Nov. 29, 1966 W. R. SMITH 3,289,173

CAR COUPLING INFORMATION STORAGE SYSTEM

Filed Dec. 31, 1962 4 Sheets-Sheet 1

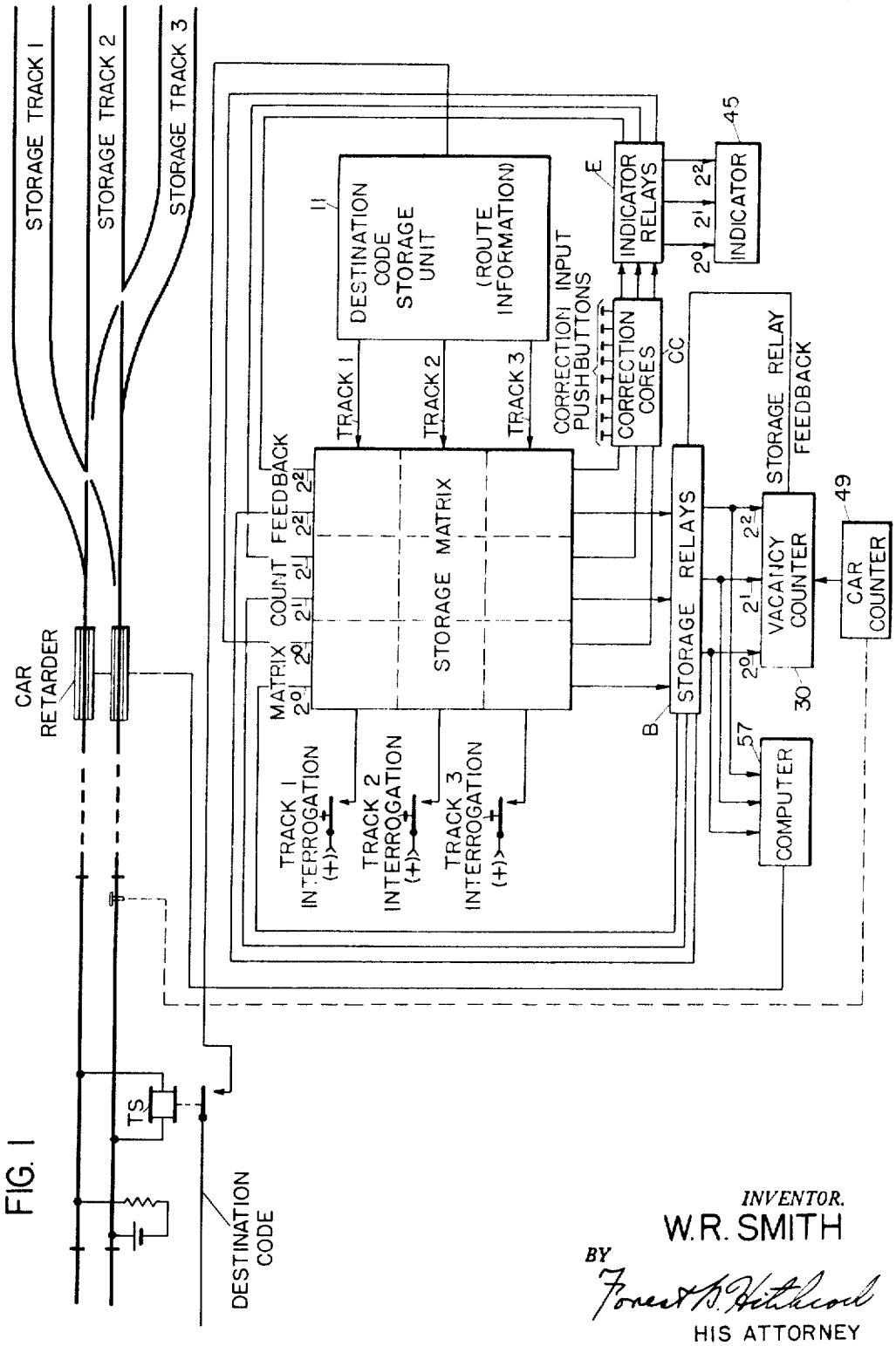


FIG. 1

INVENTOR.
W. R. SMITH
BY Forrest B. Hitchcock
HIS ATTORNEY

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CAR COUPLING INFORMATION STORAGE SYSTEM

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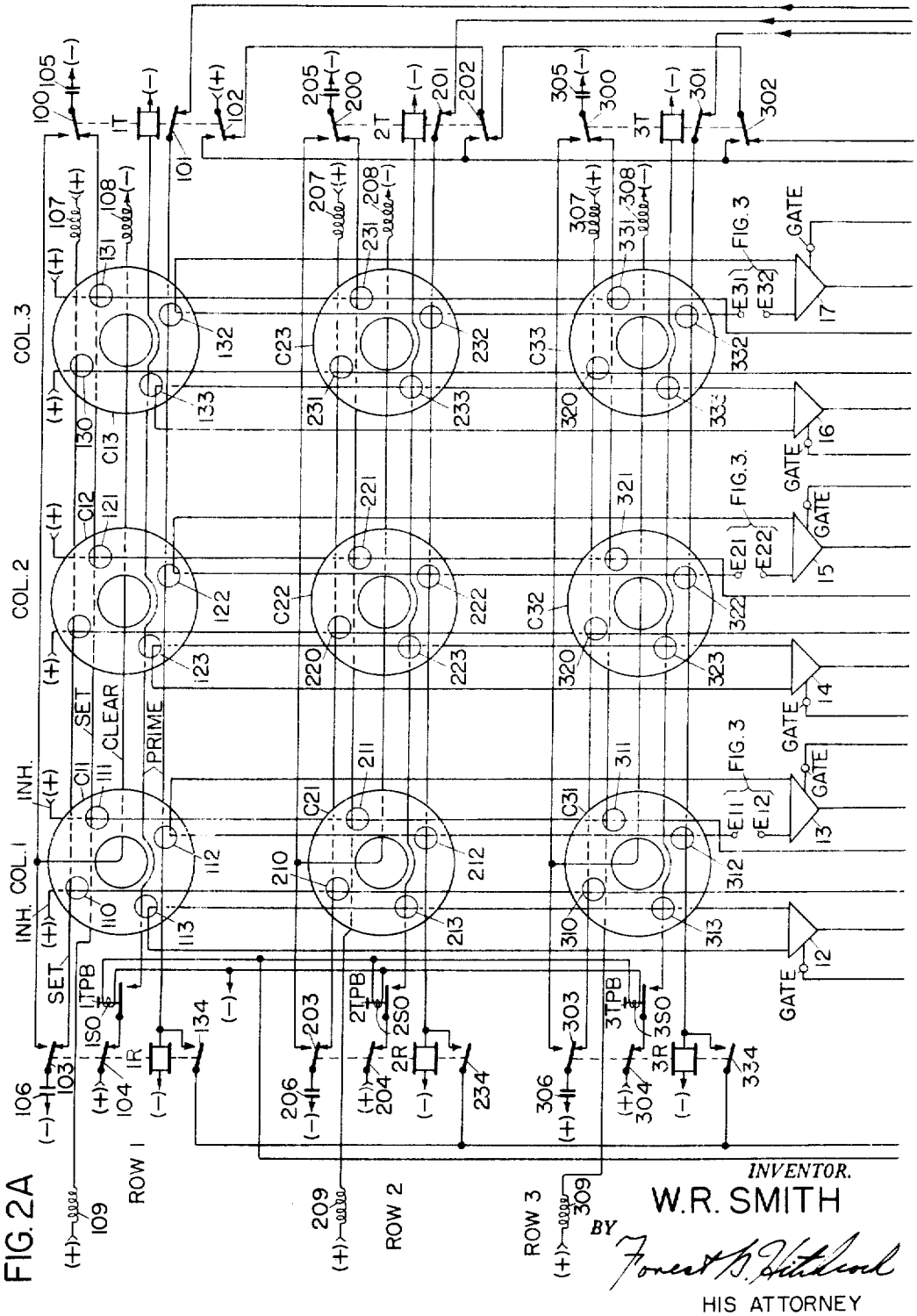


FIG. 2A

INVENTOR.
W.R. SMITH
BY Forrest B. Hitchcock
HIS ATTORNEY

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CAR COUPLING INFORMATION STORAGE SYSTEM

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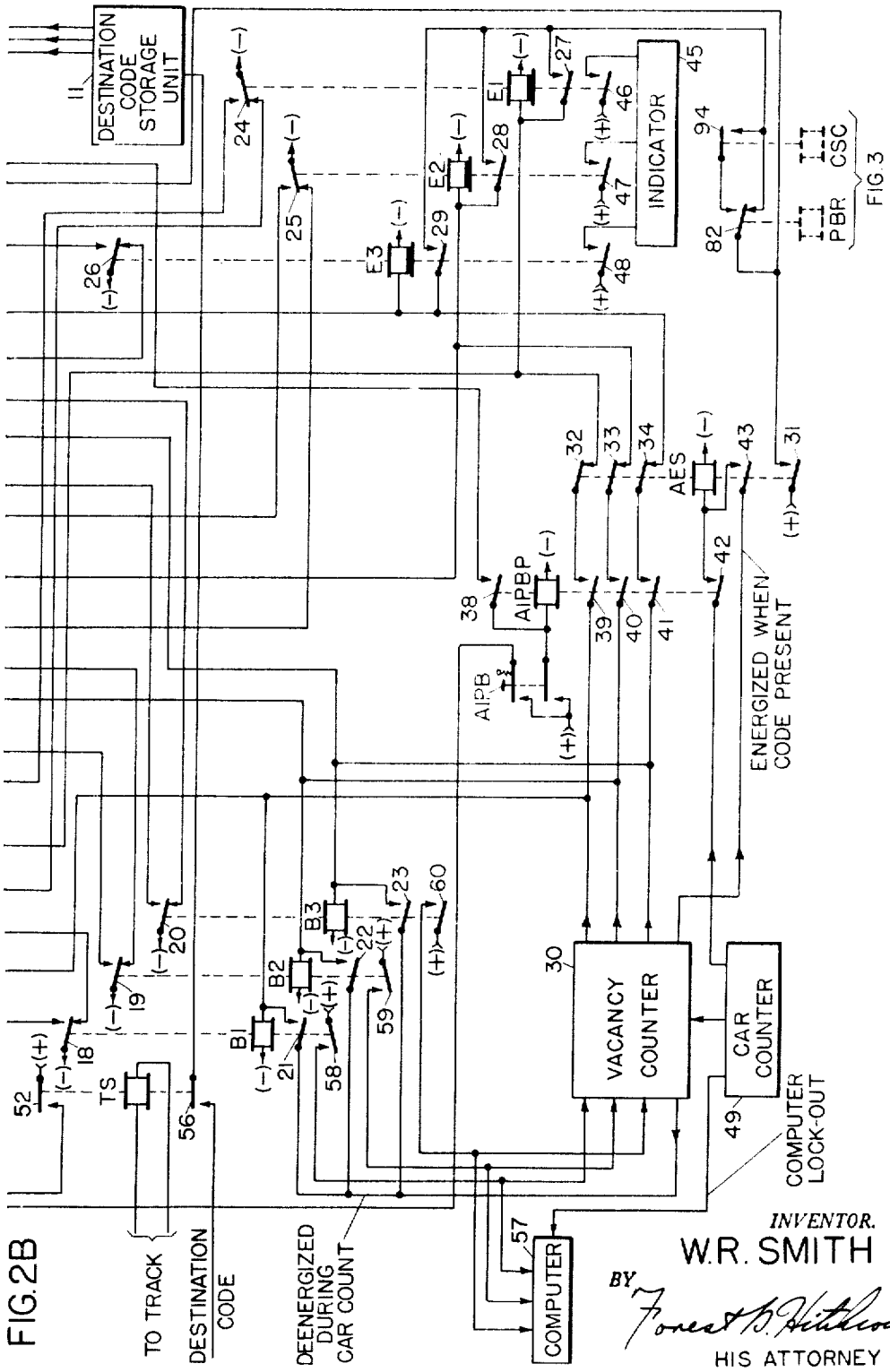


FIG.2B

INVENTOR.
W.R. SMITH
BY Forest B. Hitchcock
HIS ATTORNEY

Nov. 29, 1966 W. R. SMITH 3,289,173

CAR COUPLING INFORMATION STORAGE SYSTEM

Filed Dec. 31, 1962 4 Sheets-Sheet 4

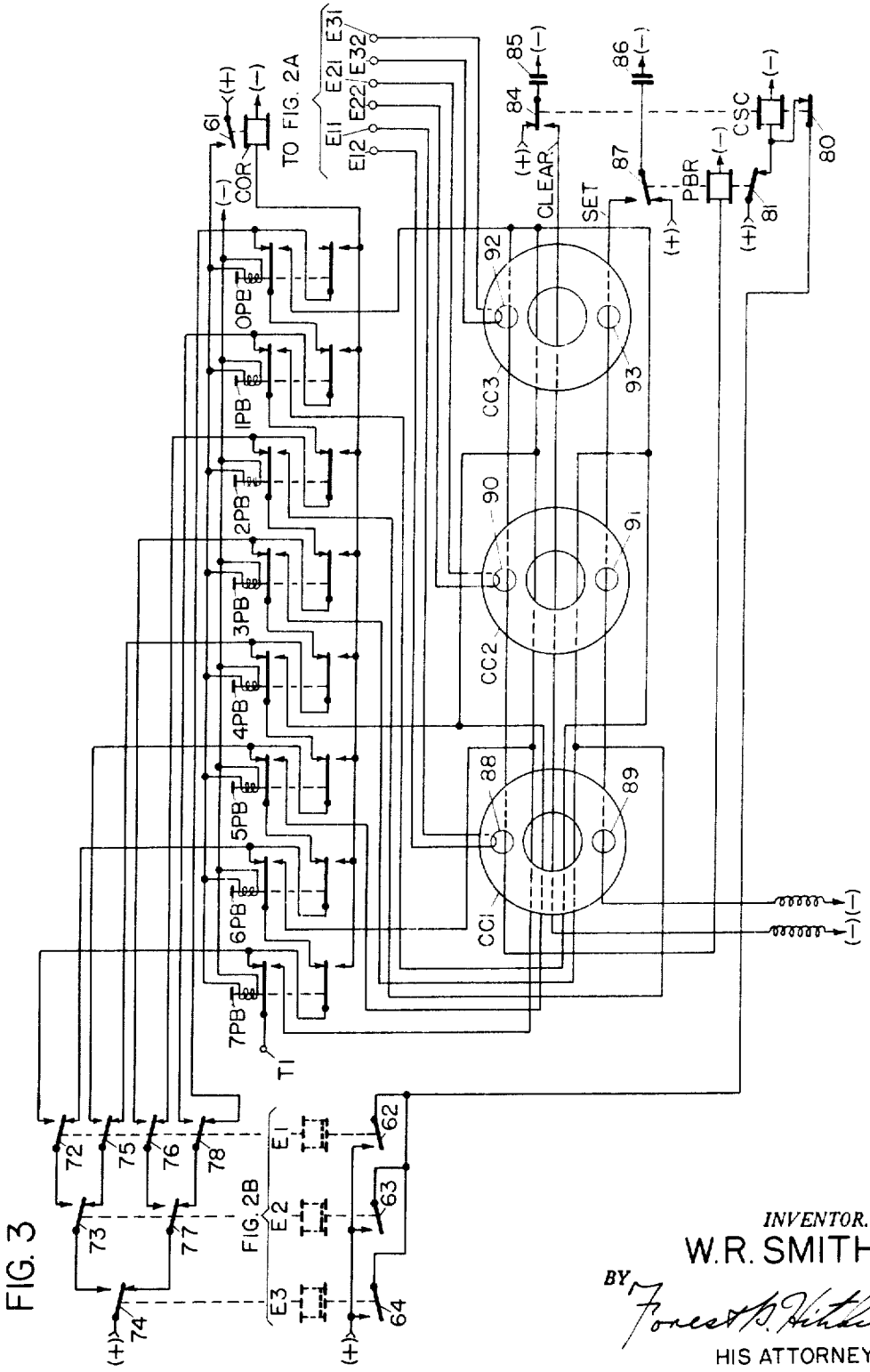


FIG. 3

INVENTOR.
W. R. SMITH
BY Forrest B. Kirkland
HIS ATTORNEY

United States Patent Office 3,289,173 Patented Nov. 29, 1966

3,289,173

CAR COUPLING INFORMATION STORAGE SYSTEM

Willis R. Smith, Rochester, N.Y., assignor to General Signal Corporation, Rochester, N.Y., a corporation of New York

Filed Dec. 31, 1962, Ser. No. 248,374
9 Claims. (Cl. 340—172.5)

This invention relates to railroad car coupling systems, and more particularly, to a system utilizing apertured magnetic cores for storing and altering information relating to distance a railway car to be coupled has to roll from a starting point to a coupling point on any selected track in a railroad classification yard.

In the common type of classification yard, a single hump track, having an elevated portion known as the "crest," branches out through track switches into a plurality of group tracks. Each of the group tracks generally branches out through additional track switches into a plurality of storage tracks. Cuts of railway cars being classified into trains are then allowed to roll, under influence of gravity, from the crest of the yard hump track onto predesignated storage tracks in accordance with the manner in which the cuts are to be assembled into trains. Actuation of the track switches is generally controlled automatically in these operations.

To prevent large impacts from occurring when a cut is coupled with cars standing on the predesignated storage track and thereby prevent damage to both cars and contents thereof, car retarders are strategically positioned at key locations in the yard in order to apply sufficient retardation of each cut being classified and thereby achieve smooth coupling.

Each cut has characteristics peculiar to itself in respect to its performance during free-rolling movement. Therefore, car retarders are normally operated so as to apply braking action in accordance with factors affecting free-rolling movement of individual cuts.

One of the most important factors for control of the car retarders in order to prevent excessive coupling impact is distance a cut must travel to the coupling point on its designated storage track. It is therefore important to provide control of the retarders in accordance with distance a cut must travel to its coupling point. This distance may be measured by the number of car lengths between the entrance end of the storage track and the rear of the last car having entered and stopped on that track, and is commonly referred to as distance-to-coupling.

In the event that motion occurs on a particular storage track, actual distance to coupling registration, as provided by existing track fullness detection systems, is unusable for control of retarders, since this distance is constantly changing. The storage system of the instant invention, however, may be used to retain the distance-to-coupling measured prior to entry of the rolling cut onto the storage track, change this number by the number of cars in the rolling out, and utilize the changed number for controlling the retarders. The invention thus adds versatility to existing classification yards.

The invention also provides facilities for simultaneous readout of distance-to-coupling information on two separate storage tracks.

Generally speaking, the invention contemplates a matrix of apertured magnetic cores arranged in rows and columns, the cores in each row having means coupled thereto to clear the cores of said row and means coupled thereto to set the cores of said row, the cores of each column having inhibiting means coupled thereto for selectively inhibiting set signals in any core and also a plurality of readout means coupled thereto for indicating the remanent magnetic condition of every core in

said column, and a plurality of priming means coupled to the cores of each row for producing an output from any set core in said row upon the priming thereof.

Each row is associated with a particular storage track. The cores of each row are set in accordance with the number of cars stored on said track by removal of inhibiting current from selected columns in accordance with a binary counting scheme. Readout is achieved by energization of a route relay or track relay or an equivalent binary electronic device associated with the particular storage track in the yard.

Means are provided for manual cancellation of a stored binary code relating to any storage track in the yard and replacement with a new binary code for storage. Limiting means are also provided to prevent accidental overcorrection for any of the storage tracks.

In accordance with the foregoing, one object of the invention is to provide a storage means for a railroad classification yard wherein distance-to-coupling information for each track is stored until required for use in controlling speed of cuts to be coupled.

Another object of the invention is to provide a matrix of apertured magnetic cores for storage of track fullness information for each track in a railroad classification yard.

Another object is to provide storage means for track fullness information whereby simultaneous readout of such information may be achieved for any two tracks in a railroad classification yard.

Another object is to provide means whereby an apertured magnetic core may be primed or set simultaneously with actuation of a relay.

Another object is to provide means for applying information to a matrix of apertured magnetic cores from a group of cores set in binary fashion.

Another object is to provide means for cancelling a previously stored binary code, and establishing and storing a new binary code in a single manual operation.

Another object is to provide a rapidly operating, low power, compact information storage and retrieval system.

These and other objects and advantages of the invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings in which:

FIG. 1 is a simplified block diagram of a distance-to-coupling system comprising the invention, showing relative locations of key positions along the track.

FIGS. 2A and 2B represent a part schematic and part block diagram of one embodiment of the invention as used in a railroad classification yard.

FIG. 3 is a schematic diagram of means for manually altering information stored in the system of FIGS. 2A and 2B.

Referring first to FIG. 1 for a brief general description of system operation, there is shown a matrix capable of receiving car route information signals from a destination code storage unit **11**. This unit may be any suitable binary storage unit, such as a group of relays, which receives and stores the destination code for particular cuts of cars and positions associated track switches in accordance therewith, to thereby select a predesignated storage track for each of the cuts. The matrix is also capable of receiving track interrogation signals. These inputs to the matrix are used for initiating readout of information stored in the matrix. Output of the matrix is applied to both a bank of storage relays B and a bank of indicator relays E. Matrix count feedback is applied to the matrix separately from relay bank B and from relay bank E.

Output from relay bank E is used to actuate an indicator **45**. Numerical output from relay bank B is applied to a vacancy counter **30**, which repeats the number ap-

plied thereto. Feedback from vacancy counter **30** is applied to storage relays B to enable application of a new number, altered by car count, to storage relays B. A suitable car counter **49** is connected to vacancy counter **30**, thereby providing means for alteration of the number temporarily stored in counter **30**, in accordance with counted cars. A computer **57** is coupled to the bank of storage relays B, enabling application of the number applied to storage relays B from the matrix to be immediately transferred to the computer. The computer is used for controlling car retarders in the classification yard. The yard is shown having but three storage tracks **1**, **2** and **3** for simplicity. However, any number of storage tracks may be used.

Upon application of a manual track interrogation signal when visual indication of track fullness information on a particular track is desired, indicator **45** produces the desired information. In addition, because destructive readout is used on the matrix, the number read from the matrix is reapplied to the matrix from indicator relays E, to avoid loss of this information.

Upon automatic operation of the system, route information for a particular cut is applied to the matrix from destination code storage unit **11**, which receives a destination code from the hump tower when track shunt relay TS is deenergized due to a presence of a cut. Track fullness information is then read from the matrix to the bank of storage relays B. This information is applied to the computer at the start of car count and is also stored on the storage relays until the cut is counted by car counter **49**. The computer thus receives information as to track occupancy, or conversely, distance-to-coupling. Because of the complementary nature of binary coding, the complement of the number representing track occupancy is representative of distance-to-coupling, and vice versa, for any given length of track. During car count, track occupancy information in counter **30** is altered by information supplied from the car counter.

Upon completion of car count, the number stored in vacancy counter **30** is altered by the number of cars in the cut counted by car counter **49**. Moreover, completion of car count causes application of the number stored in vacancy counted **30** to storage relays B. Thus, the number now stored in the bank of storage relays is representative of the cut vacancies on the storage track when the counted cut arrives on that track. When this number is applied to storage relays B, it is fed back to the storage matrix wherein it serves as new track occupancy information.

If the hump tower operator should desire to change the count stored in the matrix for any particular track, he need merely manually interrogate the particular track and then depress the proper correction input push-button. This causes a new number to be applied to indicator relays E. When the energized track relay is thereafter released, the new number is applied to the storage matrix wherein it is stored until needed for later use.

Referring next to FIGS. 2A and 2B, the storage matrix is shown comprising rows **1–3** and columns **1–3** of apertured magnetic cores. Row **1**, comprising cores **C11**, **C12** and **C13** is used for storing information pertaining to a first storage track in a classification yard, while row **2**, comprising cores **C21**, **C22**, and **C23** is used for storing information pertaining to a second storage track in the classification yard. Row **3**, comprising cores **C31**, **C32** and **C33** is used for storage of information pertaining to a third storage track in the classification yard. Although the system is shown having information stored as to but three tracks, it is to be understood that any number of rows could be used in the matrix to correspond with the number of tracks used in the classification yard, each row being responsive to condition of a different track.

Each column of cores is used for storage of a binary digit representative of the decimal number **2** raised to a particular power. Thus, the matrix may be connected so that the cores in column **1** of the matrix represent the decimal product of **2** raised to the zero power, the cores in column **2** represent the decimal product of **2** raised to the first power and the cores in column **3** represent the decimal product of **2** raised to the second power. Hence, a set core in column **1** indicates presence of a single car, a set core in column **2** indicates presence of two cars, and a set core in column **3** indicates presence of four cars. In each row, the decimal numbers represented by each set core are summed to provide a signal indicative of track occupancy measured in terms of car lengths for the track associated with the particular row. Although the matrix shown in FIG. 2A can indicate but a maximum of seven car lengths, it will be understood by those skilled in the art that any number of columns may be used in the martix in order to accommodate the maximum possible distance-to-coupling for the particular classification yard with which the system is used.

Rows **1**, **2** and **3** each have associated therewith a route relay designated **1R**, **2R** and **3R**, respectively. Energization for the route relays is supplied from destination storage unit **11**. The destination storage unit contains coded information as to the ultimate track destination of a particular cut as the cut passes a specific sensing location along the track. The cut may be sensed by a track shunt relay **TS**, connected across the rails at the sensing location. Thus, presence of a cut at the sensing location causes deenergization of relay TS. This permits the destination code associated with the particular cut to be transferred through back contact **56** into destination code storage unit **11**, which then energizes the route relay associated with the particular storage track for which the sensed cut is destined. Rows **1**, **2** and **3** of the matrix are thereby responsive to the number of cuts stored on the storage tracks.

Each row also has associated therewith a track relay corresponding to the track measured by the associated row. Thus, track relays **1T**, **2T** and **3T** are associated respectively with rows **1**, **2** and **3**. Each track relay **1T**, **2T** or **3T** is energized from a push button **1TPB**, **2TPB**, or **3TPB** respectively. Depression of any track push button provides information as to track fullness or distance-to-coupling on the particular storage track associated with the actuated push button. Because these track push buttons are of a solenoid-release type, when depressed they remain depressed until the solenoid is actuated.

In every row of cores, the conductor coupling the push button to the track relay is passed through a minor aperture in every core of the row. Thus, for example, when push button **1TPB** is depressed and track relay **1T** is energized, current passes through minor apertures **112**, **122**, and **132** of cores **C11**, **C12** and **C13**, respectively. This current flows in a direction to prime the enumerated apertures. Likewise, when destination code storage unit **11** energizes route relay **1R**, energization current for the route relay primes minor apertures **113**, **123**, and **133** of cores **C11**, **C12** and **C13**, respectively. It should be noted, however, that in any particular row, the track relay and route relay associated with the particular row cannot simultaneously be energized. This is due to interlocking between the route and track relays of each row. For example, in row **1**, relay **1R** is energized through back contact **101** or track relay **1T**, and track relay **1T** is energized through back contact **104** of relay **1R**. Therefore, if either the route relay or track relay is energized, it will be impossible to energize the other one of the relays until the relay which was first energized is deenergized. This protects against erroneous operation of the system, in that a distance-to-coupling reading for a particular track cannot be taken in the automatic mode when the manual mode of operation is desired, nor can a reading be taken in the manual mode when the automatic mode of operation is desired.

The cores in each row may be set through either of

two apertures. For example, in row 1, core C11 may be set through apertures 110 or 111, core C12 may be set through minor apertures 120 or 121, and core C13 may be set through minor apertures 130 or 131.

For optimum operation, the set signal for any given core should comprise a sharp pulse having a steep wave front. Thus, in order to set cores C11, C12 or C13, a set pulse may be applied through minor apertures 111, 121 and 131 when relay 1T deenergizes, permitting a capacitor 105 to charge from a positive voltage source through an inductor 109. Inductance added to the charging circuit of capacitor 105 provides a pulse of steep wavefront having sufficient amplitude to set any core through which it passes. Likewise, when relay 1R deenergizes, a capacitor 106 is charged from a positive voltage source through an inductor 107. The resulting current pulse which passes through minor apertures 110, 120 and 130 is of sufficient amplitude to set cores C11, C12 or C13. Large amplitude and steep wavefront pulses are attained by use of inductor 107.

The cores in each row are cleared by a positive pulse created when either the track or route relay associated with the row is energized. Thus, energization of relay 1T causes the charge on capacitor 105 to discharge through the major apertures of cores C11, C12 and C13, thereby clearing the cores. Alternatively, the same result is achieved by energization of route relay 1R. In such case, the clear pulse is generated by discharge of capacitor 106 through the major apertures of cores C11, C12 and C13. Large amplitude clear pulses of steep wavefronts are achieved by use of an inductor 108 connected in series with the energy source for the clear circuit.

Inhibiting currents are controllably coupled through every minor aperture in the matrix which receives set pulses. The amplitude of inhibiting current is sufficiently great to overcome set pulses passing through an inhibited aperture, thereby preventing the core from becoming set through the inhibited aperture. The cores of each column are inhibited simultaneously. Thus, looking at column 1 for example, inhibiting current passes through minor apertures 110, 210 and 310 of cores C11, C21 and C31, respectively, in series. Likewise, inhibiting current passes through minor apertures 111, 211 and 311 of cores C11, C21 and C31 respectively, in series. Inhibiting current for columns 1, 2 and 3 of the matrix is supplied from switching means comprising back contacts 18, 19 and 20 of relays B1, B2 and B3, respectively, and back contacts 24, 25 and 26 of relays E1, E2 and E3 respectively. Therefore, in column 1, cores C11, C21 and C31 may be set through minor apertures 110, 210 and 310, respectively, if relay B1 is energized, and through minor apertures 111, 211 and 311, respectively, if relay E1 is energized.

Each column has associated therewith a pair of amplifiers. Each amplifier receives input voltage from a minor aperture in every core of the column having a prime winding coupled thereto. Thus, taking column 1 again as an example, amplifier 12 receives a signal from cores C11, C21 and C31 through minor apertures 113, 213 and 313, respectively, while amplifier 13 receives a signal from minor apertures 112, 212 and 312, respectively. The amplifiers are of sufficient sensitivity to produce an output signal whenever an output pulse is produced from a single primed minor aperture of a core which has been set.

It should be noted that each pair of terminals E11 and E12 of column 1, E21 and E22 of column 2, and E31 and E32 of column 3 is coupled together through minor apertures 88, 90 and 92 of correction cores CC1, CC2 and CC3, respectively, as shown in FIG. 3. If it be preferred that the facility for correction of the count stored in the matrix for any particular track be temporarily rendered inoperative without affecting operation of the remainder of the system, the pair of terminals in each column need merely by jumpered together.

Output of each amplifier receiving a pulse from an odd-numbered minor aperture of any core in a column is connected to energize one of the B relays, while output of each amplifier receiving an input from an even-numbered minor aperture of any core in a column is connected to energize one of the E relays. Thus, output from amplifiers 12, 14 and 16 is connected to energize relays B1, B2 and B3, respectively, while output from amplifiers 13, 15 and 17 is connected to energize relays E1, E2 and E3, respectively. Moreover, each amplifier has a second input circuit or gate circuit, connected to a front contact of the relay which it energizes. Application of a negative voltage to this input circuit causes cessation of output from the amplifier. Thus, front contacts 18, 19 and 20 of relays B1, B2 and B3, respectively, cause cessation of output from amplifiers 12, 14 and 16, respectively, upon energization of the respective B relays. Likewise, front contacts 24, 25 and 26 of relays E1, E2 and E3, respectively, cause cessation of output from amplifiers 13, 15 and 17 respectively, upon energization of the respective E relays. Relays B1, B2 and B3 are provided with stick circuits energized, under conditions discussed below, from intermediate register 30 through their front contacts 21, 22 and 23, respectively. Relays E1, E2 and E3 are provided with stick circuits energized under conditions discussed below, from front contact 31 of a relay AES or from front contact 102, 202 or 302 of track relay 1T, 2T or 3T respectively, through front contacts 27, 28 and 29 of the respective E relays. The E relay stick circuit also includes contact 82 of a relay PBR and contact 94 of a relay CSC.

Energization of the B relays in accordance with a digital word read out from the matrix causes simultaneous application of the word to vacancy counter 30 and computer 57, as previously explained. The computer is connected to control car retarders (FIG. 1) used with the system, so that the number stored in the matrix may be applied to the computer in order to provide control of the retarders in accordance with occupancy of the storage track.

Car counter 49 is connected to actuate vacancy counter 30 in such fashion that each time a car passes a particular location along the track, the car counter is actuated by suitable means, such as a treadle, and the number of occupied spaces along the storage track, as registered in counter 30, is increased by one. For example, if the number of vacant car lengths on the storage track totals 7, vacancy counter 30 reads 7. When a single car cut is next detected by the car counter, the number of car lengths recorded in vacancy counter 30 is decreased to 6. During car count by counter 49, a track shunt relay TS is deenergized due to shunting of its source of energy by presence of a car on the detector track. One route relay 1R, 2R or 3R is energized from destination code storage unit 11, and the energized route relay remains energized by a stick circuit through front contact 52 of relay TS, as long as a car shunts the detector track section (shown in FIG. 1) across which track shunt relay TS is connected. Alteration of count in vacancy counter 30 results in application of the altered count to the B relays by means of a feedback circuit from counter 30 to relays B1, B2 and B3.

An automatic interrogation push button AIPB is provided to actuate an automatic interrogation push button repeater relay AIPBP. This relay has associated therewith a set of front contact 38, 39, 40, 41 and 42. When push button AIPB is depressed, relay AIPBP energizes, and provided all track relays 1T, 2T and 3T are deenergized, relay AIPBP sticks through its front contact 38 from a positive voltage source through back contacts 102, 202 and 302 of relay 1T, 2T and 3T, respectively, connected in series. Energization of relay AIPBP provides energization for relays E1, E2 and E3 through the respective back contacts 32, 33 and 34 of relay AES from

counter 30, provided that car count is not taking place. Push button AIPB also serves to directly release any depressed solenoid type track push buttons.

Prior to car count, energization of push button AIPBP connects the E relays to the vacancy counter through front contacts 39, 40 and 41 of relay AIPBP and back contacts 32, 33 and 34 of relay AES. This permits display of the number in counter 30 on indicator 45.

When car count takes place, relay AES is energized through front contact 42 of relay AIPBP, and when a code is stored in vacancy counter 30, relay AES sticks through its front contact 43. In addition, upon energization of relay AES, front contact 31 of relay AES closes, energizing stick circuits for relays E1, E2 and E3 through their respective front contacts 27, 28 and 29, thereby enabling any of the E relays which have been picked up in response to the code temporarily stored in vacancy counter 30 to remain up. Relays E1, E2 and E3 are of the slow dropaway type, in order to permit energization of their stick circuits prior to drop-away.

In operation, assume the system is started with a number of cars on track 1, leaving four car lengths as the distance-to-coupling on that track. Assume further that a cut of two cars is released at the hump destined for track 1. In this condition, core C13 of row 1 is initially in the set condition. Furthermore, capacitors 105 and 106 are fully charged to the amplitude of the D.C. supply. Under these initial conditions relays AES and AIPBP along with relays B1, B2 and B3 are all deenergized.

When the initial cut of two cars is counted by car counter 49, the vacancy counter receives a count of two. While car counter is being made, the computer is rendered insensitive to the changing count in the B relays, supplied from the vacancy counter, by means of a signal from the car counter, thereby avoiding erroneous computer input signals. It should be noted that the output of counter 30 is connected to the coils of relays B1, B2 and B3 and the input of counter 30 is connected to front contacts 58, 59 and 60 of relays B1, B2 and B3, respectively. Because the initial cut of two cars is destined for track 1, destination code storage unit 11, upon receipt of the destination code for the cut through back contact 56 of relay TS, energizes relay 1R, which sticks through its front contact 134 and back contact 52 of relay TS. Start of car count also removes energization from front contacts 21, 22 and 23 of relays B1, B2 and B3 respectively.

When car count is completed, those of the B relays which are picked up, are stuck through front contacts 21, 22 or 23 of relays B1, B2 and B3, respectively, with energy from the vacancy counter. Therefore, front contact 22 of relay B2 is now closed, since the coil of this relay is now energized from the vacancy counter.

When the cut progresses down the track, permitting relay TS to energize and open contacts 52 and 56, the code in destination code storage unit 11 is cancelled, and the stick circuit for relay 1R is opened. Relay 1R then deenergizes. Relay B2 remains stuck through its front contact 22 by energy from vacancy counter 30.

Energization of relay B2 causes its front contact 19 to close and its back contact 19 to open. Thus, when relay B2 is energized, the inhibiting signal passing through minor apertures 120, 220 and 320 of cores C12, C22 and C32, respectively, is removed. When route relay 1R is next energized, back contact 103 of relay 1R is opened and front contact 103 is closed. This causes a charge, comprising a clear pulse, to be transferred from capacitor 106 through the major apertures of cores C11, C12 and C13. Simultaneously, a prime signal constituting energization current for relay 1R is passed through minor apertures 113, 123 and 133 of cores C11, C12 and C13, respectively.

When the code is transferred out of destination code storage unit 11 and relay 1R deenergizes, front contact 103 opens and back contact 103 closes. Capacitor 106, which is substantially uncharged at the instant back contact 103 closes, starts to charge, causing a surge of current to pass through minor apertures 110, 120 and 130 of cores C11, C12 and C13. The direction of charging current flow is such as tends to set these cores. However, minor apertures 110 and 130 of cores C11 and C13 are inhibited through back contacts 18 and 20 of relays B1 and B3, respectively, both of which are deenergized. This prevents cores C11 and C13 from becoming set. However, as previously explained, no inhibiting current passes through minor aperture 120 of core C12, because relay B2 is stuck in the picked-up position. Therefore, core C12 becomes set and information stored in the matrix indicates that two cars are present on track No. 1. If car count should now be initiated for some other track, stick circuit energization for relays B1, B2 and B3 applied from register 30, will be removed, causing relay B2 to deenergize. The matrix is thereby prepared to store further information, in the manner described.

Assume now that the operator wishes to manually interrogate the matrix, in order to determine the number of cars stored on track 1. By depressing push button 1TPB, track relay 1T is energized with current which passes through minor apertures 112, 122 and 132 of cores C11, C12 and C13, respectively, in a direction tending to prime these apertures. However, of the three cores in row 1, only core C12 is set; therefore, only minor aperture 122 may be primed.

Upon energization of relay 1T, back contact 100 of relay 1T opens and front contact 100 closes. This causes the charge stored on capacitor 105 to discharge through the major apertures of cores C11, C12 and C13. The charge is of sufficient amplitude and proper direction to clear the cores. Upon clearing of core C12, which previously was in the set condition, an output pulse is produced from primed apertures 122. This pulse is applied to the input side of amplifier 15.

Output of minor aperture 122 after passing through amplifier 15, then energizes relay E2. Relay E2 then sticks through its front contact 28, back contact 82 of relay PBR, and front contact 102 of relay 1T.

Upon energization of relay E2, front contact 25 of relay E2 closes and back contact 25 opens. This has the effect of removing inhibiting current from minor aperture 121 of core C12. Additionally, amplifier 15 is cut off by the connection through front contact 25 of the gate circuit of amplifier 15 to a source of negative voltage. Front contacts 46, 47 and 48 of relays E1, E2 and E3, respectively, may be connected to a suitable indicator 45, thereby providing the operator with a visual indication of the distance-to-coupling on the manually interrogated track.

When manual pressure on track push button 1TPB is released, the push button remains held in the closed position due to a holding magnet. Relay 1T thus remains energized, causing relay E2 to remain stuck in the picked-up condition.

In the event such manual interrogation is made, and the hump tower operator does not wish to change the code stored in the matrix, he can release the depressed track push button by depressing push button AIPB, thus causing energization of solenoids 1SO, 2SO and 3SO on track push buttons 1TPB, 2TPB and 3TPB, respectively, thereby overcoming the effect of the holding magnet retaining the depressed push button in the depressed condition. Track push button 1TPB is thus released, permitting track relay 1T to drop away. Core C12 is thereby reset, since it receives no inhibiting current from relay E2 when relay 1T drops out and provides a set signal for row 1 of the matrix. Hence, manual interrogation of a particular track can be made without loss or change of information dealing with that track, which is stored in the matrix.

In automatic operation of the system, depression of push button AIPB energizes relay AIPBP, which sticks through its front contact 38. Front contacts 39, 40 and 41 connect the output of vacancy counter 30 to relays E1, E2 and E3, respectively. Thus, as information in the

form of a digital word indicative of fullness of a particular storage track is applied to vacancy counter **30** from the core matrix, the information in the vacancy counter may be read visually on indicator **45**. During car count, however, relay AES is energized from car counter **49** through closed front contact **42** of relay AIPBP, remaining energized through front contact **43** until no code remains in register **30**. Energization of relay AES opens back contacts **32**, **33** and **34** of relay AES, deenergizing relays E1, E2 and E3, respectively. However, relay E1, E2 and E3 are of a slow dropaway type. When front contact **31** of relay AES closes, the stick circuit through front contacts **27**, **28** and **29** of relays E1, E2 and E3, respectively, and back contact **82** of relay PBR is energized. Thus, the indication presented on indicator **45** remains thereon until either a manual interrogation is made, thereby deenergizing the stick circuit for relay AIPBP, or car count stops and the code in the register is transferred out to computer **57** for control of the next cut to be counted.

Track shunt relay TS is connected in a location preceding the point along the track where car counter operation is initiated, as shown in FIG. 1. Therefore, prior to car count, track shunt relay TS deenergizes due to presence to a cut shunting the track rails and thereby shunting the relay coil. Deenergization of relay TS causes energization of a predetermined route relay from destination code storage unit **11** through back contact **56** of relay TS. When the predetermined route relay is energized, it sticks through a front contact in series with back contact **52** of relay TS. Therefore, when car count takes place, the energized route relay remains energized until relay TS energizes, which in turn occurs when the cut leaves the detecting track. Thus, when a predetermined route relay is energized, information as to fullness of the storage track associated with the route relay is applied from relays B1, B2 and B3 to vacancy counter **30**. When car count is initiated, the number stored in counter **30**, which has already been applied to computer **57** from the B relays, is then altered by the car count from counter **49**. The computer remains unaffected during this alteration, since it is locked out by the car counter during car count. The altered number is applied from the vacancy counter to relays B1, B2 and B3, and thence to the matrix for storage, as previously explained.

It should be noted that because each row of the matrix has two separate means for energizing each core, as well as two separate output apertures, and because each column of the matrix has two separate means for inhibiting the set current applied to each aperture, as well as a separate amplifier responsive to separate columns of output minor apertures in the matrix, it is possible to simultaneously interrogate two rows of the matrix corresponding to two separate storage tracks. In the instant invention, one of the simultaneous interrogations is achieved by normal operation of the track relay in any row of the matrix, while the other of the simultaneous interrogations is achieved by automatic operation of the route relay in any other row of the matrix. Interlocking between the route and track relay associated with each row of the matrix prevents simultaneous energization of both the route and track relay associated with the same row.

Referring now to FIG. 3, there is shown means for cancelling a number stored in the matrix for any given track. Need for such cancellation often arises when a cut fails to roll the entire distance to a coupling point. Under these conditions, an erroneous count is stored in the matrix for the particular track on which this cut has "stopped short." The hump tower operator can observe this condition from his vantage point, and in order to maintain hump yard operations, may wish to continue coupling subsequent cuts to the cut that has "stopped short." The problem involved here, however, is that the computer which controls the retarders receives its information from the matrix. Although the matrix may indicate a large distance existing between the hump and the rear of the car to which the next cut will be coupled, in actuality a cut may be "stopped short" at a point much closer to the hump. If no correction is made for this condition, the next cut will be retarded only sufficiently to permit it to roll all the way to the point where the rear of the "stopped short" cut should be located. This requires a greater initial speed than the speed required for a cut to couple to the "stopped short" cut. A large impact will thus occur when the rolling cut collides with the "stopped short" cut. It is obviously desirable to prevent such collision from occurring, and thereby avoid the attendant damages resulting therefrom.

To provide correction means for the matrix in case such condition should occur, a single row of apertured magnetic cores is provided, wherein the number of cores corresponds to the number of columns in the matrix. Therefore, as shown in FIG. 3, the row used for correction comprises cores CC1, CC2, and CC3. A group of eight push buttons designated **0PB–7PB**, is provided for operating the cores. The push buttons are connected to a source of positive energy through contact of the E relays in a binary fashion. This is for the purpose of preventing overcorrection. Thus, if a particular number of cars is stored on a storage track, there is a particular maximum distance-to-coupling. This maximum is provided through the contacts of the E relays, whereby the highest correction which can be provided is determined according to the binary energization of the E relays. Thus, for a storage track of any given length, and a particular number of cars already stored on the track, the maximum number to which the matrix can be corrected for that particular track is the total car lengths of the storage track minus the number of cars stored on the track, or in other words, the distance-to-coupling. Therefore, assuming a seven cut storage track with two cuts stored thereon, the maximum number of cuts to which the track can be corrected is seven minus two, or five, which is the distance-to-coupling. Under these conditions, relay E2 is deenergized and relays E1 and E3 are energized. Positive voltage is therefore applied through front contact **74** of relay E3, back contact **73** of relay E2 and front contact **75** of relay E1, to a push button designated **5PB**. Because the push buttons are wired in series, energy applied to the upper armature of push button **5PB** is also applied to the upper armature of push buttons **4PB** through **0PB**. Thus, the upper armature of any push button in the group consisting of **5PB** through **0PB** can serve to provide a current through one or more major apertures of the correction cores. Although this energy is also applied to the upper armatures of the remaining push buttons **7PB** and **6PB**, it is obvious that depression of either of these push buttons will simply break the circuit to the depressed push button, since the energy is applied only to the front contact of the upper armature, rather than directly to the upper armature of push buttons **7PB** and **6PB**. However, on push buttons **5PB** through **0PB**, energy is applied directly to the upper armatures, enabling current to flow to the back contact of the upper armature of whichever one of these push buttons is depressed.

The push buttons are coded so as to provide inhibiting currents from their upper back contacts through the major apertures of predetermined cores, depending upon the code. The cores are cleared from relay CSC which is energized by closing of front contact **62**, **63** or **64** of relay E1, E2 or E3 respectively. Thus, a code present on the E relays maintains relay CSC in the energized condition through its front contact **80**. This causes a capacitor **85** to acquire a positive charge through front contact **84** of relay CSC.

A relay COR having a front contact **61** is connected to the back contact of the lower armature of each push button **0PB–7PB**. These push buttons are constructed similar to push buttons **1TPB–3TPB** (shown in FIG. 2A) so as to be held in the depressed condition by permanent

holding magnets, once depressed. Release of the depressed push buttons is achieved by actuation of a solenoid on each of the push buttons, thereby overcoming the effect of the holding magnets. The solenoids on push buttons **0PB–7PB** are energized in parallel from front contact **61** of relay COR.

Relay COR energizes when a correction push button corresponding to a correction equal to or less than the distance-to-coupling for a particular track is depressed. If a push button corresponding to a correction greater than the distance-to-coupling for a particular track is depressed, relay COR does not energize, and the depressed push button remains depressed until a push button corresponding to a correction equal to or less than the distance-to-coupling for the track is depressed.

When there is no code on the E relays, front contacts **62, 63** and **64** are all open. Relay CSC however, remains energized through back contact **81** of relay PBR, until relay PBR is energized by depressing a proper push button in the group of push buttons **0PB–7PB**. Then, when relay PBR is energized, relay CSC deenergizes, in turn causing capacitor **85** to discharge through the major apertures of cores **CC1, CC2** and **CC3**. This puts the cores in a clear condition. It should be noted that the upper armature of push button **7PB** is connected to a terminal **T1**. This terminal is furnished for connection to the front contact of the lower armature of a next preceding push button in a larger system providing more than eight possibilities for correction. For simplicity however, a smaller system has been here illustrated, and thus the upper armature of push button **7PB** is shown energized only from its front contact. Hence, push button **7PB**, when depressed, provides energization to the back contact of its lower armature only.

Relay PBR is connected from push buttons **0PB–7PB** through output minor apertures **88, 90** and **92** of cores **CC1, CC2** and **CC3** respectively. Operation of any of push buttons **0PB–6PB** serves to simultaneously energize relay PBR, apply a prime signal through output minor apertures **88, 90** and **92** and selectively inhibit all, any or none of cores **CC1, CC2** and **CC3**, through the major apertures thereof, depending upon which of the push buttons **0PB–6PB** is operated. When this occurs, capacitor **86** which has acquired a positive charge through back contact **87** of relay PBR, now discharges through front contact **87** and minor apertures **89, 91** and **93** of cores **CC1, CC2** and **CC3** respectively, thereby setting those cores which are clear. The energizing current for relay PBR additionally serves to prime the minor apertures **88, 90** or **92**, in those cores which are clear. Outputs are then applied from the set cores in group **CC1, CC2** and **CC3** to relays **E1, E2** and **E3** of FIG. 2A. This energizes the E relays in accordance with those cores which have been set and primed. The energized E relays then feed a new binary signal back into the matrix columns upon deenergization of an energized track relay, enabling the signal to be applied to the matrix row corresponding to the track which has been interrogated. Simultaneously with energization of any of the E relays, at least one of contacts **62, 63** or **64** closes.

When the depressed push button of the group **0PB–6PB** is released, relay PBR deenergizes, closing its back contact **81** and thereby again energizing relay CSC. Relay CSC then sticks through the closed front contacts of the energized E relay front contacts **62, 63** or **64**, and its own front contact **80**. Front contact **84** of relay CSC also closes, permitting capacitor **85** to acquire a new positive charge.

As previously noted, track push buttons **1TPB, 2TPB**, and **3TPB** are of the type which when depressed remain held depressed by permanent magnets until energization of the solenoids forces their release. Solenoids **1S0, 2S0** and **3S0** are each indicated in FIG. 2A by a winding around the stem of their respective push buttons **1TPB, 2TPB** and **3TPB**. Thus, when a track push button is depressed, a correction can be made by operation of push button **0PB–6PB**, depending upon the code stored in the E relays. This operation energizes relay COR, which in turn closes its front contact **61** and energizes the solenoids on the correction push buttons. This forces release of the depressed correction push button. The energized track relay **1T, 2T** or **3T** may then be deenergized by depression of push button **AIPB**, as previously noted.

In operation, assume a car has stopped short on the storage track associated with track relay **2T**. To make a correction for this condition, the hump tower operator upon detection of the condition need merely depress push button **2TPB** and then the correction push button corresponding to the correction which he desires to make. For example, assume a count of **5** is stored in row **2** of the matrix. If the hump tower operator wishes for some reason to change the count to **3**, he first depresses push button **2TPB**, interrogating storage track **2**, as previously explained. The push button then remains depressed due to its self-contained permanent magnet. Relay **2T** is thereby energized, and by the process previously described, relays **E1** and **E3** become energized and indicator **45** provides a count of five. Energization of relays **E1** and **E3** closes front contacts **62** and **64** thereby energizing the stick circuit for relay CSC through front contact **80** of relay CSC. This prevents clearing of cores **CC1, CC2** and **CC3**, which remain in the clear condition after prior deenergization of relay CSC has permitted discharge of capacitor **85** through cores **CC1, CC2** and **CC3**. Energization of relay CSC also permits capacitor **85** to charge to a voltage equal in amplitude to that of the D.C. supply voltage through front contact **84** of relay CSC.

Upon energization of relays **E1** and **E3**, their respective front contacts **75** and **74** close. This causes application of energy only to push button **5PB** and the remaining push buttons shown to the right of push button **5PB**. This permits the interrogated matrix row to receive a new number for storage therein corresponding to the push button depressed in the group of push buttons **5PB** to **0PB** inclusive. Push buttons **6PB** and **7PB** cannot be used to apply a new number to the interrogated row of the matrix, since these two push buttons are not energized in this instance. The purpose of this feature is to prevent change of the stored number to a number greater than that corresponding to the number of stored track vacancies. Such change would result in excessively great impacts when cuts are coupled.

When it is desired to change the number stored on row **2** from **5** to **3**, push button **3PB** is depressed. This causes application of inhibiting energy through the major aperture of core **CC3**. Simultaneously, minor aperture **88** and **90** are primed by this energy, which is also used for actuating relay PBR. This relay, upon energization, sets cores **CC1** and **CC2** through minor apertures **89** and **91**, respectively, from capacitor **86**. Core **CC3**, being inhibited through its major aperture, cannot be set and primed, while cores **CC1** and **CC2**, being clear, can be both set and primed.

When relay PBR is energized, its back contact **82** (shown in FIG. 2B) opens, deenergizing the stick circuit for relays **E1** and **E3** through their front contacts **27** and **29**. Thus, relays **E1** and **E3** deenergize, opening their respective front contacts **62** and **64**. Relay CSC thereby deenergizes, since back contact **81** of relay PBR also opens upon energization of relay PBR.

Upon deenergization of relay CSC, its back contact **84** closes. This permits discharge of capacitor **85** through the major apertures of cores **CC1, CC2** and **CC3**. Since cores **CC1** and **CC2** are both set and primed, outputs are produced from minor apertures **88** and **90**, which appear at terminals **E11, E12** and **E21, E22**. Since these terminals are connected to the correspondingly designated terminals in FIG. 2A, the outputs are transmitted through

amplifiers 13 and 15, respectively, to relays E1 and E2, respectively, energizing the relays. At this point, since relay PBR is energized and relay CSC is deenergized, relays E1 and E2 are stuck through front contact 82 of relay PBR and back contact 94 of relay CSC (shown in FIG. 2B). Energization of relays E1 and E2 causes their respective back contacts 24 and 25 to open, thereby removing inhibiting current from minor apertures 211 and 221 of cores C21 and C22, respectively.

Deenergization of relay CSC causes its back contact 94 (shown in FIG. 2B) to close, thereby completing a stick circuit for the energized relays in the group consisting of relays E1, E2 and E3. Moreover, upon deenergization of relay CSC, cores CC1, CC2 and CC3 are cleared, causing outputs to be produced from cores CC1 and CC2 and applied from columns 1 and 2 of the matrix to relays E1 and E2 respectively, energizing the relays, as previously mentioned. Because there is now a complete stick circuit for the E relays, relays E1 and E2 remain stuck in the picked up condition.

Depression of push button 3PB energizes relay COR, causing its front contact 61 to close. This completes a circuit to the release solenoids on push buttons 0PB–7PB, in turn forcing push button 3PB to release by overcoming the effect of the holding magnet on push button 3PB. Relay PBR is thereby deenergized, closing its back contact 81 which in turn causes relay CSC to become energized. Relay CSC then sticks through its closed front contact 80 and front contacts 62 and 63 of energized relays E1 and E2, respectively. Deenergization of relay PBR and energization of relay CSC causes their respective back contact 87 and front contact 84 to close, permitting capacitors 86 and 85 to resume charging.

Subsequent depression of push button AIPB (FIG. 2B) then produces release of track push button 2TPB, which in turn causes relay 2T to deenergize. Deenergization of relay 2T causes capacitor 205 to discharge through back contact 200 of relay 2T, thereby setting cores C21 and C22 through their respective minor apertures 211 and 221. Simultaneously, front contact 202 of relay 2T opens, thereby deenergizing the stick circuit for relays E1, E2 and E3. This causes reapplication of inhibiting energy from back contacts 24 and 25 of relays E1 and E2, respectively, through columns 1 and 2, respectively, of the matrix. The new code indicating 3 cuts as the distance-to-coupling on storage track is thereby established in row 2 of the matrix, and the E relays are deenergized. The system is now ready for a new interrogation and correction if necessary.

Although the system has been described in conjunction with measurement of distance-to-coupling, it should be obvious to those skilled in the art that as an alternative, track fullness may be the parameter measured by the system. This is made possible by the flexibility of binary coding, whereby the complement of the binary word representing distance-to-coupling may be used to represent fullness of any given storage track.

It should be noted that but a single bank of relays B1, B2 and B3 are required for transfer of occupancy informatiton from the matrix to vacancy counter 30, for the entire number of tracks associated with the single matrix. This represents a great reduction in physical size and power requirements of existing distance-to-coupling measuring systems. Furthermore, simultaneous readout from two separate rows of cores in the matrix, representing two separate storage tracks, may be achieved with this system. Additional versatility in the system is achieved by means of simultaneously conditioning an apertured core with the current used for energizing the coil of a relay to be actuated. Priming of an unlimited number of cores can thereby be achieved simultaneously with operation of a relay. The inherent inductance of the relay coil provides the additional beneficial result of helping to properly shape the setting and priming signals.

The system readily lends itself to correction by means of apertured magnetic cores also. Because apertured ferrite cores are employed in both the matrix and the correction circuit, the two can be readily integrated, since the orders of magnitude of currents used in both systems are substantially identical. Moreover, if in a particular instance, it is preferable to use the system without the correction feature, the terminals in the matrix to which the correction core outputs are applied may be jumpered, thereby locking out the correction circuit.

Thus, there has been shown a car coupling information storage system for a railroad car classification yard whereby distance-to-coupling information for each track may be stored until needed for use in controlling speed of cuts to be coupled. A single matrix of apertured magnetic cores is used for storage of the distance-to-coupling information for all the storage tracks in the yard. Furthermore, simultaneous readout of distance-to-coupling information may be achieved for any two tracks in the yard. Correction of information stored in the matrix may be easily achieved by use of a correction circuit employing apertured magnetic cores. The system also permits magnetic conditioning or changing magnetic state of apertured magnetic cores simultaneously with operation of relays. The complete system is compact, rapid in operation, and of low power requirements.

Although but one specific embodiment of the present invention has been described, it is to be specifically understood that this form is selected to facilitate in disclosure of the invention rather than to limit the number of forms which it may assume; various modifications and adaptations may be applied to the specific form shown to meet requirements of practice, without in any manner departing from the spirit or scope of the invention.

What is claimed is:

1. In a railroad classification yard having storage tracks and car retarder means to control speed of rolling cuts destined for preselected storage tracks, distance-to-coupling storage means comprising a matrix of apertured magnetic cores, each row of the matrix being responsive to the number of cuts stored on a particular track in the yard, means including a computer coupling the matrix to the car retarder means, automatic means energizing a route relay associated with any particular track and thereupon causing readout of track fullness information to the computer from the matrix row responsive to stored cuts on said particular track, and manual means for causing readout of the row of cores responsive to the number of cuts stored on any other track in the classification yard for energizing the track relay associated with said other track whereby output information as to fullness of said other track is produced simultaneously with the output indicative of fullness of said particular track.

2. In a railroad classification yard having a plurality of storage tracks, car retarder means to control speed of rolling cuts destined for preselected storage tracks, and computer means to provide control of the car retarder means, distance-to-coupling storage means comprising a matrix of apertured magnetic cores, each row of said matrix responsive to the number of cuts stored on a particular track in the yard, a vacancy counter for temporary storage of information supplied by the matrix simultaneous with transmittal to the computer means, switching means coupling information from the matrix to the vacancy counter, and automatic means for initiating readout of track occupancy information from said matrix for any selected track whereby said occupancy information is transferred to the switching means and immediately thereafter to the vacancy counter and the computer means.

3. The invention according to claim 2 wherein the cores of the matrix have multiple apertures and control means for the cores comprising, means for clearing the cores in every row of said matrix, means for setting the cores of every row, means for priming output minor

apertures in the cores of every row, means coupled to every output aperture of each core in every column of said matrix for providing an output from the columns each time a row of cores is cleared, and feedback means actuated by said output for resetting each core in the cleared row that had been set prior to being cleared.

4. The distance-to-coupling storage means of claim 2 having a second switching means, indicator means operated from said second switching means, and manual means for energizing the row of cores responsive to the number of cuts stored on any track in the classification yard other than the track having information transferred from the matrix to the intermediate register, thereby producing output information as to occupancy of said other track simultaneously with the output corresponding to occupancy of said selected track.

5. In a railroad classification yard having car retarder means to control speed of rolling cuts and computer means to control the car retarder means, distance-to-coupling storage means comprising a matrix of apertured magnetic cores, relay means coupled to the cores of each row whereby energizing current for said relay means constitutes a prime signal for an aperture in each core of said row, means clearing each core in said row upon actuation of said relay means, vacancy counting means, means coupling information from the matrix upon clearing of the cores of said row to the vacancy counting means for temporary storage therein, and means simultaneously coupling the information from the matrix to the computer.

6. In a railroad classification yard having storage tracks, car retarder means to control speed of rolling cuts destined for preselected storage tracks, and computer means to control the car retarder means in accordance with track fullness information, distance-to-coupling storage means comprising a matrix of apertured magnetic cores, each row of cores in said matrix being responsive to the number of cuts stored on a particular track in the yard and receiving route information from a destination code storage unit, a vacancy counter for temporary storage of track occupancy information for any selected track after transmittal to the computer means, a single bank of relays for transmitting said occupancy information from the matrix to the vacancy counter, and car counter means coupled to the vacancy counter for altering the number stored in the vacancy counter according to the number of cars in a cut after the number stored in the matrix is applied to the computer means.

7. The storage means of claim 6 having a second bank of relays, indicator means operated from said second bank, and manual means for initiating readout of the cores in a row responsive to the number of cuts stored on any track in the classification yard other than said selected track whereby output information as to occupancy of said other track is produced simultaneously with the output indicating occupancy of said selected track.

8. In a railroad classification yard having storage tracks, car retarder means to control speed of rolling cuts destined for preselected storage tracks, and computer means to control the car retarder means in accordance with track occupancy information, distance-to-coupling storage means comprising a matrix of apertured magnetic cores each row of cores in said matrix being responsive to the number of cuts stored on a particular track in the yard, a vacancy counter for temporary storage of information after transmittal of the computer means, a single bank of relays for transmitting information from the matrix to the vacancy counter automatic means for causing readout of track occupancy information from said matrix for any selected track whereby said occupancy information is transferred to the bank of relays and thence simultaneously to the vacancy counter and to the computer means, car counter means coupled to the vacancy counter for alteration of the count stored in the register after application of information to the computer means is accomplished, and means for feeding back the altered count into the matrix for storage therein.

9. The storage means of claim 8 having a second bank of relays, indicator means operated from said second bank, means feeding back information said second bank into the matrix for storage therein, and manual means for initiating readout of the cores in a row responsive to the number of cuts stored on any track in the classification yard other than said selected track whereby output information as to occupancy of said other track is produced simultaneously with the output indicating occupancy of said selected track.

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ROBERT C. BAILEY, *Primary Examiner.*

G. D. SHAW, *Assistant Examiner.*