

March 31, 1959

SIH HSUIN TSIANG

2,880,308

RAILWAY SWITCH CONTROL APPARATUS

Filed July 29, 1953

3 Sheets-Sheet 1

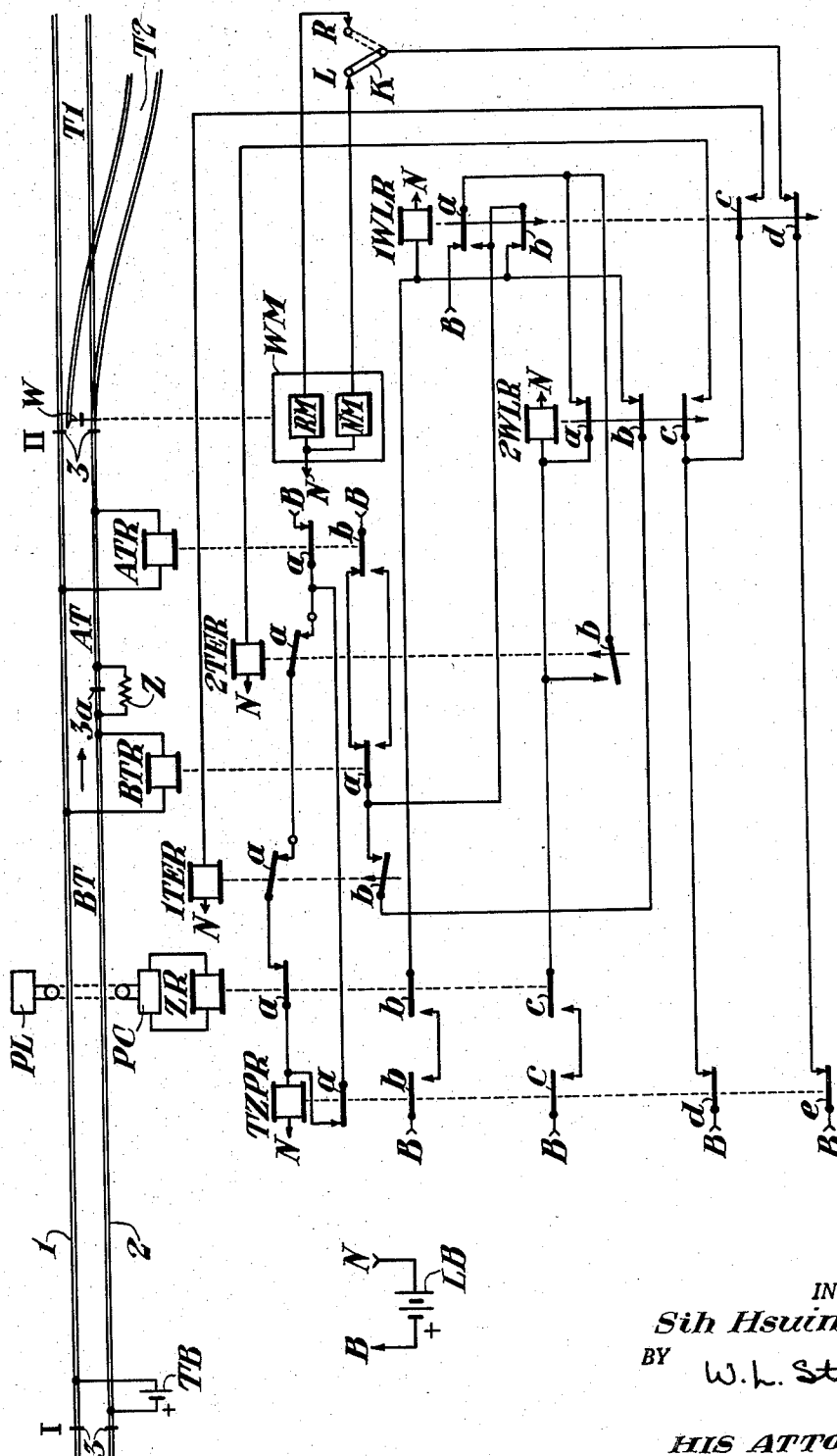


Fig. 1.

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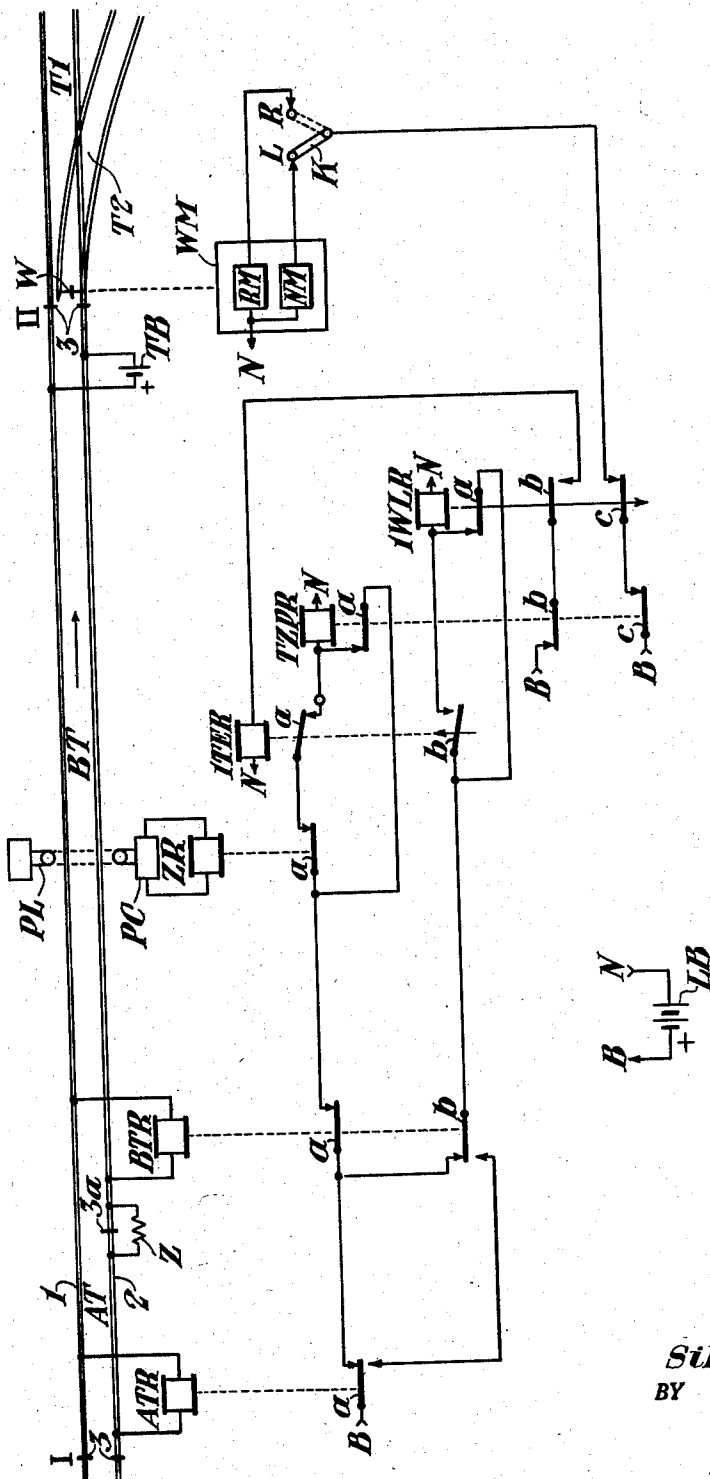
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3 Sheets-Sheet 2



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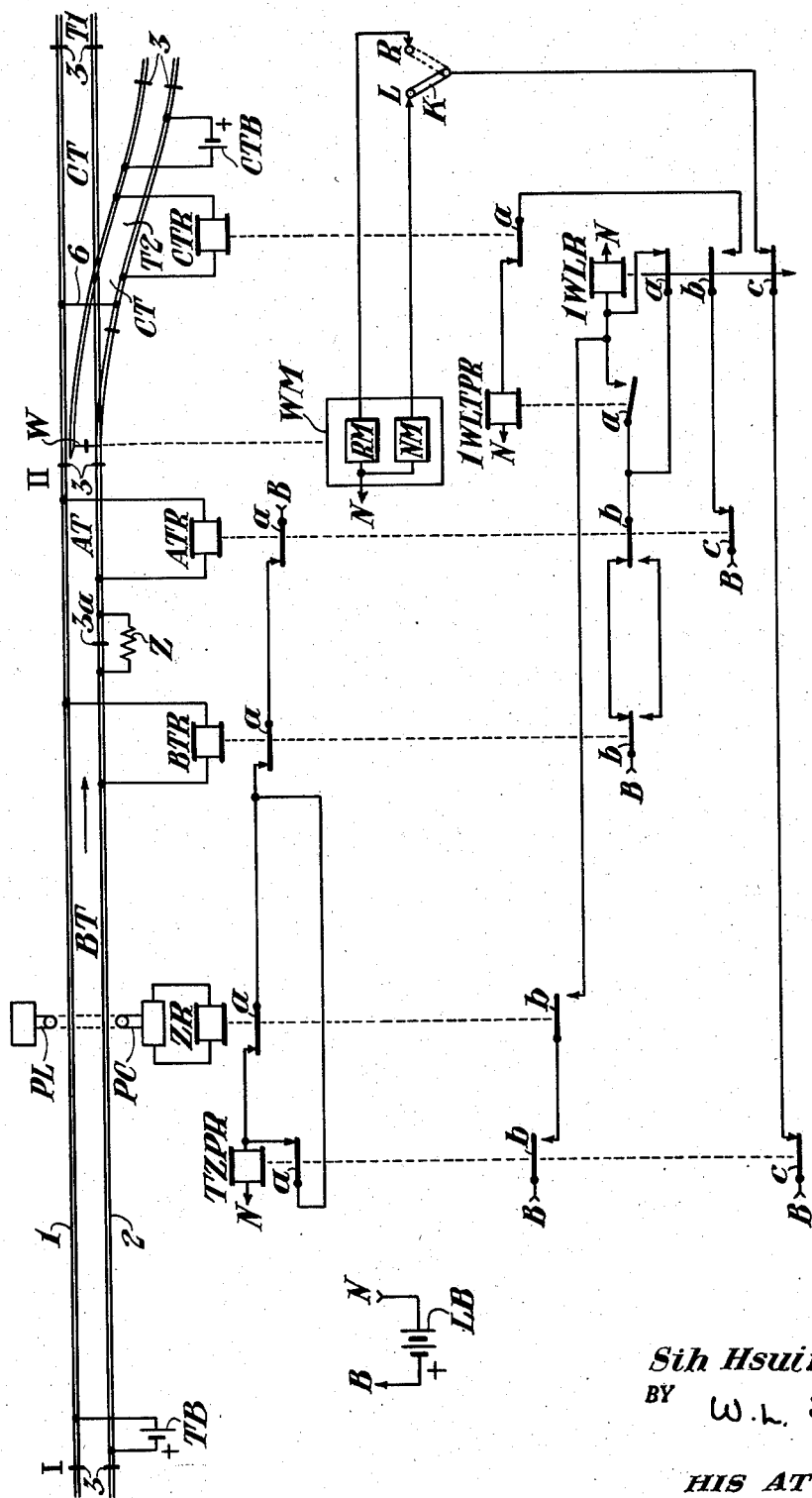
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# RAILWAY SWITCH CONTROL APPARATUS

Filed July 29, 1953

3 Sheets-Sheet 3



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2,880,308

## RAILWAY SWITCH CONTROL APPARATUS

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Application July 29, 1953, Serial No. 370,941

4 Claims. (Cl. 246—161)

My invention relates to apparatus for controlling railway switches, and in particular to apparatus for controlling railway switches in classification yards.

In classification yards, railway cars are sorted onto a number of classification or storage tracks according to the destination of the cargo in the cars. Ordinarily, a train is brought into the classification yard and individual cars or cuts of cars are cut loose at the top of an incline usually referred to as the hump. These cars or cuts are accelerated by the hump and move onto the selected storage track corresponding to the car's ultimate destination. In order to route the car or cut onto the selected storage track, the car or cut must pass over a plurality of railway switches which may be automatically or manually controlled. As the car or cut approaches each switch, it enters a detector track circuit which when occupied controls circuits for preventing the associated switch from being thrown until the car has cleared the switch, thereby preventing possible derailment. In the past, it has been customary to make the detector track circuit approximately fifty-five feet long. This necessitated spacing cars at a distance of at least fifty-five feet. However, with improvements in automatic switching in classification yards, the humping capacity of the yard can be increased by decreasing the length of the detector track circuits to thus effect a decrease in the required spacing between cars or cuts.

When the spacing between cars is reduced appreciably, the danger of a fast moving car catching up with and running into a preceding slow moving car is greatly increased. Furthermore, with cars going to different classification tracks, it is possible that after a slow moving car has moved out of the detector circuit associated with a switch, the switch may be thrown and a fast moving following car upon moving into the adjacent track may collide with the first car so that a portion of the following fast moving car, usually a front corner, will move against some portion, usually a rear corner, of the slower preceding car. Such a collision is known as cornering, and is obviously undesirable.

Accordingly, it is an object of my invention to provide control apparatus which will prevent cornering.

Another object of my invention is to provide apparatus which will delay the operation of a switch for a time if a vehicle approaches the switch at a speed below a predetermined value, but which will permit the operation of the switch immediately upon a vehicle clearing the switch points if the vehicle is exceeding the predetermined speed.

It is a further object of my invention to provide apparatus for controlling a switch movement, which apparatus will measure the speed of a car or cut as it approaches the associated switch and will thereafter prevent the throwing of the switch for a predetermined time if the speed of the car or cut is below a given speed.

Yet another object of my invention is to provide apparatus for controlling a switch movement which apparatus will measure the speed of a car approaching the

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associated switch and will provide a time delay in the subsequent throwing of the switch after the car has passed over the switch, which time delay will be inversely proportional to the speed of the car.

According to my invention, I provide a railway switch for diverting traffic approaching the switch onto one of two tracks. I further provide means for measuring the speed of a vehicle approaching the switch and if the speed is below a predetermined value, a means is actuated for delaying the operation of the switch for a sufficient time to permit the slow moving vehicle to clear the fouling point of the switch. In this manner, if a slow moving vehicle moves over the switch onto one track, a second vehicle cannot immediately move over the switch onto the other adjacent track to thereby create the possibility of cornering.

Other objects of my invention will become clear hereinafter as the characteristic features of construction and mode of operation of my invention are described in detail.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of railway switch control apparatus embodying my invention.

Fig. 2 is a diagrammatic view showing another form of railway switch control apparatus embodying my invention.

Fig. 3 is a diagrammatic view showing a third form of switch control apparatus embodying my invention.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the reference characters 1 and 2 designate the track rails of a stretch of railway track which is connected by a switch W to two adjacent tracks T1 and T2. The track rails 1 and 2 are provided at points I and II with insulated joints 3 to provide an insulated detector track section I—II. The insulated joints 3 at point II should be immediately in approach to the switch, that is, they should be located as close to the tips of the switch points of switch W as is possible and in no case should they be located from the tips more than the shortest distance between the wheels of trucks of vehicles using the switch. An insulated joint 3a is provided in rail 2 in section I—II to divide that section into two sub-sections AT, hereafter referred to as a measuring section, and BT. A resistor Z is connected around joint 3a to provide an electrical path around that insulated joint.

Detector section I—II is provided with a detector track circuit which may be traced from the positive terminal of a track battery TB, over rail 2 from point I to joint 3a, resistor Z, rail 2 from joint 3a to point II, the winding of a first track relay ATR, and rail 1 from points II to I to the negative terminal of battery TB. Sub-section BT is provided with an auxiliary track circuit which may be traced from the positive terminal of battery TB, over rail 2, the winding of a second track relay BTR, and rail 1 to the negative terminal of battery TB.

Also associated with sub-section BT is an intrusion detector including a source of light PL disposed on one side of the section, and a light responsive unit PC disposed on the other side of the section. The light responsive unit PC cooperates with an intrusion detection relay ZR so that when light is received by unit PC from lamp PL, relay ZR will be energized. A repeater relay TZPR is controlled by relays ATR and ZR and two time element relays 1TER and 2TER. Relay TZPR in turn partially controls two control relays 1WLR and 2WLR. Relays TZPR and 1WLR together control the operation of the time element relays 1TER and 2TER. Time element relays 1TER and 2TER are provided with a normally closed checking contact a which opens immediately upon the time element relay becoming energized and a

normally open front contact *b* which closes after the relay is energized for a predetermined time interval. Switch *W* is controlled by a switch movement *WM* which in turn is governed by two valve magnets *RM* and *NM*. The switch movement mechanism and the operation of the valve magnets form no part of my invention and it will suffice to say for the purpose of understanding the present invention that switch movement *WM* will operate so as to move the switch to its normal position in which cars will move onto track *T1* when and only when valve magnet *NM* is energized and switch movement *WM* will operate switch *W* to its reverse position in which cars will move onto track *T2* when and only when valve magnet *RM* is energized. Valve magnets *RM* and *NM* are partially controlled by a lever *K*, here shown as directly connected to the energizing circuits for the valve magnets. It will be clear that some remote control type of circuit controller can be substituted for lever *K*.

Except for the energy supplied by battery *TB* to relays *BTR* and *ATR*, the energy for the various portions of my novel apparatus is supplied by a battery *LB* having a positive terminal *B* and a negative terminal *N*.

As shown in Fig. 1, the apparatus is in the condition it assumes when the stretch of track is unoccupied and switch *W* is in its normal position. Relays *ATR* and *BTR* are energized by battery *TB* in the manner already described and are picked up. Since there is nothing to interrupt the light beam being emitted by lamp *PL*, light responsive unit *PC* will supply energy to relay *ZR* which will be picked up. Relay *1WLR* is energized by a first stick circuit which may be traced from positive terminal *B* of battery *LB*, over front contact *b* of relay *ATR*, front contact *a* of relay *BTR*, front contact *b* of relay *1WLR*, and the winding of relay *1WLR* to negative terminal *N* of battery *LB*. With relay *1WLR* stuck up, relay *2WLR* is energized over a first stick circuit which may be traced from the positive terminal *B* of battery *LB*, over front contact *a* of relay *1WLR*, front contact *a* of relay *2WLR*, and the winding of relay *2WLR* to negative terminal *N* of battery *LB*. With relays *1WLR* and *2WLR* both stuck up, relays *1TER* and *2TER* will be deenergized due to the fact that their energizing circuits, which circuits will be subsequently traced, are both open. With time element relays *1TER* and *2TER* released, their checking contacts *a* will be closed and, accordingly, an energizing circuit for relay *TZPR* will be established, which circuit may be traced from positive terminal *B* of battery *LB*, over front contact *a* of relay *ATR*, checking contact *a* of relay *2TER*, checking contact *a* of relay *1TER*, front contact *a* of relay *ZR*, and the winding of relay *TZPR* to negative terminal *N* of battery *LB*. With relay *TZPR* picked up, its stick circuit will be closed, which circuit may be traced from positive terminal *B* of battery *LB*, over front contact *a* of relay *ATR*, front contact *a* of relay *TZPR*, and the winding of relay *TZPR* to negative terminal *N* of battery *LB*. With relays *TZPR* and *1WLR* both energized and lever *K* in its left-hand or *L* position, an energizing circuit for valve magnet *NM* will be established, which circuit may be traced from positive terminal *B* of battery *LB*, over front contact *e* of relay *TZPR*, front contact *d* of relay *1WLR*, the contact closed by lever *K* in its *L* position, and the winding of magnet *NM* to negative terminal *N* of battery *LB*. Accordingly, switch movement *WM* will be in its normal position as heretofore described. With switch movement *WM* in its normal position, switch *W* will be in the position shown in which any vehicle moving through section *I—II* in the direction indicated by the arrow will move onto track *T1* and not onto track *T2*.

Let it be assumed that the entire detector track section *I—II* is a length of twenty-two feet and that sub-section *AT* is 2 feet long. Let it further be assumed that it is desired to interpose no time delay in the operation of switch *W* if the speed of a vehicle moving down the stretch is greater than 4 miles per hour, that it will be

safe to reverse the switch in 3 seconds after a vehicle vacates section *AT* if the vehicle is moving at a speed between 3 and 4 miles per hour, since a vehicle traveling at 3 miles per hour will have cleared the fouling point of the switch before a vehicle moving at the maximum speed for the yard will reach that point if the slow vehicle is provided with an additional 3 seconds in which to travel, and that it will be safe to reverse the switch 5 seconds after a vehicle vacates section *AT* if it is moving at a speed less than 3 miles per hour since a vehicle traveling at the minimum speed for the yard will clear the fouling point of the switch before a following vehicle moving at the maximum speed for the yard will reach that point if the slow vehicle is given an additional 5 seconds in which to travel. It is possible to interpose an additional time delay in the operation of switch *W* for all vehicles to prevent the operation of the switch while a vehicle is traveling on the switch points. However, this forms no part of the present invention and will not be considered in the following description.

When a vehicle enters the detector section *I—II*, its wheels and axles will shunt relays *BTR* and *ATR* and both of these relays will release. Upon the release of relay *ATR*, both the energizing and stick circuits for relay *TZPR* will become open at front contact *a* of relay *ATR* and, accordingly, relay *TZPR* will release. Upon relay *TZPR* releasing, the energizing circuit for valve magnet *NM* will become open at front contact *e* of relay *TZPR*. The energizing circuit for magnet *RM* is also open at front contact *e* of relay *TZPR* so that, at this time, switch *W* cannot be operated from its present normal position to its reverse position by movement of lever *K* from its *L* position to its *R* position. Furthermore, with relays *ATR* and *BTR* both released, a second stick circuit for relay *1WLR* will become established, which circuit may be traced from positive terminal *B* of battery *LB*, over back contact *b* of relay *ATR*, back contact *a* of relay *BTR*, front contact *b* of relay *1WLR*, and the winding of relay *1WLR* to negative terminal *N* of battery *LB*. Relay *1WLR* will not release during the period that relays *ATR* and *BTR* transfer their contacts from front to back since relay *1WLR* is provided with a slow release characteristic which will be described in more detail later. With relay *1WLR* remaining picked up, the previously traced first stick circuit for relay *2WLR* will remain established and relay *2WLR* will remain picked up.

Upon the front of the vehicle passing through the light beam being emitted by lamp *PL*, light responsive unit *PC* will cease to supply energy to relay *ZR* and, accordingly, relay *ZR* will release. Upon relay *ZR* releasing, the energizing circuit for relay *TZPR* will be opened at an additional point, and a first energizing circuit for relay *1WLR* will become established. This energizing circuit may be traced from positive terminal *B* of battery *LB*, over back contact *b* of relay *TZPR*, back contact *b* of relay *ZR*, and the winding of relay *1WLR* to negative terminal *N* of battery *LB*. Furthermore, a first energizing circuit will become established for relay *2WLR*, which circuit may be traced from positive terminal *B* of battery *LB*, over back contact *c* of relay *TZPR*, back contact *c* of relay *ZR*, and the winding of relay *2WLR* to the negative terminal *N* of the battery *LB*. The two last traced energizing circuits have no effect upon the system at this time since relays *1WLR* and *2WLR* are maintained in their picked up positions by their stick circuits.

As long as the vehicle occupies a portion of sub-section *BT*, both relays *ATR* and *BTR* will remain released and the system will remain in the previously described condition. However, upon the rear of the vehicle passing beyond the light beam, relay *ZR* will pick up and thereby close its front contact *a* and open its back contacts *b* and *c*, but this will have no effect on the system at this time. Relay *ZR* along with its associated light responsive unit *PC* and lamp *PL* are included in the arrangement in order to prevent the apparatus from falsely clearing the switch

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movement WM under certain conditions. With the detector track circuit of extremely short length (only 22 feet), it is possible that the wheels of a car might bridge the length of the section. If this happens, relays ATR and BTR will pick up, thereby reestablishing the energizing circuit for relay TZPR which will pick up. With relay TZPR picked up, energy will be supplied to either of the valve magnets of switch movement WM, thereby creating a dangerous condition in which the switch may be moved while a car is passing over it. Accordingly, there is provided the relay ZR, which is responsive not to the shunting of a track circuit but to the physical occupancy of a portion of the detector section by a vehicle. With a vehicle cutting off the light beam from light responsive unit PC, relay ZR will remain released and thereby prevent relay TZPR from picking up to clear switch movement WM. Furthermore, with relays 1WLR and 2WLR energized over their first energizing circuits, they will not release prematurely, thereby interposing an unnecessary time delay in the operation of switch movement WM, which delay will be more fully explained subsequently. It will be obvious that the light unit and light responsive unit arrangement shown could be replaced by some other type of intrusion detector, such as radar. It will also be obvious that the stick circuit for relay TZPR is provided to prevent the possible deenergization of relay TZPR due to an interruption of the light beam by a person walking through it, or for some reason other than a railway vehicle moving through the detector section.

When the rear wheels of the vehicle clear insulated joint 3a, relay BTR will become energized and will pick up, but relay ATR will remain deenergized since it is still being shunted by the wheels and axles of the vehicle. Accordingly, the previously traced second stick circuit for relay 1WLR will become open at back contact *a* of relay BTR and relay 1WLR will become deenergized. Relay 1WLR is provided with a slow release characteristic which will keep the armature of the relay picked up for .34 seconds after the winding of relay 1WLR becomes deenergized. This slow release period has been selected because it is equivalent to the time it will take a vehicle traveling at 4 miles per hour to travel a distance of 2 feet, namely the length of measuring section AT. It will be clear that other slow release periods for relay 1WLR may be used if the critical speed is changed or the length of measuring section AT is altered.

If the vehicle is traveling at a speed greater than 4 miles per hour, the rear wheels of the vehicle will vacate section AT in a time less than .34 second and, upon the rear wheels vacating section AT, relay ATR will pick up and reestablish the first traced stick circuit for relay 1WLR. Accordingly, relay 1WLR will not release upon a train moving faster than 4 miles per hour, traversing the measuring section and the system will be immediately restored to its normal condition. If lever K is now thrown to its right-hand or R position, valve magnet RM will become energized and the switch movement WM will move switch W to its reverse position.

However, if the vehicle is moving between the speed of 3 and 4 miles per hour, the rear wheels of the vehicle will occupy section AT for a period of more than .34 second after they vacate section BT and, accordingly, relay 1WLR will release. Therefore, the first stick circuit for relay 2WLR will become open at front contact *a* of relay 1WLR, but relay 2WLR will not immediately release because of its slow release characteristic. The slow release characteristic of relay 2WLR is so selected that relay 2WLR will release in a period of time equivalent to the difference in time it would take a vehicle to traverse section AT traveling at 4 miles per hour and traveling at 3 miles per hour. Again, this time will depend on the assumed critical speeds and the length of section AT. This time is .12 second for the distance and speed chosen. Assuming the vehicle is traveling at greater than 3 miles per hour, it will vacate section AT in less than .12 second

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after relay 1WLR releases. Accordingly, relay ATR will pick up and establish a second stick circuit for relay 2WLR, which circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay ATR, front contact *a* of relay BTR, back contact *a* of relay 1WLR, front contact *a* of relay 2WLR, and the winding of relay 2WLR to negative terminal N of battery LB. Accordingly, relay 2WLR will remain picked up. Furthermore, upon relay ATR picking up, the previously traced energizing circuit for relay TZPR will be reestablished and relay TZPR will pick up. Therefore, an energizing circuit for time element relay 1TER will become established, which circuit may be traced from positive terminal B of battery LB, over front contact *d* of relay TZPR, back contact *c* of relay 1WLR, and the winding of relay 1TER to negative terminal N of battery LB. Upon relay 1TER becoming energized it will open its checking contact *a* but will not close its front contact *b* for a predetermined time interval, here selected at 3 seconds, although other time intervals may be used. The selected interval should preferably be long enough to assure that a vehicle moving at the measured speed will be clear of the fouling point when a vehicle moving at maximum speed reaches that point. Upon the checking contact *a* of relay 1TER opening, the energizing circuit for relay TZPR will become open but relay TZPR will remain energized over its previously traced stick circuit. Upon the expiration of the 3 seconds, relay 1TER will close its front contact *b* and, accordingly, will close a second energizing circuit for relay 1WLR which may be traced from positive terminal B of battery LB, over front contact *b* of relay ATR, front contact *a* of relay BTR, front contact *b* of relay 1TER, front contact *b* of relay 2WLR, and the winding of relay 1WLR to negative terminal N of battery LB. Therefore, relay 1WLR will pick up and reestablish its first stick circuit and the previously traced first stick circuit for relay 2WLR. Furthermore, upon relay 1WLR picking up, the energizing circuits for valve magnets RM and NM are conditioned for switch operation. Accordingly, if lever K is thrown to its R position, valve magnet RM will become energized over a circuit which may be traced from positive terminal B of battery LB, over front contact *e* of relay TZPR, front contact *d* of relay 1WLR, the lever contact closed with lever K in its R position, and the winding of valve magnet RM to negative terminal N of battery LB. Accordingly, the switch movement WM will operate switch W to its reverse position. It will be clear that during the entire time that the vehicle occupied either section BT and AT, relay TZPR was released and, accordingly, regardless of the position of lever K, neither valve magnet could be energized. Furthermore, as long as relay 1WLR was deenergized, neither valve magnet could be energized to operate the switch. Therefore, a time delay of 3 seconds has been effected, thereby assuring that if any vehicle moving at a rate much greater than the first vehicle was following immediately behind the first vehicle, the second vehicle will move onto the same track as the first vehicle and thereby preclude the possibility of cornering.

Now let it be assumed that a vehicle moves down section I—II at a speed less than three miles per hour. When this is the case, the rear wheels of the vehicle will occupy section AT for a period of time greater than .46 second. Upon the expiration of .34 second, relay 1WLR will release as previously described and thereby deenergize relay 2WLR. However, relay 2WLR will remain picked up for .12 second after relay 1WLR releases. Since the vehicle is traveling at less than three miles per hour, relay 2WLR will release before the vehicle vacates section AT. When the vehicle finally does vacate section AT, relay TZPR will become energized over its previously traced energizing circuit and thereby establish the energizing circuit for time element relay 1TER, which circuit has already been traced. Furthermore, with relay 2WLR released, upon the picking up of relay TZPR an energizing circuit

will be established for time element relay 2TER, which circuit may be traced from positive terminal B of battery LB, over front contact *d* of relay TZPR, back contact *c* of relay 2WLR, and the winding of relay 2TER to negative terminal N of battery LB. Relay 2TER will immediately open its checking contact *a* but is designed to not close its front contact *b* for a period of 5 seconds. Upon the expiration of 3 seconds after the vehicle vacates section AT, relay 1TER will pick up and close its front contact *b* but this will not energize relay 1WLR over its second energizing circuit since that circuit will remain open at front contact *b* of relay 2WLR. Upon the expiration of another 2 seconds, relay 2TER will close its front contact *b* and, accordingly, will establish a second energizing circuit for relay 2WLR, which circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay ATR, front contact *a* of relay BTR, back contact *a* of relay 1WLR, front contact *b* of relay 2TER, and the winding of relay 2WLR to negative terminal N of battery LB. Upon relay 2WLR picking up it will establish its previously traced second stick circuit and it will cause relay 2TER to become deenergized and to release. Furthermore, upon relay 2WLR picking up, the previously traced second energizing circuit for relay 1WLR will become established and relay 1WLR will pick up. Upon relay 1WLR picking up it will reestablish its first stick circuit and will close the energizing circuit for either of the valve magnets RM and NM, depending on the position of lever K. Furthermore, upon relay 1WLR picking up, the previously traced energizing circuit for relay 1TER will become open and relay 1TER will release. With relay 1WLR now picked up, the second energizing circuit for relay 2WLR will become open at back contact *a* of relay 1WLR, but the first stick circuit for relay 2WLR will be reestablished and relay 2WLR will remain stuck up. In this manner the system will be restored to its normal condition. It should be noted that with relay 1WLR released for the full time interval of operation of relay 2TER, the switch W could not have been thrown until a full 5 seconds after the vehicle vacated section AT. If a second vehicle were to follow shortly behind the first vehicle, it will move down the same track as the first vehicle and thereby preclude the possibility of cornering.

It should be clear that if it is desired to introduce only one time delay depending upon whether the speed of a cut was above or below a single predetermined value, such as four miles per hour, that relays 2WLR and 2TER and their associated circuits can be omitted and the system will function as described for a vehicle moving at speeds greater or less than four miles per hour. In view of this, the remaining embodiments of my invention, as shown in Figs. 2 and 3, will be described with only one control relay 1WLR and only one means for introducing a time delay.

In the described operation of the embodiment shown in Fig. 1, it will be clear that the apparatus is controlled by the speed of the rear set of wheels of a vehicle. It is also possible to govern the apparatus by the speed of the front wheels of a vehicle, as is shown in Fig. 2. Referring to Fig. 2 it will be seen that the short measuring section AT is at the entrance end of the detector section made up of sub-sections AT and BT. For the sake of clarity the dimensions of section AT will be two feet long and that of BT twenty feet long, thereby making the total detector section I—II twenty-two feet long, as it was in Fig. 1. The system is shown in Fig. 2 in its normal condition with relays ATR and BTR energized by track battery TB, and relay ZR energized by light responsive unit PC which is actuated by lamp PL. With the relays so energized, an energizing circuit is established for energizing relay TZPR, which circuit may be traced from positive terminal B of battery LB over front contact *a* of relay ATR, front contact *a* of relay BTR, front contact *a* of relay ZR, checking contact *a* of relay 1TER which relay is deenergized, and the winding of relay

TZPR to negative terminal N of battery LB. Furthermore, relay TZPR is supplied with energy over a stick circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay ATR, front contact *a* of relay BTR, front contact *a* of relay TZPR, and the winding of relay TZPR to negative terminal N of battery LB. At this time control relay 1WLR will be energized by its first stick circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay ATR, front contact *b* of relay BTR, front contact *a* of relay 1WLR, and the winding of relay 1WLR to negative terminal N of battery LB. The switch W is shown in its normal position in which traffic will move onto track T1. Normal valve magnet NM is energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *c* of relay TZPR, front contact *c* of relay 1WLR, contact L of lever K, and the valve magnet NM to negative terminal N of battery LB.

Again assuming that the critical speed is four miles per hour, relay 1WLR will be provided with a slow release time of .34 second since that is the time it will take a vehicle moving four miles per hour to traverse measuring section AT. Let it now be assumed that a cut enters section I—II traveling at a speed greater than four miles per hour. As the cut enters section I—II, relay ATR will become shunted by the wheels and axles of the train and accordingly will release, thereby opening the previously traced energizing and stick circuits for relay TZPR which relay will also release. Furthermore, upon relay ATR releasing the previously traced first stick circuit for relay 1WLR will become open at front contact *a* of relay ATR and, accordingly, relay 1WLR will become deenergized. However, relay 1WLR will not immediately release because of its slow release characteristic. With the cut traveling at a speed in excess of four miles per hour, the front wheels of the cut will enter section BT prior to the time that relay 1WLR will release and accordingly relay BTR will release. Of course, relay ATR will remain released. Upon the release of relay BTR, a second stick circuit will become established for relay 1WLR, which circuit may be traced from positive terminal B of battery LB, over back contact *a* of relay ATR, back contact *b* of relay BTR, front contact *a* of relay 1WLR, and the winding of relay 1WLR to negative terminal N of battery LB. Therefore relay 1WLR will not release. When the vehicle interrupts the light beam emitted by the light unit PL, relay ZR will release and open the energizing circuit for relay TZPR at another point. This will have no effect upon the circuit. It will be obvious that the function of relay ZR in the second embodiment is the same as that described with respect to Fig. 1.

Upon the rear wheels of the cut vacating section I—II, relays ATR and BTR will both pick up and relay ZR will already be picked up. Therefore, the previously traced energizing circuit of the relay TZPR will become reestablished. Accordingly, relay TZPR will pick up and reestablish the energizing circuit for valve magnet NM. If at any time during the further movement of the vehicle lever K is thrown to its right-hand or R position, reverse valve magnet RM will become energized and switch W will be operated to its reverse position. Therefore there will be no time delay introduced in the operation of switch W.

Assuming that a vehicle traveling at a speed less than four miles per hour enters section I—II, relay ATR will release and thereby deenergize relay TZPR and open the first stick circuit for relay 1WLR. Since the vehicle is traveling at less than four miles per hour, its front wheels will occupy section AT for a time greater than .34 second and, accordingly, relay 1WLR will release prior to relay BTR being shunted by the wheels and axles of the vehicle. Upon relay 1WLR releasing the energizing circuits for the valve magnets will become open at a second point but this will have no immediate effect upon the system. When the vehicle enters section BT, relay BTR will

become shunted and will release, thereby opening the energizing circuit for relay TZPR at a second point. When the vehicle interrupts the light beam emitted by the source of light PL, relay ZR will release but this will have no effect upon the system.

Upon the train vacating section I—II, relays ATR and BTR will pick up as will relay ZR. Accordingly, relay TZPR will become reenergized and will pick up and, with relay 1WLR released, an energizing circuit will be established for relay 1TER. This energizing circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay TZPR, back contact *b* of relay 1WLR, and the winding of relay 1TER to negative terminal N of battery LB. Accordingly, relay 1TER will open its checking contact *a* but will not close its front contact *b* for a predetermined time interval which, for the sake of explanation, will be assumed to be 5 seconds for reasons which have heretofore been made clear. Upon checking contact *a* of relay 1TER opening, the energizing circuit for relay TZPR will become open but relay TZPR will remain energized over its previously traced stick circuit. It will be noted that as long as relay 1WLR is released it will be impossible to move switch W to its reverse position since the energizing circuits for the valve magnets are open at front contact *c* of relay 1WLR.

Upon the 5 seconds time interval expiring, relay 1TER will close its front contact *b* and thereby establish a circuit for energizing relay 1WLR, which circuit may be traced from positive terminal B of battery LB, over front contact *a* of relay ATR, front contact *b* of relay BTR, front contact *b* of relay 1TER, and the winding of relay 1WLR to negative terminal N of battery LB.

Therefore, relay 1WLR will pick up and reestablish its previously traced first stick circuit and, furthermore, with relay 1WLR now picked up, relay 1TER will become deenergized and thereby release, thus opening its front contact *b* and closing its checking contact *a*. This will open the energizing circuit for relay 1WLR but relay 1WLR will remain energized over its first stick circuit. Furthermore, the previously traced energizing circuit for relay TZPR will be reestablished. Upon relay 1WLR picking up, it will place valve magnets NM and RM in a condition to be energized and, accordingly, the switch may now be operated to either its normal or reverse position depending on the position of lever K. It will be seen therefore that as long as a vehicle is moving at less than four miles per hour, the switch S cannot be operated until 5 seconds after the vehicle vacates section I—II, which time delay is interposed by the operation of relay 1TER. In this way the first vehicle will be given sufficient time to clear the fouling points of the switch W and, accordingly, a following fast moving vehicle will not corner the initial vehicle.

The embodiments shown in Figs. 1 and 2 utilize a time delay based upon the operation of a time element relay. Such a time delay is based purely on a predetermined time interval. It is also possible to delay the operation of switch S until a slow moving vehicle traverses a predetermined distance. Such an arrangement is shown in Fig. 3. In order to accomplish this, an insulated track section CT must be provided in both adjacent tracks T1 and T2. A track circuit associated with sections CT is provided in advance of section AT and this track circuit is energized by track battery CTB which energizes a track relay CTR. In order to include both tracks in the track circuit, a jumper 6 and the usual frog arrangement at the switch are employed to connect the rails in multiple.

As shown in Fig. 3, the apparatus is in its normal condition in which the track relays ATR, BTR and CTR are all energized by their associated track batteries. Accordingly, relay TZPR is energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay ATR, front contact *a* of relay BTR, front contact *a* of relay ZR, the winding of re-

lay TZPR to negative terminal N of battery LB. Furthermore, relay TZPR is at this time energized by its stick circuit which may be traced from positive terminal B of battery LB, over front contact *a* of relay ATR, front contact *a* of relay BTR, front contact *a* of relay TZPR, and the winding of relay TZPR to negative terminal N of battery LB. Furthermore, relay 1WLR is energized over a first stick circuit which may be traced from positive terminal B of battery LB, over front contact *b* of relay BTR, front contact *b* of relay ATR, front contact *a* of relay 1WLR, and the winding of relay 1WLR to negative terminal N of battery LB.

As shown traffic control lever K is in its left-hand or L position and accordingly valve magnet NM is energized over a circuit which may be traced from positive terminal B of battery LB, over front contact *c* of relay TZPR, front contact *c* of relay 1WLR, the contact closed when lever K is in its L position, and the winding of valve magnet NM to negative terminal N of battery LB. With valve magnet NM so energized, switch W will be in its normal position in which traffic will move onto track T1.

Assuming that a vehicle moves down the stretch in the indicated direction at a speed greater than the critical speed, herein assumed to be four miles per hour, as the front wheels of the cut enters section I—II, relays ATR and BTR will both release due to the fact that they are shunted by the wheels and axles of the vehicle. Accordingly, relay TZPR will release but relay 1WLR will remain energized over a second stick circuit which may be traced from positive terminal B of battery LB, over back contact *b* of relay BTR, back contact *b* of relay ATR, front contact *a* of relay 1WLR, and the winding of relay 1WLR to negative terminal N of battery LB. Due to the slow release characteristic of relay 1WLR, it will not release during the time it takes relays BTR and ATR to release their armatures. Upon the vehicle interrupting the light beam emitted by light source PL, relay ZR will release and thereby close a first energizing circuit for relay 1WLR which circuit may be traced from positive terminal B of battery LB, over back contact *b* of relay TZPR, back contact *b* of relay ZR, and the winding of relay 1WLR to negative terminal N of battery LB. Since relay 1WLR is at this time energized over its second stick circuit, the establishment of the energizing circuit has no effect upon the apparatus.

When the front wheels of the cut enter section AT there will be no effect upon the apparatus hence both relays ATR and BTR remain shunted. However, upon the rear wheels of the cut passing insulated joint 3a, relay BTR will pick up thereby opening the second traced stick circuit for relay 1WLR. As in the other embodiments heretofore described, relay 1WLR will have a slow release characteristic which will maintain its armature in a picked up position for .34 second after it becomes deenergized. Accordingly, with the cut traveling at a speed greater than four miles per hour, the rear wheels of the cut will vacate the two foot long measuring section AT in a time less than .34 second at which time relay ATR will pick up and reestablish the first stick circuit for relay 1WLR, thereby preventing that relay from releasing. Furthermore, relay ZR will pick up upon the light responsive unit being reactuated by the light beam emitted by the light source PL and, accordingly, upon the cut vacating section AT, an energizing circuit will be immediately established for energizing either the normal or reverse valve magnets NM and RM depending on the position of lever K. It will be seen therefore that with a cut moving at a speed of four miles per hour or greater, there will be no time delay interposed in the operation of the switch W and it may be moved upon section I—II being vacated.

Now let it be assumed that a vehicle enters section I—II traveling at a speed less than four miles per hour. Upon the front wheels of the cut entering section BT, relays BTR and ATR will release as already described,

and relays ZR and TZPR will both release. Relay 1WLR will remain energized over its second stick circuit as already described and this stick circuit will not be opened until the rear wheels of the vehicle vacate section BT at which time relay BTR will pick up and open the second traced stick circuit for relay 1WLR at back contact *b* of relay BTR. With the vehicle traveling at a speed less than four miles per hour, the rear wheels of the vehicle will occupy section AT for a time in excess of .34 second. Accordingly, relay 1WLR will release. Upon the rear wheels of the vehicle vacating section I—II, relay ATR will pick up and reenergize relay TZPR which will pick up. However, the energizing circuit for the valve magnets RM and NM will now be open at front contact *c* of relay 1WLR and will remain open until relay 1WLR is again energized. At this time, a circuit for energizing an auxiliary relay 1WLTPR, which circuit may be traced from positive terminal B of battery LB, over front contact *c* of relay ATR, back contact *b* of relay 1WLR, front contact *a* of relay CTR, and the winding of relay 1WLTPR to negative terminal N of battery LB will be open at front contact *a* of relay CTR, which is now released due to its being shunted by the wheels and axles of the vehicle. It will be clear that as long as the vehicle occupies section CT thereby shunting relay CTR, this energizing circuit for relay 1WLTPR will remain open. Section CT may be of any desired length but preferably will be long enough to insure that a vehicle, prior to vacating the section, will have moved a sufficient distance down either track to insure that a following vehicle moving at maximum yard speed will not reach the fouling point of switch W until the slow vehicle has cleared that point. When the rear wheels of the vehicle vacate section CT, relay CTR will pick up and thereby energize relay 1WLTPR which relay will pick up and close a second energizing circuit for relay 1WLR. The second energizing circuit for relay 1WLR may be traced from positive terminal B of battery LB over front contact *b* of relay BTR, front contact *b* of relay ATR, front contact *a* of relay 1WLTPR, and the winding of relay 1WLR to negative terminal N of battery LB. Upon relay 1WLR picking up the valve magnets NM and RM will be put in a condition to be energized and, accordingly, the switch W can now be operated to its desired position. Furthermore, upon relay 1WLR picking up, the energizing circuit for relay 1WLTPR will become open at back contact *b* of relay 1WLR and, accordingly, relay 1WLTPR will release. Upon relay 1WLTPR releasing, the previously traced second energizing circuit for relay 1WLR will become open at front contact *a* of relay 1WLTPR but relay 1WLR will not release since it is now being energized over its previously traced first stick circuit. In this manner the apparatus will be restored to its normal condition.

It will be clear from the above description that if a vehicle is moving at a speed below four miles per hour, then no movement of the switch to its reverse position will be possible until the vehicle vacates section CT at which time the vehicle will be beyond the fouling point of the switch and, accordingly, it will be impossible for any cornering to take place.

It should be pointed out that the slow release relays 1WLR and 2WLR shown in the three embodiments of my invention are designed to have a particular slow release characteristic at the highest voltage to which they will be subjected, namely the rated voltage for a battery LB. Accordingly, in the event that the voltage on battery LB decreased due to undue drain or age, the slow release relays will merely release in a time which

is less than the prescribed release time, and the system will therefore operate on the safe side.

Although I have herein shown and described only three forms of my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Control apparatus for a railway track switch in a classification yard connecting a first stretch of track to second and third diverging track stretches, comprising, in combination, operating means connected to said switch for moving it between first and second positions in which cars on said first stretch are routed to said second and third track stretches, respectively, means for measuring the speed of a cut of one or more cars approaching said switch on said first stretch, and timing means controlled by said measuring means and operatively connected to said operating means to interrupt the operation thereof for a time interval after a cut has passed over said switch dependent on the speed of said cut.

2. Means for preventing the cornering of a first cut of one or more cars passing over a railway switch in one of two operable positions by a following cut of one or more cars passing over said switch in the other of said positions, said switch being provided with control means for moving it from one to the other of its positions, comprising, in combination, means responsive to the speed of cuts approaching said switch, and means controlled by said speed responsive means for delaying the operation of said control means after said first cut has passed over said switch for a time in accordance with the speed of said first cut sufficient to prevent cornering if said first and second cuts pass over said switch in different positions thereof.

3. Means for delaying the operation of a railway switch after a first cut of one or more cars has passed thereover to prevent a following cut from colliding with the rear end of the first cut, comprising, in combination, switch control means for moving said switch from a first to a second position, means located in advance of the switch for measuring the speed of said first cut, means actuated from a first to a second condition by a car entering said switch, and means controlled by said speed measuring means and said car actuated means for preventing the operation of said switch control means for a time after said car actuated means has moved from its second to its first position in accordance with the speed of said first cut.

4. In combination with a railway track switch having two operative positions for diverting railway vehicles moving along a stretch of track onto one or the other of two adjacent tracks, depending on the position of said switch, speed measuring means located along said stretch immediately in approach to the switch for measuring the speed of vehicles entering the switch, switch operating means for operating said switch between its two positions, circuit means for controlling said switch operating means, and a contact in said circuit means controlled by said speed measuring means in response to a vehicle entering said switch below a predetermined speed to interrupt said circuit means for a time sufficient to permit said vehicle to clear the fouling point of the switch.

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