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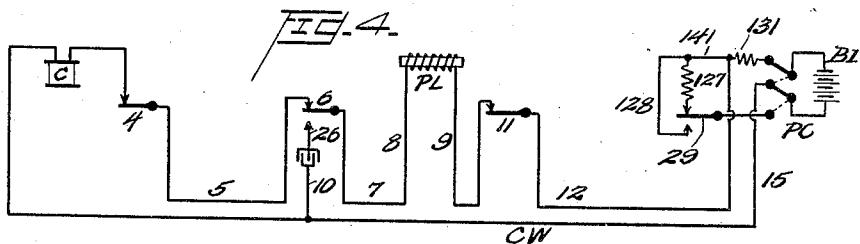
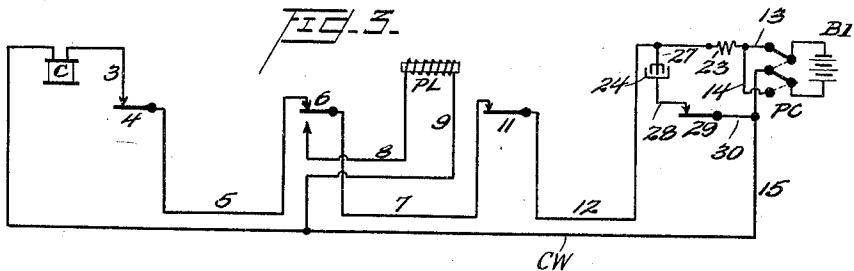
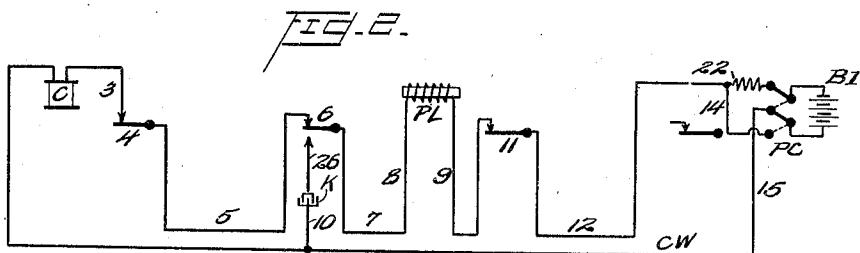
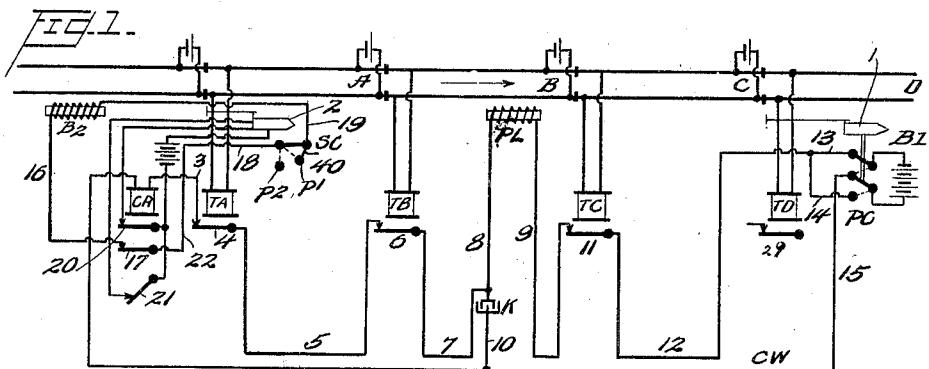
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1,734,603

TRAIN CONTROL SYSTEM

Filed July 19, 1926

3 Sheets-Sheet 1



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FIG. 6.

Circuit diagram showing a vacuum tube circuit. The circuit includes a CR circuit (3), a grid leak detector (5, 6, 9, 11), a power supply section (14, 15, 23, 24, 27, 28, 29), and a CW section (7, 12). The diagram uses a mix of block diagrams and detailed component labels.

FIG-7-

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TRAIN-CONTROL SYSTEM

Application filed July 19, 1926. Serial No. 123,335.

This invention relates broadly to an improvement in train controlled signaling systems. One of the objects of the invention is to provide a device at an intermediate point 5 in the block which cooperates with train carried devices to give desired indications on the train. This object is accomplished in the present system without the use of any additional line wiring, the device being connected 10 to the roadside block signaling circuit.

There are a great number of conditions under which the basic element of the present invention finds useful application. Only a limited number of such applications are illustrated in the present application, and other manners of applying the present invention to various practical conditions will be apparent to any person skilled in the art.

For the purpose of facilitating the understanding of the invention I shall describe hereinafter in general terms the various uses of the invention and the manner of its application under certain specific conditions, and shall describe it in more specific terms 25 in a later portion of the application in conjunction with the drawings appended herewith.

In the broad outlines the block signaling system disclosed herewith comprises a semaphore capable of assuming clear, caution and stop positions and disposed at the entrance to each block. The operation of the semaphore is controlled by a block signaling circuit which is disposed on the roadside and extends 20 substantially the entire length of the block. This circuit contains a control relay which controls the operation of the semaphore, the semaphore and relay being disposed at the 25 entrance to the block. A source of energy such as a battery is disposed at the further end of the block and is connected to the control relay by means of wires extending substantially the entire length of the block. A 30 plurality of normally energized relays and which are successively deenergized by the progress of a train in the block, control a series of make and break switches in the circuit connecting the battery and the control relay. A 35 device designed to cooperate with train car-

ried devices for the automatic application of the brakes or for otherwise giving a danger indication on the train by cooperation with such train carried devices, is disposed in the roadside in the vicinity of the semaphore 55 signal. This device may be of such a nature and is preferably so controlled by the semaphore that when the semaphore is in a clear or in a caution position no indication is given on the train, but an indication is given on the 60 train when the semaphore is in stop position, or it may be so constructed that it will give a clear indication on the train when the semaphore is in clear or caution position, but will give a stop indication as by effectuating the 65 application of the brakes or otherwise when the semaphore is in the stop position.

When the train operator reaches the entrance of a block having its semaphore set at a stop position, and if the operator attempts 70 to enter the block against the stop signal the automatic device described above will effectuate the application of the brakes on the train, or will otherwise indicate danger to the operator within the line of his vision. 75 Under some conditions, however, it becomes desirable for the operator to enter the block against the stop signal while traveling cautiously at a low rate of speed. For this purpose the train is provided with a manual 80 resetting device whereby the operator may reset the train carried devices or the train carried braking devices to normal position while moving at a restricted speed. It is, however, frequently desirable, after the train has progressed some distance within a block, that in 85 case the danger or stop conditions still persist in the remainder of the block the brakes be again automatically applied or some other danger indication be given on the train to the operator. It is, therefore, the object of 90 this invention to provide a device at some point intermediate the ends of the block, whereby if the danger conditions still persist in the remainder of the block, the brakes be automatically applied or some other danger indication be given on the train. While 95 any one of a number of devices to accomplish this purpose may be used, the applicant pre- 100

fers to install at an intermediate point of the block, a device which is a duplicate of the automatic device that is disposed in the roadside at the entrance to the block. In the specific form of the applicant's invention, disclosed in the present application, the type of automatic devices utilized are of the type known as inductors. This type of device is broadly disclosed in U. S. Patents Nos. 888,416 and 888,417. The specific construction of the train carried devices that cooperate with the wayside inductors, and their manner of cooperation, are disclosed in my Patent No. 1,552,962, in my copending application, Serial No. 506,595, filed October 10, 1921, and my application filed on even date herewith Serial No. 123,334.

There are also other conditions under which it frequently becomes desirable to provide an automatic train stopping device at a point intermediate the ends of a block, such conditions arising in the vicinity of bad curves or at the approach to the entrance of a tunnel or the like. Under such conditions the train carried devices may be speed controlled, so that the automatic stopping of the train will not take place unless the speed of the train exceeds a predetermined maximum.

Whereas the wayside inductor, which is disposed at the entrance of a block, is connected in a circuit which, although controlled by the block signaling circuit, is nevertheless separate and distinct from such circuit, the inductor that is disposed intermediate the ends of the block, is connected directly to the block signaling circuit at the point where said device is installed, and thereby it becomes unnecessary to duplicate any line wires.

Under some conditions it becomes desirable to provide for an overlapping relationship between adjacent blocks. In other words, it frequently becomes desirable to bring about an application of the brakes on a train in one block when certain conditions exist in the next block in advance, or in a portion of the next block in advance. The present invention may, therefore, be utilized to accomplish this end. In the system shown in Fig. 2 the inductor, disposed at an intermediate point of the block, is responsive to the conditions in the next succeeding block. In the system shown in Figs. 3 and 4, the intermediate inductor is responsive to conditions which exist in the first section of the next succeeding block.

While there are various types of inductor devices available to accomplish the function desired, the applicant prefers to use the type of inductor device which cooperates with train carried devices which are fed by alternating current. It thereby becomes possible to establish circuits for the wayside inductor which will permit the passage of alternating currents, but will not permit the passage of

the direct current employed in the block signaling circuits.

In the drawings:

Fig. 1 shows a wayside block signaling circuit in accordance with the present invention.

Fig. 2 shows a similar circuit in which a full block overlap is obtained.

Figs. 3 and 4 show modifications in which only a one section overlap is obtained.

Figs. 5, 6, 7 and 8 show the application of the invention to similar systems, except that the inductor device is of the type which contains a tripping inductor and a resetting inductor.

Fig. 9 is a schematic showing of the train carried devices and the manner of cooperation of same with a roadside device where the roadside device is of the single inductor type.

Fig. 10 is a schematic device of the train carried devices and their manner of cooperation with the roadside device when the roadside device is of the double inductor type, namely of the type that has a tripping inductor and a reset inductor.

Fig. 1 shows a block signaling system which is modified in accordance with the present invention. In order to make the disclosure more readily intelligible, some of the duplicate devices have been eliminated, but it will be understood that the devices shown at the entrance to the block are duplicated at the entrance of every other block and that the battery pole changer and other connections shown at the opposite end of the block are also duplicated at the corresponding end of other blocks.

At this point I shall explain the diagrammatic showing of some of the elements of the system. The construction of the remainder of the system will be apparent when the operation of the system is described herein-after. B2 represents the wayside inductor which is normally close-circuited by means of the wire 16, relay contact 17, wire 22, wire 18, switch contact SC and wire 19. The switch contact SC is mechanically or otherwise operable by the semaphore 2, which is capable of assuming clear, caution and stop positions. As shown in the drawings, the semaphore is in the clear position. When it assumes the caution position the switch contact SC will move to dotted line position P1, and will remain in circuit with the wire 19 by the aid of conductor 40. When the semaphore 2 assumes its stop position the switch contact SC will take position P2, whereby the circuit of the inductor device B2 is broken.

The operation of the semaphore is controlled by the control relay CR. While any suitable type of relay may be used for this purpose, in the present disclosure a polarized relay is shown. This relay is designed to operate unpolarized contacts 17 and 20 and the polarized contact 21. When the relay CR is energized by a current of a given polar-

ity, all of its contacts are closed and the semaphore is thereby maintained in clear position. When the control relay CR is energized by a current of opposite polarity the contacts 17 and 20 will be closed, while the contact 21 will be open and thereby the semaphore will be maintained in the caution position. When, however, the control relay CR is entirely deenergized all of its contacts 17, 20 and 21 will be open and the semaphore will be moved to stop position. It will be understood that standard control circuits for semaphore operation are utilized and have therefore not been described in detail.

15 At the opposite end of the block a battery B1 for energizing the control relay CR is disposed and it is provided with a pole changer PC, which is operable by the movements of the semaphore 1. The battery B1 is 20 connected to the control relay CR by means of the conductor 15 and common wire CW on one side and by means of the conductor 3, track relay contact 4, conductor 5, track relay contact 6, conductors 7 and 8, inductor PL, conductor 9, track relay contact 11, conductors 12 and 13 on the other side.

I do not wish to be limited to the specific form of the block signaling circuit illustrated and described. Any one of the well known 30 block signaling circuits may be utilized in the place of the one shown herewith. The specific block signal circuit is shown merely as illustrative of one type of circuit with which the present invention may be combined 35 without altering the operation of the block signals.

In the block signaling system illustrated herewith the entry of a train into the block of signal 2 will open the contact 4 by the 40 deenergization of the corresponding track relay TA; the control relay CR will be de-energized thereby, the semaphore 2 will be put in its stop position, and the circuit of the inductor B2 will be opened at 17 and at SC. 45 A train attempting to enter the block against the stop signal will have its brakes applied by the effect of the open circuited inductor B2. As long as there is a train in the block in any one of the sections A, B or C, one 50 of the contacts 4, 6, or 11 will be open by the deenergization of one of the track relays and the semaphore 2 will remain at stop.

When the train enters section D of the 55 next succeeding block the semaphore 1 will be set at stop in the same manner. The movement of the semaphore 1 will shift the pole changer to its dotted line position, wire 14, now serving in place of wire 13. The contacts 4, 6 and 11 being closed, the control 60 relay CR is now again energized, but in the opposite direction. Armatures 17 and 20 will be closed, but contact 21 will remain open. Signal 2 will, therefore be put in its caution 65 position and the circuit of inductor B2 will be closed.

When the train passes out of the block of signal 1, the signal 1 will be moved to its caution position, which movement will shift the pole changer back to its normal position and the control relay CR will again be energized in its normal direction and the contact 21 will be closed, which will cause the signal 2 to take its clear position.

While in Fig. 1 of the drawings the signal 1 is shown as controlling the pole changer PC and the signal 2 as controlling the circuit closer SC, it will be understood that when the system of the invention is applied to a plurality of successive blocks, each signal or semaphore element will control both a circuit closer such as SC and a pole changer such as PC.

The inductor PL, it will be noted, is connected to the block signaling circuit at a point between two adjacent track relays. A condenser K is connected by conductor 10 between one side of the inductor and the common wire CW.

The inductor PL shown diagrammatically in Fig. 1, the specific construction of which is more clearly explained in the applications and patents referred to hereinabove, is so designed and constructed that when its circuit is closed, it will be ineffectual, will not transmit any signal and will not operate any devices carried by the train. If, however, the circuit in which the inductor PL is connected is open and a train carrying cooperating devices should pass over this inductor when its circuit is open, an application of the brakes or some other indication will take place on the train.

The operation of the system disclosed in Fig. 1 is as follows:

Assume a train to pass from the left to the right and enter the block shown in the figure; the train may have entered the block because the semaphore 2 indicated clear or caution. It is also possible that the operator of the train may have entered the block against the stop signal by utilizing the manual reset as will be seen further hereinafter.

After the train has passed into the block of signal 2, but before reaching the inductor PL, the circuit of the control relay CR is opened either at contact 4 or at contact 6, or at both. The circuit of the inductor PL, however, remains closed through wire 9, contact 11, wires 12 and 13, battery B1, wires 15, CW and 10, and the condenser, provided, however, that the remainder of the block is clear and the signaling circuit to the end of the block is intact. The train, therefore, when it approaches and passes inductor PL will receive no indication and will be able to proceed. But should the remainder of the block be occupied, or should the remainder of the block signal circuit be open for any other reason, the circuit traced above for the inductor PL would be open at 11 and the pass- 125

ing train would receive a stop indication by means of the cooperation between the wayside inductor PL and the train carried devices.

It will be seen from the above that by the mere insertion of the inductor PL in the block signaling circuit, and by the aid of the condenser connection, an additional check is obtained, whereby the progress of the train within the block is checked, if the conditions of the remainder of the block are such as to make it dangerous for the train to pass further in the block.

The system shown in Fig. 2 is identical with the system shown in Fig. 1, so far as the block signaling system is concerned and it is, therefore, thought unnecessary to duplicate all of the detail shown in Fig. 1. It is thought sufficient merely to indicate wherein the system shown in Fig. 2 differs from that shown in Fig. 1. The condenser K in this system instead of being connected directly to one side of the inductor PL, is connected to the back contact of the track relay armature 6 by wire 26 and to the wire CW by wire 10. An inductive resistance 22 is inserted in the circuit in the place of the wire 13 shown in Fig. 1. The inductive resistance 22 and the condenser are so chosen that, together with the inductor PL they constitute a circuit which is resonant at the frequency of the current employed by the train carried devices.

The operation of this system is as follows:

When a train enters a block and approaches the inductor PL, the deenergization of the track relay TB will cause the contact 6 to close the circuit of the condenser, thereby establishing a resonant circuit, or a circuit of low resistance to the alternating current carried by the train devices. If, therefore, the remainder of the block is clear, and if also the block next succeeding is clear, the circuit of the inductor PL is closed and the passing train will not receive any indication. If, however, there should be a train ahead of the passing train in the remainder of the block, the circuit of the inductor PL will be opened at the track relay contact 11 and the passing train will receive a stop indication. If there is a train in the next succeeding block the connection of the battery B1 will be reversed and the inductive resistance 22 will be removed from the circuit. This will unsettle the resonant condition of the circuit of the inductor PL, with the result that such circuit will offer a high resistance to the flow of current and its effect will be the same as though the circuit were open. A train which will attempt to pass the inductor PL under these conditions will receive a stop indication or an application of the brakes.

It will be seen, therefore, that in the system shown in this figure a full block overlap is attained. The inductor PL is responsive not only to the conditions that exist in the remainder of the block, but is also responsive

to the conditions that exist in the block next succeeding, and a stop indication will be given to a passing train if there is a train at any point between the inductor and the further end of the next succeeding block.

In the system shown in Fig. 3 the block signaling system remains substantially identical with the system shown in Fig. 1, but the manner of connection of the inductor PL is again modified. In the present case one side of the inductor PL is connected to the return wire CW, whereas the other side is connected to the back contact of the track relay armature 6. At the battery connection the inductive resistance 23 and the condenser 24 are connected in parallel with each other, the condenser 24 being connected in series with the track relay armature 29 by the wires 27 and 28, the armature 29 being connected to 15 by wire 30. The armature 29 is controlled by the first track relay TD of the next succeeding block.

In the operation of the system disclosed in Fig. 3 the approach of a train to the inductor PL will, as in the system described in Fig. 2, establish an alternating current circuit for the inductor PL, which will include the parallel circuit which contains the inductive resistance 23 and the battery in one arm and the condenser 24 and the track relay armature 29 in the other arm. The inductive resistance 23 and the condenser 24 are so chosen that they constitute a circuit resonant to the frequencies used for the train devices. It will be seen that in the present system, as well as in the system described in Fig. 2, the presence of a train in the remainder of the block ahead of inductor PL, will cause the opening of track relay contact 11 and thereby break the circuit of the inductor PL. A train attempting to pass inductor PL under such conditions will receive a stop indication or an application of the brakes. A train in the first section of the next succeeding block will cause the contact 29 to open by the deenergization of the corresponding track relay TD. This will unsettle the resonant conditions in the circuit and the circuit of the inductor PL will then offer a high resistance to the flow of alternating current and put it in a virtually open circuit condition. Under such conditions a train that may attempt to pass the inductor PL will also receive a stop indication or an application of the brakes. However, the presence of a train in the next succeeding block beyond the first section of that block, will leave the circuit of the inductor PL undisturbed and it will, therefore, be possible for a train to pass the inductor PL without receiving any indication. This is due to the fact that the circuit is now so arranged that the reversing of the polarity of the battery connection does not alter the constants of the alternating current circuit which includes the inductor PL, the inductive re-

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sistance 23 remaining in the circuit thru the connection by wire 14 and the condenser 24 remaining in the circuit due to the energization of TD.

5 The system shown in Fig. 4 accomplishes the same ends as that shown in Fig. 3, but in a different manner. The condenser here is connected to the back contact of the armature 6, while at the battery connection there 10 are two duplicate inductive resistances 131 and 127, one of which is connected in lieu of the wire 13 shown in Fig. 1, and the other of which is connected to the front contact of the track relay armature 29, the armature 29 being controlled by track relay TD (see Fig. 1). In the present case connections are so arranged that only one of the inductive resistances remains in the circuit, depending upon whether the battery is connected to the block 15 signaling circuit in one direction or in the other. If, however, the track relay contact 29 is opened by the presence of a train in the first section of the next succeeding block, both of the inductive resistances are removed 20 from the circuit, with the result that the resonant condition of the circuit is disturbed, this having the same effect as the opening of the circuit. In this system the inductor PL will give a stop indication on the passing 25 train when there is a train in the remainder of the block or in the first section of the next succeeding block.

The A. C. circuits of the inductor PL may be traced as follows: Assume that there is 30 a train in section B of the block. The armature 6 is therefore closed on its back contact and the circuit is closed between 6 and 26. We will now assume the conditions: (1) where there is no train in the remainder of the block and no train in the next succeeding block; (2) where there is a train in the next 35 succeeding block but at points beyond the first section thereof; (3) where there is a train in the first section of the next succeeding block and (4) where there is a train in the remainder of the block of signal 2.

(1) When neither the remainder of the block nor the next succeeding block are occupied the circuit is as shown in the drawings. The circuit is completed from 6 40 through 7, 8, PL, 9, 11, 12, inductive resistance 131, PC, B1, PC, 15, CW, 10, K, and 26 back to 6. This circuit contains the inductive resistance and the condenser which tune said 45 circuit to resonance, and PL is therefore virtually short circuited. It will, therefore, transmit no indication to the train.

(2) When there is a train in the next succeeding block beyond the first section thereof, 50 the pole changer is shifted to the dotted line position and the armature 29 is in its closed position. The circuit is then completed from 6 through 7, 8, PL, 9, 11, 12, 141, inductive resistance 127, 29, PC, B1, 15, CW, 10, K and 55 26, back to 6. In this circuit, like in the

one described in the preceding paragraph, the inductance 27 and the condenser K tune the circuit of PL to resonance. PL is virtually short circuited and it will transmit no indications to the train.

(3) When the first section of the next succeeding block is occupied the circuit traced in the preceding paragraph is broken at 29 and a new circuit is established through the wire 128 on the back contact of 29 whereby both inductive resistances are eliminated. The resonant condition of the circuit is disturbed and the circuit will offer a high impedance to the flow of alternating current of the frequency employed in the train mechanism. Inductor PL will therefore behave in the same manner as if it were open circuited and it will under these conditions effect the application of the brakes on a passing train.

(4) When there is a train in section C of the block the circuit of the inductor PL will be open at 11, and PL will, therefore, effect the application of the brakes on a passing train.

The inductive resistances 22, 23, 127 and 49 131, which are utilized in Figures 2, 3 and 4, are such that they do not interfere with the operation of the control relay CR.

The system shown in Fig. 5 is substantially identical with that shown in Fig. 2, except for the substitution of the double element type of inductor in the place of the single element type of inductor. In this type of inductor each element has its function, one of them (T with a suitable exponent) being known as a trip inductor and the other (R with a suitable exponent) being known as a reset inductor. The function of these tripping and resetting inductors will become clearer hereinafter particularly with the description of the combination apparatus shown in Fig. 10 of the drawings. The block signaling system per se as shown in this figure is identical with that shown in Figure 1 and the same reference characters are utilized in order to clearly indicate the identity of the two systems.

At the entrance to the block in place of the inductor B2 of Figure 1 is placed an inductor which is composed of the two elements R3 and T3. T3 is the trip element and is so designed that it operates with train carried devices to effect an application of the brakes and to give a danger indication on the train when the semaphore 2 is at stop position. The element R3 of this inductor is the reset element and is designed to cooperate with train carried devices to give a clear indication on the train or to reset the train devices that might have been previously operated by a trip inductor. The inductors R2 and T2 operate in the same way. In this system, therefore, as explained in connection with the discussion of the operation of the system shown in Figure 2, the inductors R2 and T2 125 130

will give a danger indication on the train or will effect an application of the brakes if there is a train on the track anywhere between the inductor and the other end of the next 5 succeeding block. If the remainder of the block and the next succeeding block are clear the reset inductors will serve to give a clear indication on the train.

In the system shown in Figure 6 the type 10 of inductor utilized is the same as that utilized in Figure 5, and is connected to the block signaling circuit in the manner as shown in Figure 3. The inductive resistance 23 and condenser 24 which are so chosen as to constitute a circuit resonant to the frequency employed in the train carried devices are the 15 equivalents of the corresponding elements in Figure 3 and function in the same manner as in Figure 3. In this system as in the system 20 shown in Figure 3, an overlap of only one section is obtained. In other words the presence of a train in the last section of the block or in the first section of the next succeeding block will either break the inductor circuit 25 or destroy the resonance of the circuit by removing the condenser due to the opening of the contact 29 and thereby the trip element T2 will become effective to cooperate with the train carried devices and effect an application 30 of the brakes or cause a danger indication.

In the system shown in Figure 7 the inductor is connected to the block signaling circuit in the same manner in which the corresponding inductor is connected to the block signaling circuit as shown in Figure 4. In lieu of the inductive resistances utilized in the system shown in the other figures the system in Fig. 7 utilizes resistance 41, which may or may not be inductive. This resistance is connected between wire 141 and the back contact of 40 29 and is inserted into the circuit for the purpose of putting the circuit in the stop condition. The condenser in the present system is so chosen that the inductor circuit will give a 45 clear indication to the passing train when it is free of resistance. This normal inductor circuit may be traced as follows and is completed when a train approaches the inductor: Beginning with the inductor R2, the circuit 50 passes through wire 7, contact 6, wire 26, condenser K, conductor 10, return wire CW, wire 15, pole changer PC, battery, wire 12, contact 11, wire 9 and inductor T2. The presence 55 of a train in the last section of this block will open contact 11 and the inductors will give a stop indication on the train. The presence of a train in the first section of the next succeeding block will open the front contact 60 29 and close the back contact 29 and at the same time the pole changer PC will be moved to the dotted line position and the circuit of the inductor will be as follows: the inductor R2, conductor 7, contact 6, wire 26, condenser K, wire 10, return conductor CW, wire 15,

70 pole changer PC, battery B1, pole changer PC, wire 131, contact 29, resistance 41, wire 281, wires 141 and 12, contact 11, wire 9 and trip inductor T2. The insertion of the resistance 41 into this circuit will have the same effect upon the inductors as opening the circuit, and it will effect an application of the brakes or a danger indication on the train. The operation of the control relay CR will not be affected by the insertion of the resistance. Under these conditions, however, the inductors will give a stop indication when there is a train in the last section of the block or in the first section of the next succeeding block. When, however, there is no train in either of these sections, although there may be a train in the remaining section of the next succeeding block, the resetting of the contact 29 to its front contact will again remove the resistance 40 from the circuit and the normal circuit of the inductor is reestablished and it will give a clear indication.

In the system shown in Figure 8, the two elements of the inductor are connected in the manner shown so that its circuit is closed by the back contact 6 when the train approaches the inductor. Normally the control relay CR is energized from battery B1, through pole changer PC, conductor 113, relay RS, conductors 32 and 12, contact 11, conductor 9, inductor coils T2 and R2, conductor 7, front contact 6, conductor 5, contact 4, conductor 3, coil CR, conductor CW, back contact 301, conductor 142 and pole 85 90 95 changer PC.

100 Normally the amount of current flowing in this circuit is insufficient to energize relay RS. A train approaching the inductors R2 and T2 causes the front contact of 6 to open and the back contact of 6 to establish a circuit, from which the control relay C has been removed. The current in the circuit is increased and the relay RS then becomes energized to close the contact 312 and front contact 301. This establishes the clear operating circuit for the inductor R2, T2, to include conductor 9, contact 11, conductor 12, contact 29, conductor 15, condenser K, conductor 271, front contact 312, conductors CW and 82, back contact 6, conductor 7 and coils of inductors R2 and T2. In the circuit just traced the condenser K is so chosen that together with the winding of inductors R2 and T2 the circuit is resonant at the frequency of the current utilized in controlling the train apparatus. The inductor coils R2 and T2 will under such conditions, give the clear indication to passing trains.

110 When the relay RS becomes energized and picks up its armatures 301 and 312, a stick circuit is established which includes battery B1, pole changer PC, conductor 113, relay RS, contact 33, conductor 228, front contact 301, conductor 142, pole changer PC. This 115 120 125 circuit remains closed as long as there is no 130

train in the first section of the next succeeding block. The presence of a train in the first section of the next succeeding block will open the front contact 33, the stick circuit just traced will open and RS becomes de-energized. The A. C. circuit for the inductors is opened at 312, but the circuit for the control relay CR is closed at back contact 301. Deenergizing of the relay RS and the opening of the inductor circuit does not interfere with the operation of the clock signaling system. It will be seen, therefore, that the presence of a train in the first section of the next succeeding block will put the inductors in a stop indication position.

Fig. 9 is a diagrammatic showing of the train carried device which cooperates with the type of roadside inductor shown in Figs. 1 to 4. PL is a diagrammatic showing of the roadside inductor shown in Figs. 1 to 4. The train carries a source of alternating current 60 and the inductors 61, 62. The inductor 62 has a winding 63 which is connected to the element 64 of a trip relay. The trip relay also includes the normally energized element 65. The inductor 61 has a winding 66 which is connected to the source 60. Winding 67 which links the inductor 62 is in series with the winding 66. The operation of this system is described in the applications and patents referred to hereinabove.

In broad terms, the operation of the system is as follows: The inductors 61 and 62 are carried by the train in such a manner that they pass over wayside inductor PL in close proximity therewith when the train passes the inductor. The train carried system will remain unaffected if the winding of the inductor PL is close circuited. If the winding of PL is open circuited or if the resistance of the circuit is very high, the electromagnetic relationships of the train carried elements will be disturbed and the trip control relay will operate to effect an application of the brakes or give some other indication of danger.

As described more particularly in the applications and patents hereinabove referred to, the vehicle carried coils 61 and 62 form coupled magnetic elements, the coil 61 normally defining an energizing coil receiving energy from the alternator 16 and the coil 62 defining an energy receiving coil receiving energy from coil 61 through the inductive gap therebetween for correspondingly energizing the relay element 64. These coils are in effect a transformer; and when the coupled coils or transformer combination move over the roadside winding PL with the latter in open circuit, magnetic flux is shunted from the secondary coil 62, the flux path now being more intensively from the core of the coil 61 to and through the roadside core or magnetic element over which PL

is wound. This diversion of flux effects the substantial deenergization of the relay element 64. If the roadside inductor PL, however, is close circuited, then the vehicle inductively coupled coils move over the roadside element without a change in effect, that is, without a substantial disturbance or variation in the flux conditions between said vehicle coupled coils 61 and 62.

Fig. 10 shows the train carried devices designed to cooperate with the type of roadside inductor shown in Figs. 5 to 8, inclusive. This system includes everything shown in Fig. 9 and designed to cooperate with the trip inductor T3. The system includes additionally the reset control relay 70, 71, and the inductor 72. The inductor 72 is provided with a winding 73 which is connected to the winding 70. The inductor 72 also has a winding 74 which is in series with the inductor and condenser being preferably so chosen that they constitute a resonant circuit.

The devices 70 to 75 cooperate with the roadside reset inductor R3 so that when the circuit of R3 is closed in resonant condition, energy having its source in the generator 60 is reflected and transmitted from the vehicle coil 66 to roadside inductor T3 to inductor R3 to the vehicle reset inductor 73. When the circuit to R3 and T3 is open, T3 forms a tripping element cooperating with the coils 61 and 62 in the same manner as hereinabove described in connection with Fig. 9 of the drawings; and under this condition R3 does not perform a resetting function. When, however, the series circuit of R3 and T3 is closed, T3 does not trip the vehicle carried circuits but forms an energy receiving coil receiving energy from the vehicle transmitting coil 66, said energy being transmitted to the resetting coil R3 which in turn cooperates with the vehicle carried energy receiving coil 73, the latter functioning to reenergize the relay winding 70.

I do not wish to be limited to the form of block signaling circuit disclosed herewith, nor to the form of train carried devices disclosed therewith. These are shown as merely illustrative of the embodiment of my invention.

Having described my invention, I claim:

1. In a train controlled block signaling system of the type having a normally closed electric circuit energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by a train to give an indication on the train of the condition of the remainder of the block, and means whereby an alternating current circuit is established

for the said inductor when a train reaches the vicinity of said inductor.

2. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by a train to give an indication on the train of the condition of the remainder of the block, means whereby an alternating current circuit is established for the said inductor when a train reaches the vicinity of the said inductor, and means whereby the constants of the said alternating current circuit may be altered by the presence of a train in the remainder of the block.

3. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by a train to give an indication on the train of the condition of the remainder of the block, means whereby an alternating current is established for the said inductor when a train reaches the vicinity of the said inductor, and means whereby the constants of the said alternating current circuit may be altered by the presence of a train in the block ahead.

4. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by a train to give an indication on the train of the condition of the remainder of the block, means whereby an alternating current circuit is established for the said inductor when a train reaches the vicinity of the said inductor, and means whereby the last mentioned circuit may be altered to offer a high resistance to alternating currents by the presence of a train at any point between the said inductor and the farther end of the next succeeding block.

5. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by a train to give an indication on the train of the condition of the remainder of the

block, means whereby an alternating current circuit is established for the said inductor when a train reaches the vicinity of the said inductor, and means whereby the last mentioned circuit may be altered to offer a high resistance to alternating current by the presence of a train in advance of the inductor at any point between the inductor and the farther end of the next succeeding block.

6. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby an alternating current circuit of low resistance is established for the said inductor when a train reaches the vicinity of the inductor, and means whereby the said last mentioned circuit may be altered to offer a high resistance to alternating current by the presence of a train in the remainder of the block.

7. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby an alternating current circuit of low resistance is established for the said inductor when a train reaches the vicinity of the inductor, and means whereby the said last mentioned circuit may be altered to offer high resistance to alternating current by the presence of a train at any point between the inductor and the further end of the next succeeding block.

8. In a train controlled block signaling system of the type having an electric circuit normally energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby an alternating current circuit of low resistance is established for the said inductor when a train reaches the vicinity of the inductor, and means whereby the said last mentioned circuit may be altered to offer a high resistance to alternating current by the presence of a train at any point between the inductor and a point intermediate the ends of the next succeeding block.

9. In a train controlled block signaling system of the type having a normally closed

electric circuit energized by direct current disposed on the roadside substantially the entire length of the block for operating the block signals, an inductor connected to an intermediate point of said circuit and adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train of the condition of the circuit. 5

10. In a train controlled block signaling system of the type having a normally closed electric circuit energized by direct current disposed on the roadside substantially the entire length of the block for operating the block signals, an inductor connected to an intermediate point of said circuit and adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train of the condition of the circuit, and means whereby an alternating current circuit is established for the said inductor when a train reaches the vicinity of said inductor. 15

11. In a train controlled block signaling system of the type having a normally closed electric circuit energized by direct current disposed on the roadside substantially the entire length of each block for operating the block signals, an inductor connected to an intermediate point of said circuit adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train of the condition of the circuit in the next block in advance. 20

12. In a train controlled block signaling system of the type having a normally closed electric circuit energized by the direct current disposed on the roadside substantially the entire length of each block for operating the block signals and having a pole reversing switch operable by the operation of the block signal, an electroresponsive device connected to an intermediate point of said circuit and adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby an alternating current circuit of low resistance is established for the said electroresponsive device when a train reaches the vicinity of said device, and means whereby the operation of the said polarity reversing device converts said alternating current circuit into a high resistance circuit. 25

13. In a train controlled block signaling system of the type having an electric circuit substantially the entire length of each block for operating the block signals, an electroresponsive device connected to an intermediate point of said circuit and adapted to operate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby a resonant circuit is established for the said electroresponsive device when a train reaches the vicinity of said device, and 30

means whereby the resonance of the circuit is destroyed by the presence of a train in the remainder of the block. 35

14. In a train controlled block signaling system of the type having an electric circuit substantially the entire length of each block for operating the block signals, an electroresponsive device connected to an intermediate point of said circuit and adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby a resonant circuit is established for the said electroresponsive device when a train reaches the vicinity of said device, and means whereby the resonance of the circuit is destroyed by the presence of a train at any point between the said electroresponsive device and the further end of the next succeeding block. 40

15. In a train controlled block signaling system of the type having an electric circuit substantially the entire length of each block for operating the block signals, an electroresponsive device connected to an intermediate point of said circuit and adapted to cooperate with corresponding alternating current devices carried by the train to give an indication on the train, means whereby a resonant circuit is established for the said electroresponsive device when a train reaches the vicinity of said device, and means whereby the resonance of the circuit is destroyed by the presence of a train at any point between the said electroresponsive device and a predetermined point intermediate the ends of the next succeeding block. 45

16. In a train controlled block signaling system, a roadside circuit comprising a source of energy and a plurality of switches, an electroresponsive device adapted to cooperate with train carried devices, means whereby said switches may be operated by the presence of a train on the track in the vicinity of said switches, and means whereby an alternating current circuit is established for said electroresponsive device by the opening of one of said switches and said alternating current circuit is broken by the opening of another of said switches. 50

17. A train controlled block signaling system of the type having a semaphore signal, and a control relay for said signal at the entrance to each block, a battery at the other end of the block, a normally closed circuit connecting the battery and the control relay, roadside devices responsive to the presence of a train in the block for opening said circuit, and means responsive to the presence of a train in the next succeeding block for reversing the connection of the battery to the circuit, in combination with an electroresponsive device, adapted to cooperate with train carried devices to give an indication on the train, said device being installed on the road- 55

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side at a point intermediate the ends of the block and connected to the circuit at the point of its installation, an inductance connected to said battery in the said circuit, a capacitance connected to said circuit, and 5 means whereby the presence of a train in the vicinity of the device will establish an A. C. circuit through the device, the capacitance and the inductance.

18. The combination recited in claim 17, 10 and means whereby the reversal of the connection of the battery to the block signaling circuit will disconnect the inductance.

19. The combination recited in claim 17, 15 and means responsive to a train in the first section of the next succeeding block for disconnecting said capacitance from the said A. C. circuit.

20. In a train controlled block signaling 20 system of the type having a normally closed circuit extending substantially the entire length of each block, an electroresponsive device connected to an intermediate point of said circuit adapted to cooperate with train carried devices for giving an indication on 25 the train, a control relay in the said circuit for controlling the operation of the block signals, a normally unenergized signal relay in the said circuit, means controlled by the presence of a train in the block in the vicinity 30 of the said device for deenergizing the control relay and energizing the signal relay, a capacitance, and means operated by the energization of the signal relay for electrically connecting said capacitance to said device.

21. The combination recited in claim 20, 35 and means responsive to the presence of a train in the next succeeding block for disconnecting said capacitance.

Signed at New York city in the county of 40 New York and State of New York, this 25th day of June, A. D. 1926.

ARCHIBALD G. SHAVER.

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