Oct. 17, 1961 SIH HSUIN TSIANG 3,005,092

ROUTE REPORTING SYSTEM FOR RAILROAD CLASSIFICATION YARDS

Filed May 20, 1958 3 Sheets-Sheet 1

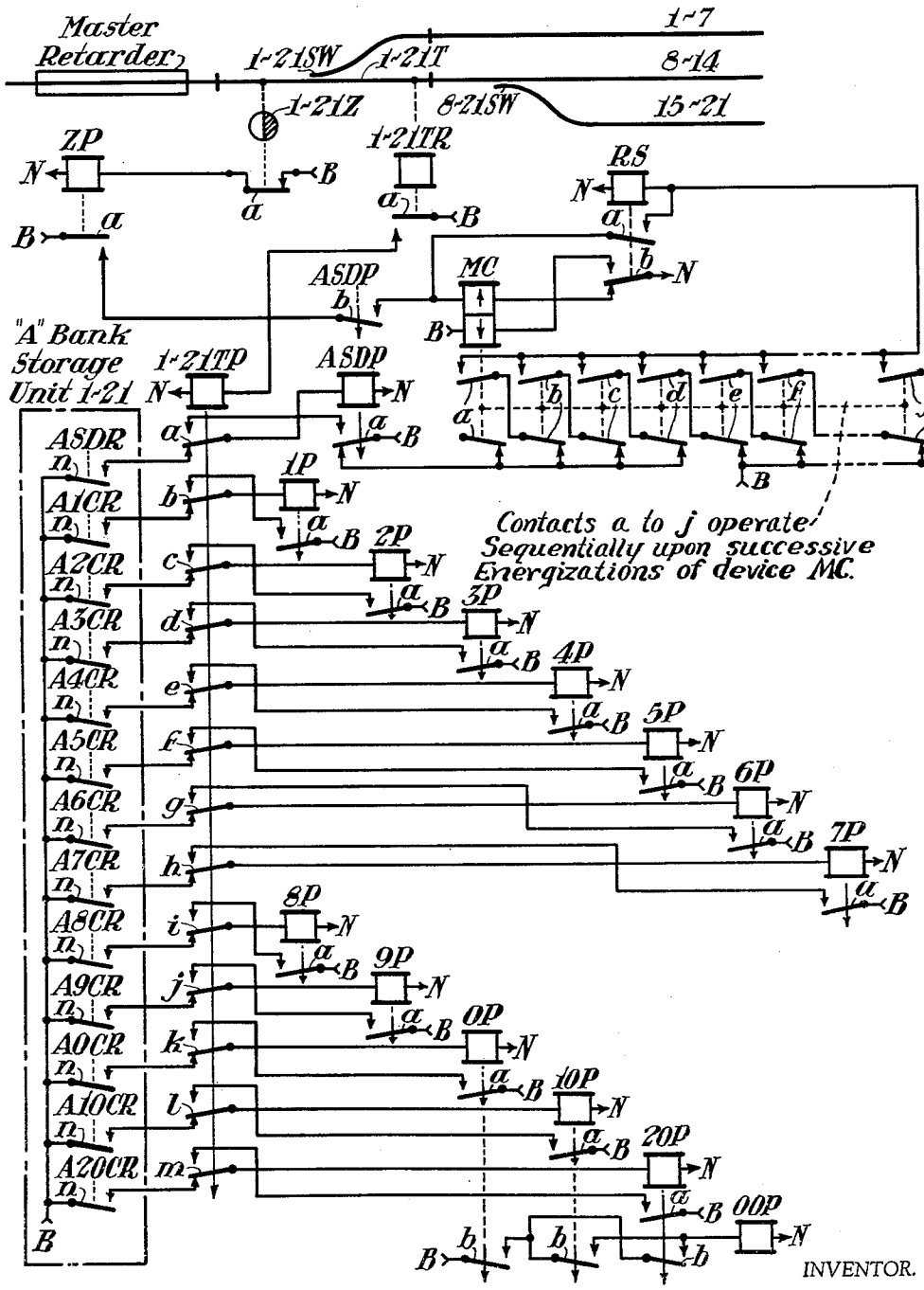


Fig. 1.

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Filed May 20, 1958 3 Sheets-Sheet 2

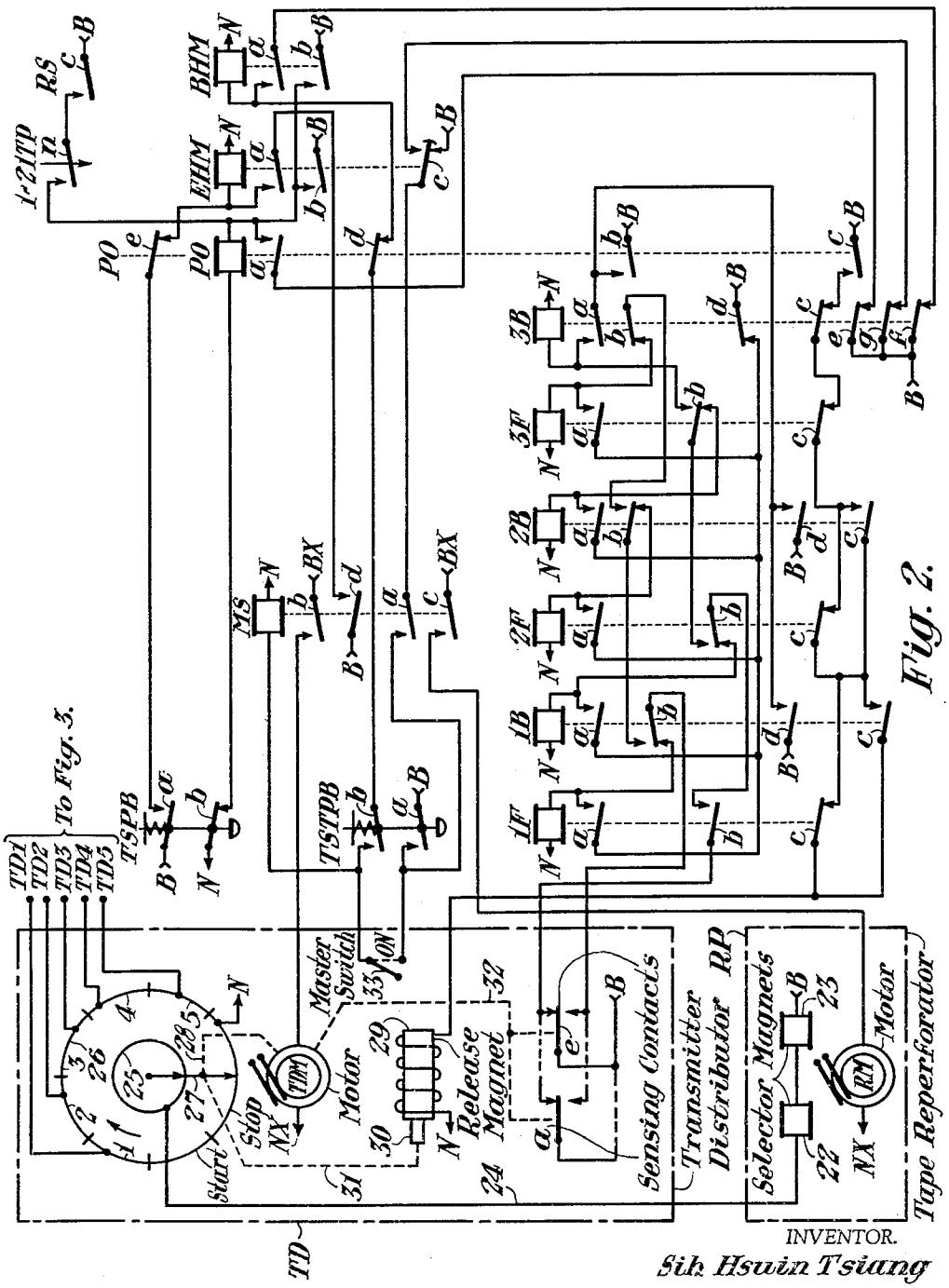


Fig. 2.

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ROUTE REPORTING SYSTEM FOR RAILROAD CLASSIFICATION YARDS

Filed May 20, 1958 3 Sheets-Sheet 3

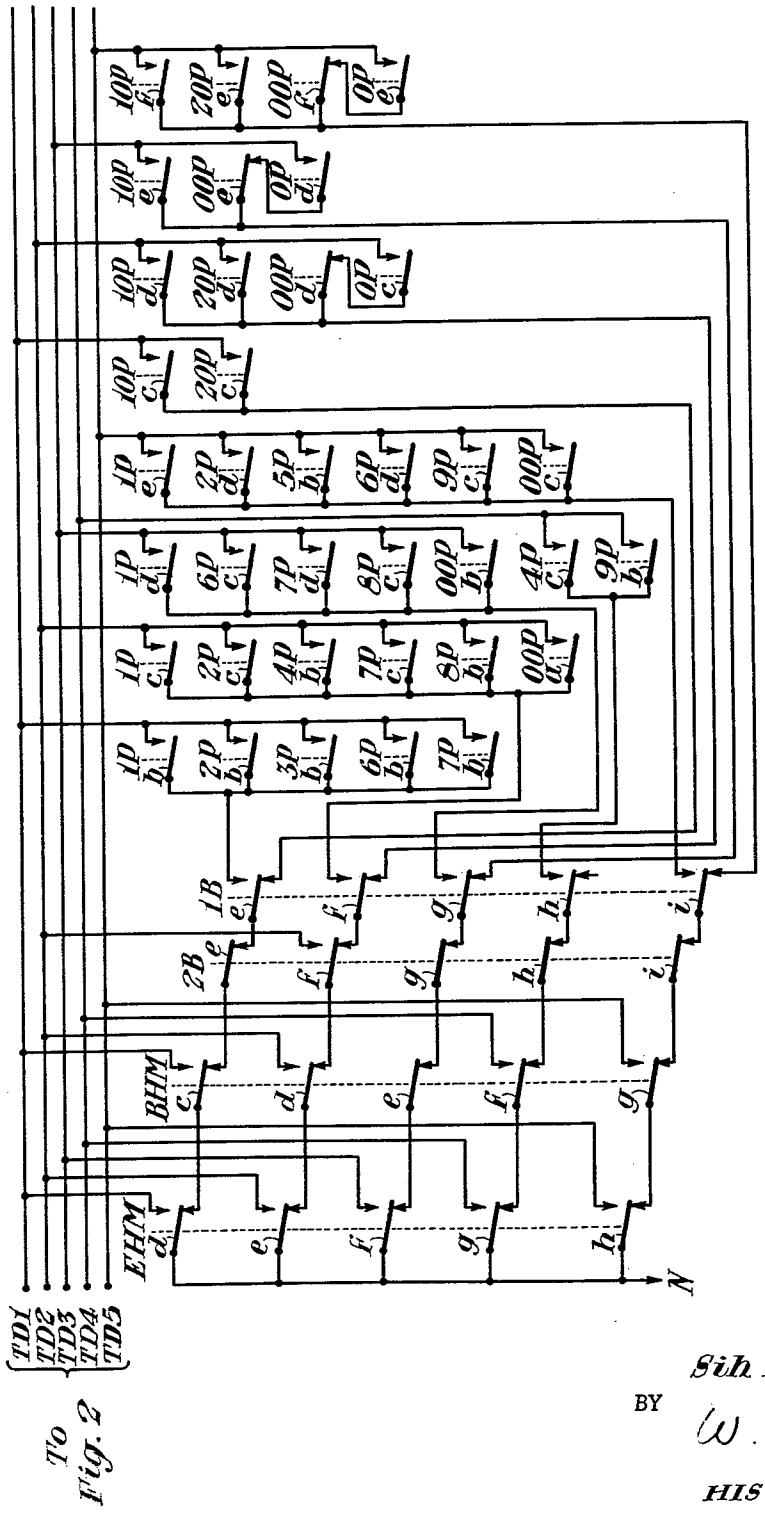


Fig. 3.

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United States Patent Office 3,005,092 Patented Oct. 17, 1961

3,005,092

ROUTE REPORTING SYSTEM FOR RAILROAD CLASSIFICATION YARDS

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Filed May 20, 1958, Ser. No. 736,513
8 Claims. (Cl. 246—2)

My invention relates to a route reporting system for railroad classification yards. More particularly, my invention pertains to a system for use in automatic classification yards for registering on a permanent recording medium the storage track destination of each car entering the yard whether it moves to the storage tracks in a single or a multiple car cut.

Automatic operation of railroad classification yards is relatively well known in the art. Such installations include automatic switching systems which provide route control for the cuts of cars moving in that yard and also automatic retardation systems which provide speed control. However, to further handle the cars or their lading, the railroad must know the specific storage track to which the various cars have been routed. In practice, this varies from the actual switch list provided for a particular train due to the filling of assigned storage tracks so that other tracks must be substituted in their place and to the late discovery of bad order cars which must be routed to specific repair tracks. The information as to the actual storage tracks into which the cars have been classified is used in preparing waybills for further movement, train lists for departing trains, and, quite frequently, in system car location reporting arrangements whereby the shippers may be readily and frequently informed as to progress of their shipments. Automation of such clerical work as is involved in preparing and registering the actual location of the cars increases the efficiency and economy of the railroad's operation. Thus it is of considerable advantage to have storage track information in a form which may be used with the various electrical-mechanical clerical machines now available. For example, it may be desired eventually to prepare some form of punched card for each car containing the storage track information as well as other routing information. In this specific example, if the storage track information is contained in some form of punched tape, it can be readily transformed by machine into the desired punch card form.

Accordingly, it is an object of my invention to provide a route reporting system for railroad classification yards.

Another object of my invention is to provide, in a railroad classification yard, a reporting system to register the storage track to which each car entering that yard is routed.

A further object of my invention is to provide a track registry means for railroad classification yards to report the destination track of each car entering that yard.

Still another object of my invention is to provide, in a railroad classification yard having an automatic switching system to route cuts of cars to preselected storage tracks, a registry means to record on a permanent recording medium the storage track destination for each car.

A still further object of my invention is to provide a route reporting means that registers the storage track destination of each car moving over the initial switch in a railroad classification yard.

It is also an object of my invention to provide a track reporting arrangement to register the destination track for each car being classified into a railroad classification yard in accordance with an automatic switching system.

Another object of my invention is to provide a route or track registry means to record the storage track destination of each car entering a classification yard in accordance with the route stored for the corresponding cut of cars in the automatic switching system at the initial switch of the yards as the cut passes that switch.

Other objects, features, and advantages of my invention will become apparent from the following specification and claims when taken in connection with the accompanying drawings.

In practicing my invention, I provide, in one specific form, a repeater storage bank which directly repeats the final bank of the automatic switching system associated with the initial switch of the classification yard. Each route or switch control storage relay and the storage detector relay are repeated in this added bank. In the form specifically shown herein, the route storage in this final bank is in a digital form, that is, the destination track is indicated or stored by track number rather than by a switch control code. The route storage is then held in the repeater storage bank while the corresponding cut of cars occupies the detector section associated with the lead (initial) switch. At this same location, I provide a car counting means actuated by the cars passing through the detector section over the lead switch. As specifically shown herein, the counting means is an axle counting arrangement which divides the final count by four to indicate the passage of each car. The recording means by which I register the storage track information for each car is a tape reperforator controlled by a transmitter distributor. This latter unit may be a standard tape reading distributor modified for this special use. A bank of sequencing relays is driven by the distributor during its cycle of operation and these relays in turn control the cycling of the distributor to register three punch codes for each car. In the specific example herein illustrated, the three punch codes comprise two digits for the track information and a line feed code which spaces the track information for successive cars. The actual code punch for each track digit is selected over contacts of the relays of the storage repeater bank. There are two such contact networks with a shift between these networks, to select the two digits, being accomplished by the first sequence counting relay. The spacing arrangement is a line feed code as selected by the second sequence relay, after which the punch operation halts in accordance with the sequence count. Other circuits permit the entry and selection of code punches marking the beginning and the end of the humping operation. These latter two codes are the only manual operation that is required to start and stop the tape punching operation for an entire train. That is, between the beginning and the end of a particular humping cycle, all of the punching operations proceed automatically under the control of the various details of the system as the cars pass in succession over the lead switch of the yard.

Referring now to the drawings, FIG. 1 thereof shows diagrammatically a portion of route reporting apparatus embodying one form of my invention. This figure shows in particular the route storage repeater bank and the car counting arrangement.

FIG. 2 is a diagrammatic showing of another portion of the system embodying my invention showing particularly the tape reperforator, the transmitter distributor, the sequencing chains, the coordination circuits, and other punching controls.

FIG. 3 of the drawings shows the final portion of the specific system embodying my invention, this drawing showing the code selection or translation circuits to register the proper code punches through the transmitter distributor into the tape reperforator in accordance with the route stored in the initial bank.

In each of the drawings, similar reference characters are used to identify similar parts of the apparatus.

In the circuit arrangement illustrating the system specifically shown, the contacts of the various relays included in the system are shown generally in vertical alignment with the winding symbol of the controlling relay. However, where this practice would unduly complicate the circuit connections, relay contacts are not show aligned with their control winding. For example, to simplify the code selection circuits (FIG. 3), the relay contacts are shown separated from the corresponding control relay windings. A few other isolated instances of similar simplification occur in the other figures. In each case where the circuits are thus simplified, each particular relay contact is identified with its control winding by repeating immediately above the contact symbol the relay reference character used with the control winding. Each such contact is also identified by an individual contact reference, herein a lower case letter, to distinguish from other contacts of the same relay. It is believed that this method of simplifying the circuits is clear and that the circuit arrangement may be more easily understood thereby.

Where slow acting relays are intended in the arrangement, they are indicated as such by vertical arrows drawn through the movable portion of the associated contacts. Thus the slow release relays herein are indicated by downward pointing arrows drawn through the various contacts associated therewith. The complete system, shown in the three figures of the drawings, is supplied with a local source of direct current energy which may be in the form of a battery of proper size and capacity. However, the source as such is not shown, the positive and negative terminals only being indicated by the conventional reference characters B and N, respectively. When alternating current energy is used, the terminals of the corresponding source are indicated by the references BX and NX.

Referring now to FIG. 1, there is illustrated at the top thereof, by conventional symbols, the initial portion of a small railroad classification yard of the gravity or hump type. It is considered herein that this yard is provided with an automatic switching system which controls the positioning of the switches in the yard to automatically route the various cuts of cars to the preselected storage tracks. It is also considered, although it does not enter into the system of my invention, that this yard is provided with automatic retardation whereby the speed of the cars moving through the yard into the storage tracks may be controlled to provide an optimum coupling speed. Along the main lead track, over which cars enter this classification yard from the left of the drawing, is the master retarder. Following the master retarder is the lead or initial switch of the yard, designated by the reference character **1–21SW**. Only one other switch, an intermediate switch **8–21SW**, is shown. To simplify the illustration, only the leads to the three groups of storage tracks are shown to complete the abbreviated illustration, these group lead tracks being designated by numerical references as leading to storage tracks **1** to **7**, **8** to **14**, and **15** to **21**, respectively, from top to bottom in the illustration.

The leading switch **1–21SW** is provided with the usual detector track section, indicated by the reference **1–21T**, which is set off from the adjacent track by the usual insulated joints which are shown conventionally. This track section is provided with a track circuit in order to detect the occupancy of the section by any part of a cut of cars passing over the switch. Since the track circuit may be of any well-known type and the use of such track circuits for detection purposes is so well known, only the track relay portion of the circuit is shown connected to the rails by a conventional dotted line. This track relay is designated by the reference character **1–21TR**. As is usual in such detector track circuits, the track relay is normally energized when the section is unoccupied and is shunted and released when any part of a cut of cars occupies any portion of the track section. A track repeater relay **1–21TP** is also provided, this being a back contact repeater energized over a simple circuit extending between terminals B and N of the local source and including back contact *a* of track relay **1–21TR** and the winding of repeater relay **1–21TP**. It is obvious that the repeater relay will be energized during the time that any portion of the track section is occupied by a cut of cars passing therethrough.

At the location of the lead switch, there is also provided a track instrument, which may be a wheel contactor so positioned as to be actuated by the passage of each wheel along one of the rails of the track. Since such wheel contactors are well known, the one used here is shown by a conventional symbol designated by the reference **1–21Z**. It is to be understood that any type of instrument which will detect each wheel of a car may be used. In the form herein considered, the passage of each wheel along the one rail of the track at this location actuates the wheel contactor to open its single contact *a*. It is known that the operating time of such wheel contactors is short and generally non-uniform. Therefore, a repeater relay ZP is provided which is normally energized over contact *a* of the contactor in its closed position. Relay ZP thus is deenergized and quickly releases each time a car wheel actuates the contactor to open its contact. Thus relay ZP whose use will be shown hereinafter, releases for each wheel, that is for each pair of wheels and axle of a car passing over this lead switch. It is to be noted that the wheel contactor as shown is located inside the limits of the track circuit of the leading switch. This location permits the wheel or axle count to occur while the car is traversing the lead switch track section, and as will be shown hereinafter, permits the tape punching operation to be completed before the car vacates this track circuit.

At the left of FIG. 1, shown by a conventional dot-dash rectangle, is a portion of storage unit **1–21** of the automatic switching system for the yard, this storage unit being associated wtih lead switch **1–21SW**. This automatic switching system may be any one of several well-known types of switching systems. For purposes of reference to simplify the present description and the drawings, the switching system is preferably of the type shown in the copending application for Letters Patent of the United States, Serial No. 355,281, filed May 15, 1953 by Benjamin Mishelevich, for Automatic Control of Railway Classification Yard Track Switches, now Patent No. 2,863,991, granted December 9, 1958, this prior patent and the present application being of common ownership. A similar type of system is also shown and described in Manual 517, entitled Automatic Switching For Classification Yards, published in January 1953, by the Union Switch and Signal, Division of Westinghouse Air Brake Company. Reference is made to either the prior patent or to the aforementioned manual for a complete description and showing of the automatic switching system used in conjunction with the yard shown herein.

The only details of the automatic switching system actually shown herein are contacts of the route or storage relays and a contact of the storage detector relay in the final or A bank of storage unit **1–21**. Each of these relay contacts is designated by a relay reference character similar to those used in the Mishelevich patent, but without the numerical prefix which here would be the same as the storage unit, that is, **1–21**. Additional relays to those actually shown in the Mishelevich patent are here necessary in order to allow for the **21** track yard. However, these reference characters are also similar to those used in the aforementioned Manual 517 so that the significance of each reference character is obvious. The use of these reference characters in this form simplifies any cross reference which may be desired between this application and the aforementioned prior publications. Each relay contact is also provided with a lower

case reference *n* which signifies that these are additional contacts over and above those required and shown in the prior publications for the regular switch control system. Briefly summarizing, at this point in the switch control system, route storages are in digital form, that is, the route storage shows in digital form the preselected track for the cut of cars corresponding to the route storage. For each of the 21 tracks in the yard shown herein, two of the route or track storage relays are energized to provide in combination the digital storage for that track. For example, the route storage for a cut of cars destined to track **17** will, when stored in bank A of this initial storage unit, cause relays A**1**0CR and A7CR to be energized, the numeral 1 of the tens digit being represented by relay A**1**0CR and the numeral 7 of the units digit being represented by relay A7CR. For a route to a storage track of the first nine, the tens digit is represented by relay A0CR. For tracks **10** and **20**, the route storage consists of the energized combination of relays A**1**0CR or A**2**0CR, respectively, and relay A0CR.

As explained in detail in the aforementioned references, the route storage transfers from bank A of this initial storage unit to the storage unit associated with the next switch location along the selected route when the corresponding cut of cars occupies detector section **1–21**T. However, for the present recording system, the route information is required at the lead switch location until the corresponding cut completes its passage through section **1–21**T. It is therefore necessary to repeat and hold the route storage information at this location. There is thus provided the bank of storage repeater relays designated by the references 1P to 0P, inclusive, and **1**0P and **20**P. In other words, there is one repeater relay for each storage relay in the A bank, that is, each CR relay. In addition, it is necessary to store the information that a route storage was stored in bank A for the corresponding cut and has been transferred to the next location. Therefore, a repeater relay ASDP of the storage detector relay ASDR of bank A is provided.

Each storage repeater relay directly repeats the corresponding storage relay in bank A. This repeating action occurs only when track section **1–21**T is clear so that track repeater relay **1–21**TP is released. At this time in the operation of the classification yard, a new route storage has been transferred into bank A so that the repeater relays may assume an energized combination indicated by the route storage. For example, when appropriate, relay **1**P is energized to repeat relay A1CR by a simple circuit extending from terminal B over front contact *n* of relay A1CR, back contact *b* of relay **1–21**TP, and the winding of relay **1**P to terminal N. A similar circuit for relay 0P includes front contact *n* of relay A0CR and back contact *k* of relay **1–21**TP. The energizing circuit for storage detector repeater relay ASDP is traced from terminal B over front contact *n* of relay ASDR, back contact *a* of relay **1–21**TP, and the winding of relay ASDP to terminal N. Each energized repeater relay is held in its energized condition when the track section is occupied, which causes relay **1–21**TP to be energized and pick up. Each stick circuit includes the corresponding front contact of the track repeater relay and front contact *a* of the storage repeater relay itself. It is obvious that the repeater relays are thus held energized, if initially energized by the corresponding route storage in bank A, as long as that cut of cars occupies any portion of detector section **1–21**T. It is also to be noted that in addition to the track or route storage information, the fact that a route storage was stored for the cut of cars then occupying the track section is indicated by the energized condition of relay ASDP. The utility of this latter storage will appear hereinafter.

One final relay is included in the repeater storage bank, the zero zero repeater relay **00**P. Since relay A0CR and thus relay **0**P are energized to indicate the numeral 0 in either the tens or the units digit position, it is necessary, as will appear later, to differentiate and select between the two digits which may be represented by this single relay. The energizing circuit arrangement for relay **00**P extends from terminal B over front contact *b* of relay **0**P, front contacts *b* in multiple of relays **10**P and **20**P, and the winding of relay **00**P to terminal N. It is apparent that relay **00**P is thus energized when the numeral 0 designated by the energized condition of relay **0**P occupies the units digit position in the track code. When the numeral 0 is occupying the tens digit position, as in the track codes for storage tracks up to and including track **9**, relays **10**P and **20**P will both be deenergized so that relay **00**P is not energized. The actual use of relay **00**P to select between the numeral 0 in these two positions will be described more fully in the description of the code translation or selection circuits. It is thus apparent that the storage repeater relay bank shows the track destination and the fact that a storage was held in bank A of the initial unit for the cut of cars crossing the lead switch at that particular moment. This information storage is held until the cut of cars clears the detector section.

Also shown in FIG. 1 is a car counting means. This means comprises a counting device which advances one count for each period of energization of the device and a reset arrangement which as specifically used herein, indicates each fourth count in the counting device and also resets the device to its initial position. More specifically, the counting device is shown as a magnetic impulse type counter having two separate windings and designated by the reference character MC. Resetting is accomplished by a reset relay RS. Magnetic impulse counters of this type are well known in the art and any one of several equivalent devices may be used. As a specific example, counter MC may be of the type disclosed in Letters Patent of the United States No. 2,538,817 issued January 23, 1951, to J. I. Bellamy for an Electromagnetic Counting Device. As shown herein, the upper winding is the operating winding, as designated by the upward pointing arrow within the winding symbol, which causes the device to advance one count for each period of energization. The lower or reset winding, designated by a downward pointing arrow, when energized causes the counter to reset to its zero position, releasing all of the counting armatures. As illustrated herein, and as usual in this type of device, there are ten counting armatures which are actuated in sequence to indicate the total count that has been entered into the counter. Each armature has associated therewith a normally open front contact and a normally closed back contact. The armatures, and the corresponding contacts, occupy the positions shown in the drawing when the counter is in its zero or no-count position, the counter returning to this position upon reset action. The initial period of energization of the upper winding of counter MC causes armature *a* to be actuated, closing front contact *a* and opening the corresponding back contact. This operation of armature *a* also primes or conditions armature *b* to operate during the next period of energization of the upper winding. However, no matter what the length of the initial energization pulse through the upper winding, only armature *a* is operated during this pulse. During the second energization period of the upper winding, armature *b* is operated, closing its associated front contact and opening the back contact. Again this conditions the succeeding armature to operate during the next energizing pulse. Once operated, each armature is held in its operated position, either by residual or by permanent magnetism depending upon the actual construction of the counter, until a reset pulse flows through the lower winding. To simplify the drawing, since not all of the armatures are directly involved in the system of my invention, only a portion of the total number of armatures are actually shown, the continuity of the circuits being indicated by the conventional dotted

lines between armatures *f* and *j* and the associated contacts.

The counting operation of counter MC is controlled by the wheel contactor **1–21Z** through its repeater relay ZP. The energizing circuit for the upper winding extends from terminal B over back contact *a* of relay ZP, front contact *b* of relay ASDP, the upper winding of counter MC, and back contact *b* of relay RS to terminal N. Front contact *b* of relay ASDP is included in this energizing circuit to assure that counts are entered into counter MC only when a route storage is held in the storage repeater bank for the cut of cars then passing over the initial switch. This eliminates counting action when trimmer engines, or extra cuts of cars moved directly by these engines, are passing through the detector section. Back contact *b* of relay RS assures that no extra count can inadvertently be entered into the counting device during the reset action since, as will appear hereinafter, relay RS picks up during the reset count and is held until the count is complete. In the specific system herein, relay RS is energized during every fourth count entered into counter MC. The circuit is traced from terminal B over back contact *e* and front contact *d*, in series, of counter MC and the winding of relay RS to terminal N. Once energized, relay RS closes its front contact *a* to complete a stick circuit which also includes back contact *a* of relay ZP and front contact *b* of relay ASDP. This circuit holds relay RS energized until the end of that particular count, that is, until relay ZP again picks up after the wheel passes off contactor **1–21Z**. This assures, as previously explained, that no extra count can be entered into counter MC by the early release of relay RS. When energized, relay RS also completes the circuit over its front contact *b* for energizing the lower or reset winding of counter MC which causes the release of all of the operated armatures of the counter, each armature returning to its at-rest position shown in the drawing.

During normal operation, it is apparent that each energization and resulting pick up of relay RS indicates the completion of the passage of one car whether the car is in a single or a multiple car cut. It is thus assumed that each car is provided with only four axles. A second circuit for energizing relay RS, which is completed at times, will cause extra counts, entered into the counter inadvertently or due to cars having more than four axles, to be cleared out of the system. This circuit for relay RS includes back contact *a* of relay ASDP and, in parallel, three series paths through contacts of counter MC, these paths including, respectively, back contact *b* and front contact *a*, back contact *c* and front contact *b*, and back contact *d* and front contact *c*. The extra counts entered into counter MC will thus be cleared at any time that relay ASDP releases which assuredly occurs at least at the end of the classification action for each train entering the yard.

Referring now to FIG. 2, shown at the left thereof is the destination track recording means or device which comprises the transmitter distributor unit TD and a tape reperforator unit RP, each unit being outlined by a conventional dot-dash rectangle. Since such units in their basic form are well known in the art, only such details are shown within these conventional rectangles as are necessary for an understanding of my invention.

The transmitter distributor unit TD is a motor driven combination tape transmitter and distributor. In standard form, its primary purpose is to translate code combinations perforated in a tape into electrical impulses transmitted sequentially to a signaling line. The distributor is made up of two units, the tape transmitter and the commutator distributor. The commutator distributor sends the code combinations out over the line as marking (on) pulses or spacing (off) pulses in proper sequence at a predetermined speed. It is to be here noted that standard transmitter distributor units may be used in the system of my invention, but must be modified to serve the purposes hereinafter described.

The communtator is made up of two concentric conducting rings **25** and **26** which are connected together by a connecting arm **27** through sliding brushes. The outer ring **26** is divided into seven segments, each one insulated from the adjacent segments as indicated conventionally in the drawing. The nomenclature assigned to these segments on clockwise order starting at the lower left are Start, **1**, **2**, **3**, **4**, **5**, and Stop. The Stop segment is somewhat longer in length than the other segments in order to make the stop pulse longer during transmission. This longer time is used to differentiate the stop position and to maintain synchronism with other associated rotating equipment such as the tape reperforator. Each of these segments, except the Start segment, has an external connection. The Stop segment is connected directly to terminal N of the local source while segments **1** to **5**, inclusive, are connected, respectively, to terminals TD1, TD2, TD3, TD4, and TD5, shown in FIG. 2, and which also appear in FIG. 3. The continuous inner ring **25** is connected to the transmission line **24**.

Brush arm **27** is connected to a main shaft which is geared through a friction clutch to a synchronous motor TDM. This geared connection is herein shown conventionally by a dotted line **28**. The clutch and main shaft are normally held in the stop position by a release magnet **29** in its deenergized condition. Magnet **29** controls a stop arm **30** which engages a detent arrangement in a stop cam connected to the main shaft, this arrangement being indicated in a conventional manner by dotted line **31**. When release magnet **29** is energized, stop arm **30** is pulled away from the stop cam detent allowing the clutch to engage, thereby causing the brush main shaft, and thus brush arm **27**, to rotate in a clockwise direction at the geared speed of synchronous motor TDM. When magnet **29** is deenergized, the brush shaft will rotate until stop arm **30** engages the detent means at the stop position of the commutator.

The sensing contacts which are also part of transmitter distributor TD are operated by sensing pins which usually serve to detect holes punched in a tape being read by the transmitter distributor. In such operation, the upper or spacing contact is normally closed and all such contacts are closed when the brush arm is in its stop position. When unit TD is being used to read code punched in a tape, as the motor and the brush arm rotate together, a cam arrangement located on a main shaft allows the sensing pins to move upward through a tape guide whenever the distributor brush arm has moved from the Stop segment. If a hole is present in the tape, the pin moves to its full extended position allowing the associated lower or marking contact to close. If there is no hole in the tape, the adjustment of the pin relative to the contact is such that the upper or spacing contact remains closed. However, in the present use of this transmitter distributor unit, since no tape is being read, all the sensing pins move upward as soon as the brush arm leaves the Stop segment and all marking contacts close and remain closed during each period of rotation of brush arm **27** around distributor ring **26**. When designed for the usual five positon tape code, five such sensing contacts are provided. However, since they operate in unison under the present conditions, the five contacts are represented by two contacts *a* and *e*, similar parts of which are connected in multiple. The multiple connections include dotted portions to conventionally indicate the presence of other contacts. The control of these contacts through the sensing pins by the motor and the brush arm is indicated by dotted line **32**.

The tape reperforator unit RP is a motor driven tape reperforating machine which receives electrically transmitted signals and translates these signals through the medium of a selecting and perforating mechanism into

code combinations of holes in a paper tape. For purposes of a specific description, it is herein considered that the code is of the five position type commonly used in such systems. The main shaft assembly of the reperforating unit is driven by a motor RM through a worm gear and pinion arrangement also including a series of clutches, none of which are shown here for the sake of simplicity. The selector mechanism receives electrical signals and distributes them mechanically to set up certain combinations with transfer levers. These combinations cause the punch levers to be positioned so as to select certain punches in the punch block. When the punch hammer finally moves upward, the selected punch pins will be forced through the tape causing a code combination of holes to be perforated.

The selecting mechanism is controlled by selector magnets **22** and **23** which receive code impulses from unit TD over transmission line **24** with which they are connected in series. When a start impulse (no energy on line **24**) is received, the magnet armatures release and are pulled away from the pole pieces by an armature spring. This action allows the selector cam to revolve with the main shaft. When this selector cam rotates from the stop point, it revolves at a speed synchronized with the speed of the transmitting mechanism by means of the gears and the speed of the synchronous motors. When transmitter distributor TD is used as the transmitting mechanism, as herein, this means that, as segment **1** on ring **26** is being scanned by brush arm **27**, the No. 1 selector cam on reperforator RP is in the position to move the No. 1 transfer lever if the magnets are energized by an impulse at this time. Each selector cam is similarly positioned as the corresponding segment on ring **26** is scanned. If no impulse is received as a selector cam is in that particular position, the magnet armatures are released and pulled away by a spring. Thus, the transfer levers are not placed in position to actuate the punch levers. When the final or stop position is again reached, the selected punch levers will force the associated punch pins through the tape, perforating the holes in the corresponding positions in the tape. Transfer levers which were not selected during the rotation of the shaft are held out and the corresponding punches are not actuated.

In any case, a sixth punch pin which is operated during each punching sequence will cause a smaller feed hole to be punched in the tape. At the conclusion of the punch stroke, in the stop position, the punch hammer falls back into place causing the tape to advance one code space in preparation for the next punching sequence. Summarizing, for purposes of describing the present invention, it is only necessary to understand that the energization of selector magnets **22** and **23** of reperforator RP, as the various segments of ring **26** of unit TD are scanned during a rotation sequence, causes the corresponding punch pins to be actuated during the final punching operation to perforate the corresponding code holes in the tape.

The sensing contacts of unit TD control a bank of sequencing relays **1F**, **1B**, **2F**, **2B**, **3F**, and **3B**. These sequencing relays are used to count the rotations of brush arms 27 of unit TD, which rotations are further indicated by the alternate closing of the marking and spacing contacts *a* to *e* of the unit. The references F and B used alternately for the sequencing relays indicate control by the marking and spacing contacts, respectively. When brush arm **27** of unit TD starts the initial rotation of a series and moves off the Stop segment of ring 26, marking contacts *a* to *e* of unit TD are closed and a circuit is completed from terminal B over the marking contacts in multiple, back contact *b* of relay **1B**, and the winding of relay **1F** to terminal N. Relay **1F** is thus energized and picks up, closing its own front contact *a* to complete a stick circuit which also includes back contact *d* of the final sequencing relay 3B. When the initial rotation of arm **27** is completed, the closing of spacing contacts *a* to *e* of unit TD completes a circuit extending from terminal B over the spacing contacts in multiple, front contact *b* of relay **1F**, back contact *b* of relay **2F**, and the winding of relay **1B** to terminal N. Similarly, as with sequencing relay **1F**, the closing of front contact *a* of relay **1B** completes a stick circuit for this relay also including back contact *d* of relay **3B**. At the completion of an initial rotation sequence of a series or cycles of rotations of arm **27**, it is thus obvious that relays **1F** and **1B** will be energized and picked up, the pick-up of relay **1B** indicating or counting the completion of the first rotation sequence.

At the start of a second rotation of a cycle, the movement of arm **27** from the Stop segment again closes sensing contacts *a* to *e* in their marking position and completes a circuit including front contact *b* of relay **1B**, back contact *b* of relay **2B**, and the winding of relay **2F**. This latter relay is thus energized at this time and picks up, closing at its front contact *a* a stick circuit also including, as do the previous stick circuits, back contact *d* of relay **3B**. The return of arm **27** to the Stop segment of ring **26** closes the sensing contacts in their spacing position and completes a circuit over these contacts also including front contacts *b*, in series, of relays **1F** and **2F**, back contact *b* of relay **3F**, and the winding of relay **2B**. This latter relay is thus energized and picks up to count the completion of the second rotation sequence. A stick circuit for relay **2B**, completed at its front contact *a*, like the stick circuits for the previously energized sequencing relays, also includes back contact *d* of relay **3B**. At the close of the second rotation of the series, sequencing relays **1F**, **1B**, **2F**, and **2B** have been energized and have picked up, and are held energized by similar stick circuits.

As the third rotation sequence of the series is initiated, the circuit over marking contatcs *a* to *e*, in multiple, and also including front contacts *b* of relays **1B** and **2B**, back contact *b* of relay **3B**, and the winding of relay **3F**, is completed to energize this latter relay which picks up, completing the usual stick circuit including its own front contact *a* and back contact *d* of relay **3B**. Relay **3B** is energized upon the completion of this third rotation by a circuit including spacing contacts *a* to *e*, in multiple, and front contacts *b* in series, of relays **1F**, **2F** and **3F**. Relay **3B** picks up to count the third and final rotation sequence and thus, in this specific system, mark the completion of the cycle. The stick circuit for relay **3B**, however, includes its own front contact *a* and, at this time, in multiple front contacts *d* of relays **1B** and **2B** and front contact *b* of punching operation relay PO, which will be discussed hereinafter. It is obvious that, when relay **3B** picks up, the opening of its back contact *d* interrupts the stick circuits for all of the other sequencing relays which, thus deenergized, immediately rerelease. The opening of front contact *b* of relay **1F** at this time prevents the reenergization, over the original circuits, of any of the other sequencing relays. The opening of front contacts *d* of relays **1B** and **2B** does not deenergize relay **3B** as the stick circuit path over front contact *b* of relay PO remains intact.

As will appear more fully hereinafter, the operation of the sequencing relay bank controls and coordinates the energization and deenergization of release magnet **29** which permits rotation of brush arm **27**. The coordination circut network for release magnet **29** extends from terminal B at front contact *c* of relay PO over back contact *c* of relay **3B**, back contact *c* of relay **3F**, front contact *c* of relay **2B** in multiple with back contact *c* of relay **2F**, front contact *c* of relay **1B** in multiple with back contact *c* of relay **1F**, and the magnet winding to terminal N.

The tape punching operation is directly controlled by punching operation relay PO. This relay is usually energized to start a punching cycle by a circuit traced from terminal B over front contact *c* of relay RS, front contact *n* of relay **1–21TP**, the winding of relay PO, and normally closed contact *b* of tape stop push button TSPB to terminal N. Another circuit for relay PO includes front

contact *b* of begin hump marking relay BHM and normally closed contact *b* of push button TSPB. A third energizing circuit for relay PO includes front contact *b* of end hump marking relay EHM and contact *b* of push button TSPB. However energized, relay PO picks up to complete a stick circuit including its own front contact *a*, back contact *e* of relay 3B and contact *b* of push button TSPB. As will appear more specifically hereinafter, contact *b* of push button TSPB is included in all of these circuits for relay PO to assure a completion of the final tape punching cycle which is initiated by the energization of relay EHM. However, as long as contact *b* of push button TSPB remains closed, relay PO is held energized by its stick circuit during any cycle of operation of unit TD until sequencing relay 3B is energized, at the completion of the third rotation of arm 27, to open its back contact *e* to interrupt the stick circuit for relay PO.

Certain manual control is necessary in the system of my invention to coordinate the beginning and the end of a particular tape punching operation to separate the various trains classified into the yard from each other. This manual control is obtained and provided by the tape start push button TSTPB and the previously mentioned tape stop push button TSPB. Each of these push buttons is of the spring return type so that, once operated and released, they return to their at-rest position, as shown in the drawing. Push button TSTPB is provided with two normally open contacts *a* and *b* while push button TSPB is provided with a normally open contact *a* and a normally closed contact *b*. Additional manual control is also provided by a master switch located in unit TD. Operation of this switch to its on position moves the switch arm 33 to its dotted position to close the circuit through this switch, as is obvious from an inspection of the drawings. For purposes of the rest of the description, it will be considered that the master switch is in its on position so that arm 33 has closed the circuit through the switch.

When push button TSTPB is operated, the closing of its two contacts *a* and *b* completes a circuit from terminal B over contact *a* of the push button, switch arm 33, contact *b* of the push button, back contact *d* of relay PO, and the winding of relay BHM to terminal N. This latter relay is thus energized and picks up, completing a stick circuit including its own front contact *a* and back contact *f* of relay 3B. A circuit is also completed for motor start relay MS which includes contact *a* of push button TSTPB, switch arm 33, and the winding of relay MS. A first stick circuit for relay MS, which is completed by the closing of its own contact *a*, includes back contact *c* of relay EHM, arm 33 of the master switch, and the winding of relay MS. The stick circuits for relays BHM and MS thus hold the relays energized when push button TSTPB is released and opens its two contacts. The operation of relay MS, closing front contacts *b* and *c*, starts motors TDM and RM, in units TD and RP, respectively, by completing the circuits to these motors extending between terminals BX and NX of the alternating current source. The closing of front contact *d* of relay MS prepares a stick circuit which will later be effective to hold relay EHM energized.

When tape stop push button TSPB is operated, the closing of its contact *a* completes a circuit from terminal B over this contact, *a*, back contact *e* of relay PO, and the winding of relay EHM to terminal N. Relay EHM, thus energized, picks up closing its own front contact *a* to complete the stick circuit which includes front contact *d* of relay MS, which is closed at this time. The opening of back contact *c* and the closing of the corresponding front contact of relay EHM transfers the stick circuit for relay MS from terminal B at back contact *c* of relay EHM to terminal B at back contact *g* of relay 3B. However, since contact *c* of relay EHM is of the continuity transfer type, as indicated conventionally by the short arc appended to the end of the movable portion of this contact, the energization of the winding of relay MS is not interrupted during this operation and relay MS continues in its picked-up position. As long as push button TSPB is held operated, its open back contact *b* interrupts the energizing circuit for relay PO which includes front contact *b* of relay EHM. Relay PO thus is not energized under these conditions until the push button is released to again close its contact *b*.

The code translating or code selection circuit arrangement, shown in FIG. 3, provides a means for translating between the route storage or track storage held in the storage repeater bank of FIG. 1 and terminals TD1 to TD5 of unit TD so that the necessary energizing pulses will be transmitted to magnets 22 and 23 to properly punch the tape in accordance with the track storages. This circuit network of FIG. 3 comprises an arrangement of the contacts of the relays P of the repeater storage bank to place energy on the various terminals TD1, TD2, TD3, TD4, and TD5 shown in FIG. 3 which are identical with the corresponding terminals shown in FIG. 2, as previously mentioned. This supplies energy to the various numbered segments of commutator ring 26 of unit TD which in turn are sequentially connected to the selector magnets of the tape reperforator. Contacts of relay 1B serve to select between the numeral code for the tens and the unit digits of the track storages these circuits also including back contacts of relay 2B. The code selection for the energy for the third punch which spaces between the track storages for successive cars is obtained over a front contact of relay 2B. The contacts of relays BHM and EHM select code energy for the first and last series of punches in the tape for a particular train, serving to coordinate and separate the tape for one particular train from the tape for another train classified into the yard. The specific circuits established for the various code punches at various times in the operation of the track reporting system of my invention will be described shortly during the operational description of the apparatus, it being felt that the circuits will be better understood at that time.

I shall now describe the operation of the system of my invention as a train is pushed over the hump and classified into the appropriate preselected storage tracks. Prior to the start of the movement of the train over the hump, the operator prepares the system to report the track destination of each car in the train. The master switch in unit TD is moved to its on position if not already in that position so that arm 33 of this switch closes the circuit therethrough. After checking this switch in this position, the operator actuates push button TSTPB to initiate route reporting as the cars are humped. As has been previously described, the closing of contacts *a* and *b* of push button TSTPB energizes relays MS and BHM, each relay completing a stick circuit to hold it energized when the push button is released. The closing of front contacts *b* and *c* of relay MS energizes and starts the operation of motors TDM and RM, respectively. The closing of front contact *b* of relay BHM energizes the punching operation relay PO since contact *b* of push button TSPB is closed at this time. Relay PO is held energized over back contact *e* of relay 3B, as previously traced.

With all of the sequencing relays released at this time, the closing of front contact *c* of relay PO within the coordination circuit network completes an energizing circuit for release magnet 29 of unit TD, the circuit also including back contacts *c*, in series, of relays 3B, 3F, 2F, and 1F, and the winding of release magnet 29. Energization of the release magnet causes movement of stop arm 30 which releases the detent means allowing brush arm 27 of the commutator to begin an initial rotation. As soon as brush arm 27 leaves the Stop segment, the sensing contacts close in their marking position, causing the energization of relay 1F. When relay 1F picks up,

the opening of its back contact *c* interrupts the circuit energizing release magnet **29**. This magnet, upon deenergization, releases stop arm **30**. However, once the brush arm has moved from the Stop segment, its rotation continues whether or not the release magnet is deenergized until it again returns to the Stop segment. As the brush arm traverses the Start segment of outer ring **26**, no energy is applied to line connection **24** so that selector magnets **22** and **23** of the tape reperforator are deenergized and this unit is prepared for a new punching sequence. It is to be noted that the rotation of brush arm **27** and the shaft of the tape reperforator is synchronized by the release of the selector magnets as the brush arm traverses the Start segment of commutator ring **26**. The brush arm continues to rotate, traversing in sequence segments **1**, **2**, **3**, **4**, and **5** before it returns to the Stop segment and is held. As the brush arm rotates, energizing circuits for the selector magnets of the tape reperforator are completed through segments **1**, **2**, **4**, and **5**. These circuits may be traced from terminal B through the windings of selector magnets **22** and **23**, line wire **24**, inner ring **25**, brush arm **27**, segments **1**, **2**, **4**, and **5**, in sequence, of outer ring **26**, terminals TD1, TD2, TD4, and TD5 in series with the corresponding segments, and from the corresponding terminals of FIG. 3 over the multiple paths to terminal N including, in series respectively, front contact *c* of relay BHM and back contact *d* of relay EHM, front contact *d* and back contact *e* of the two relays, front contact *f* and back contact *g* of the two relays, and front contact *g* and back contact *h* of the two relays. This sequence of energization of the selector magnets as motor RM rotates the shaft prepares the punches to record a figure shift code (in the type code specifically considered) in the tape during the tape punching period at the end of the rotation sequence. This selection of this code combination for the begin hump marking is arbitrary and other code combinations may be selected for other similar systems.

When the brush arm reaches the Stop segment in its rotation, further rotation is halted since the release magnet is at this time deenergized. The connection to terminal N from the Stop segment retains the selector magnets energized at this time and the punching operation, as previously mentioned, is completed. As the brush arm reaches the Stop segment, the sensing contacts close in the spacing position, energizing sequencing relay **1B** over the circuit previously traced. This relay picks up and is retained energized by the stick circuit including back contact *d* of relay **3B**. Since relay PO is still picked up, being retained energized by its stick circuit, the closing of front contact *c* of relay **1B** bypasses the open back contact *c* of relay **1F** in the energizing circuit for release magnet **29** and this magnet is again energized, operating stop arm **30** to release the shaft and brush arm **27**. The brush arm immediately starts another period of rotation, and as it leaves the Stop segment and traverses the Start segment, the selector magnets of the tape reperforator are deenergized and reset the unit. The sensing contacts again close in their marking position completing the circuit to energize relay **2F**, this circuit including also front contact *b* of relay **1B** which is closed at this time. Relay **2F** picks up, completing the previously traced stick circuit and opening its back contact *c* to interrupt the circuit for release magnet **29** which is again deenergized and releases stop arm **30**.

As the brush arm traverses the numbered segments during this second rotation, the same circuits are completed in sequence for the selector magnets since relay BHM is held energized during this entire period by its stick circuit including back contact *f* of relay **3B**. Thus, another figure shift character code is entered into tape reperforator RP to position the punches to record this code at the proper time.

When the brush arm reaches the Stop segment at the end of its second rotation sequence, the sensing contacts close in their spacing position to cause the energization of relay **2B**. The closing of front contact *c* of this latter relay bypasses open back contact *c* of relay **2F** in the energizing circuit for release magnet **29**. With this circuit again completed, the release magnet is energized and stop arm **30** is removed from its detention position. The operation of the brush arm again repeats through another period of rotation. Once again, the same circuits are completed in sequence as the brush arm traverses the numbered segments in order since relay BHM is still held energized. It is apparent, therefore, that three figure shift code characters are recorded in the tape by the tape reperforator as a result of the operation of push button TSTPB by the operator to begin the tape punching operation.

During this third rotation sequence of arm **27**, relay **3F** is energized in the previously described manner and picks up. Opening of its back contact *c* deenergizes release magnet **29** to release stop arm **30**. When brush arm **27** reaches the Stop segment at the end of the third period of rotation, the closing of sensing contacts *a* to *e* in their spacing position completes the circuit for energizing relay **3B**, the final relay in the sequencing bank. All of the stick circuits for relay **3B** are complete at this time since front contacts *d* of relays **1B** and **2B** are closed and front contact *b* of relay PO is also closed. The opening of back contact *c* of relay **3B** interrupts the energizing circuit for release magnet **29** at a second location. Since relay **3B** is held energized, this release magnet energizing circuit is continually interrupted so that brush arm **27** halts and holds on the Stop segment. The opening of back contact *d* of relay **3B** interrupts the stick circuits for all of the other sequencing relays and they release at this time. The opening of back contacts *e* and *f* of relay **3B** interrupts, respectively, the stick circuits for relays PO and BHM and the latter of these two relays immediately releases. Relay PO is held energized over front contact *b* of relay BHM for a short period after its stick circuit is interrupted so that the release of relay PO occurs a short time after the release of relay BHM. The opening of front contacts *d* of relays **1B** and **2B** interrupts two paths of the stick circuit arrangement for relay **3B** and this relay is now deenergized by the opening of front contact *b* of relay PO to interrupt the last remaining stick circuit. Relay **3B** releases at this time, but the stick circuit arrangement including the contacts of relays **1B** and **2B** assures that this release cannot occur unless the other sequencing relays have previously released. By this time, the final figure shift code character has been punched into the tape as a result of the completion of the cycle of operation of the transmitter distributor unit TD.

I shall now assume that a single car cut approaches switch **1–21SW** and that this cut is routed to storage track **6**. The route storage for this cut has previously been entered into bank A of the initial switch storage unit so that relays ASDR, A6CR, and AOCR are picked up, closing their front contacts *n*. It is to be noted that the track destination is stored as a two-digit figure 06 in order that all such storages may be two-digit numbers. With relay **1–21TP** released at this time, relays ASDP, **6P**, and **0P** in the repeater storage bank are also energized. A typical circuit traced for relay ASDP includes front contact *n* of relay ASDR, back contact *a* of relay **1–21TP**, and the winding of relay ASDP. Similar circuits may be traced for relays **6P** and **0P**. As the first wheels and axle of this single car cut occupy section **1–21T**, relay **1–21TR** is shunted and releases, completing the energizing circuit for relay **1–21TP**. The closing of front contacts of this latter relay complete the stick circuits for the energized relays in the repeater storage bank. All of the relays in the repeater storage bank have sufficient slow release periods that they do not release during the momentary deenergization of the relay winding as the transfer contacts of relay **1–21TP** move from their back to front contact positions.

As the wheels of the car pass the wheel contactor

1–21Z, each wheel causes contact *a* of this contactor to open so that relay ZP follows the operation releasing, for each wheel, that is, axle, of the car. Each period of closing of back contact *a* of relay ZP energizes the upper winding of counter MC since relay ASDP is picked up to close its front contact *b* and relay RS is in its released position during this operation. As the fourth wheel passes the contactor and a fourth count is entered into counter MC, the circuit for energizing relay RS is completed over back contact *e* and front contact *d* of counter MC. Relay RS picks up and the closing of its front contact a completes a circuit for holding the relay energized as long as relay ZP is deenergized by the passage of the wheel. The lower winding of counter MC is energized over front contact *b* of relay RS and all of the operated armatures of the counter are reset to their released position. The counter is now prepared for a new car count to begin at any time.

Referring to FIG. 2, with front contact *n* of relay 1–21TP already closed, the closing of front contact *c* of relay RS completes the energizing circuit for relay PO which also includes contact *b* of push buttons TSPB. Relay PO picks up, completing the previously traced stick circuit. With relay PO picked up to close its front contact *c*, the energizing circuit for release magnet **29** of unit TD is completed and stop arm **30** is moved from the detention position to allow brush arm **27** to be rotated by motor TDM which is continuously energized through out this entire period. As described in connection with the recording of the begin hump marking code, the operation of brush arm **27** closes the sensing contacts in their marking position to energize sequencing relay 1F at this time. The release magnet of unit TD is thus deenergized, but the rotation of the brush arm continues since it has already passed off the Stop segment.

During this initial rotation sequence, the selector magnets of the tape reperforator are energized as the brush arm crosses segments **2**, **3**, and **5**. The first of these circuits may be traced from terminal B through the winding of the selector magnets, wire **24**, brush arm **27**, segment **2**, terminal TD2, front contact *c* of relay 0P, back contact *d* of relay 00P, which is closed at this time since the relay is released, back contacts *f*, in series, of relays 1B and 2B, and back contacts *d* and *e*, in series, of relays BHM and EHM, respectively, to terminal N. Similar circuits may be traced as the brush arm traverses segments **3** and **5** over terminals TD3 and TD5. The first of these two circuits includes front contact *d* of relay 0P, back contact *e* of relay 00P, back contacts *g* of relays 1B and 2B, and back contacts *e* and *f* of relays BHM and EHM, respectively. The last circuit over segment **5** includes front contact *e* of relay 0P and back contact *f* of relay 00P and thence over back contacts of relays 1B, 2B, BHM, and EHM to terminal N. When brush arm **27** reaches the Stop segment in this initial rotation sequence, the punches of the tape reperforator are so positioned that holes are punched in positions **2**, **3**, and **5** in the tape. Completion of this punching operation also causes the tape to advance one space in preparation for the next digit.

The second rotation period of the brush arm in this cycle of operation starts immediately since the release magnet of unit TD is energized, with relay PO held up, by the closing of front contact *c* of relay 1B, as previously described. During the second rotation period, segments **1**, **3**, and **5** are connected to terminal N so that the selector magnets are energized as the brush arm traverses these segments. The circuit from segment **1** to terminal N includes terminal TD1, front contact *b* of relay 6P, front contact *e* of relay 1B, which is closed at this time, and back contacts *e*, *c*, and *d* of relays 2B, BHM, and EHM, respectively. Similar circuits may be traced in the circuit arrangement on FIG. 3 from terminals TD3 and TD5 over front contacts *c* and *d* of relay 6P, respectively. Since relay 2F was energized as soon as the brush arm left the Stop segment during this second period of rotation, the release magnet of unit TD is deenergized so that the brush arm halts when it reaches the Stop segment at the completion of the second rotation. The selector magnets have been so energized that the punches are positioned to record code holes in positions **1**, **3**, and **5** on the tape during the actual punching operation. As previously described, relay 2B is also energized at this time, closing its front contact *c* to again energize the release magnet and permit the brush arm to initiate a third sequence of rotation.

During the third rotation sequence, energy is supplied to the selector magnets of unit RP only while brush arm **27** of unit TD traverses segment **2**. It will be noted on FIG. 3 that, with relay 2B picked up, back contacts *e* to *i* of this relay interrupt all circuits through the storage repeater relay contacts in the circuit network and only front contact *f* of relay 2B completes a circuit from terminal N through back contacts *e* and *d* of relays EHM and BHM, respectively, to terminal TD2. This code character which registers in the selector magnets of the reperforator is the line feed code character in the five position code system herein used. However, other suitable code characters may be used, the only requirement being that a spacing character be inserted between the track number just recorded and the next track number. The spacing character recorded and punched into the tape may also be used to actuate other operations during the read-out from the tape into such electrical mechanical devices as may be used in the automation system.

The beginning of the third rotation sequence energizes sequencing relay 3F which in turn deenergizes the release magnet, and at the completion of the third rotation, relay 3B is energized as previously described. Release magnet **29** is held deenergized by open back contact *c* of relay 3B and open back contact *d* of relay 3B interrupts the stick circuits of all other sequencing relays which release. The opening of back contact *e* of relay 3B deenergizes relay PO by interrupting its stick circuit, the energizing circuit for this relay having been previously interrupted by the release of relay RS, at the completion of the car count, to open its front contact *c*. The release of relay PO deenergizes relay 3B by interrupting its only remaining stick circuit while the opening of front contact *c* of relay PO in the coordination network assures that the release magnet of unit TD remains deenergized so that the tape punching operation halts at this time.

I shall now assume that a second cut consisting of two or more cars coupled together approaches the initial switch, this cut being routed to storage track **20**. In addition to storage detector relay ASDR, the route storage transferring into bank A of the initial storage unit causes the energization of relays A20CR and A0CR. As soon as the preceding cut has cleared track section 1–21T, relay 1–21TR is reenergized and picks up to deenergize relay 1–21TP which releases. The closing of back contacts of this latter relay completes the circuits for entering the new route storage into the repeater storage bank. At this time, relays ASDP, 0P, and 20P are energized. However, relay ASDP, having previously been energized, will likely remain in its picked-up position without releasing during this operation. In addition, the circuit for relay 00P is also completed over front contacts *b* of relays 0P and 20P. Relay 00P picks up to indicate that the numeral 0 represented by the energized condition of relay 0P is in the units digit position. As soon as the second cut occupies the detector track section, relay 1–21TR releases and relay 1–21TP picks up to complete the stick circuits for relays ASDP, 0P, and 20P.

As the first car wheels pass the wheel contactor, the operation of unit 1–21Z is repeated by relay ZP to alternately close and open its back contact *a*. This operation drives counter MC, and as soon as a fourth wheel count is entered into the counter, relay RS is energized in the manner previously described. Counter MC is reset, pre-

pared to count the next car of the cut. Relay RS is held energized and in turn energizes relay PO, the circuit including front contact *c* of relay RS and front contact *n* of relay 1–21TP. Relay PO, as before, is held energized over a stick circuit including back contact *e* of relay 3B. Relay RS is deenergized, when relay ZP picks up after the fourth wheel has cleared the wheel contactor, and releases prior to the arrival of the first wheel of the following car at unit 1–21Z. Counter MC is then actuated by wheels of the second car to again enter the axle count.

Meanwhile, with relay PO picked up, the initial energizing circuit within the coordination network is complete for release magnet 29 of unit TD. The brush arm is released and is rotated through an initial rotation sequence by unit motor TDM. This rotation initially energizes relay 1F, and at the completion of the rotation relay 1B will be energized as previously described. During this first period of rotation, the selector magnets are energized as the brush arm traverses segments 1, 2, and 5. Referring to FIG. 3, it is seen that circuits are completed to terminals TD1, TD2, and TD5 over front contacts, *c*, *d*, and *e* of relay 20P at this time, the tens digit selection being made over back contacts of relay 1B which is still deenergized. The circuit to terminal TD3 over front contact *d* of relay 0P, which is closed, is interrupted at back contact *e* of relay 00P so that no energy is supplied over segment 3 of unit TD. This is necessary since the energized condition of relay 0P represents the numeral 0 in the units digit and not in the tens digit which is being registered at this time. It is to be noted that a similar series circuit through back contact *d* of relay 00P and front contact *c* of relay 0P and again over back contact *f* of relay 00P and front contact *e* of relay 0P exists in the network to terminals TD2 and TD5. Although these series connections are open at this time, they are bypassed so that energy is supplied to the terminals over front contacts of relay 20P. When the brush arm reaches the Stop segment and while the tape reperforator magnets are held energized in this position, the tape punching operation is completed and holes are punched in positions 1, 2, and 5 to represent the numeral 2.

The first period of rotation of the brush arm ends and the second sequence starts immediately since relay 1B is now energized to energize the release magnet. During the second period of rotation, circuits are completed over segments 2, 3, and 5 in sequence, the corresponding circuits in the network on FIG. 3 being completed over front contacts of relay 1B and front contacts *a*, *b*, and *c* of relay 00P to terminals TD2, TD3, and TD5, respectively. When the tape punching actually occurs at the end of this period of rotation, holes are punched in positions 2, 3, and 5 to represent the numeral 0 in the units position. By this time, relays 2F and 2B are picked up and a third period of rotation is initiated as before. Again the line feed code is selected over front contact *f* of relay 2B and that code character punched at the completion of the period. Brush arm rotation halts at this time since relay 3B holds the release magnet circuit open until such time as relay PO is released to interrupt the circuit at another point. This cycle of punching operation, including the three periods of rotation of brush arm 27, is completed prior to the entry into counter MC of the fourth wheel count for the second car of the cut.

When relay RS is again energized and picks up upon the entry of another fourth count into counter MC to indicate the completion of the passage of the second car of the cut, another cycle of code punching operation is initiated. As before, there are three rotation sequences of brush arm 27 of unit TD. Since all cars of this multiple car cut are destined to enter the same storage track, the same code combination is punched into the tap during this second cycle of operation. In other words, track number 20 and the line feed code character are again punched in sequence into the tape at the proper time and point.

Successive cars in the same multiple car cut cause similar cycles of code punching operation. Each cycle is actuated by the pickup of relay RS which energizes relay PO in a manner previously described. The successive cycles of operation are halted when the final car of the cut is recorded and the cut clears section 1–21T. At this time the opening of front contact *n* of relay 1–21TP interrupts the energizing circuit for relay PO so that no succeeding cycles can be initiated.

Code selection circuits for other track storages may be traced as desired through the circuit network in FIG. 3. As an example, the route storage for storage track 17 will complete circuits for the tens digit to terminals TD1, TD2, TD3, and TD5 over contacts *c*, *d*, *e*, and *f* of relay 10P, respectively, it being noted that back contacts of relays EHM, BHM, 2B, and 1B are closed at this time. The units digit for track 17 is selected over front contacts of relay 1B and front contacts *b*, *c*, and *d* of relay 7P connecting to terminals TD1, TD2, and TD3, respectively. For storage track 19, the tens digit is again selected over the front contacts of relay 10P previously mentioned. The units digit, in addition to front contacts of relay 1B, is further selected over front contacts *b* and *c* of relay 9P connected to terminals TD4 and TD5, respectively. Circuit network paths for other storage track codes are believed to be obvious from a study of FIG. 3 when taken in connection with those circuits already traced in the preceding description. It is to be remembered that the track storage code for each car is separated from similar codes for adjacent cars by the line feed code character selected over front contact *f* of relay 2B and terminal TD2, as previously described.

It may be noted that no connection is made, in the code selection circuit network, to back contact *h* of relay 1B. Referring to the corresponding front contact, it is evident that the numerals 4 and 9, in the tens digit position, would be selected over this back contact *h* and thence to terminal TD4. Since the specific illustration used does not require these numerals in the tens digit position, this connection is omitted. It is to be understood that the various multiple contact connections to the five terminals for selection of the tens digit are similar to those used for the units digit, insofar as the same numerals are required. Only in the connections using contacts of relays 0P and 00P to select the numeral 0 is there a slight difference.

After the final car of the train is classified into the yard, the operator actuates the tape stop push button TSPB. The closing of front contact *a* of this push button energizes relay EHM. At the same time, however, relay PO is held deenergized by the open contact *b* of the push button. Relay EHM, thus energized, picks up and completes a stick circuit including front contact *d* of relay MS so that relay EHM holds energized when the push button is released. The release of push button TSPB completes an energizing circuit for relay PO, this circuit being completed over front contact *b* of relay EHM at this time. The pickeup of relay EHM transfers the stick circuit for relay MS from terminal B at back contact *c* of relay EHM to terminal B at back contact *g* of relay 3B over the associated front contact of relay EHM. However, since contact *c* of relay EHM is of the continuity type, the winding of relay MS is not deenergized during this action. Again, a tape punching cycle of three rotation periods of brush arm 27 of unit TD occurs, the various sequencing relay actions being as previously described for other punching cycles. During each rotation of the brush arm, circuits are completed for the selector magnets over all of the numbered segments of the commutator. These circuits are completed from terminals TD1, TD2, TD3, TD4, and TD5 over front contacts *d*, *e*, *f*, *g*, and *h*, respectively, of relay EHM to terminal N. This sequence of energization of the selector magnets causes the registry of the letters shift code character in the tape when the punching operation is completed for each rotation. It is to be under-

stood, however, that other code characters could be chosen for this final end hump marking action.

When relay 3B is energized and picks up at the end of the third period of rotation, relay MS is deenergized by the interruption of its stick circuit at back contact *g* of relay 3B. The release of relay MS, opening its front contacts *b* and *c*, deenergizes the motors of units TD and RP to halt the operation of these units. The opening of front contact *d* of relay MS interrupts the stick circuit for relay EHM which shortly releases. This in turn causes the deenergization of relay PO by the interruption of its circuit at front contact *b* of relay EHM, the stick circuit for relay PO having been previously interrupted by the opening of back contact *e* of relay 3B. Finally, relay 3B is deenergized and releases, but the circuit for release magnet **29** of unit TD is already open at front contact *c* of relay PO and all operation of the apparatus ceases. The system is thus returned to its at-rest condition in which it is shown in the drawings.

It is thus apparent from the preceding description that the route reporting system of my invention will provide a punched tape record of the storage track destination by number for each car classified into the yard in the order in which these cars pass over the lead switch of the yard. This location is chosen for the registry of the track destinations since there is very little probability that the track destinations will be deliberately changed after the car leaves this location. This track destination registry, once initiated by the yard operator, proceeds automatically as the route storages for the cars enter the final bank in the storage unit associated with this lead switch, the passage of the cars over the lead switch actuating the various items of the apparatus to register the destination track number in the tape through the transmitter distributor and the tape reperforator. No action or supervision of the recording apparatus on the part of the yard operator is required during the humping of the cars and their movement into the classification tracks. The final manual operation to stop the tape punching operation completes the tape and prepares it for removal for use elsewhere in the railroad operation. The tape is thus prepared in an economical and efficient manner requiring the least amount of supervision by the yard operator and causing negligible interference with his regular duties.

Although I have herein shown and described but one form of circuit arrangement providing a route reporting system 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. In a railroad classification yard through which cuts of cars move into various storage tracks in accordance with preselected routes, a route reporting means to register the storage track destination for each car comprising, a bank of storage repeater relays for receiving by the energized combination thereof the preselected route designation for a particular cut of cars while it approaches a selected section of track common to all routes in said yard and for holding said particular route designation while said particular cut traverses said selected section, a car counting means actuated by the passage of each car of said particular cut for indicating the completed passage of each car past an established point within said selected section, a recording device operable through a predetermined cycle for registering on a recording medium the storage track destination for each car traversing said selected section, a coordination circuit network controlled by said counting means in its actuated position and by sequencing contacts operated by said recording device during a recording cycle for initiating and coordinating a cycle of operation of said recording device upon the passage of each car of said particular cut, and a selection circuit network including energized position contacts of said storage repeater relays for selecting the track destination to be registered on said recording medium for each car of said particular cut in accordance with the energized combination of said storage repeater relays.

2. In a railroad classification yard through which cuts of cars move into various storage tracks in accordance with preselected routes, the combination comprising, a bank of storage repeater relays for storing by the energized combination thereof the preselected route control for a particular cut of cars approaching a selected track section common to all routes, holding circuits controlled by the occupancy of said selected track section for retaining energized a particular energized combination of said repeater relays while said particular cut occupies said selected track section, a car counting means having connection to the track at said selected section and actuated by the passage of each car of said particular cut for closing a contact, a recording device operable in predetermined cycles of repeating registry sequences for registering in code symbols on a recording medium the track destination of each car traversing said selected section, a sequencing relay bank controlled by said recording device for counting the repeating sequences of operation of each recording cycle, a coordination circuit network controlled by said counting means contact and by contacts of said sequencing relays and having connections for initiating and coordinating a cycle of operation of said recording device upon the passage of each car, and a code selection circuit network including energized position contacts of said repeater relays and having connections to said recording device for selecting the correct code registry for said particular cut of cars in accordance with the energized combination of said repeater relays.

3. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system to register the destination track of each car of a train being classified into the yard, comprising a bank of storage repeater relays for receiving the preselected route designation for a cut of cars next approaching the initial switch of said yard, the preselected route being stored by the energized combination of said repeater relays, holding circuits for said repeater relays effective to hold energized an existing energized combination thereof while the corresponding cut traverses said initial switch, a car counting means having connections to the track at said initial switch and actuated by the passage of cars over that switch for closing a contact periodically in response to the completed passage of each car, a recording device operable in cycles to register the destination track for each car in code on a recording medium, each recording cycle including a predetermined plurality of registering periods; a bank of sequencing relays, control circuits for said sequencing relays including contacts alternately closed by said device at the beginning and end of each registering period, said control circuits being effective to successively energize said sequencing relays to count the plurality of registering periods of each recording cycle, a first and a second manually operable control means for starting and stopping respectively the recording operation of said device to register the track destinations of an entire train, another control circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response individually to the operation of said counting contact and of said first and said second manually operable means, said other control circuit being effective to initiate and coordinate a cycle of operation of said device for each car and for the beginning and the end of the route reporting operation for a train; and a code selection circuit network having connections to said device and including energized position contacts of said repeater relays, contacts closed in response to the operation of said first manually

operable means, and other contacts closed in response to the operation of said second manually operable means; said selection network being effective during a recording cycle to select the proper code to register the destination track of the corresponding car crossing said initial switch and to select the proper code to mark the beginning and the end of the route reporting operation for a train.

4. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system to register the destination track of each car of a train being classified into the yard, comprising, a bank of storage repeater relays for receiving by the energized combination thereof the preselected track designation for a cut of cars next approaching the initial switch of said yard, a stick circuit for each repeater relay including a contact closed when the section of track including said initial switch is occupied, the stick circuits being effective to hold energized an existing energized combination of said repeater relays while the corresponding cut traverses said initial switch, a car counter having connections to the track at said initial switch to be actuated by the passage of cars over that switch and including a contact closed periodically upon the completed passage of each car, a recording device operable in cycles to register the destination track for each car in multi-digit code on a recording medium, each recording cycle including a predetermined plurality of registering periods, there being one such period at least for each digit of said code, a bank of sequencing relays, control circuits for said sequencing relays including contacts alternately closed by said device at the beginning and end of each registering period, said control circuits being effective to energize said sequencing relays to count the plurality of registering periods of each recording cycle, a first and a second manually operable contact closed to start and to stop respectively the recording operation of said device to successively register the track destinations for an entire train, a coordination circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response to the operation of any one of said counter and said first and said second manually operable contacts, said coordination circuit being effective to initiate and coordinate a cycle of operation of said device for each car and for the beginning and the end marking of the route reporting operation for a train; and a code selection circuit network having connections to said device for selecting the proper codes to register the destination track of the corresponding car crossing said initial switch and at times the proper code to mark the beginning and the end of the route reporting operation, said code selection circuit network including a plurality of network paths comprising, a first network path including back contacts of said sequencing relays and energized position contacts of the repeater relays corresponding to the first digit of the destination tracks, each other digit network path except the final digit path including contacts closed by the sequencing relays corresponding to the preceding code digit and energized position contacts of the corresponding repeater relays, said final digit network path including contacts closed by the sequencing relay corresponding to the next to last digit, a begin network path including contacts responsive to the operation of said first manually operable contact, and an end network path including contacts responsive to the operation of said second manually operable contact.

5. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system for registering the destination track of each car of a train being classified into the yard, comprising a bank of storage repeater relays to receive the preselected route designation for a cut of cars next approaching the initial switch of said yard, the pre-selected route designation being stored by the selected energized combination of said repeater relays, holding circuits controlled by the occupied condition of the track portion including said initial switch for retaining energized an existing energized combination of said repeater relays while the corresponding cut traverses said initial switch, a car counting means having connections to the track at said initial switch and actuated by the passage of cars over that switch for closing a contact periodically to indicate the completed passage of each car, a recording device operable in cycles to register the destination track for each car in multi-digit code on a recording medium, each recording cycle including at least one registering period for each digit of said code, a bank of sequencing relays, and control circuits therefor including contacts alternately closed by said device at the beginning and end of each registering period, said control circuits being effective to successively energize said sequencing relays to count the registering periods of each recording cycle, a first and a second manually operable control means for starting and stopping respectively the recording operation of said device to register an entire train, a coordination circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response individually to the operation of said counting contact and of said first and said second manually operable control means, said coordination circuit being effective to initiate and coordinate a cycle of operation of said device for each car and for the beginning and the end marking of the route reporting operation for a train; and a code selection circuit network having connections to said device to select the proper codes to register the destination track of the corresponding car crossing said initial switch and at times the proper code to mark the beginning and the end of the route reporting operation, said code selection circuit network comprising a first network path including back contacts of said sequencing relays and energized position contacts of said repeater relays corresponding to a first digit of the destination tracks, a second network path including front contacts of the sequencing relay corresponding to the first registering period and energized position contacts of the repeater relays corresponding to a second digit of said destination tracks, and a third network path including front contacts of the sequencing relay counting the second registering period, said code selection circuit network further comprising a first and a second auxiliary network path including respectively contacts responsive to the operation of said first and said second manually operable control means.

6. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system to register the destination track of each car of a train being classified into the yard, comprising, a bank of storage repeater relays for receiving the preselected track destination for a cut of cars next approaching the initial switch of said yard, the preselected track being designated by the particular energized combination of said repeater relays, holding circuits for retaining energized an energized combination of said repeater relays while the corresponding cut traverses said initial switch, a car counting means having connections to the track at said initial switch and actuated by the passage of cars over that switch for closing a contact periodically upon the completion of the passage of each car, a recording device operable in cycles for registering the destination track for each car in code on a recording medium, each recording cycle including a predetermined plurality of successive registering periods; a bank of sequencing relays and control circuits therefor including contacts alternately closed by said device at the beginning and end of each registering period, said control circuits being effective to successively energize said sequencing relays to count the plurality of registering periods of each recording cycle, a coordina-

tion circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response to each operation of said counting means contact and held closed until the energization of the final sequencing relay during each recording cycle, said coordination circuit being effective to initiate and coordinate the successive registering periods of a cycle of operation of said device; and a code selection circuit network having other connections to said device and including energized position contacts of said repeater relays and contacts of the sequencing relays counting each registering period except the final period, said selection network being effective during a recording cycle to select the proper code for registering the destination track of the corresponding car crossing said initial switch.

7. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system to register the destination track of each car of a train being classified into the yard, comprising, a bank of storage repeater relays for receiving the preselected track destination for a cut of cars next approaching the initial switch of said yard, the preselected track destination being designated by the energized combination of said repeater relays, stick circuits controlled by the occupied condition of the track section including said initial switch for retaining energized an existing energized combination of said repeater relays while the corresponding cut traverses said initial switch, a car counting means having connections to the track at said initial switch and actuated by the passage of cars over that switch for closing a contact periodically in response to the counting of each complete car, a recording device periodically operable through a predetermined plurality of registering sequences to register the destination track for each car in multi-digit code on a recording medium, there being one such sequence for each digit of said code and a final sequence; a bank of sequencing relays and control circuits therefor including contacts alternately closed by said device at the beginning and the end of each registering sequence, said control circuits being effective to successively energize said sequencing relays to count each plurality of registering sequences, a coordination circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response to each operation of said counting contact and held closed until the energization of the final sequencing relay, said coordination circuit being effective to initiate and coordinate the successive registering sequences during operation of said device; and a code selection circuit network having connections to said device for selecting the proper code digits to register the destination track of the corresponding car crossing said initial switch, said code selection circuit network including a plurality of network paths, one path for each registering sequence of a recording cycle, the first network path including back contacts of said sequencing relays and energized position contacts of said repeater relays corresponding to the first digit of the destination tracks, each other network path except the final path including front contacts of the sequencing relay counting the preceding sequence and energized position contacts of the storage repeater relays corresponding to the associated digit of the destination track, said final network path including front contacts of the sequencing relay counting the next to last sequence.

8. In a railroad classification yard provided with an automatic switching system to route cuts of cars into preselected storage tracks, a route reporting system to register the destination track of each car of a train being classified into the yard, comprising, a bank of storage repeater relays for receiving the preselected route designation for a cut of cars next approaching the initial switch of said yard, the preselected route designation being stored by the energized combination of said repeater relays, holding circuits controlled by the occupied condition of the track section including said initial switch for retaining energized the existing energized combination of said repeater relays while the corresponding cut traverses said initial switch, a car counting means having connections to the track at said initial switch and actuated by the passage of cars over that switch for closing a contact periodically in response to the counting of each complete car, a recording device operable through a predetermined plurality of registering periods for registering the destination track for each car in multi-symbol code on a recording medium, there being one such period at least for each symbol of said code, a bank of sequencing relays and control circuits therefor including contacts alternately closed by said device at the beginning and end of each registering period, said control circuits being effective to successively energize said sequencing relays to count each plurality of registering periods, a coordination circuit having connections to said device and including contacts of said sequencing relays and a contact closed in response to each operation of said counting contact and held closed until the energization of the final sequencing relay, said coordination circuit being effective to initiate and coordinate the successive registering periods of operation of said device for each car; and a code selection circuit network having connections to said device for selecting the proper codes to register the destination track of the corresponding car crossing said initial switch, said code selection circuit network comprising a first network path including back contacts of said sequencing relays and energized position contacts of said repeater relays corresponding to a first symbol of the destination track code, a second network path including front contacts of the sequencing relay counting the first registering period and energized position contacts of the repeater relays corresponding to a second symbol of said destination track code, and a third network path including front contacts of the sequencing relay counting the second registering period.

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