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MOTOR CAR PROTECTION SYSTEM FOR RAILROADS

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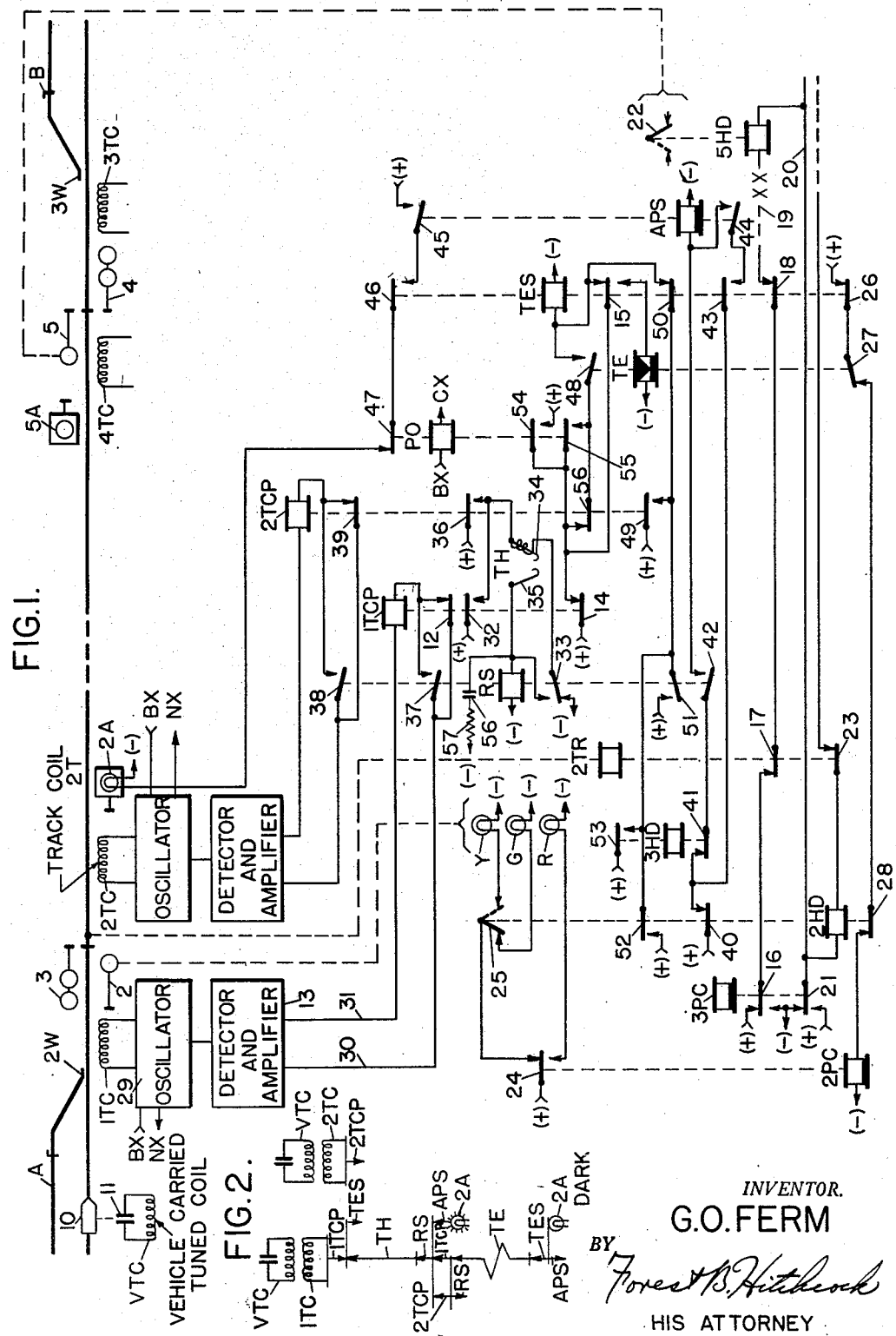


FIG. 1.

FIG. 2.

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MOTOR CAR PROTECTION SYSTEM FOR RAILROADS

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This invention relates to motor car protection system for railroads and it more particularly pertains to automatic means for controlling railway signals to indicate the presence of a motor car within a given stretch of track.

Some cars, such as the motor cars used by railway maintenance men, either have their axles insulated to prevent the shunting of the track rails, or the cars are so light as to make shunting of the track rails unreliable. Therefore, these cars must generally proceed with no signal protection.

The system according to the present invention provides a means for automatically registering when a motor car or similar vehicle passes a particular point and for providing signalling protection for the vehicle to be effective for a predetermined length of time after registration has been made. The registration of the presence of the car is accomplished by the inductive coupling of a tuned coil of the vehicle with a wayside receiver coil located at the entrance to the territory in which protection for a motor car is to be provided. When this registration means is actuated, the last signal in the rear is put to stop, and the signal behind that is put to caution. These signals are again permitted to clear at the end of a predetermined time interval.

It is further provided for single track railroads that motor car protection can be provided for the stretches of track, or blocks, between passing sidings in a manner to automatically render protection effective for motor cars entering the respective blocks, but to be ineffective for the passage of motor cars in the opposite direction, as it is assumed that these cars will use the passing sidings. If trains are encountered on the passing sidings, they are generally proceeding slow enough to allow sufficient time for motor cars to be removed from the track.

This distinctive control as to direction of movement of the motor cars is accomplished by the use of two track coils at each end of each block, direction being indicated by the sequence of the loading of detector apparatus associated with the respective track coils.

An object of the present invention is to provide means inductively initiated for providing signaling protection for a motor car for a predetermined time interval.

Another object of the present invention is to automatically initiate a timer for the control of wayside signals upon passage of a motor car in one direction but not the other.

Another object of the present invention is to distinctively indicate when signaling protection for a motor car has been rendered effective.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings and in part obvious as the description progresses.

In describing the invention in detail, reference is made to the accompanying drawings in which:

Fig. 1 is a schematic diagram of one embodiment of the present invention as applied to a typical stretch of trackway; and

Fig. 2 is a sequence chart illustrating the sequence of operation of the relays upon entrance of a block by a motor car.

The illustrations employed in the disclosure of the present invention have been arranged to facilitate the disclosure as to the mode of operation and the principles involved rather than for the purpose of illustrating the construction and arrangement of parts that would be employed in practice. Thus, the various parts are illustrated by conventional symbols, and some parts well known in the art have been shown by block diagram. The symbols (+) and (—) are employed to indicate connections to the respective positive and negative terminals of suitable batteries or other sources of direct current.

With reference to Fig. 1, the embodiment of the invention illustrated is shown as being applied to the control of signals governing entrance to a stretch of single track conveniently called a block connecting passing sidings A and B. Signals 2 and 5 are provided for governing entrance to the block at the respective ends of the block, and the signals 3 and 4 are provided for governing trains leaving the block. These signals can be of any conventional type such as signals having individual color light units or searchlight signals. It is to be understood that other signals are included within the block according to the requirements of practice in the portion illustrated as being broken. The passing siding A is connected to the main track by a track switch 2W and the passing siding B is connected at its left hand end to the main track by the track switch 3W.

Located along the trackway at the ends of each block are respective pairs of receiver track coils TC, the track coils 1TC and 2TC of Fig. 1 being respectively disposed along the trackway so as to be subject to inductive coupling successively by the passage of an eastbound motor car (traffic to the right) upon entering the block between the passing sidings A and B, and the track coils 3TC and 4TC being respectively disposed along the trackway so as to cooperate inductively and in succession with the vehicle carried coil on a westbound motor car (traffic to the left) upon entering the block between the passing sidings A and B.

Each of the track coils TC is a part of a tuned circuit of a radio frequency oscillator, and although the oscillator is shown only in block form in Fig. 1, it is to be understood that this oscillator can be constructed according to the disclosure of Fig. 5 of the U.S. Patent of H. C. Kendall et al. No. 2,693,525, granted November 2, 1954. The oscillator disclosed in that patent is of the sweep frequency type, which has the advantage of increasing the sensitivity of the receiver. It is to be understood, however, that a conventional oscillator without the sweep frequency feature can be used if desired.

Detector and amplifier apparatus, as is illustrated in block form in Fig. 1, is associated with the respective oscillators for the purpose of detection of times when the associated oscillators are loaded by inductive coupling with a tuned vehicle carried coil. This apparatus can be in the form of a reaction detector connected to the control grid of the tube of the associated oscillator. There is sufficient amplification provided to furnish an output to pick up a relay, or a gas tube is triggered to operate a relay, in accordance with the requirements of practice. The reaction detector, amplifier, and control gas tube organization can be provided according to the system fully disclosed in the above mentioned Kendall et al. Patent No. 2,693,525.

A detection relay TCP is provided in association with

each of the track coils TC as a means for registering the detection of the passage of a motor car.

Each of the motor cars is provided with a vehicle carried tuned coil VTC such as the coil VTC illustrated in Fig. 1 as being associated with a motor car **10**. This coil is tuned to a given frequency by a condenser **11** connected in multiple therewith.

The track layout is divided into track circuits for the control of the signals in a conventional manner, and conventional automatic signaling means is provided with modifications as will be hereinafter considered. The track section 2T is illustrated as having associated therewith a conventional track relay 2TR, the track section 2T being the section immediately ahead of the signal 2 for governing eastbound traffic.

A line circuit controlled relay 2HD is illustrated as being associated with the control of signal 2, and a line circuit controlled relay 5HD is illustrated as being associated with the control of signal 5. Signals 2 and 3 have associated therewith slow drop away pole changing relays 2PC and 3PC respectively.

A reset relay RS is provided for resetting the relays 1TCP and 2TCP subsequent to their actuation and for use in governing other control circuits, the relay RS having associated therewith a thermal relay TH which must be actuated before the relay RS can be picked up. Relay RS is made slow to drop away by its winding being shunted by a condenser **56** in series with a resistor **57**.

A normally energized timing repeater stick relay TES is used in controlling a motor driven timer TE which governors the amount of time for which protection is provided for a motor car subsequent to passage of an associated receiver track coil upon entering the block between passing sidings. This timer is required to time a relatively long interval, and thus the motor timer structure according to the U.S. patent of O. S. Field, No. 2,378,293, granted June 12, 1945, is particularly adapted for this purpose.

Signals 2A and 5A are provided for indicating when the motor car protection is effective. These indicators should be so disposed as to be visible to the operators of the motor cars, and it may be advisable that the indicators be disposed so as to be visible to the operators of trains as well. Each of the indicators 2A and 5A has a slow drop away approach control stick relay APS associated therewith.

A power-off relay PO is provided for rendering the system ineffective when the power is off.

The relay control apparatus has been illustrated particularly associated wtih the track coils 1TC and 2TC, and it is to be considered that this apparatus is typical of the apparatus that is provided in association with each pair of track coils that may be provided at the entrance end of the respective blocks for both directions of traffic.

Having thus considered the apparatus in general, consideration will now be given as to the specific circuit organization when considering the mode of operation under specific assumed typical operating conditions.

Operation

Normally, with no trains or motor cars present, the track relays are all energized in the usual manner and the signals are clear, the signaling organization assumed to be provided for the present embodiment being a conventional three wire absolute permissive block signaling system.

The receiving relays TCP are all normally maintained energized by their respective stick circuits, relay 1TCP, for example, being maintained picked up by a stick circuit through its front contact **12** in accordance with energization by the detector and amplifier **13**.

The timing stick relay TES is normally maintained picked up by a stick circuit extending from (+), including front contact **14** of relay 1TCP, front contact **15** of relay TES and winding of relay TES, to (—).

The line relays HD and the pole changing relays PC are normally energized according to usual practice. Relay 5HD, for example, which is associated with the control of signal 5, is normally energized by a circuit extending from (+), including front contact **16** of relay 3PC, front contact **17** of relay 2TR, front contact **18** of relay TES, line wire **19**, selections as indicated by XX, winding of relay 5HD, common return wire **20**, and front contact **21** of relay 3PC, to (—). In accordance with such energization, the signal 5 is normally clear because of the closure of contact **22** of relay 5HD in its right hand position. Relay 2HD is energized by a similar circuit (not shown complete) including front contact **23** of relay 2TR. The polarity of energization of relay 2HD is such as to operate the polar contacts of that relay to their left hand positions and thus cause the energization of the green lamp G of signal 2 through front contact **24** of relay 2PC and contact **25** of relay 2HD in its left hand position.

Relay 2PC is in its picked up condition normally because of the energization of a circuit extending from (+), including front contact **26** of relay TES, back contact **27** of relay TE, front contact **28** of relay 2HD, and winding of relay 2PC, to (—).

The power-off relay PO is normally energized because of the application of energy directly to its winding from the same source of alternating current that is used for the energization of the oscillators and detector and amplifier equipment at the associated location.

To consider the mode of operation under a typical operating condition, it will be assumed that a motor car **10** is equipped as has been described with a vehicle-carried coil VTC which is tuned by a condenser **11**. When this coil VTC becomes inductively coupled with the track coil 1TC upon entrance of the motor car into the block between the passing sidings A and B, the oscillator **29** becomes loaded and thus causes the detector and amplifier **13** to interrupt the energization of the detector relay 1TCP so as to cause that relay to be dropped away. Although the loading of the oscillator **29** is only momentary in accordance with the motion of the motor car **10**, the relay 1TCP is not again immediately picked up when energy is restored to the output wires **30** and **31** of the detector and amplifier **13** after passage of the car. This delay in restoration is established to insure time for operation of other relays in accordance with the presence of the motor car **10** having been detected.

Upon the dropping of relay 1TCP, the timing stick relay TES becomes dropped away by the opening of its stick circuit at front contact **14** of relay 1TCP. The dropping away of relay 1TCP also starts the heating of the thermal relay TH by the energization of a circuit extending from (+), including back contact **32** of relay 1TCP, winding of relay TH, and back contact **33** of relay RS, to (—). Upon the completion of operation of the thermal relay TH, the reset relay RS is picked up by the energization of a circuit extending from (+), including back contact **32** of relay 1TCP, contact fingers **34** and **35** of the thermal relay TH and winding of relay RS, to (—). Upon the picking up of relay RS, a stick circuit is established for this relay through front contact **33** to shunt the contact fingers **34** and **35** of the thermal relay TH out of the circuit just described. Because of the time involved in the operation of the thermal relay TH, in all probability the motor car **10** has proceeded to the point of causing the dropping away of the relay 2TCP and the dropping away of this relay has been effective to close its back contact **36** to also provide energy for the relay RS.

The picking up of relay RS causes the restoration of the relay 1TCP to its picked up position by the closure of front contact **37**, and this relay when picked up is maintained energized by its stick circuit including front contact **12** which is connected in multiple with front contact **37**. Similarly, the relay 2TCP becomes picked up

upon the closure of front contact 38 of relay RS, and the picking up of this relay establishes a stick circuit through front contact 39 which is connected in multiple with front contact 38 of relay RS. Relay RS then becomes dropped away because of back contacts 32 and 36 of relays 1TCP and 2TCP respectively being both open.

Assuming that there are no trains approaching the right-hand end of the passing siding A, proceeding in either direction, the relays 2HD and 5HD are both in their picked up positions as has been described, and in accordance therewith, the relay APS is picked up at this time to apply energy to the motor car indicator lamp 2A. The pick-up circuit for relay APS extends from (+), including front contact 40 of relay 2HD, front contact 41 of relay 3HD, front contact 42 of relay RS, and winding of relay APS, to (−). This relay when picked up is maintained energized through a stick circuit shunting contacts 41 and 42 of relays 3HD and RS, respectively, out of the circuit just described. This stick circuit extends from (+), including front contact 40 of relay 2HD, back contact 43 of relay TES, front contact 44 of relay APS, and winding of relay APS, to (−).

The picking up of relay APS causes the energization of the motor car indicator signal lamp 2A by a circuit extending from (+), including front contact 45 of relay APS, back contact 46 of relay TES, front contact 47 of relay PO, and lamp 2A, to (−).

The dropping away of relay TES in response to detection of the presence of the motor car proceeding in the direction as specified is effective to put the signals 2 and 5 which govern entrance to the block to stop. Signal 2 is put to stop because of the dropping away of the relay 2PC upon the opening of its circuit at front contact 26 of relay TES. The opening of front contact 24 of relay 2PC opens the circuit for the green lamp G of signal 2, and the closure of back contact 24 establishes a circuit for the energization of the red lamp R of that signal.

Signal 5 is put to stop because of the opening of the circuit for relay 5HD at front contact 18 of relay TES. This relay in dropping away opens a circuit (not shown) for a relay 5PC comparable to the circuit shown in detail for the control of relay 2PC so that such relay is dropped away. The dropping away of this relay is effective like the dropping away of relay 2PC to extinguish the green lamp G of the associated signal 5 and energize the red lamp R of that signal.

As soon as the relay 1TCP has become picked up after its actuation, a circuit is closed for the energization of the timer TE to time the interval during which protection is to be maintained for the motor car. The circuit for energization of the timer TE includes front contact 14 of relay 1TCP and back contact 15 of relay TES. The duration of the time interval for which the timer TE is set to time, is such as to provide the desired time of protection for the motor car in order that the motor car may have time to reach its destination which may be the next siding, or the car may be set off the track within the block. After the timer TE has completed its operation, the relay TES is picked up by the energization of a circuit extending from (+) including front contact 14 of relay 1TCP, front contact 56 of relay 2TCP, front contact 48 of timer TE, and winding of relay TES, to (−). Relay TES, when picked up, closes the circuit for relay 5HD at front contact 18 and closes the circuit for relay 2PC at front contact 26 so as to permit the signals 2 and 5 governing entrance to the block to be restored to their normally clear indicating conditions. The picking up of relay TES opens the circuit for the energization of the timer TE at back contact 15 of relay TES, and thus the timer TE is restored to its normal condition so as to close back contact 27 in the circuit for relay 2PC. Relay TES is maintained energized at this time by the stick circuit that has been described as being normally effective for that relay, and thus the opening of front contact 48 of relay TE has no bearing upon the control of relay TES at this time.

The lamp of the indicator signal 2A is extinguished upon the picking up of relay TES by the opening of its circuit at back contact 46, and the opening of back contact 43 of relay TES causes the dropping away of the approach stick relay APS by the opening of its circuit. Thus the control apparatus has been completely restored to its normal conditions after having been actuated by the entrance of a motor car into the block between the passing sidings A and B.

For the passage of traffic in the opposite direction, similar apparatus (not shown) associated with the receiving coils 3TC and 4TC is operated in a similar manner to the mode of operation that has been described for the passage of an eastbound car.

If a westbound motor car leaves the block, however, the inductive coupling of the vehicle carried coil VTC with the track coils 2TC and 1TC successively does not put the signals 2 and 5 to stop because of the car leaving the block rather than entering it. This is because of the sequence in which coupling with these coils is established. The dropping away of the receiver relay 2TCP prior to the dropping away of relay 1TCP maintains relay TES picked up by the energization of a stick circuit extending from (+), including back contact 49 of relay 2TCP, front contact 50 of relay TES, and winding of relay TES, to (−). The reset relay RS is picked up by a similar mode of operation to that which has been considered, and this relay when picked up establishes another stick circuit for the relay TES to maintain it picked up until the relay 1TCP has been restored to its picked up position after passage of the motor car. The stick circuit by which relay TES is maintained energized by relay RS extends from (+), including front contact 51 of relay RS, front contact 50 of relay TES and winding of relay TES, to (−).

Because of the relay TES being maintained picked up when a motor car leaves the block, singals 2 and 5 are not put to stop as the circuit for the signal control relay 2PC is maintained closed at back contact 26 of relay TES and the circuit for relay 5HD is maintained closed through front contact 18 of relay TES.

Another condition of operation that will now be considered is a condition when a motor car enters a block at a time when the entering signal at the associated entrance end of the block is at stop. Such a signal indication is indicative of the presence of a train in the immediate vinicity and thus no signal should be given the motor car indicating that protection has been provided. In other words, the failure to illuminate the motor car indicator 2A is an indication that the motor car does not have protection and should be set off of the track. Failure to illuminate the indicator 2A under these conditions is effective because the relay TES is maintained picked up whenever either of the relays 2HD or 3HD which are associated with the head block signals respectively are dropped away. Thus, relay TES is maintained picked up by a stick circuit extending from (+), including back contacts 52 and 53 of relays 2HD and 3HD respectively connected in multiple, front contact 50 of relay TES, and winding of relay TES, to (−). With relay TES maintained picked up, the circuit for the motor car indicator 2A is maintained open at back contact 46, even though the relays 1TCP and 2TCP may have been actuated by a motor car.

The electronic apparatus including the oscillators is dependent for energization upon a source of alternating current as is indicated by the alternating current terminals (BX) and (NX) shown connected to the oscillators. In case of an alternating current power failure, the detector relays TCP become dropped away because their energization is dependent upon the electronic apparatus. Such dropping away of the relays TCP should not put the signals to stop, and thus the power-off relay PO is

provided for the purpose of maintaining the relay TES picked up under these conditions.

The relay PO is normally energized, and is dropped away upon a power failure. Upon dropping away, relay PO provides energization of a stick circuit for relay TES extending from (+), including back contact 54 of relay PO, front contact 15 of relay TES and winding of relay TES, to (—). In case the power failure should occur while the relay TES is in its dropped away position in accordance with the passage of a motor car, the relay TES can be restored to its normally energized condition after the timer TE has completed its operation. The energizing circuit for relay TES under these conditions extends from (+), including back contact 54 of relay PO, back contact 55 of relay PO, front contact 48 of relay TE, and winding of relay TES, to (—).

In case of simultaneous entry of a train at one end of a block and a motor car at the other end, it is provided that the energization of the motor car indicator, such as indicator 2A, is delayed until the signal control tumble-down system has become effective to prevent the picking up of the relay APS. This is desirable, because in case of simultaneous entry, there would be no warning signal displayed for the train to indicate that the block was occupied by a motor car, thus it should be provided that no clearance is given a motor car by the energization of the indicator 2A under these conditions of simultaneous entry.

Upon consideration of the circuit for the relay APS, it will be noted that this relay cannot be picked up until front contact 42 of the reset relay RS has been closed. Relay RS, however, cannot be picked up until the thermal relay TH has completed its operation, and the energization of the thermal relay TH is effected upon passage of a motor car over one of the track coils. It will thus be seen that there is considerable time delay after entrance of a motor car into the block before the relay APS can be picked up to close its front contact 45, and thus provide energization for the motor car indicator 2A. In this length of time, if there has been a simultaneous entry of a train upon accepting signal 5, the usual tumble down of the signal circuits has been effected so as to cause the dropping away of the relay 2HD. Upon the dropping away of this relay, the opening of front contact 40 prevents the energization of the stick relay APS from becoming effective upon the picking up of the reset relay RS. Therefore, there is no energization under these conditions of the indicator 2A, and thus the operator of the motor car is warned that the motor car should be removed from the track as there is a train in the vicinity.

Having thus described a motor car protection system as one specific embodiment of the present invention, it is to be understood that this form has been disclosed more particularly for an illustration of the mode of operation and principles involved in the present invention, and that various modifications, adaptations, and alterations may be made to the specific form shown within the scope of the present invention as defined by the appending claims.

What I claim is:

1. A motor car protection system for a stretch of single track having passing sidings and having railway train controlling signals for governing entrance to the stretch of track at its respective ends comprising, a track coil energized at a particular frequency at each end of said stretch of track, a coil tuned to said frequency carried by a motor car and positioned thereon so as to pass through an inductive coupling relationship with said track coil as said motor car enters said stretch of track, detector means operatively connected to each of the track coils and being distinctively operated from a normal to an abnormal position upon passage of said tuned coil past the associated track coil for registering the presence of the motor car in said stretch of track, timing means responsive to the actuation of said detector means to said abnormal condition for timing a predetermined interval, and signal control means for said signals governed by said timing means for putting said signals to stop while said timing means is timing said predetermined interval.

2. A motor car protection system according to claim 1 wherein the detector means includes a detector relay that is maintained normally energized and is operated to its dropped away position upon passage of said tuned coil past the associated track coil.

3. A motor car protection system according to claim 1 wherein the detector means includes a detector relay that is normally energized by a stick circuit and is operated to its dropped away position upon the inductive coupling of said tuned coil with the associated track coil and is restored to its normally energized position at the end of a predetermined time after its operation.

4. A motor car protection system for a stretch of single track having passing sidings and having motor car traffic control signals for governing entrance to the stretch of track at its respective ends comprising, a track coil energized at a particular frequency at each end of said stretch of track, a coil tuned to said frequency carried by a motor car and positioned thereon so as to pass through an inductive coupling relationship with said track coil as said motor car enters said stretch of track, detector means operatively connected to each of the track coils and being distinctively operated from a normal to an abnormal position upon passage of said tuned coil past the associated track coil for registering the presence of the motor car in said stretch of track, timing means responsive to the actuation of said detector means to said abnormal condition for timing a predetermined interval, and signal control means for said motor car traffic control signals governed by said timing means distinctively conditioned only during said predetermined timing interval.

5. A motor car protection system for a stretch of single track extending between passing sidings and having railway train controlling signals for governing entrance to the stretch of track at its respective ends comprising, two track coils each energized with alternating current of a particular frequency and located a short distance apart along the trackway at one end of the stretch of track, a coil tuned to said frequency and being carried by a motor car and positioned thereon so as to pass through an inductive coupling relationship with said track coils successively as said motor car enters said stretch of track, a first and second detector means operatively connected to each of the track coils respectively and being distinctively operated from a normal to an abnormal condition upon passage of said tuned coil past the associated track coil for registering the presence of the motor car in said stretch of track, a normally energized detector relay, pick-up circuit means for energizing said detector relay when said first and second detector means are in their normal conditions, stick circuit means for maintaining said detector relay energized when said first and second detector means are successively operated to said abnormal condition in one sequence but said stick circuit means being ineffective to maintain said detector relay energized when said first and second detector means are operated to said abnormal conditions in the opposite sequence, and signal control means for said signals governed by said detector relay for putting said signals to stop in accordance with the deenergization of said detector relay.

6. A motor car protection system for a stretch of track between passing sidings having railway train controlling signals for governing entrance to the stretch of track at its respective ends comprising, signal control means for controlling the indications of said signals in accordance with traffic conditions, motor car carried means for denoting the presence of a motor car in the

system, detector means at each end of said stretch of track for detecting the passage of said motor car carried means, registering means controlled by said detector means for registering the response of said detector means, and normally inactive timing means controlled by said registering means for controlling the signal control means for a given period of time irrespective of the time period of control by said registering means.

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