wave would be returned and signal RA or RB, as the case may be, would not be cleared. Likewise, if the opposing block signals LA and LB are not set to stop and the opposing centralized traffic control relay SR2 is not released, no return wave would be sent out from location PS2 and the signal RA or RB would not be cleared.

Furthermore, if for any reason the eastbound wave is received at location PS2 and transmitter OS2 is made active, or if transmitter OS2 is made active due to a failure of the equipment at location OS2, the westbound wave would be intercepted and blocked by any train occupying the stretch and the eastbound block signals RA and RB could not be cleared.

A westbound train would be dispatched from location PS2 by the operator sending a code to energize relay SR2. With relay SR2 picked up to close front contact 20, the transmitter OS2 is powered by an obvious circuit including front contact 20 of relay SR2 and that transmitter is made active to supply its ultra high frequency energy which is radiated from antenna TW toward location PS1 to be picked up at receiver antenna RW if no train occupies the stretch to intercept the wave. Energy picked up at antenna RW is applied to receiver DA1 where it is detected and amplified to energize relay 25. Relay 25 on picking up to close front contact 21 completes a circuit that can be traced from terminal B through contact 23 operatively associated with signal RB and closed only when that signal indicates stop, contact 24 operatively associated with signal RA and closed when that signal indicates stop, front contact 21 of relay 25, back contact 22 of the opposing centralized traffic control relay SR1 and input side of transmitter OS1 to terminal C, and the transmitter is made active to supply its high frequency energy to antenna TE. This high frequency wave is radiated from antenna TE toward location PS2 to be picked up at antenna RE and applied to receiver DA2 where it is detected and amplified to energize relay 13. Relay 13 on picking up to close front contact 27 completes a signal control circuit, such signal circuit including terminal B, front contact 28 of relay SR2, front contact 27 of relay 13, controller contact 29 operatively connected to switch SW2 and moved to the position illustrated by the solid lines in the drawing when switch SW2 is set for trains on the main track, and signal LA to terminal C, and signal LA is energized to display a clear signal for the train at location PS2.

In case switch SW2 is set for a train on the siding so that contact 29 occupies the position illustrated by dotted lines in the drawing, the signal LB is included in the signal control circuit and that signal is cleared to dispatch the train on the siding west to the location PS1.

It is to be seen therefore that to permit an eastbound train to move through this stretch, the operator selects relay SR1 to render the transmitter OS1 active to supply a first high frequency

current which is radiated from antenna TE to antenna RE if the stretch is unoccupied. This energy when picked up at antenna RE is detected and amplified by receiver DA2 at location PS2 to energize relay 13, which on picking up completes a circuit to power the transmitter OS2 at location PS2. Transmitter OS2 when active supplies a return high frequency current which is radiated from antenna TW back to the location PS1 if the section is unoccupied where such energy is picked up by antenna RW and amplified and detected at receiver DA1 to energize relay 25 which relay on picking up completes the signal control circuit for clearing the signal to permit an eastbound train to move from location PS1.

Similarly, a westbound train is permitted to move through the stretch by the dispatcher selecting relay SR2, which picks up to power transmitter OS2, and that transmitter supplies a high frequency wave which is radiated from antenna TW west to antenna RW if no train occupies the block. Such energy when detected and amplified at receiver DA1 controls relay 25 to complete a circuit to power the transmitter OS1 and that transmitter supplies its high frequency current to antenna TE from which the wave is radiated back to the location PS2 if no train is in the block. This return wave is picked up at antenna RE to be applied to receiver DA2 to energize relay 13, which relay on picking up completes the signal control circuit for clearing the signal LA or LB to permit the train to leave location PS2.

Although I have herein shown and described but one form of railway traffic controlling 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. In combination with a stretch of railway track having a block signal located at a first end of the stretch to govern traffic through the stretch, transmitting means at said first end of the stretch operative at times to radiate an ultra high frequency current along the track toward the second end of the stretch, said current having a wave that is beamed along the track to be intercepted by a train occupying the stretch, receiving means at said second end responsive to such ultra high frequency current to detect the current wave when the stretch is unoccupied, another transmitting means at said second end governed by said receiving means to radiate another ultra high frequency current along the track toward said first end, another receiving means at said first end responsive to said other ultra high frequency current to detect that current wave, and control means at said first end governed by said other receiving means to clear said block signal in response to detection of said last mentioned current wave.

2. In combination with a stretch of railway track having a block signal located at a first end of the stretch to govern traffic through the stretch, transmitting means including a directive antenna operative at times to radiate an ultra high frequency current, said current having a quasi-optical wave and said antenna disposed to beam the wave along the track toward the second end of the stretch at a height corresponding to the height of railway cars for the wave to be intercepted by a train occupying the stretch, receiving means at said second end of the stretch

to detect said ultra high frequency current and having an antenna disposed to pick up said radiated wave when the stretch is unoccupied, another transmitting means at said second end of the stretch governed by said receiving means in response to such detected current to supply another ultra high frequency current, another directive antenna connected to said other transmitting means to radiate said other ultra high frequency current toward said first end, another receiving means at said first end to detect said other high frequency current and having an antenna disposed to pick up the current radiated by said other transmitting means, and means governed by said other receiving means in response to detection of said other high frequency current to control said block signal.

3. In combination with a stretch of railway track having a block signal located at a first end of the stretch to govern traffic through the stretch, transmitting means located at said first end of the stretch to radiate an ultra high frequency current along the track toward the second end of the stretch, receiving means located at said second end of the stretch responsive to such radiated current to pick up and detect the current radiated by said transmitting means, another transmitting means including a directive antenna located at said second end of the stretch governed by said receiving means to radiate another ultra high frequency current, said other current having a quasi-optical wave for the wave to be beamed by said directive antenna along the track to be intercepted by a train occupying the stretch, another receiving means including an antenna located at said first end to pick up and detect said other radiated wave when the stretch is unoccupied, and control means governed by said other receiving means to control said block signal to clear the signal in response to the picking up of said quasi-optical wave.

4. In combination with a stretch of railway track having a block signal located at a first end of the stretch to govern traffic through the stretch, transmitting means including a directive antenna located at said first end of the stretch to radiate an ultra high frequency current along the track toward the second end of the stretch, said current having a quasi-optical wave for the wave to be beamed along the track to be intercepted by a train occupying the stretch, receiving means including an antenna located at said second end of the stretch to pick up and detect said radiated current when the stretch is unoccupied, another transmitting means including a directive antenna located at said second end of the stretch governed by said receiving means to radiate another ultra high frequency current along the track toward said first end, said other current having a quasi-optical wave for the wave to be beamed along the track to be intercepted by a train occupying the stretch, another receiving means including an antenna located at said first end to pick up and detect said other radiated current when the stretch is unoccupied, and control means governed by said other receiving means to control said signal.

5. In combination with a stretch of railway track having a block signal located at a first end of the stretch to govern traffic through the stretch, transmitting means including a directive antenna located at said first end and operable when powered to supply an ultra high frequency current, manually controlled means to at times power said transmitting means, said high fre-

quency current having a quasi-optical wave and said antenna disposed to beam such wave along the track toward the second end of the stretch at a height corresponding to the height of railway cars for the beam to be intercepted by a train occupying the stretch, receiving means at said second end operable to detect such high frequency current and having an antenna to pick up said radiated wave when the stretch is unoccupied, another transmitting means including another directive antenna located at said second end and operable when powered to supply another ultra high frequency current, means including a contact governed by said receiving means and a contact responsive to traffic conditions at said second end to power said other transmitting means, said other high frequency current having a quasi-optical wave and said other directive antenna disposed to beam such wave along the track toward said first end at a height corresponding to the height of railway cars for the beam to be intercepted by a train occupying the stretch, another receiving means at said first end operable to detect said other high frequency current and having an antenna to pick up the wave radiated from said second end when the stretch is unoccupied, and means including a relay controlled by said other receiving means to govern said block signal.

6. In combination with a stretch of railway track having block signals located at opposite ends of the stretch to govern traffic in opposite directions through the stretch, transmitting means including a directive antenna at each end of the stretch, each transmitting means operable when powered to supply an ultra high frequency current, each such high frequency current having a quasi-optical wave and each said directive antenna disposed to radiate the wave of the respective transmitting means along the track toward the opposite end of the stretch at a height for the wave to be intercepted by a train occupying the stretch, receiving means including an antenna at each end of the stretch, each receiving means operable to detect the high frequency current supplied by the transmitting means at the opposite end and each receiving antenna disposed to pick up the wave radiated at the opposite end of the stretch, control means at each end of the

stretch to power the transmitting means at the same end of the stretch, each of said control means having alternative circuit paths a first one of which paths including a manually controlled contact and the other of which paths includes a contact controlled by the receiving means at the same end of the stretch whereby the closing of either manually controlled contact causes a first wave to be radiated from that end of the stretch and a second wave to be radiated from the opposite end of the stretch in response to the first wave, and a signal circuit at each end of the stretch and including a contact governed by the receiving means at the same end of the stretch to control the block signal at that end of the stretch.

7. In combination with a stretch of railway track having opposing block signals, a transmitter and a receiver at each end of the stretch, each transmitter operable when powered to supply an ultra high frequency current having a quasi-optical wave and each transmitter having a directive antenna disposed to radiate the wave along the track toward the opposite end of the stretch at a height to be intercepted by a train occupying the stretch, each receiver operable to detect the current supplied by the transmitter at the opposite end of the stretch and each receiver having an antenna disposed to pick up the wave radiated from the opposite end of the stretch when the stretch is unoccupied, a manually controlled relay at each end of the stretch, a receiving relay at each end of the stretch energized by the respective receiver in response to detection of the wave radiated from the opposite end, and circuit means partly at each end of the stretch governed by said manually controlled relays and said receiving relays to power either transmitter to originate a wave which is detected by the receiver at the end of the stretch opposite the powered transmitter to power the transmitter at such opposite end to radiate a return wave which is detected by the receiver at the originating end of the stretch when the stretch is unoccupied, and other circuit means at each end of the stretch controlled by the respective manually controlled and receiving relays to control the respective block signal.

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