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ANTI-CORNERING PROTECTION FOR RAILROAD CLASSIFICATION YARDS

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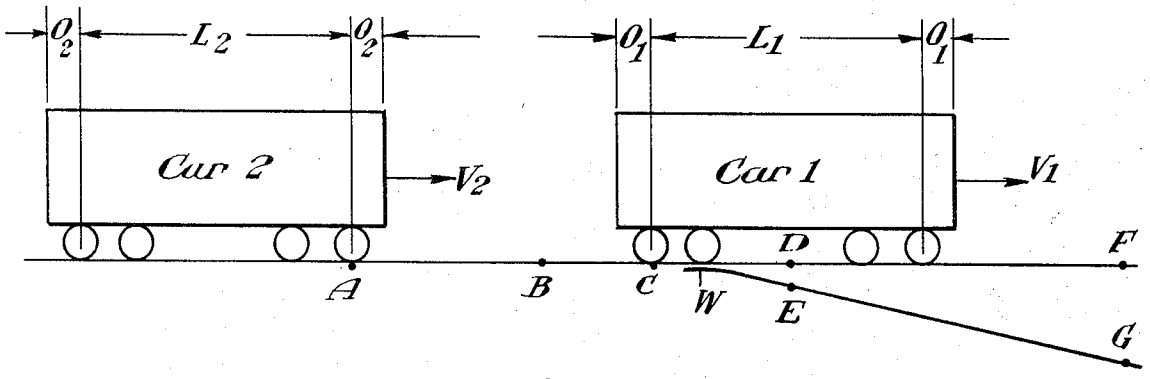


Fig. 1.

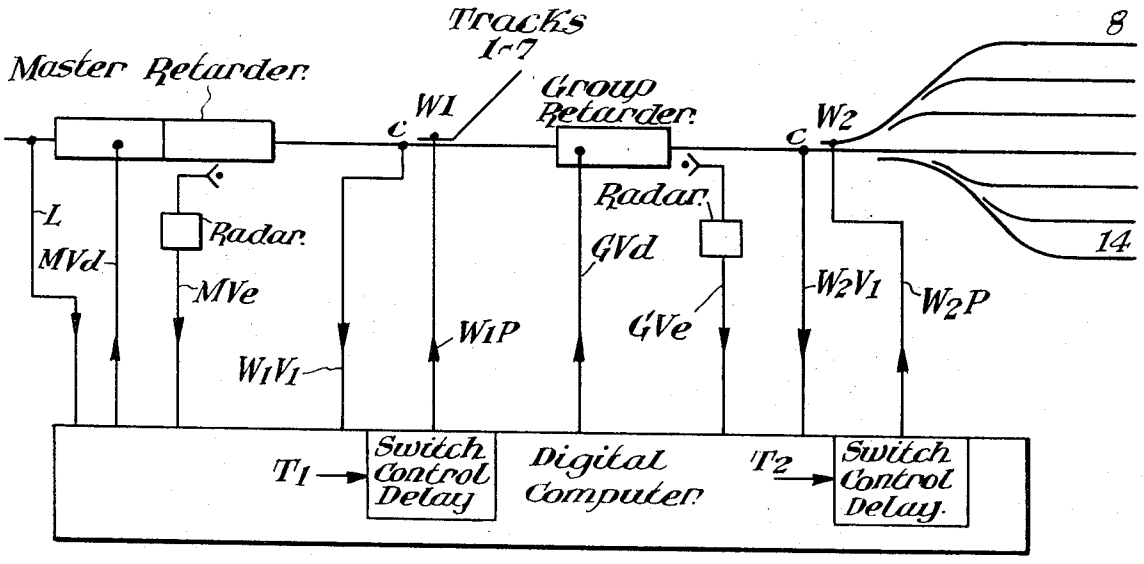


Fig. 2.

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ANTI-CORNERING PROTECTION FOR RAILROAD CLASSIFICATION YARDS

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U.S. Cl. 246—1 10 Claims

ABSTRACT OF THE DISCLOSURE

As a cut traverses a switch in a classification yard, a time interval is computed as a product of the distance to clearance beyond that switch and the difference between the reciprocals of the speeds of that cut and the following cut, where the following cut speed is greater. During this time interval, delivery of a diverging route switch control for the following cut is delayed. If the following cut enters the switch detector section prior to expiration of computed time delay, the switch is locked to prevent a diverging movement which would result in a cornering accident.

This invention pertains to a method of and apparatus for preventing the cornering of cuts of cars in railroad classification yards. More specifically, our invention relates to an arrangement which enforces a computed time delay prior to the establishment of diverging routes over a track switch if relative speeds of successive cuts of cars which are to move over that switch create the probability of a cornering situation.

One problem in the operation of railroad classification yards, for which no satisfactory solution has been achieved in the past, is cornering between successive cuts of cars moving over a particular switch along diverging routes. The term "cornering" is herein defined as that condition or action which occurs when a second cut of cars, moving over a track switch along the diverging route, catches up with the preceding cut within the distance beyond the switch where there is no clearance between the bodies of the railroad cars and a collision occurs. Under this condition, serious damage to the cars and their contents may occur and the possible derailment of the cars causes extra expense and delays the scheduled operations of that particular yard. As partial solutions in the prior systems used to control such classification yards, a first method reduces the humping speed and thus increases the separation between successive cuts of cars while a second solution provides longer switch detector sections so that the switches will be locked in position when successive cuts of cars have relatively little separation. The first solution reduces the operating capacity of the yard since a fewer number of cars may be moved over the hump in a specific period of time. The second solution tends to increase the frequency of misrouting of cuts of cars and thus slows yard operations and increases the expense since time must be expended to find the cars which have been misrouted and then trimming time allowed to correctly reclassify or position the cars in the storage tracks. However, the cornering problem is serious enough that the delays or reduced capacity caused by these two partial solutions received some acceptance since the collisions and possible derailments when cornering occurs are more than likely to cause even more expense and serious delays. Further, it is recognized that a following cut of cars which is moving at a higher speed and catches up to a preceding cut moving along the same track so that coupling occurs during movement causes no more damage, in fact is no more serious, than coupling occurring in the storage tracks. With the use of digital computers in the more recent and improved automatic control systems for classification yards, there is an increased capacity for handling control functions due to the capacity of the computer. An example of such a system is described in the Automatic Classification Yard System Manual 555 published by the Signal & Communications Division of Westinghouse Air Brake Company, the assignee of this present application. This increased capacity of the control system to handle additional functions and information has suggested to us a new and improved solution for the problem of cornering between successive cuts of cars traversing the same switch.

Accordingly, an object of our invention is an improved arrangement for anti-cornering protection in railroad classification yards.

Another object of our invention is apparatus which prevents cornering accidents between successive cuts of cars moving across a track switch when the diverging route has been preselected for the following car.

Still another object of our invention is an improved method for providing anti-cornering protection during the automatic operation of railroad classification yards.

A further object of our invention is a method for providing anti-cornering protection at a track switch in which the operation of this switch to establish a diverging route for the second of two successive cuts of cars traversing the switch is delayed for a time interval computed in accordance with the car clearance distances beyond the switch and the difference in speeds of the two cuts.

It is also an object of our invention to provide an anti-cornering arrangement which computes a time delay for enforcement prior to the operation of a switch to establish a diverging route for the second of two successive cuts of cars moving across the switch if a probability of the cornering of the lead cut of cars by the following cut exists.

Other objects, features, and advantages of our invention will become apparent from the following description when taken with the appended claims.

In the practice of our invention, it is apparent that the principal application of the novel arrangement will be in classification yards where the operation is fully automated through a control system based on the use of a digital computer, as in the example described in the previously cited Manual 555. However, it is to be understood that the basic method of operation described hereinafter may be applied at any railroad track switch location where control apparatus is available having the capability of performing the functions and storing information discussed hereinafter. More specifically, in practicing our invention, the speed of each cut of cars traversing a track switch is measured at that point. In the specific showing herein, this speed measurement is accomplished by determining the time of passage at a point adjacent the track switch between the first and last axle of the cut of cars. In the automatic control system assumed, the length between these axles has already been recorded and is stored in the control computer. Thus the speed may be computed by dividing the distance between the axles by the time elapsed between the passage of the selected axles. Following this speed measurement, the existence of a potential cornering situation is determined by checking the next approaching cut of cars for a higher speed and a requirement for a diverging route at that switch. These facts are already stored in the control computer storage banks due to previous operations in controlling the approaching cut of cars this far along its selected route. A time interval is then computed as a product of the difference between the reciprocals of the

speeds of the two successive cuts of cars and a preselected clearance distance along each diverging track beyond that switch. The latest available speed information stored in the computer for the following cut is used while the just measured speed for the leading cut of cars as it passed over that switch is available. A preselected distance to clearance for each switch in the yard is also stored in the computer. This distance to points along the diverging tracks beyond the switch is selected such that any combination of configurations of two cars will clear at that point, that is, no cornering will occur. This computed time interval is applied as a delay time prior to the delivery of the next position control to this switch movement, that is, the position control for establishing the route for the following cut. The computation formula is developed, as will be explained later, so that if the switch could be changed and the following cut arrives within the switch detector section prior to the expiration of this time period, there is a very high degree of probability that cornering will occur. However, when the position control is delivered with the following cut within the detector section, the switch is locked so that no movement can occur and the diverging route is not established. Of course the following cut is misrouted and a catch up with the preceding cut may occur within a relatively short distance, but the more serious situation of the cornering accident is avoided. If the following cut has not reached the detector section, prior to the expiration of the time delay, the position control delivered to the switch movement is executed and the diverging route is established, since cornering can not now occur.

We shall now describe the arrangement of our invention in greater detail referring from time to time to the accompanying drawings in which:

FIG. 1 is a schematic illustration of two single cars moving over a switch showing the various distances and factors used to derive the anti-cornering equations.

FIG. 2 is a diagrammatic illustration of a portion of a railroad classification yard to which our invention is applied.

Where appropriate, similar reference characters have been used in each of the drawing figures to designate similar elements of the illustrations.

Referring now to FIG. 1, there is shown, by conventional single line representation, a stretch of railroad track extending from the left of the drawing through the marked points A, B, C, D, and F. This stretch of track includes a typical track switch, designated W, which at times may be positioned to divert cars to the track stretch through points E and G. Point C is specifically located a few feet in the approach to the points of track switch W. A wheel detector device or the equivalent apparatus is associated with point C to provide the means to sense when an axle of a moving car is located at that point. Such method of detecting the axles of moving cars is conventional and the details need not be shown.

Points B, D, and E define the boundaries of the locking area for the track switch, more commonly known as the switch detector section. A conventional track circuit or other well known means is provided to detect the presence of one or more axles within this switch detector section and, under such situation, to prevent the switch control circuits from responding to any positioning control that might be supplied in an attempt to make the swtch change position. These points are so located as to insure that the switch can not change position when any car is passing over it. Of course, the nearest to this switch that the first axle of any approaching car can be located and still have the switch change position to establish a route for that car is point B.

Points F and G are defined as the clearance points for the track switch. Said in another way, when a car is routed toward point F, its last axle must advance at least as far as point F to assure it will not be cornered by a following car routed towards point G. Similarly, when

a car is routed toward point G, its last axle must reach that point in order to insure against a similar cornering by a car moving along the track towards F. The location of points F and G are determined when setting up the yard control system by taking into account track curvatures and the worse case car body geometries to be expected. With points F and G defined in this way, track sections CF and CG are not necessarily equal in length. However, for purposes of the anti-cornering arrangement provided by our invention, their lengths are set equal to the greater of the two. Such clearance distances for each switch in the classification yard will be predetermined and stored within the control computer.

Point A is not a specifically fixed location but is rather defined as the location of the first axle of a following car, such as car 2, when the last axle of the leading car, such as car 1, is located at point C. Since the location of point A thus depends upon the spacing between cars, it is obviously a variable. If the car spacing is such that point A falls within the switch locking area, that is, within the bounds of points B, D, and E, cornering obviously can not take place since the switch is locked. Therefore for purposes of the anti-cornering computations involved in the arrangement of our invention, point A is constrained to be at, or in the approach to, point B.

Two single car cuts are shown moving along the stretch of railroad track, each represented in schematic form as a 4-axle car. However, as will become apparent, anti-cornering protection for 6- or 8-axle cars will be provided in a similar manner. The symbols L_1 and L_2 are defined as the wheel bases, that is, the distance from the first axle to the last axle for cars **1** and **2**, respectively. For multi-car cuts, the distance L is also measured from the first axle, of the first car, to the last axle, of the last car. The symbols O_1 and O_2 are, respectively, the overhangs for cars **1** and **2**, that is, the distance at each end of the car from the end of the car body to the center of the first axle at that end. These lengths, or distances O, may or may not include the length of the coupler at the end of the car. However, as will become apparent later, this is unimportant to the arrangement of our invention since these distances cancel out of the equations used. The length L for each car or cut of cars will be stored within the control computer, having been determined during the measurement of the parameters of each car or cut of cars moving throughout the yard. One arrangement for making these measurements is described and shown in a copending application for Letters Patent of the U.S. Ser. No. 712,738, filed Mar. 13, 1968 by E. F. Brinker for the Measurement of Freight Car Parameters, which application has the same assignee as this present application. Also shown, associated with each of the schematic illustrations for the moving cars, are velocity arrows designated V_1 and V_2. These symbols designate the velocities of the respective cars and are assumed for practical purposes to remain constant as the cars move through the area of interest in the direction shown.

With car **1** in FIG. 1 routed towards point F as illustrated, we shall assume that the proper preselected routing for car **2** is towards point G. Cornering between these two cars will then occur if the switch can change position and car **2** can overtake car **1** before the last axle of car **1** reaches point F. But this overtaking condition can exist only if the following inequality is true:

$$\frac{S_{CF}}{V_1} > \frac{S_{AB}+S_{BC}+S_{CG}-(O_1+O_2)}{V_2} \qquad (1)$$

where:

S_{AB}—length of track section AB
S_{BC}—length of track section BC
S_{CF}—length of track section CF
S_{CG}—length of track section CG
V_1, V_2, O_1, and O_2—as previously defined.

Since the quantity $[S_{BC}-(O_1+O_2)]$ is approximately equal to zero and is anyway very much less than S_{CG}, expression (1) may be simplified to the following:

$$\frac{S_{CF}}{V_1}>\frac{S_{AB}+S_{CG}}{V_2} \quad (2)$$

By rearranging expression (2), we obtain:

$$\frac{S_{AB}}{V_2}<\left(\frac{S_{CF}}{V_1}-\frac{S_{CG}}{V_2}\right) \quad (3)$$

If car **1** is routed toward point G and the proper routing for car **2** is toward point F, an expression for the overtake condition can be developed in a manner similar to the development of expression (3), resulting in:

$$\frac{S_{AB}}{V_2}<\left(\frac{S_{CG}}{V_1}-\frac{S_{CF}}{V_2}\right) \quad (4)$$

Since S_{CG} and S_{CF} are equal by definition, expressions (3) and (4) are identical. By substituting S_C for S_{CF} and S_{CG}, a general expression that applies to both of the two overtake conditions is obtained:

$$\frac{S_{AB}}{V_2}<S_C\left(\frac{1}{V_1}-\frac{1}{V_2}\right) \quad (5)$$

Both the left-hand and right-hand sides of inequality (5) dimensionally represent time, since each is distance divided by velocity.

Expression (5) provides the basis for our anti-cornering protection arrangement. This basis may be stated to be that potential cornering situations will be prevented if the track switch can not change position when this inequality is satisfied by existing car spacings and velocities. This can be accomplished by imposing a time constraint on the control of the switch. Thus a time interval of delay, prior to positioning the switch to establish the diverging route for the following car, must normally be provided, i.e., computed, when each car traverses the switch. Said in another way, as long as the time for the following car to reach the detector section, i.e., arrive at point B, which time is represented by the left quantity of expression (5), remains less than the catchup time beyond the switch, as represented by the right quantity, cornering will occur if the switch is allowed to change position to establish a diverging route for the following car. Conversely, if car spacings and velocities are such that the time prior to arrival at point B for the following car, i.e., the left quantity, is equal to or greater than the catch-up time of the right quantity, cornering will not occur even if the switch changes position. Therefore, if, subsequent to the time that the last axle of car **1** is located at point C, the "command" for the switch to change position is not delivered to the switch control circuits until a time interval has elapsed that is equal to or greater than the catch-up time represented by the right quantity of expression (5), any potential cornering will be prevented.

For computation purposes, the left quantity of the inequality (5) is not a readily usable item, from a practical standpoint, since, by the definition of point A, the distance S_{AB} is a relatively unmeasurable variable for each car. However, the right quantity contains only terms which may be measured for each car or for which information is predetermined and thus available. Thus, this delay time interval for each car traversing the switch may be represented by the right quantity of expression (5) and can be expressed by the following equation:

$$T=S_c\left(\frac{1}{V_1}-\frac{1}{V_2}\right) \quad (6)$$

This means that, when the car spacing and car velocities are such that cornering can occur, i.e., inequality (5) is satisfied, the switch will not be "commanded" to change position until the first axle of car **2** has passed point B. Such being the case, the switch cannot change position and cornering will be prevented. If car spacing and velocities are such that cornering cannot occur, i.e., inequality (5) is not satisfied, time T will elapse before the first axle of car **2** has passed point B. Under this condition, when the switch "command" is delivered, the switch will change position to properly route car **2**. It is obvious that only positive values of T (when V_2 is greater than V_1) are used to impose time constraints on control of the switch.

The basic anti-cornering arrangement described above may be applied at every switch location in a classification yard. Referring to FIG. 2, we shall describe the general details of such an application and also in a general way the operation thereof. FIG. 2 is a diagrammatic illustration of an anti-cornering system in a classification yard using a flow chart and conventional block diagram format to represent the apparatus and its operation. The single line representation at the top of FIG. 2 illustrates part of the track layout in a classification yard. In the portion illustrated, cuts of cars moving from the crest of the hump at the left of the drawing travel through the master retarder, over switch W_1, through the group retarder for one group of storage tracks, and over at least switch W_2 to the preselected one of that group of storage tracks, here designated as tracks **8** to **14**. Switch W_1 designates a track switch which routes cars over one diverging track to storage tracks **1–7** and by the other diverging movement to the previously mentioned storage tracks **8–14**. Switch W_2 is the initial group switch for routing the cuts of cars to the various tracks of the illustrated storage group. Other switches associated with storage track group **8–14** are not specifically designated but similar control arrangements including the anti-cornering protection are provided for each of these switches.

This particular classification yard is provided with an automatic system of operation, controlled by a digital computer shown by a conventional block at the bottom of FIG. 2. Various forms of digital computers may be adapted and applied to control such automatic classification yard systems. A specific example of one such computer unit actually used in an automatic yard control system, which further includes the anti-cornering arrangement disclosed herein, is the Honeywell Model DDP–516, manufactured by the Computer Control Division of Honeywell, Inc., located in Framingham, Mass. The interfacing of the computer with the other yard apparatus, and its programming to execute the control functions required, are not a part of the inventive concept herein disclosed. Thus it is sufficient to define that this computer receives the routing information for the cuts of cars, issues switch controls to properly establish the desired routes to the preselected storage tracks, receives car and track characteristics and condition measurements from the track side apparatus, computes the desired leaving speed from the various retarders, issues controls to these retarders for operation to obtain the selected speeds, and receives car speed information measured at various points as cuts of cars move throughout the yard to the selected storage tracks. The computer records and/or stores the information and measurements for later use as needed in the operation of the control system. A specific arrangement is described in the previously cited Manual 555. In addition to car speed information, the stored information includes car lengths and other related parameters for the various cuts of cars moving in the yard, as described, for example, in the aforementioned Brinker application, and the predetermined clearance distance for each switch.

The flow chart arrows shown in FIG. 2 indicate in some greater detail the information received and the controls issued, both of which are recorded, which are particularly involved in the anti-cornering arrangement of our invention. For example, a desired leaving speed is computed for the master retarder and for a group retarder for each cut of cars. These are indicated by the flow lines designated by symbol V_d with a prefix M or G designating the master or group retarder. The actual exit speed from the retarders for each cut of cars is measured by the associated radar apparatus, conventionally shown,

which is provided with a velocity meter so that direct speed information is supplied to the computer, as designated by the flow lines V_e. Both the V_d and V_e speed information for each cut of cars as it passes through the master and group retarders is stored by the computer. It is to be noted that the distance between the end axles, that is, the lead axle and the final axle of each cut of cars, is also stored within the computer. This distance is measured during the approach to the master retarder, as described in the aforementioned Brinker application, and is supplied to the computer as indicated by the flow line designated by the previously defined symbol L. As each cut of cars traverses a switch location, its present speed is measured in a manner previously described briefly and in more detail shortly. This information is supplied to the computer for storage as illustrated by the flow lines designated by symbol V_1 with a prefix in accordance with the associated switch location.

The remaining flow lines, designated by the symbol WP with a subscript to designate the particular associated switch, represent the positioning controls supplied from the computer to the switch movements in order to establish the preselected routes for the cuts of cars. The necessary inputs, outputs, and stored programs are provided within the computer so that the car following action and the issuance of the necessary switch control at the proper times are performed by the computer. However, the switch locking constraints upon the operation of the switch movements is provided within the switch detector sections and associated wayside apparatus and not within the computer. In other words, the computer controls the positioning of the track switches only to the extent that it delivers positioning commands to the external switch control and locking circuits. These external control and locking circuits provide the necessary safety so that switch points are not moved while cuts of cars are passing over them, or are within such a short range of approach that the full movement of the switch points cannot be completed before the arrival of the lead wheels of the car. Such safety controls are conventional in the automatic operation of switch movements and need not be further described.

It is now assumed that two cuts of cars are approaching switch W_2, these cuts having moved along the selected routes from the hump through the master retarder, switch W_1, and the selected group retarder towards switch W_2. The final speed control function for each cut is performed as it passes through the group retarder. The various items of speed information have been recorded for each of these cuts and stored in the digital computer. For example, for each cut, speed information designated by the flow lines MV_d, MV_e, W_1V_1, GV_d, and GV_e has, or shortly will have, been taken and recorded by the computer. During the approach of each of these two cuts to the master retarder, car and/or cut parameters were measured and recorded so that at this time a wheel base distance L is stored in the computer for each cut of cars. The car following action by the control system as these cuts moved throughout the yard from section to section, as detected by wheel detectors, track circuits, and/or other conventional means, results in the location of each cut and its identity being known. Thus its recorded information regarding speed and characteristic distances is available whenever desired. In other words, the digital computer, through its car following procedures, recognizes which particular cuts are now approaching switch W_2 and can identify and recall the stored information concerning the individual cuts.

As the first or leading cut passes point C in the immediate approach to switch W_2, its velocity V_1 is measured. One specific way of accomplishing this is to determine the time elapsing between the passage of the first and last axles of this particular cut, as detected by the wheel detector at point C. This timing may be accomplished by recording exact times based on a standard clock or by recording a count of uniform clock pulses provided within the computer apparatus. In any event, the velocity V_1 is then determined in accordance with the wheel base L_1 divided by the elapsed time.

When the last axle of this lead cut is detected as passing point C in the approach to switch W_2, the computer determines whether or not a potential cornering situation exists at the present time. This is accomplished by seeking the answers to three questions. First, is there another cut approaching the switch in question, i.e., switch W_2? If the answer to this first question is yes, then a second question is asked: Does the position of the switch have to be changed to properly route the approaching second cut? If the answer to this second question is also yes, then a third question is asked: Is the current velocity (V_2) of the approaching second cut greater than the just determined velocity V_1 of this lead cut? If the answer to this third question is also yes, a potential cornering situation exists. Obviously, if the answer to any one of these questions is no, there is no potential cornering situation existing and further action is not required for this particular cut. These three questions are all answered within the computer by reference to information already stored. This includes the current locations of the assumed cuts of cars, the stored routes, and the speed information recorded for the various cuts. It is to be noted that V_2 used for the second cut, in determining whether it is moving faster, is the latest information available regarding that particular cut. In the situation here assumed, this would likely be either the computed leaving speed desired from the group retarder, designated by VG_d, or the actual exit speed from the group retarder, as measured by the radar apparatus and designated as GV_e. If, however, the next cut to follow this same route towards switch W_2 is even further back up the hump, the V_2 information used will be that concerning its operation in the master retarder or perhaps that measured at the lead switch group W_1.

When a potential cornering situation exists, the delay time interval for switch operation is then computed in accordance with expression (6) previously discussed. All the information necessary for solving this equation is stored within the computer at this time. The predetermined clearance distances S_c are stored for each of the switches in the yard and thus are available for switch W_2. Measurement of V_1 of the leading cut has just been completed as it passed point C while the velocity V_2 of the following cut is stored and the latest available information again is used for this particular item.

When the delay time has been computed, one possible method for controlling and providing the anti-cornering protection is to withhold the switch position or control commands designated by the flow line W_2P for the following cut of cars until the time delay has elapsed. This delay time designated by the arrow symbol T_2 within the computer block is measured from the time of the passage of the last axle of the first cut at point C. The operation is illustrated conventionally in FIG. 2 by the switch control delay block within the computer to which is applied the time delay signal T_2. Several methods by which the application of the switch control may be delayed will be apparent to those skilled in the computer art. For example, a gating circuit may be used which will pass the switch control only when the time signal expires. Or some form of binary variable may be supplied which is changed to its permissive condition when the particular time is reached, on the computer clock, at which the delay time has expired.

Whatever the method, when time T_2 expires, the switch command for positioning the switch to establish the route for the following cut will be supplied to the switch movement and locking apparatus at the switch location. Referring to FIG. 1, if the leading axle of this following cut 2 has not reached point B in the approach to switch W_2 when the switch position command is supplied, sufficient time is available and the switch movement will respond

to the command to position the switch for the diverging route for the second cut. However, if the leading axle of cut 2 has entered the switch detector section, bounded by points B, D, and E, switch W_2 is locked in its existing position and no movement of the switch points can occur. Under this condition, cut 2 will follow the route already established for cut 1 even though the preselected route calls for a diverging movement. This misrouting of cut 2 and its probable catch up with cut 1 is, however, more acceptable than a cornering accident which was highly probable under these conditions. As previously mentioned, catch up between two cuts moving along the same track is the equivalent to coupling within the storage tracks and no damage is expected to result to the cars or their contents. It is true that this misrouting requires a trimming operation which will result in lost time in the overall yard operation, but this normally is less lost time than a cornering accident will cause through blocking a portion of the yard. With the provision of misrouting reports from the digital computer which records the various misroutes, a misrouted car and its location are identified and the car can be easily recovered and moved to its proper position in the classification yard.

The described arrangement of our invention thus provides a practical and efficient anti-cornering system for use in classification yards. Misroutings of cuts of cars occur only to avoid anti-cornering accidents and are thus acceptable minimum delays in line with the goal of increasing the safety and efficiency of yard operations. Most of the functions required to provide our anti-cornering system are already used in the yard and the information or data thus already available within the computer control apparatus. Even the wheel detector at point C in the immediate approach of each switch is used also in the car-following operation throughout the yard. Some additional storage elements within the computer and additional programming of the computer operation constitute most of the additional apparatus or operation required to provide this anti-cornering arrangement. The humping speed need not be reduced in order to space the cars to prevent cornering and thus the full capacity of the yard may be used. Also, the switch detector sections need only be of sufficient length, whether they be track circuits or other means, to assure that switch points will be fully positioned prior to the arrival of the leading wheel of any cut and that no switch movement will occur while the cut of cars is passing over that switch.

Having thus described our invention, what we claim is:

1. A method for preventing cornering between successive cuts of railroad cars traversing a track switch, said switch being included in a detector locking section to prevent movement of the switch while a cut is traversing said section, comprising the steps of,

(a) measuring the speed of the first of the two successive cuts while said first cut traverses said switch in its first position,

(b) measuring the speed of the second cut of said successive cuts while approaching said switch,

(c) computing, by a programmed computer, in accordance with the measured speeds and a known distance to the clearance point between cuts moving along the diverging routes beyond said switch, the time interval required prior to arrival of said second cut at said switch to insure clearance of said first car at said point when said second car travels the diverging route, and

(d) delaying the positioning of said switch to the opposite position to route said second cut until the expiration of said time interval.

2. The method for preventing cornering as defined in claim 1 in which said time interval is computed by said computer as the product of said distance to the clearance point and the difference between the reciprocals of the measured speeds of said successive cuts, where the speed of said second cut is greater.

3. The method of preventing cornering as defined in claim 2, where said switch is located in a railroad classification yard operated by an automatic control system, and in which,

(a) the step of measuring the speed of said first cut includes,

(1) measuring the time for passage of a selected portion of said first cut at a point adjacent said switch, the length of said selected portion being known and recorded in said control system,

(2) calculating by said computer the speed in accordance with said recorded length and said measured time, and

(b) the step of measuring the approach speed of said second cut is part of the control operations of said yard, the latest valid speed information recorded in said control system being used.

4. The method of preventing cornering as defined in claim 3 where said automatic yard control system includes a digital computer for recording and storing length, speed, and route information for each cut and clearance distance for each switch and for computing said time interval, and in which,

(a) the step of delaying comprises delaying the delivery from said computer to the switch of the switch position control for said second cut until the expiration of said time interval,

and which further includes the step of,

(b) determining in said computer from the stored data that a potential cornering situation exists prior to computing and enforcing said time interval delay.

5. Apparatus for controlling the operation of a track switch movement, which positions an associated switch located in a stretch of track to a first or second position to establish a selected one of two diverging routes for cuts of railroad cars traversing the switch, comprising in combination,

(a) a first means responsive to the movement of a cut of cars over said switch for measuring the speed of that cut,

(b) a second means responsive at selected points to the approach of the next following cut of cars for determining the present speed of approach of that following cut,

(c) a computing means controlled by said first and second means, when successive cuts are traversing and approaching said switch, respectively, for computing a time interval in accordance with a predetermined relationship between the difference between the speeds of the two successive cuts and a preselected distance from said switch to clearance points along each diverging route within which distance cuts simultaneously moving along said diverging routes will corner, and

(d) delay means with connections to said switch movement and controlled by said computing means for delaying the operation of said movement to position said switch to establish a diverging route for said following cut until the expiration of said time interval.

6. Control apparatus as defined in claim 5 further including,

(a) a detector track section spanning said switch location, and

(b) detection means responsive to a cut of cars occupying said detector section and having connections for locking said switch in its existing position when a cut of cars is detected, whereby said switch is retained in the position existing for the leading cut when said following cut occupies said detector section prior to the expiration of said time interval.

7. Control apparatus as defined in claim 6, the combination further including,

(a) means responsive to the passage of each cut of cars

at a point in approach to said switch for measuring the length of a preselected part of that cut, and

(b) said first means comprising,

(1) timing means responsive to the passage of a cut of cars over said switch for measuring the time for passage of said preselected part of that cut,

(2) speed computing means controlled by said length measuring means and by said timing means for determining the speed of each cut moving over said switch in accordance with the measured length and time of passage of said pre-selected part of each cut.

8. Control apparatus as defined in claim **7**, in which said delay means comprises,

(a) a delay element operable to a first and a second condition and having connections to said switch movement for inhibiting the delivery of control functions thereto only when said delay element is in its first condition,

(b) said delay element being controlled by said computing means for operating to said first condition during said time interval and for holding in said second condition at all other times.

9. Control apparatus for a track switch in a railroad classification yard selectively connecting a first stretch of track to second and third diverging track stretches, comprising in combination,

(a) operating means for said switch for moving it between a first and a second position to selectively route cuts of cars to said second and said third track stretches respectively,

(b) a first speed measuring means for measuring the speed of a cut of cars as it traverses said switch,

(c) a second speed measuring means for measuring the speed of a cut of cars approaching said switch, and

(d) delay means controlled by said first and second speed measuring means, in accordance with a predetermined relationship between the measured speeds of two successive cuts of cars and a preselected clearance distance along said second and third track stretches, and having connections to said operating means for delaying operation of said switch to its other position between successive cuts of cars routed over said switch to diverging tracks when the following cut will catch up to the leading cut within said preselected distance, thereby avoiding cornering of the lead cut by the following cut.

10. Switch control apparatus as defined in claim **9**, further including,

(a) computing means with connections for receiving speed measurements from said first and said second speed measuring means and having stored therein said preselected distance,

(1) said computing means being responsive to the reception of a speed measurement of said leading cut, when the measured speed of said following cut routed to the diverging track is greater, for computing a time interval in accordance with said predetermined relationship,

(b) said delay means being controlled by said computing means for delaying the movement of said switch to its other position after passage of said lead cut, to route said following cut to the diverging route, until the end of said time interval.

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