

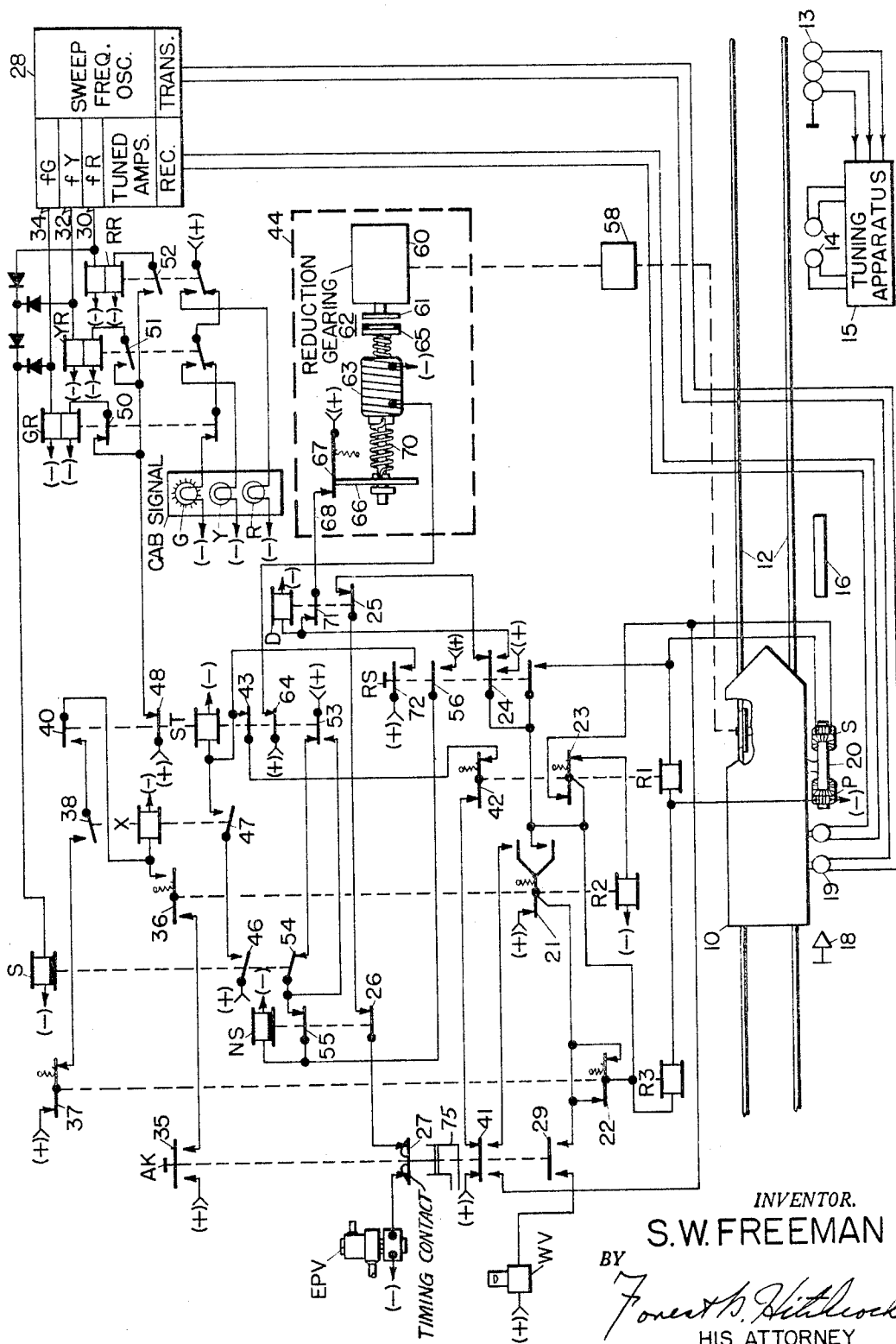
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INTERMITTENT TRAIN CONTROL SYSTEM

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INTERMITTENT TRAIN CONTROL SYSTEM
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The present invention relates to a train control system, and more particularly to an improved train control system of the intermittent type.

In intermittent train control systems presently in use, observance of the speed restricting indication of wayside signals is accomplished by requiring the engineman to "acknowledge" when passing signals displaying such indications. The penalty for failure to acknowledge a speed restricting indication is an automatic brake application which cannot be released until the engineman operates a reset contact which may be so located that the engineman must leave the cab of the locomotive to operate it. The transmission of control between the wayside signal circuits and the locomotive is accomplished through the interaction of two devices, one mounted beside the track, called the inductor, and one carried on the locomotive, called the receiver.

The inductor, is usually equipped with a winding for control purposes. This winding or choke coil, is open circuited when the signal is restrictive and influences the receiver in a conventional manner as the locomotive passes the inductor. When the signal is clear, the choke coil circuit is closed which prevents the receiver from being influenced by the wayside inductor. In some installations, the inductor has no choke coil and the engineman is required to acknowledge each time the receiver passes the inductor. This system requires that the engineman is alert, and permits him to retain full control of the brakes by performing the proper act of acknowledgement when the receiver passes an inductor.

When the receiver is influenced by the inductor with the acknowledging contactor operated, a whistle is sounded in the cab. If the train were to proceed by the inductor, without receiving a whistle, there would be evidence that the inductor was not present or not electrically intact, or that the train control equipment in the locomotive was not functioning properly. In these circumstances, particularly in situations of very low visibility, such as fog or snow, it is possible that the engineman could operate the train past a signal location without receiving proper action on the locomotive by way of the intermittent system.

The purpose of the present invention is to provide a train control system which insures proper functioning of the vehicle carried equipment and the presence and integrity of the wayside apparatus each time the train passes a signal location.

In furtherance thereof, one of the objects of the present invention is to provide a system wherein the engineman is habitually required to acknowledge a predetermined distance in advance of every signal location to which his attention should be fixed.

Another object of this invention is to provide an intermittent train control system which causes a brake application if the wayside apparatus is missing or the vehicle carried apparatus is not functioning.

Another object of this invention is to provide an intermittent train control system which causes a brake application if a signal is not received from the wayside when the vehicle reaches a point a predetermined distance beyond a wayside inductor.

Another object of this invention is to provide an intermittent train control system which causes a brake application in response to an act of acknowledgement if the

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vehicle apparatus does not function when passing an approach location and/or a signal is not received on the locomotive before the vehicle reaches a predetermined distance beyond the approach location.

A further object of this invention is to provide an intermittent train control system that requires an act of acknowledgement and an electrically intact inductor in advance of each location together with positive receipt of information concerning the aspect of the wayside signal or other information a predetermined distance thereafter in order for the train to proceed beyond the location without receiving a brake application.

A still further object of this invention is to provide a system wherein the receipt of wayside information at a location governs the train to stop in the event that both the act of acknowledgement and the influence of wayside apparatus is lacking at the approach to the location.

Other objects of this invention will become apparent in the specification, the drawing, and the appended claims.

In the drawing:

The single figure illustrates schematically the apparatus and circuitry of an intermittent train control system in accordance with one embodiment of this invention.

Generally speaking, and without intending to limit the scope of the present invention, the wayside apparatus, includes at each location an information transmitting means, which may be a pair of wayside coils that are selectively tuned in accordance with the aspect displayed by the wayside signal or other desired information. A predetermined distance in advance of and at the approach to each location is a wayside inductor, the position of which is noted by a suitable marker to denote the point at which the engineman must perform his manual act of acknowledging the signal.

The vehicle carried equipment includes a conventional normally energized electro-pneumatic valve, which when deenergized initiates a brake application. This pneumatic electro-responsive valve is controlled in one aspect by an intermittent train control system of the type generally disclosed in Patent No. 1,686,434 to which reference may be made for a more detailed description thereof. A receiving apparatus is provided which may be of the well known type wherein a pair of pick up coils become inductively coupled to the wayside transmitting coils as they pass thereover. A tuned amplifier is thus selectively activated in accordance with the frequency of the wayside coils to display a cab signal aspect.

Either the response of the vehicle carried train control apparatus to the wayside inductor or the act of acknowledgement by the engineman activates means for determining a particular distance travelled by the vehicle after such activation. If the receiving apparatus fails to receive a signal as the vehicle passes the tuned coils, the electro-responsive valve is deenergized at the particular predetermined distance as governed by the distance determining means. If the wayside inductor is missing and the engineman fails to acknowledge, means are provided that operate to deenergize the electro-responsive valve upon the receipt of signal information at the tuned coils.

Thus, the vehicle carried system is so constituted that a brake application is initiated at each location if either of four conditions, the act of acknowledgement, the proper influence of the wayside inductor, or the receipt of the signal information is missing or if the locomotive interpreting equipment is not functioning. In order for a vehicle to pass a location without receiving a brake application either all four conditions must be lacking, or all four properly executed.

Referring in detail to the drawing, by numerals of reference, a locomotive 10 is illustrated on a section of track 12 approaching wayside signals referred to at 13. A pair of wayside coils 14 are positioned adjacent the

signals 13 and are selectively tuned by conventional tuning apparatus 15 in accordance with the aspect display by the signals 13. Positioned a predetermined distance in advance of the coils 14 at the approach to the signals is an unwound wayside inductor 16. A marker 18 is provided adjacent the inductor 16 to notify the engineman when to acknowledge. The locomotive 10 is provided with a receiver 20 which is positioned to inductively couple with the wayside inductor 16. A pair of coils 19 are also attached to the locomotive to be influenced inductively by the pair of tuned coils 14 after the receiver 20 is influenced by the inductor 16.

The car carried receiver 20, which is provided with a primary coil P and a secondary coil S, is connected by conventional circuitry to a normally energized primary relay R1, a normally energized secondary relay R2, and a normally energized main relay R3. The relay R1 is normally energized by a circuit which extends from (+) and includes closed contact 21 of the relay R2, closed contact 22 of the relay R3, closed contact 23 of the relay R1, the secondary coil S of the receiver 20, the winding of the relay R1, and the primary winding P to (-). The relay R2 is normally energized by a circuit which extends from (+) and includes closed contact 21 of the relay R2, closed contact 22 of the relay R3, closed contact 23 of the relay R1, and the winding of relay R2 to (-). The relay R3 is normally energized by a circuit which extends from (+) and includes a closed contact 21 of the relay R2, closed contact 22 of the relay R3, the winding of the relay R3, and the winding P of the receiver 20 to (-). In a well known manner, when the receiver 20 passes the inductor 16, the bucking voltage induced in the coil S causes R1 to release. When the relay R1 releases, the coil of the relay R2 is deenergized by the opening of the front contact 23 of the relay R1 and this relay becomes dropped away. If acknowledging contactor AK is closed when this occurs, relay R3 remains energized by a circuit which extends from (+) and includes the winding of the whistle valve WV, closed contact 29 of the acknowledging contactor AK, closed contact 22 of the relay R3, the winding of the relay R3 and the primary coil P to (-). If the acknowledging contactor AK is not operated properly, the relay R3 releases upon the opening of closed contact 21 of the relay R2.

The electro-pneumatic valve EPV, is a well known solenoid operated air valve which when deenergized opens a control air line to initiate a service brake application. The valve EPV is normally energized by a circuit which extends from (+) and includes closed contact 21 of the relay R2, the closed contact 22 of the relay R3, normally closed contact 24 of a reset contactor RS, front contact 25 of a normally energized relay D, front contact 26 of a normally energized relay NS, a conventional timing contact 27 of the acknowledging contactor AK, which opens if the contactor is held operated for too long a time and the winding of the valve EPV to (-). The timing of contact 27 is indicated in the drawings by a dashpot 75 which is connected to that contact to retard its action. The valve EPV is held energized, even through the relays R1 and R2 drop away upon passage of the receiver 20 over the inductor 16 as previously mentioned, by a circuit which extends from (+) and includes the winding of whistle valve WV the closed contact 29 of the acknowledging contactor AK when operated, the closed contact 22 of the relay R3, and through the normally closed contact 24 of the reset contactor RS in the previously described energizing circuit. The restoration of the relays R1 and R2 after passing the inductor 16, and the restoration of the relay R3 in the event that a brake application is well known in the art as is disclosed, for example, for relays having corresponding reference characters in the Bushnell Patent No. 1,877,555, granted September 13, 1932, and its detailed description is considered unnecessary in describing the present invention.

The vehicle carried coils 19 are connected to well known apparatus 28 that includes a sweep frequency oscillator and tuned amplifiers 30, 32, and 34. When the receiving coils 19 are inductively coupled with the wayside coils 14, one of the amplifiers 30, 32 or 34 provides an output depending upon the particular frequency to which the wayside coils 14 are tuned as controlled by the tuning apparatus 15.

A relay RR is energized in response to the output from tuned amplifier 30. Similarly a relay YR and a relay GR is energized in response to the output from the amplifier 32 and 34 respectively. A signal detection relay S is normally deenergized and picks up momentarily in response to the output from any one of the amplifiers 30, 32 and 34. Relay S has slow drop away characteristics to allow time for the stick circuit for relay ST to become established. A cab signalling apparatus is controlled by the relays GR, YR and RR, to display an aspect corresponding to the information received. For example, the picking up of the relay GR causes the cab signal to display a proceed or green aspect G. The picking up of the relay YR causes the signal to display a caution or yellow aspect Y, and the picking up of the relay RR causes the signal to display a stop or red aspect R.

The relays GR, YR and RR are held up by a stick circuit that includes front contact 48 of a relay ST so that the particular signal aspect continues to be displayed after the vehicle passes the coils 14 only if the system does not operate to initiate a brake application as herein-after described.

As in the well known intermittent train control system, the influence of the inductor 16 on the receiver 20 causes the relay R1 to become deenergized which in turn deenergizes the relay R2. The operation of the acknowledging contactor AK maintains the relay R3 energized when the relay R2 is deenergized by virtue of the closing of contact 29 of the contactor AK. The closing of contact 29 of the contactor AK when the relay R2 is deenergized operates the whistle valve WV to inform the engineman of the passage by the inductor 16.

A relay X is provided to detect that the train control equipment has responded properly on passing the inductor 16 and the engineman has operated the acknowledging contact AK. The relay X is picked up by a circuit which extends from (+) and includes contact 35 of the contactor AK which is closed when the engineman acknowledges, and contact 36 of the relay R2 which closes in response to the dropping away of relay R1 as previously described, and the winding of the relay X to (-). The relay X is held energized after the act of acknowledgement and the passing of the inductor 16 by a stick circuit which includes front contact 37 of the relay R3 which is closed if the apparatus responded properly, front contact 38 of relay X, back contact 40 of relay ST, and the winding of the relay X to (-).

The relay ST which is normally energized by a stick circuit which extends from (+) and includes front contact 41 of the acknowledging contactor AK, contact 42 of the relay R1, front contact 43 of the relay ST, and the winding of the relay ST to (-) is dropped away to activate distance detecting apparatus 44 in response to either the operation of the acknowledging contactor AK or the release of the relay R1 when the receiver 20 is influenced by the inductor 16. The relay ST is provided to be picked up to deactivate the distance detecting apparatus 44 when the vehicle coils 19 pass the coils 14 if the engineman has properly acknowledged, the train control apparatus has properly responded to the inductor 16, and the relay S picks up in response to the receipt of information. The circuit for picking up the relay ST extends from (+) and includes front contact 46 of the relay S and front contact 47 of the relay X. The dropping away of the relay ST as previously mentioned also opens a respective stick circuit for the energized relay GR, YR or RR to extinguish the aspect displayed by

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the cab signal. This stick circuit extends from (+) and includes front contact 48 of the relay ST and the front contacts 50, 51 or 52 and the lower windings of relays GR, YR and RR, respectively to (-).

A relay NS is provided to be deenergized upon the picking up of the relay S upon receipt of information in the event that neither an act of acknowledgment is made by the engineman and the influence of the inductor 16 is not detected by the release of the relay R1, such as would be the case if the inductor 16 were missing, and the engineman was not alert or incapacitated. The relay NS is held energized by a stick circuit that extends from (+) and includes front contact 53 of the relay ST, back contact 54 of the relay S, front contact 55 of the relay NS and the winding of relay NS to (-). When relay ST drops away as previously described, the relay NS is held energized by a stick circuit which extends from (+) and includes the back contact 53 of relay ST, the front contact 55 of relay NS and the winding of the relay NS to (-). The dropping away of the relay NS opens its front contact 26 to deenergize the valve EPV; and once it drops away it can be energized only by operating the reset contactor RS to close its contact 56.

The distance detecting apparatus 44 is comprised of a conventional odometer 58 which is connected in a conventional manner to the vehicle wheel. The odometer 58 is connected to reduction gearing 60 which rotates one section 61 of a normally disengaged friction clutch 62. The clutch 62 is held disengaged by a solenoid 63 that is normally energized by a circuit which extends from (+) and includes front contact 64 of the relay ST. The plunger of the solenoid 63 has connected thereto a clutch disc 65 and a cam 66. When the solenoid 63 is deenergized, the clutch plate 65 engages the clutch plate 61 to be rotated through the reduction gearing 60. The reduction gearing 60 and the cam 66 are so constituted that lever arm 67 disengages contact 68 when the vehicle has travelled a predetermined distance in accordance with this embodiment of the invention. When the solenoid 63 is again energized, the clutch 62 is disengaged thereby permitting the cam 66 to rotate by virtue of the force of the spring 70 to assume its normal starting angular position. Thus, if the cam 66 is permitted to rotate its full predetermined angular distance, the contact 68 opens to remove electrical energy therefrom. However, if the cam 66 is not permitted to rotate its predetermined angular distance, it returns, when the solenoid 63 is reenergized to its starting position without deenergizing the contact 68. A relay D is normally energized by a stick circuit which extends from (+) and includes the lever 67, the front contact 68, front contact 71 of the relay D and the winding of the relay D to (-). The dropping away of the relay D is caused by the opening of the contact 68 which causes front contact 25 of the relay D in the energizing circuit for the valve EPV to open. This deenergizes the valve EPV to initiate a brake application. Once the relay D is dropped away it cannot be picked up except by operating the reset button RS to close back contact 24 of the reset button.

In, operation, and assuming that the engineman properly acknowledges as he passes the wayside inductor 16, the vehicle carried apparatus is functioning properly, and the wayside inductor 16 is electrically intact, the relays R1 and R2 are deenergized and the relay R3 remains energized as previously described. In response to the operation of the contactor AK, and the release of the relay R2, the relay X is energized by its previously described pick up circuit. Upon operation of the contactor AK the normally energized relay ST is deenergized by opening its previously described stick circuit at front contact 41 of AK. The dropping away of the relay ST completes the stick circuit for the relay X at back contact 40 of the relay ST. In response to the dropping away of the relay ST, the solenoid 63 is deenergized by the opening of front contact 64 and the cam 66 starts rotating.

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When the coils 19 pass over the receiving coils 14, the relay S is picked up momentarily by the output from one of the amplifiers 30, 32, or 34. The picking up of the relay S completes the pick up circuit for the relay ST, which energizes the solenoid 63 to permit it to return to normal before level 67 removes energy from contact 68 in the stick circuit of the relay D and the cam 66 returns to normal.

Assuming that the engineman operates the acknowledging contactor AK as he passes the wayside inductor 16, but the vehicular apparatus fails to respond properly to the influence of the wayside inductors 16 or the wayside inductor 16 is missing, the relay X does not pick up. If, in the case of malfunction, the relay X does pick up, because the particular malfunction permits the relay R2 to release, but the relay R3 drops away, the relay X is not held energized because of the open condition of contact 37 of the relay R3 in the stick circuit of the relay X. Further, if the engineman failed to properly acknowledge, but for some reason the electro-pneumatic valve EPV did not become deenergized even though the relays R1, R2 and R3 responded to the influence of the inductor 16, the relay X would not pick up because contact 35 of contactor AK did not close. Under these conditions, the relay ST drops away, upon either the operation of the acknowledging contactor or the opening of contact 42 of the relay R1, which releases solenoid 63 to start the cam 66 rotating. When the locomotive reaches the point where the coils 19 inductively couple with the coils 14 and the relay S picks up momentarily, the relay ST is not energized because contact 47 of the relay X is open, and the cam 66 continues to rotate until the lever 67 opens the contact 68 to deenergize the relay D. The dropping away of the relay D opens its front contact 25 in the energizing circuit for the valve EPV and a brake application is initiated. In order to release the brakes by reenergizing the valve EPV, the engineman must operate the reset button RS which is located in an inconvenient location. The operation of the button RS closes its back contact 24 to energize the relay D and closes its back contact 72 to pick up the relay ST for applying energy to the solenoid 63 which permits the cam 66 to return to its proper angular position for sticking the relay D in its energized position.

Assuming that the engineman fails to operate the acknowledging contactor AK and the wayside inductor 16 is missing or the vehicle apparatus does not respond thereto, the relay ST remains energized and of course the relay X does not pick up. However, when the locomotive coils 19 pass the wayside coils 14, the relay S picks up, which opens the stick circuit for deenergizing the normally energized relay NS at back contact 54. The dropping away of the relay NS opens its front contact 26 in the circuit for energizing the valve EPV and a brake application occurs. The relay NS is restored to normal by operating the reset push button RS to close its back contact 56. The relay NS does not drop away upon the picking up of the relay S under conditions where the relay ST drops away because when the relay ST closes its back contact 53, the previously described alternate stick circuit is established. The relay NS is made slow acting to remain picked up during the crossover time of the contact 53.

With respect to the operation of the cab signal, and assuming that the signal displays its proceed aspect because the relay GR is held energized, when the relay ST drops away, the relay GR drops away extinguishing the aspect G displayed by the signal. A new aspect is not displayed by the signal until one of the tuned amplifiers 30, 32 or 34 is activated to again energize a respective relay GR, YR or RR. In the event that the relay ST does not pick up in response to the picking up of the relay S, at location 13 the new display of the cab signal is only momentary.

From the foregoing description, it is also evident that if the train control equipment does not respond, or the wayside inductor 16 is missing, and also the tuned coils 14 are missing or not electrically intact whereby relay S

does not pick up, a brake application will be initiated if the engineman acknowledges properly, because of the dropping away of the relay ST.

It should be understood also, and in accordance with the present invention, if the relay ST, the relay D, the solenoid 63, or the relay NS should fail because of an open circuit, a brake application is initiated regardless of the location of the locomotive.

Although, a conventional intermittent inductive system using a receiving coil is shown in accordance with one embodiment of the invention it is understood that another system may be used with equal facility. It is further understood, that although one specific manner of transmitting information to the vehicle concerning the aspect of the signal is illustrated, that any other system of transmitting information may be used and that other information can be transmitted such as speed, grade, or other conditions which might effect the operation of the train.

Having described one specific embodiment of the present invention, it is understood that various modifications, alterations and adaptations may be provided without departing from the spirit or scope of the invention as set forth in the appended claims.

What I claim is:

1. In a train control system wherein a normally energized electro-responsive valve circuit means on a vehicle is deenergized to apply the brakes of the vehicle by electro-magnetic means operated in response to the influence of a device that is adapted to be positioned along the wayside, and wherein acknowledging means when manually operated during operation of the electro-magnetic means maintains the electro-responsive valve circuit means energized, the combination of a receiving means on the vehicle responsive to a signal received from a wayside transmitting means that is disposed along the wayside ahead of the wayside device as the vehicle passes the transmitting means, a normally inactive distance detecting means on the vehicle operative when active to deenergize the valve circuit means when the vehicle travels a predetermined distance after being activated, a first means normally in one condition and operated to its other condition in response to the operation of either one of the acknowledging means and the electro-magnetic means to activate the distance detecting means, a second means normally in one condition and operated to its other condition in response to the detected operation of both the acknowledging means and the electro-magnetic means, a third means responsive to the signal received by the receiving means when the second means is in its other condition to operate the first means to its one condition to deactivate the distance detecting means before the vehicle has traversed all of said predetermined distance of travel, and a fourth means responsive to the reception of a signal from the receiving means when the first means is in its one condition to deenergize the valve circuit means.

2. In a train control system according to claim 1, wherein the fourth means includes a relay normally energized through its front contact and the signal receiving means when no signal is being received and the first means in its one condition all in series connection to a source of energy, and includes an alternate stick circuit including said second means in its other condition and the front contact of the normally energized relay in series connection to a source of energy, whereby the fourth means relay is deenergized only if both the first means is in its one condition and the signal receiving means is operated.

3. In a train control system according to claim 1, wherein the distance detection means includes an odometer, and an engageable clutch normally disengaged by an energized solenoid, and cam means controlled through the clutch to deenergize a normally energized relay after said predetermined distance to open the valve circuit means.

4. In a train control system according to claim 1

wherein the electro-magnetic means includes a first normally energized relay that is deenergized by the influence of the wayside device and a second normally energized relay that is maintained energized if the acknowledging means is operated when the electro-magnetic means is operated by the wayside device, and wherein the second means includes a relay having a pick up circuit that includes a contact of the first relay in its deenergized condition and the acknowledging means in its operated condition, and includes a stick circuit means for the relay of the second means that includes a contact of the second relay of the electro-magnetic means in its energized condition, a front contact of the relay of the second means, and the first means in its other condition.

5. In a train control system according to claim 1 wherein the electro-magnetic means includes a normally energized relay that is deenergized by the influence of the wayside device, and wherein the first means includes a normally energized relay that is held energized through its front contact by a contact of the acknowledging means and a contact of the normally energized relay of the electro-magnetic means in series connection to a source of energy.

6. In a train control system according to claim 5 wherein the third means is an independent pick up circuit for the normally energized relay of the first means to restore the relay of the first means to its normally energized condition in response to the reception of a signal from the receiving means.

7. In a train control system according to claim 1 including a cab signalling means to display an aspect corresponding to the signal received from the receiving means in response thereto, stick circuit means operative to govern the cab signalling means to display the signal after passing the wayside transmitting means when the first means is in its one condition and to extinguish the displayed aspect upon operation of the first means to its other condition.

8. In a train control system including vehicle carried apparatus having a normally energized electro-responsive valve circuit means operative to be deenergized to apply the brakes of the vehicle as governed by the operation of electro-magnetic means in response to the influence of a device positioned along the wayside in advance of a signal location and acknowledging means when manually operated while the vehicle carried apparatus is being influenced by the wayside device to maintain the electro-responsive valve circuit means energized, the combination of a wayside transmitting means positioned along the wayside ahead of the wayside device in the direction of travel of the vehicle for transmitting a signal to the vehicle, vehicle carried receiving means operative when in proximity to the transmitting means to receive on the vehicle the transmitted signal, a distance detecting means on the vehicle operative when activated to deenergize the valve circuit means when the vehicle reaches a predetermined distance beyond the point of activation when the distance detecting means is in an activated condition at said predetermined distance, a first circuit means responsive to the reception of a signal from the receiving means to deenergize the valve circuit means, a second circuit means rendered effective in response to the operation of either one of the acknowledging means and the electro-magnetic means by the influence of the wayside device to activate the distance detecting means, said second circuit means being operable when rendered effective to render said first circuit means ineffective, a third circuit means governed by either the operation of the acknowledging means and the operation of the electro-magnetic means by the influence of the wayside device to deactivate the distance detecting means in response to the reception of the signal by the receiving means before the vehicle reaches said predetermined distance beyond the point of activation.

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References Cited by the Examiner

UNITED STATES PATENTS

1,686,434	10/1928	Bushnell	-----	246—63
1,877,555	9/1932	Bushnell	-----	246—63
2,291,372	7/1942	Bushnell	-----	246—63
2,554,056	5/1951	Peter et al.	-----	246—63

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FOREIGN PATENTS

674,104 10/1929 France.

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