TRAN IDENTITY CONTROL SYSTEM

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ABSTRACT

A selectively tuned train coil is provided for each digit of a train's identity number, mounted to successively couple, in descending digit order, with coils of the wayside receiving apparatus. Each digit successively received by the wayside apparatus is immediately translated from decimal to a two-out-of-five code format and temporarily registered in a separate bank of code bit relays. This identity code is transmitted to a remote location including a route type interlocking control system. Each identity code is received and cascaded through a series of relay storage banks, reaching the final bank when the corresponding train is next to arrive at the interlocking. The code readout circuit network, which automatically selects the desired route control relay, includes a code format checking matrix, to assure that two but only two bits are actually registered for each identity digit, and a translation matrix to reconvert the unit digit code to decimal form.

11 Claims, 7 Drawing Figures
Fig. 4.

Communication system to remote location - Fig. 5.

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Communication system from Fig. 4.

Fig. 5.

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Our invention pertains to a train identity control system. More particularly, the invention is directed to a control system by which a controllable function located along the wayside of a railroad track is controlled in accordance with a function control signal, normally in the form of a train identity signal, transmitted from a train and registered at a wayside point remote from the control function location.

In the initial design or the improvement of rapid transit and commuter railroad systems, a principal goal is to increase the average speed of the trains and thereby increase the passenger carrying capacity of the overall system. One manner in which this goal may be achieved is the reduction of train delays at stations, at interlockings, and at other locations where any other type control function is exercised over the movement of the train and at which trains frequently encounter delays. For example, passengers on a station platform may not be ready to immediately board the train because they lack knowledge as to the destination or class of the arriving train. In another instance, the operator at an interlocking cannot accomplish quickly enough the required actions to manually select and thus set up the routes for each train when such trains arrive along one or several approach routes with close headway, that is, with close time spacing between the trains. If advance notice can be given to the passengers so that they may be ready to board the desired train when it arrives, less station dwell-time will occur. For example, if a controlled display may be provided showing the identity of an approaching train, passengers will be aware of its destination and whether or not they desire to board the train. A similar type display will aid the interlocking operator in deciding on the necessary routes and in his preparation for selecting such routes. The automatic selection and control of the routes within the interlocking is even better. This last feature requires that the train identity be forwarded to the interlocking control system to select and initiate the establishment of the proper route, when wayside conditions are safe for such operations, while the train is approaching. In other words, the train identity signal must be registered as a function control signal at some location in the approach in the interlocking, the signal being first transmitted from train carried apparatus to wayside apparatus, and then transmitted forward to actuate the selection and control operation for the interlocking arrangement.

Accordingly, an object of our invention is a train identity control system for transmitting a control function signal from a train wayside apparatus to actuate a controllable function located at some point along the railroad track traversed by that train. Another object of the invention is a train identification system in which a multi-digit identity signal is transmitted from the train apparatus to a wayside receiver.

A further object of the invention is an arrangement for controlling a function along the track wayside by a control signal received from an approaching train.

Still another object of the invention is a multi-digit train identification system using one coull mounted on the train for each digit and successively receiving and registering the digits of the identity signal as that train passes a wayside receiver.

It is also an object of the invention to provide a multi-digit train identification system using one tuned coil mounted on the train for each digit to successively actuate wayside receiver apparatus to register the train identity signal for use in controlling a wayside function in advance along the route for that train.

A still further object is a function control arrangement for a railroad system in which a multi-digit train identification signal, transmitted successively digit by digit from the train to wayside receiver-registry apparatus, is used to actuate the operation of a controlled wayside function in advance along the route of the train.

Yet another object of our invention is automatic route selection apparatus in which a multi-digit train identity signal, received and registered by wayside apparatus one digit at a time as the train passes an identification point, is transferred by a communication means to storage banks and then extracted to select the proper route through an interlocking as the corresponding train approaches that location.

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

In practicing our invention, each train is provided with one tuned coil for each digit of the multi-digit train identity number, herein shown as being two digits. Specifically shown and preferably, the coil representing the higher digit, that is, the tens digit, precedes the lower digit or units digit coil as the train moves along the track. However, the reverse positioning of such coils may be selected and the registry of such digit arrangement is within the scope of our system. The tuning of these train marker coils is selected by the train operator or others at the origin of the train, using an identity selector device herein shown as a switch for each coil, in accordance with the train class, its route, type of train, or other identifying characteristics. At the wayside location for registering the identification, apparatus responsive to the passage of the train coils to detect the specific characteristic signal, i.e., frequency tuning, of each coil, is mounted in a position along the track appropriate for the mounting point of the coils on the train. This wayside apparatus responsive to separately register the digit numbers represented by the frequency tuning of each coil. In other words, passage of the first train coil by the wayside point actuates the registry, in accordance with the tuned frequency signal of that coil, of the higher or tens digit of the train number. Passage of the second coil actuates the registration of the units digit number. This two digit train identity number is temporarily registered in a relay bank in decimal form in successive digit order in accordance with the passage of the coils. A stepping apparatus arrangement assures that the temporary registry of each coil signal is properly identified with its digit position. Further, in order to conveniently serve communication requirements, the decimal registration is immediately converted into a selected code form. In the specific illustration, we have chosen a two-out-of-five bits code format (hereinafter usually designated 2/5 code), which is well known in the communication art. The translation is done digit by digit through circuitry including a diode matrix. Each digit of the train number thus specifically requires five bit relays in order to register the two-out-of-five code. A display of the registered train identity at this registry location is provided, as specifically shown herein by means of lights, a separate bank being provided for each digit with one light for each decimal number.

To provide a useful operation such as the control of a wayside function in advance of the train, the registered train identity code is transmitted to such an advance location. As specifically shown, the controllable function comprises the route selection function in a route type interlocking control system. This route selection in turn actuates the interlocking control system to establish the selected route. The train identity is transferred as soon as all the digits are registered in the 2/5 code form. This transmission is over a communication channel to a similar bank of bit relays at the advance location, again five relays for each digit of the train number. For convenience, as will be later discussed, the communication channel is shown as a cable, but other forms of communication means using other types of transmission may be used as required. From the advance location bit relay bank, the train identity signal is transferred into an initial storage bank using the same two-out-five code format. The identity storage is held in this bank until a storage space is available in successive banks of the apparatus. The number of storage banks provided assures that the initial bank will always be available for a newly registered train identity. In other words, the number of banks used will be in accordance with the maximum number of trains which may possibly occupy the stretch of track between the identity registry location and the location of the function to be controlled. As succeeding ones of the
storage banks become available, this train identity code storage is transferred forward. For simplicity, we specifically show only two banks. In the final storage bank, the stored identity code is checked for accuracy, decoded, and then used to select the desired route for the corresponding train. The selected route is established by conventional route interlocking control apparatus, in such manner that the desired route is prepared when the train arrives.

We will now describe the arrangement embodying our invention in greater detail with reference to the accompanying drawings in which:

FIG. 1 is a schematic block diagram and flow chart illustrating the overall concept of the system embodying our invention.

FIG. 1A is a schematic illustration of one possible arrangement for selecting the characteristic tuning for each train coil. FIG. 2 provides a chart to illustrate the physical arrangement of FIGS. 3 to 6 necessary to properly connect the detailed circuitry of our system.

FIGS. 3, 4, 5, and 6, when arranged as illustrated in FIG. 2, show a detailed schematic circuit diagram illustrating one form of the train identity control system embodying the principles of our invention.

In each of the drawings, similar references refer to similar parts of the apparatus. Also in the drawings, a direct current source of energy is assumed for supplying such energy for operation of the various relays. A specific source is not shown since the use of such is conventional and any type known in the art which provides the necessary voltage and capacity may be used. For convenience, connections to the positive and negative terminals of this direct current source are designated by the reference characters B and N, respectively.

Reference now to FIG. 1A, across the top is shown, by conventional symbols, a stretch of railroad track. Trains normally move from left to right along this stretch to approach the interlocking shown at the right where three routes are available, completed over the conventionally shown track switches to tracks TE, TF, and TG. At the left of the figure, remote from the interlocking location, is the train identity registry apparatus, which is normally located some distance in approach to the interlocking. A train is symbolically shown as approaching the receiving and registry location, the dotted symbol being designated by the reference V. This train or other type vehicle is provided with two identity coils for the two digit train identity number specifically illustrated here. Each of these coils is selectively tuned by a variable capacitance to one of the preselected number of frequencies. The coil VCT, mounted in such a manner as to precede the other coil VCU as the train moves in a normal direction, designates the tens digit of the train identity number. Obviously then, coil VCU designates, by its selected characteristic frequency tuning, the unit digit number of the train identity.

A typical arrangement for selecting the frequency characteristic of the train carried identity coils is shown at the lower left of the same drawing sheet in FIG. 1A. It is to be noted that, although FIG. 1A shows but a single typical train coil VC, an equivalent arrangement is provided for each of the train carried coils, that is, one for each digit of the train identity number. For each coil, a manually operable coil tuning selector switch CTS is provided having an "OFF" position and ten numbered positions designated 0 to 9, inclusive. When the switch CTS is positioned at any one of the numbered positions, a predetermined amount of capacitance is connected across the coil VC to establish the predetermined frequency tuning which designates the selected digit number. Obviously the circuits may be so arranged that various capacitors provided are connected in parallel by certain switch positions to provide the necessary tuning capacitance without having a large number of separate capacitors. The showing in FIG. 1A is typical for each coil carried on a train and each switch CTS is positioned by the train operator, or by a carman at the train origin, to establish the selected train identity number.

Immediately in advance of the symbol for train V is a track section AT, which is insulated from the remainder of the stretch of track by insulated joints conventionally shown. Within the insulated section AT are mounted two coils TC and RC of the sidesway receiving apparatus. Coil TC is the transmitter coil and coil RC is the receiver coil which are associated with the sidesway amplifier and receiver, shown here by conventional block and in somewhat more detail in the referenced FIG. 3. However, such train identification receiving apparatus is known in the art and that used in the system of our invention may be similar to that disclosed in U.S. Pat. No. 2,753,550, issued to R. W. Treharne on July 3, 1956 to the somewhat similar apparatus disclosed in U.S. Pat. No. 2,828,480, issued to L. R. Golladay on Mar. 25, 1958. For this reason only such details of the amplifier and receiver apparatus are shown in FIG. 3, to be later described, as are absolutely necessary for an understanding of the present arrangement. Reference is made to either of the cited patents for a full understanding and showing of such receiver apparatus.

The sidesway coils TC and RC are so mounted as to be in close proximity to, and thus in inductive relationship with, each of the train carried coils as the vehicle passes through section AT.

It is to be noted that section AT is provided with a track circuit to detect its occupancy by passing trains. This track circuit apparatus is shown very briefly and any type of track circuit apparatus known in the signaling art is to be included. Track relay ATP, together with the other apparatus now herein shown, is so connected to the rails of the section that it will be energized and in its picked up position when no train is occupying any portion of track section AT. When a train occupies this track section, relay ATP is deenergized and releases. A front contact repeater relay ATP is provided which is normally energized by the obvious circuit connected between terminals B and N of the direct current source and including front contact b of relay ATP. A similar switch track section and track circuit are provided at the interlocking location shown in the upper right of FIG. 1. The track section WT is outlined by insulated joints shown by conventional symbols, a track portion of each of the three possible routes being included in the track section. Track relay WTR is provided to detect the occupancy of any portion of this switch track section by a train. Again, the track circuit arrangement is shown very conventionally but, as will be understood, relay WTR is energized and picked up when no train is occupying the interlocking track circuit and will release when a train occupies the section. A front contact repeater relay WTP is provided, energized over a simple circuit including front contact b of relay WTR. As indicated by the downward pointing arrow drawn through its contact armature, relay WTP has slow release characteristics so that this front contact remains closed for a predetermined time period after the relay winding is deenergized. The operation of such track circuits and track relays and repeaters are so well known in the signaling art that further detail is not given in this specification.

As will be explained in detail later in connection with FIGS. 3 and 4, when train V traverses section AT, the passage of train coils VCT and VCU in succession over wayside coils TC and RC actuates the reception of the train identity number by the receiver apparatus. In turn, both digits of the train identification are registered in the registry apparatus. At this location, the train identity in decimal form may be displayed visually as indicated by the conventional block designated as the train identity display. Also, during registry, the train identification information is translated into the aforementioned 2/S code form and then transmitted over the communication channel to the bit relays block at the interlocking location. From the bit relays, the train identification data is stored in the initial or first storage bank. When any or all other preceding trains have cleared the interlocking, this train identification information is then transferred into the final storage bank. Although intermediate banks are not here shown for simplicity's sake, additional intervening storage banks may be provided to transfer the train
identity one step at a time while preceding trains clear the interlocking. When the train identity data is received and stored in the final storage bank, it is used to select a route predetermined for the destination, type, or class of train designated by the identity number. The route interlocking apparatus, such systems being known in the art, then controls the establishment of the selected route, all safety factors being taken into account by such interlocking control systems. It may be desirable also to provide a visual display of the train identification number, as indicated by a conventional dotted block so designated, at the interlocking location. However, due to similarity with other visual displays, no specific circuits for this second display arrangement are shown in the detailed drawings. It will be noted that when the train clears section AT at the receiver and registry location, the sequential response of relays ATR and ATP as they pick up in succession provides energy to reset the registration apparatus. Similarly, when a train clears section WT at the interlocking, the sequential response of relays WTR and WTP clears the identity storage from the final bank to make way for the transfer of a similar identification for a following train. These reset and clearance operations of the bit relays and the train identities are described in detail later.

Reference is now made to the detailed circuits and apparatus of the inventive arrangement as illustrated in FIGS. 3 to 6 when these drawings are physically positioned in the arrangement illustrated in FIG. 2. Across the top of FIG. 3 is shown a portion of the track stretch from FIG. 1 including track section AT. At the left, in dotted outline form, is the train or vehicle V which has mounted thereon the two coils VCT and VCU which are variably tuned to predetermined frequencies to establish the two-digit train identification number. Again, as in FIG. 1, the wayside or track coils TC and RC are shown as mounted between the rails of section AT to inductively couple with the train carried coils during passage of the train through section AT. Track relay ATR and its repeater relay ATP are also shown in this figure of the drawing for convenience.

The wayside receiving apparatus includes an amplifier unit, a series of filters 0 to 9, each tuned to a frequency corresponding to the frequency established by the similarly numbered position of each train carried switch CTS, and a filter MF which is tuned to respond to each of the ten possible frequencies to which the train coils may be tuned. Associated with each filter unit is a receiver relay designated as relay MF, or as relays R0 to R9, each associated with its correspondingly designated filter. Each filter is designed to energize its associated relay when the frequency characteristic of the received signal is the same as that frequency to which the filter is tuned. Since this apparatus is of the type shown in the previously cited Trehanos patent, except that additional units are used to correspond with the number of frequencies employed, a detailed description is not needed. The apparatus disclosed in the cited Golladay patent may also be adapted for use, if desired. Briefly describing the operation of the receiver apparatus, the passage of each tuned train coil VC to couple with wayside coils TC and RC provides a received signal having the frequency characteristic of the train coil. This signal is passed through a single one of the filters 0 to 9 and causes the corresponding relay R0 to R9 to be energized and pick up. Of course, all frequencies are passed by filter MF to energize the corresponding relay MF. Therefore the operation of relay MF detects the passage of each track carried coil, that is, the passage of each coil representing a specific digit of the train identification number. Thus the response of this relay may be used to assure the proper registration of the train identity digits.

Since relays R0 to R9 function in an identical manner, except for distinguishing between the received signal frequency during the passage of each train coil, a half-step arrangement, including relays X, Y, and Z is provided to operate in conjunction with relay MF to separate the successive digits of the train identity number as they are sequentially received from the passing train. Relay X is a two-winding relay of the biased type, as indicated by the small arrow shown within the symbol for each relay winding. The use of this type relay is preferable in order to assure that the relay will initially pick up during the relatively brief operating time of relay MF in response to the passage of the first train coil. Each of the relays Y and Z are of the magnetic stick type, as indicated by the arrow shown within each winding of these two-winding relays and illustrating the contact armatures of these relays in the vertical position. Such magnetic stick relays respond to brief pulses of energizing current and operate their contact armatures to the left or normal position when the conventional flow of energizing current through either winding is in the direction of the arrow shown within that winding. These relays operate their contacts to close in the reverse or right hand position when the conventional current flow opposes the arrow. In either case, the relay contacts remain in the position to which last operated when energizing current is removed from both windings.

Each winding of relay X is provided with an energizing circuit, that for the upper winding being traced from terminal B over back contact a of relay MF and, in multiple, reverse contacts a of relays Y and Z through the upper winding of relay X to terminal N. A very simple circuit exists for the lower winding of relay X which includes only front contact c of relay MF. The closing of either of these energizing circuits will cause relay X to pick up its contacts. The energizing circuits for the upper winding of relay Y includes front contact c of relay MF, reverse contact c of relay Z, and the upper winding of relay Y. When this circuit is completed, relay Y is so energized as to operate its contacts to close in their normal position. The circuit for the lower winding of relay Y also includes front contact c of relay MF but is traced over normal contact c of relay Z and through the lower winding of relay Y in a direction opposite to the arrow shown therein. Obviously, when this circuit is completed, relay Y is so energized as to close its contacts in their reverse position. The circuit for the lower winding of relay Z is traced from terminal B over front contact b of relay X, back contact b of relay MF, normal contact c of relay Y, and the lower winding of relay Z to terminal N. The conventional flow of current when this circuit is completed is in the direction of the arrow in the lower winding so that relay Z, thus energized, operates to close its contacts in the normal position. The circuit for the upper winding of relay Z includes that just traced for the lower winding except for including reverse contact c of relay Y and thence through the upper winding of relay Z to terminal N. Since the conventional flow of current in this circuit will be opposite to the direction of the arrow in the upper winding, energization under this situation will cause relay Z to close its contacts in their reverse position.

In describing the operation of this half-step relay arrangement, it is to be noted that, as shown in the drawing, the relays are in their at-rest positions which they occupy when all of the train carried coils of a train have passed over wayside coils TC and RC and moved beyond section AT, although the train need not necessarily have completely cleared the track section. When a train first enters section AT, so that its coil VCT comes into inductive relationship with coils TC and RC, relay MF responds to this detection of the train coil and picks up. The closing of front contact c of relay MF obviously energizes the lower winding of relay X which immediately picks up. The lower winding of relay Y is also energized over front contact c of relay MF since contact c of relay Z is presently in its normal position. Relay Y, thus energized, by conventional current of opposing flow, operates its contacts to close in the reverse position. With relays X and MF picked up and relay Y in its reverse position, energy is then supplied to the wire bus 11 by a circuit traced from terminal B over front contact b of relay X, front contact b of relay MF, reverse contact b of relay Y, and normal contact c of relay Z. It will be briefly described, the supply of energy from terminal B to bus 11 causes the less digit of the train identity, registered temporarily in decimal
form by relays R0 to R9, to be translated into a 2/5 code form and registered in a bit relay bank. When coil VCT of this train clears the wayside coils, relay MF responds by releasing. The opening of front contact c of relay MF obviates the considered that the circuits to bus 11 which is thus deenergized. The closing of back contact a of relay MF, with reverse contact a of relay Y already closed, completes a holding circuit for relay X through its upper winding. This circuit is effective before relay X can release due to the opening of front contact c of relay MF. At this time, the upper winding of relay Z is energized over the circuit including front contact b of relay X, back contact b of relay MF, and reverse contact a of relay Y. The conventional flow of current in this circuit opposes the arrow in the upper winding and relay Z operates its contacts to their reverse position.

When the second or units digit coil VCU of the train comes into inductive relationship with the wayside coils, relay MF is again energized and picks up. This reenergizes the lower winding of relay X quickly enough that this relay remains picked up, even though its upper winding is now deenergized. With contact c of relay Z closed in its reverse position, the closing of front contact c of relay MF also energizes the upper winding of relay Y, the current flow being such as to cause this relay to operate its contacts to their normal position. Energy is now supplied from terminal B to bus 12 over the circuit including front contact b of relay X, and contact a of relay MF, reverse contact b of relay Z, and normal contact b of relay Y. As will be shortly described, this supply of energy on bus 12 translates the units digit presently registered in decimal form into a 2/5 code form in a manner similar to that already accomplished for the tens digit. When coil VCU clears the wayside coils, relay MF again releases. The closing of back contact a of relay MF again provides holding energy to the upper winding of relay X, this time the circuit including reverse contact a of relay Z. However, the closing of back contact b of relay MF provides energy from front contact b of relay X over normal contact c of relay Y to the lower winding of relay Z. Conventional current flow is such as to cause this relay to operate its contacts to their normal position. The opening of reverse contact a of relay Z deenergizes relay X and, since front contact c of relay MF is already open, both windings of relay X are deenergized and it immediately releases. Bus 12 is also deenergized when front contact b of relay MF opens. The relays X, Y, and Z are now returned to their usual, at-rest positions as illustrated in the drawings. It is to be noted that the closing of back contact a of relay X supplies energy to a bus wire 13 which is used at this time to transmit the train identity code in its 2/5 form to the advance location over the communication channel. This will be described shortly. However, it will be obvious that the transmission of the train identity code to the advance location, here the interlocking location, does not occur until the train identity is full registered.

The diode matrix shown at the bottom of FIG. 3 translates the train identity from decimal form to the two-out-of-five code form used in the rest of the arrangement. This diode matrix is controlled by contacts of the R relays which, of course, successively receive each digit of the train identity in decimal form. The circuits through the R relay contacts and the corresponding diodes control the application of energy to the 2/5 code bit relay banks shown in FIG. 4. The upper bank of bit relays B1 to B5 register the tens digit code while relays B6 to B10 register the associated units digit code. Each of these bit relays is of the magnetic stick type previously defined. As will appear, contacts a of the R relays control the translation of the tens digit while contacts b of the R relays control the translation of the units digit. Each translation occurs as the corresponding bus lead 11 or 12 is energized by the half-amplitude relay arrangement.

If it is assumed that the tens digit received is the number 1, registered by relay R1, the circuit for translating this decimal number into the equivalent 2/5 code may be traced from bus 11 over front contact a of relay R1 and, in multiple, through the two associated diodes and thence in multiple over leads 14 and 16 to the lower windings, respectively, of relays B1 and B3. Since the conventional current flow in each of these circuits is in the direction of the arrow in the lower winding of the relay, both relays B1 and B3 are properly energized to operate their contacts to close in the normal position. The diodes are used principally to prevent sneak circuits from being set up during the translation process. Now assuming that the units digit of the train identity is registered as the decimal number 5 by relay R5, the corresponding translation circuits may be traced from bus 12 over front contact b of relay R5 and thence in multiple over the associated diodes and leads 20 and 22 to, respectively, the lower windings of relays B7 and B9. Again, the current flow is proper so that these relays operate to close their contacts in a normal position. When the leads 11 and 12 are deenergized, and thus the lower windings of these bit relays, the actuated contacts are held in the normal position to which they have been operated until the relays are later reset, this being a characteristic of the magnetic stick type relay.

This registers the 2/5 code bits until they can be transferred over the communication channel to the storage banks at the interlocking location. It should be noted that a principal characteristic of the 2/5 code format for each identity digit is that two code bits are "on" (B relay normal) while the other three bits are "off" (B relay reverse). Said another way, in each digit code, two bits have a 1 value and the other three bits a 0 value. No other combination provides a proper code format and this characteristic is later used to check correct transmission.

When the corresponding train completely clears section AT so that track relay ATR is again energized and picks up, and prior to the subsequent pickup of repeater relay ATP, a circuit is completed from terminal B over front contact a of relay ATR and back contact c of relay ATP, lead 24, and, in multiple, through the upper windings of all of the bit relays B1 to B10, inclusive, to terminal N. Since the flow of current in these upper windings is opposite the direction of the arrows shown therein, such of these relays that are positioned normal will be reset, operating their contacts to close in the reverse position. This prepares the bit relays at the registry location for accepting the identity code registration for the next train. For simplicity in the schematic circuit layout, drawings, we have chosen to illustrate the readout of the train identity into a visual display panel in connection with the bit registry relays of FIG. 4. The train identity display panel outlined in dot-dash rectangle in the upper right of FIG. 4 includes ten lights for each digit of the train identity. Thus two columns are shown, one for the tens digit and the other for the units digit, each with ten lamps designated by the reference E with a prefix numeral corresponding to the decimal number which that lamp represents. It will be obvious that such display panels may be provided in the arrangement wherever desired if a readout from code bit relays is available. For example, it is to be noted that such a display may be provided at the interlocking location as designated by the dotted rectangle identified as a train identity display shown at the right of FIG. 1 below the final storage bank. Such panel will be controlled by a translation readout from the 2/5 code bit registry or storage. For example, using the assumed train identity 15, lamp 10E in the panel of FIG. 4 is energized, while the identity code for that train is registered in the bit relays of that figure, by a circuit extending from terminal B over contact a of relay B1, normal contact 1 of relay B3, and through the filament of lamp 10E to terminal N. A corresponding circuit for lamp 5E of the unit column extends from terminal B over reverse contact a of relay B6, normal contact b of relay B7, normal contact b of relay B9, and the filament of lamp 5E to terminal N. Thus lamp 10E and 5E will be illuminated to indicate that the train identity registered is 15. Similar circuits for the other display lamps may be traced as desired by reference to the drawing and the above description of the circuits for lamps 10E and 5E.
Upon completion of the registry of all the digits of the train identity, here two digits, the code format is transferred to the remote location over a communication system, that is, from the registry banks of FIG. 4 to the interlocking location shown in FIGS. 5 and 6. It is obvious that the 5 bit code may be transmitted by any type of remote control system or other communication channel which is suitable for handling digital data. Various types of such systems are well known in the art and their use would be understood by those so skilled. For example, a time code relay system or a solid state code control system would be suitable. But for simplicity's sake in the present schematic diagram, the communication system is illustrated as a cable 25, one end of which is shown in the bottom of FIG. 4 and the other in FIG. 5. This cable, for example, includes at least the 10 wires necessary to transmit the 2/5 code bits. The various terminals of these wires, where they fan out from the cable at each end to relay contacts or windings, respectively, are designated by the references 31 to 40, inclusive.

When the train identity registration is complete, at the receiver-registry location, the code is transmitted over the cable by the application of energy through selected ones of wires 31 to 40 to the bit storage relays B-A at the remote location, shown in column B of FIG. 5. As previously described, when the half-step relay arrangement returns to its at-rest condition at the end of the registration and transmission of a train identity code, energy is supplied from terminal B over back contact a of relay X to lead 13, which is connected in multiple to contacts d of the relay registers of FIG. 4. Using the present example, with the train identity number 15 registered, normal contacts d of relays B1, B3, B7, and B9 are closed. Thus energy is applied to terminals 31, 33, 37, and 39 of the cable wires and flows through the cable to the corresponding terminals at the left of FIG. 5 and thence through the windings of the bit storage relays B1A, B3A, B7A, and B9A, respectively. It is to be noted that, if a cable is actually used as the communication channel, an additional lead is necessary to provide a connection to terminal N of the energy source provided at the identity registration location of FIGS. 3 and 4 so that the right hand terminals of relays B-A may be connected to the corresponding negative terminal of their energy source. Such matters are within the limits of system design, however, and need not be discussed in more detail here. It is also to be noted that, after energy is reapplied to lead 13 at the end of an identity registration, i.e., when relay X releases, the transmission of the registered 2/5 code format from relays B to relays B-A over the communication channel cable 25 is continuous until that train clears section AT and relays B are reset, as previously described.

At the remote or interlocking location, two relay storage banks for the 2/5 code bits received from the registry location are provided. The first or initial bank includes various storage relays 2S, each with a suffix number corresponding to the bit position or number in the code format. The final storage bank includes the storage relays 1S, each with a suffix also corresponding to the number of the bit in the code format. Obviously other intervening banks may be provided as necessary between these initial and final storage banks shown. The requirement is that there must be sufficient banks to store the train identity code for each train which can possibly occupy the track stretch between the receiver-registry location of FIG. 3 and the interlocking location of FIG. 6. One particular element of this requirement is that at least the initial bank must be empty and prepared to accept a storage immediately for any train permitted to pass the registry location, i.e., section AT, and enter the stretch. This is true since, as will become evident shortly, the bit code transmitted over the communication channel into the B-A relays of FIG. 5 must immediately transfer into the initial bank since the bit relays are not provided with any holding circuit.

Each bank includes a storage repeater relay or relays, for example, relay 2SP associated with the initial bank and relays 1SP and 1SPP associated with the final bank. The SP relay in each case repeats the storage of any train identity code within the bank and must be in its released condition to allow a new code to transfer into the corresponding bank. For example, the energizing circuit for relay 2SP includes, in multiple, front contact c of each of the storage relays 2S1 to 2S10, inclusive.

The stick circuit for relay 2SP includes, in multiple, front contact b of each bit relay register B1A, B3A, B7A, and B9A and the winding of relay 2SP completing the stick arrangement. Relay 1SP is provided with a back contact repeater relay 1SPP which is normally energized over back contact b of relay 1SP. The energizing circuit of relay 1SP includes front contacts c, in multiple, of storage relays 1S1 to 1S10 of the final storage bank, front contact a of relay 1SP, and the winding of relay 1SP. The stick circuit for relay 1SP substitutes its own front contact a to bypass front contact a of relay 1SPP in the energizing circuit. Relay 1SPP has slow release characteristics, which is indicated by the downward pointing arrow drawn through the movable portion or armature of each of its contacts. It should be noted that, if intermediate storage banks are provided, the energizing and stick circuits for the SP relay associated with each such bank are similar to those just described for the final bank relay 1SP.

The stick circuit for relay 2SP differs from that for other banks and includes contacts of the bit relays so that no second transfer of the same identity code registered in bit relays B1A to B10A can occur into the input bank in case the code storage immediately cascades forward into other storage banks. Thus as long as a code bit registry remains in relays B1A to B10A, a second transfer cannot occur into the initial storage bank relays 2S1 to 2S10. Back contact repeaters such as relay 1SPP are provided for each intermediate storage bank also but are not necessary for the initial storage bank.

Assuming that the train identity code for train number 15 is transmitted over the communication channel into relays B1A, B3A, B7A, and B9A as previously described, this code is transferred into the initial storage bank relays having the same suffix numbers. For example, a circuit exists from terminal B over back contact b of relay 2SP, a diode, front contact a of relay B1A, the winding of relay 2S1, and either back contact c of relay 1SP or back contact c of relay 1SPP to terminal N. Similar circuits may be traced for relays 2S3, 2S7, and 2S9 over multiple circuits including, respectively, front contacts a of relays B3A, B7A, and B9A, the connections to the right terminal of each storage relay winding being connected to the common circuit over contacts c of relays 1SP and 1SPP. As each storage relay 2S picks up, it completes a stick circuit for itself over its own front contact a further including the corresponding relay winding and back contact c of relay 1SP or 1SPP. If the final bank in this case already contains a code storage, back contact c of relay 1SPP will be closed to complete the energizing and stick circuits. Back contact c of relay 1SP will close to retain the stick circuits when the final bank becomes clear of a code storage. As the storage in the initial bank is transferred forward so that relay 1SP is again energized and picks up to open its back contact c, the stick circuit for the 2S storage relays will be interrupted since relay 1SPP, with its slow release characteristics, will retain its back contact c open for a sufficient period to allow release of the storage relays 2S.

When the final storage bank is empty so that relay 1SP is released and its repeater 1SPP is again picked up, a circuit network is completed for transferring the code storage from the initial bank into the final bank. These circuits extend from terminal B at front contact b of relay 1SP over back contact d of relay 1SP, front contact c of relay 2SP, indicating that a storage exists in the initial bank, thence in multiple through circuit paths including a diode and front contact b of each relay 2S which is picked up and the winding of the correspondingly numbered relay 1S, and finally over front contact a of relay WTP or back contact a of relay WTR to terminal N. The last two relays were discussed in connection with the illustration in FIG. 1 and the relay winding symbols are here shown dotted as the control circuit for each relay winding.
is shown in FIG. 1. Under the assumed condition that the train identity code stored represents the number 15, relays 1S1, 1S3, 1S7, and 1S9 are energized when this transfer from the initial to the final storage bank occurs since the similarly numbered relays 25 are picked up. The stick circuit for relay 1S1 under these conditions includes its own front contact of the relay winding, and either back contact a of relay WTR or front contact a of relay WTP. It will be noted that initially front contact a of relay WTP is used to complete the connection to terminal N since this storage transfer only occurs when the interlocking arrangement is clear of a train. Back contact a of relay WTR is used to retain the code storage in the final bank when the corresponding train has accepted the established route and moves through the interlocking track circuit. Since relay WTP has a slow release characteristic, its front contact a will remain closed until after back contact a of relay WTR closes. When the train clears section WT, back contact a of relay WTR opens before front contact a of relay WTP closes. This interrupts the stick circuits for all energized relays 1S, which then release to cancel the identity code storage.

For purposes of clarity in the drawings, we have chosen to use repeaters of the 1S storage relays to control the actual route selection matrix. These are the train identity relays T shown across the top of FIG. 6. Each T relay repeats the 1S relay naming but with a similar suffix number and is energized over a simple front contact circuit controlled by back contact b of the corresponding 1S relay. Each circuit extends through cable 26 between the identically numbered cable terminals. Thus relay T1 repeats relay 1S1 over the circuit including front contact b of relay 1S1 and extending between terminals 41 of cable 26 through the winding of relay T1. Each T relay thus registers a bit of the 2/5 train identity code which has been transmitted from the registry location and cascaded through the storage relay banks. In keeping with the previously discussed characteristics of the 2/5 code format, a T relay registers a code bit 1 value when picked up and a code bit 0 value when in its released condition.

This use of repeater relays will allow the storage banks to be mounted outside the interlocking control machine and the T relay bank, together with the U relays shortly described, to be mounted at or in the machine. It also permits the use of a simpler type relay with multi-contact structure as needed for the checking, translation, and route selection matrices. However, any visual display of the train identity provided at the interlocking location will be controlled directly by the 1S storage relays. The same kind of translation circuitry as used for the display panel illustrated in FIG. 4 will be used to control the display lamps. Since the illustration of a second display panel and its control circuitry would be redundant, only the arrangement of FIG. 4 is illustrated herein for simplicity. Also in FIG. 6 is shown a series of unit digit registry relays U. Each of these relays is further designated by a numerical suffix which indicates the decimal numeral which that relay registers. The control circuit arrangement for these U relays translates from the 2/5 code storage into the decimal storage as will be shortly described.

Referring again to FIG. 6, the contact matrix and associated circuitry immediately below the T relays are a 2/5 code check arrangement for both the ten and unit digit portion of the train identity code. This check assures that each digit code, that is, each digit portion of the code format, registers only two "on" or 1 value bits out of the five bits of the group for a proper registration of the digit. The check signal is then passed through other contacts of relays T6 through T10, inclusive, to translate the unit digit code into a decimal format which is registered in the aforementioned U relay bank. Unless a relay U is energized, there is no route selection. This assures that both parts of the 2/5 code format have been correctly registered and transmitted to this location. As an example, let us trace the check of the code format for the train identity number 15 which has been assumed throughout the previous discussion. If such a code format is correctly registered, relays T1 and T3 will be energized and picked up to store the tens digit portion while relays T7 and T9 will be picked up to store the units digit portion. As a result of the check and translation operation, relay US should be energized through the circuit matrix.

Tracing now from terminal B, the circuit extends over back contact a of relay T10, back contact b of relay T8, back contact c of relay T6, front contact a of relay T7, front contact a of relay T9, back contact b of relay T8, front contact a of relay T7, front contact b of relay T1, back contact c of relay T2, and back contact a of relay T4 to complete the code format check. To complete the code translation, the circuit further extends over front contacts c of relays T7 and T9 and through the winding of relay US to terminal N. The energization of relay US by this traced circuit thus assures that a proper 2/5 code format has been registered and also translates the unit digit portion thereof into decimal form, energizing relay US to indicate that the unit digit is the number 5. A review of the checking circuit matrix will illustrate that if, in either portion of the 2/5 code format, a third relay was energized or only one relay was energized, this incorrect code registry would have interrupted the previously traced circuit at some point and relay US would not have been energized.

The remaining circuit network in FIG. 6, which includes a matrix of contacts of the U relays and front contacts of relays T1, T2, and T3, is a typical route selection circuit network provided as an example only. This circuit network is not exclusive, in our invention, in that other circuits could be used but the code is there available routes or other routes for other train identity numbers. For example, in the illustrated network, trains having identity numbers 01, 04, and 12 will select a route E, that is, leading from the principal track stretch in the approach and continuing into track TE shown in the upper right of FIG. 6 and also in FIG. 1. The circuit network also provides that trains having identity numbers 02, 03, and 10 will select route F while those with identity numbers 06, 07, and 15 will select route G. Actually, route selections for other train numbers are also included in the illustrated network but sufficient examples have been given. It is to be understood that other train identity numbers, of the total plurality possible in the multi-digit system here disclosed, will select the same or other routes over distinct circuit networks not here shown. For example, the dotted lines also extending from front contact c of relay T1 designate other possible route selection circuits for other train identity numbers which would include this contact of relay T1. Other circuit networks would originate at contacts of other T relays of the group T1 to T5, inclusive.

As a particular example, let us trace the route selection circuit for the train identity number 15 that has been used in the previous examples. The circuit extends from terminal B at front contact d of relay T1, which is closed, over front contact c of relay T3, front contact a of relay US, and through the winding of route selection relay G to terminal N. Relay G is thus energized by this circuit and picks up to select a route into track TG for the approaching train having the identity number 15. The energization and pickup of relay G together with an indication of the approach of train number 15 will activate the route control apparatus of the interlocking control system to establish the route from the approach track into track TG, operating the switches and clearing the signals as safety conditions permit to allow this train to move along the interlocking route into track TG. The operation of this interlocking control system will be understood by those skilled in the art and additional details of its operation need not be illustrated or discussed herein since such is not a specific part of our invention.

Summarizing now the previous description of the detailed circuits in FIGS. 3 to 6 as an operational description, let us assume that a train with the identity number 15 approaches track section AT shown in FIG. 3. The switch CTS for coil VCT on this train is set in its number 1 position to establish the tens digit at 2. The corresponding switch for train coil VCU is set at its position 5 to establish the units digit 5. The setting of these two switches tunes the corresponding train carrier coils to the selected frequency for these decimal num-
bers. Track relay ATR followed by its repeater relay ATP sequentially release as the train occupies track section AT. However, since front contact a of relay ATR opens first, prior to the closing of back contact a of relay ATP, no energy is applied at the close lead 24. As coil VCT passes over wayside coils TC and RC, relays MF and R1 of the receiving apparatus pick up. Relay R1, of course, establishes the characteristic of the received signal, that is, the frequency tone representing the digit signal in decimal form. As previously described, the pickup of relay MF actuates relay X to pick up and relay Y to operate to its reverse position so that energy from terminal B is applied to bus 11. With relay R1 also picked up, energy from bus 11 is further applied through front contact a of relay R1 and the corresponding multiple circuits through the diodes to leads 14 and 16. This in turn energizes bit relays B1 and B3 shown in upper left of Fig. 4. These relays operate to close their contacts in their normal position. As coil VCT passes out of its inductive relationship with the wayside coils, relays MF and R1 release, causing relay Z to operate to its reverse position. However, as previously noted, relay X is held in its picked up position at this time. Energy is removed from bus 11 so that no further transfer of any information to bit relays B1 to B5 can occur.

Conversely, when VCT passes over wayside coils TC and RC, relay MF again picks up together with relay R5. Relay Y at this time operates to its usual normal position so that energy is supplied to bus 12. With relay R5 picked up to close its front contact, energy from bus 12 flows through the associated diodes to leads 20 and 22 which in turn energizes relays B7 and B9 in a manner to close their contacts in the normal position. When train coil VCU clears the wayside coils, relay MF again releases together with relay R5. Relay Z operates to its normal position and relay X subsequently releases, restoring the half-step relay arrangement to its at-rest condition. Bus 12 is also deenergized, but now relays B1, B3, B7, and B9 hold in their normal position due to the characteristic of the magnetic stick type relay. Eventually, when the train itself completely clears section AT so that track relay ATR picks up, energy is applied to wire lead 24 to reset all relays B1 to B10 to their usual reverse positions. However, prior to this time the forward transmission of the train identity information has occurred.

With normal contacts a of relays B1 and B3 closed, energy is applied to lamp 10E of the train identity display panel so that this lamp is illuminated. Similarly, with reverse contact a of relay B6 closed and normal contacts b of relays B7 and B9 closed, energy is also applied to lamp 5E which is likewise illuminated so that the train identity display panel indicates that the passing train has the identity 15. When relay X releases to close its back contact a energy is supplied to wire lead 13, which reoccurs prior to the reset of the bit relays of Fig. 4. This energy from lead 13 is applied over normal contacts d of relays B1, B3, B7 and B9 to, respectively, terminals 31, 33, 37, and 39 of cable 25. This energy flows over the communication channel, illustrated by cable 25, to energize the auxiliary bit relays B1A, B3A, B7A, and B9A on Fig. 5. Thus the train identity registration is now transmitted to the interlocking location which is in advance along the stretch of track from the position of the approaching train.

If a sufficient number of storage banks have been provided, relay ISP of the initial storage bank will be in its released position so that energy is available over its back contact b and over front contacts a of the energized auxiliary bit relays to energize its time to wire lead 24 and ISP of the initial storage bank. These relays, thus energized, pick up and close their front contacts a to complete a stick circuit for each relay, which further includes the corresponding relay winding and back contact c of either relay ISP or ISPP, to hold the code storage in the initial bank. The closing of front contacts c of the energized initial storage relays completes the multiple circuits for energizing relay ISP and this relay picks up to indicate the presence of a storage in the initial bank. Relay ISP sticks over its own front contact a and over front contact b of any one of the auxiliary bit relays which is energized. As previously mentioned, this unique stick circuit arrangement prevents a second transfer of the same train identity information into the initial storage bank in case the information is immediately cascaded forward to other storage banks, since with back contact b of relay ISP held open, no entry of an identity storage into the initial bank can occur. If the second or final storage bank illustrated here already contains a storage, the relay circuit to hold the storage in the initial bank include back contact c of relay ISPP. However, if no storage exists in the final bank, so that back contact c of relay ISP is closed, the stick circuit is completed over this connection.

If or when the final storage bank is free of any storage so that relay ISP is released and relay ISPP is picked up, a circuit is completed over front contact b of relay ISPP, back contact d of relay ISP, and front contact c of relay ISP (closed with a storage in the initial bank) to transfer this existing storage into the final bank, the multiple circuits also including front contacts b of whichever 2S relays are energized. Under the presently described conditions, circuits are completed to energize relays 1S1, 1S3, 1S7, and 1S9 which energizes the correspondingly numbered relays of the initial bank are picked up. This also transfers the identity storage 1S into the final bank. The energized storage relays 1S complete stick circuits, over their own front contacts a, further including front contact a of relay WTP which is closed at this time since any preceding train has now cleared the interlocking area. When the train is now in the final bank, as indicated by the picked up condition of selected 1S relays, enters the interlocking area over the selected route, relay WTR will release to close its back contact to complete a second and alternate connection for the stick circuit which remains closed until the train clears the interlocking track circuit. Thus a train identity storage in the final bank cannot be cancelled until the corresponding train has completely cleared the interlocking area along its selected route.

When this storage transfers into the final storage bank, relay 15P is energized over its circuit including front contacts a, in multiple, of whichever 15 relays are picked up and front contact c of repeater relay ISPP. Relay ISP is held energized over a stick circuit including its own front contact a and front contacts c of the energized storage relays. When back contact c of relay 15P opens and prior to the closing of back contact c of relay ISPP, which is held open for a selected period by the slow release characteristics of this later relay, the stick circuits for the energized storage relays are still in the bank are interrupted. The train storage held therein is thus cancelled, having been cascaded forward into the final bank prior to this time. With back contact d of relay 15P now open, any subsequent storage for a following train can not be transferred into the final bank on top of the storage held therein and the separation of the train identity information is maintained.

The train identity storage now held in the final bank, that is, the 1S relay storage bank, is repeated by the train identity relays T in the route selection network of Fig. 6. In the present example, energy is supplied to relays T1, T3, T7, and T9 over front contacts b of, respectively, relays 1S1, 1S3, 1S7, and 1S9 and cable leads 41, 43, 47, and 49 of cable 26. When the train identity is registered in the T relays as indicated, the code check circuit network and the units digit translation network check the proper format of the 2/5 code received and translate the units digit back to decimal form. For example, with the train identity code 15 now stored in the T relays, the previously traced circuit is completed for checking the code and translating the units digit. The code checking portion includes back contacts a, b, and c of relays T10, T12, T6, respectively, front contacts a of relays T7 and T9, back contact a of relay T5, front contacts b of relays T3 and T4, and back contacts b and a of, respectively, relays T2 and T4, while the translation portion includes front contacts c of relays T7 and T9 and the winding of relay U5. Since each half of the code format checking network indicates that any of the possible five relays are picked up so that proper format exists, the unit digit is then translated so that relay U5 is energized.
As previously explained, if in either half of the 2/5 code format, that is, in the relay groups T1 to T5 and T6 to T10, less than or more than two relays are picked up, the translation network is incomplete and unit relay U8 will not be energized. In other words, if less than or more than two 1 bits are registered for either digit, the unit digit translation cannot occur. Thus the energization of a unit relay, to translate that portion of the train identity multi-digit code, indicates that the original 2/5 code format has proper characteristics.

The route selection circuit network at the bottom of Fig. 6 now selects the route for the train in accordance with the registered train identity, here assumed to be the number 18. The circuit network illustrated is so designed that the train identity 15 selects a route from the approach track to track TG so that route selection relay G must be energized. This circuit includes front contacts d of relay T1 and c of relay T3 and then over front contact a of relay U5 to the winding of relay G so that this later relay is energized and picks up to select the proper route. If, for another example, the train identity registered in the T relays had been the number 08, the illustrated route selection network will select route relay E for energization. Under these conditions, the circuit includes front contact d of relay T1 and front contact c of relay T2, which are closed to indicate a digit of zero, and hence over front contact a of relay U8 to the winding of relay E. If desired, the code format check circuit completed at this time to energize relay U8 may be traced, remembering that, for a proper 2/5 code format registration, relays T1 and T2 must be picked up for the tens digit and relays T8 and T10 picked up for the units digit. If the train identity number is 10, so that relays T1 and T3 and, if the code format is proper, relay U0 are picked up, a circuit exists for selecting relay F including front contact d of relay T1, front contact c of relay T3, and front contact a of relay U0. Other route selection circuits may be traced if desired. For example, such train identity numbers as 04, 05, and 13 will, respectively, cause the selection of relays E, F, and G.

The specific tracing of additional circuits appears to be redundant in view of the preceding descriptions and further details will not be included.

When any one of the three illustrated route selection relays E, F, or G has been energized, the route control apparatus of the interlocking control system is actuated to establish the desired route. For the train identity number 15 used in the principal example herein, the route control apparatus will operate the switches shown conventionally to route the train from the approach track over the two switches into track TG. A very simple interlocking arrangement has been shown in order to illustrate the arrangement of our invention, but the control of a more complicated track arrangement by similar interlocking apparatus and the selection of the necessary routes therein in accordance with the registered train identity will be obvious when taken in connection with the accompanying drawings and the preceding description.

The arrangement of our invention thus provides a convenient and straightforward means of receiving, registering, and transmitting to an advance location a multi-digit train identity signal. This identity signal may be used as a function control signal to actuate a wayside identity display or, preferably, to select a route through an interlocking and activate the establishment of such a route prior to the arrival of the corresponding train. This, of course, conserves train time and thus increases its average speed of travel by reducing the delays which may occur at a station location due to passenger, resistance as to train destination or delays resulting from the inability of an operator to set up interlocking routes sufficiently in advance of train arrival. The system provides a maximum of one hundred different train identities, but is not limited to such a complete system and may be used to handle a smaller number of different identities. Under these conditions, the amount of apparatus provided is reduced to only that required. A check is also provided of the register of the proper code format for a train identity at the final location. Utilization of an incorrect code for selecting an improper control function, for example, an improper route, is thereby prevented. An efficient and economical system is thus provided for controlling a wayside function for an approaching train.

Although we have herein shown and described but one form of an arrangement embodying our invention for controlling a wayside function in accordance with an identity control signal transmitted from approaching trains, further changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of our invention.

Having thus described our invention, what we claim is:

1. Apparatus for controlling from a train a wayside function located along the stretch of track traversed by that train, comprising in combination,
   a. a plurality of coils on said train, each preset to a selected one of a plurality of possible signal characteristics and mounted in a predetermined relationship with the other coils to represent a predetermined digit of a multi-digit function control signal,
   b. receiver apparatus positioned to couple with each train coil for momentarily recording each digit of said function control signal in decimal form during passage of the corresponding train coil in accordance with its selected signal characteristic,
   c. a bank of code registry relays for each digit of said function control signal,
   d. translation means controlled by said receiver apparatus and responsive to the passage of each train coil for successively translating the corresponding recorded digit decimal signals into preselected code formats and connected for registering each digit signal code format in the corresponding digit bank of said code registry relays, and
   e. function control means for operating the wayside function to a condition determined by the digit characteristics of the registered function control signal,
   f. said code registry relay banks connected for controlling said function control means in accordance with the signal characteristics represented by each digit of the registered function control signal code.

2. Function control apparatus as defined in claim 1 in which said receiver apparatus comprises,
   a. a pair of coils mounted along said track for coupling with each train-carried coil,
   b. a plurality of receiver relays, one for each of said possible signal characteristics, each controlled by said track coils to receive the corresponding characteristic signal from said train coils, and
   c. stepping means responsive to the successive passage of said train coils for actuating the translation and registration of each characteristic signal received by said receiver relays into the corresponding digit bank of registry relays.

3. Function control apparatus as defined in claim 2 in which said train coils are mounted to couple with said track coils successively in descending order of the digits of said function control signal.

4. Function control apparatus as defined in claim 3, further including,
   a. a communication means controlled in part by said registry relays for transmitting said function control signal code from the location of said track coils to a remote location where the wayside function is located,
   b. said function control means connected to said communication means to receive the signal code format from said registry relays and responsive thereto for operating said wayside function.

5. Function control apparatus as defined in claim 4 in which,
   a. the selected signal characteristic of each train coil is a signal frequency to which the coil is selectively tuned.
   b. each receiver relay is frequency coupled to said track coils to respond only to a predetermined different one of said signal frequencies to which said train coils may be tuned.
6. Function control apparatus as defined in claim 5, in which the wayside function is the route selection for a route type interlocking control system to establish a route through an interlocking track network for a train from an approach track to an exit track predetermined by the selected route, said track coil location being along the approach track stretch, and in which said function control means includes,
  a. a plurality of storage relays connected to said communication means for receiving and storing a function control signal code transmitted from said track coil location,
  b. a route selection circuit arrangement controlled by said storage relays for checking the proper code format of the stored control signal and for selecting a desired route through said interlocking in accordance with the characteristics of the stored control signal only if the code format is proper,
  c. a code check circuit network also controlled by said registry relay banks for completing the selection of the single route relay only when the registered function control signal code format has the proper code characteristics.

8. A multi-digit train identity control system for a stretch of track traversed by trains, comprising in combination,
  a. plurality of coils on each train mounted in sequence so that each coil represents a predetermined one of the train identity signal digits, each coil selectively tuned to one of a plurality of different frequencies to establish a predetermined value for the corresponding digit of the train identity signal,
  b. wayside coils positioned along said track to inductively couple with each train-carried coil during passage of the corresponding train for receiving a separate frequency signal in accordance with the frequency tuning of each train coil,
  c. a bank of receiver relays, each frequency coupled to said wayside coils to receive a predetermined one of said frequency signals from said train coils for recording the value of each train identity signal digit in decimal form,
  d. stepping means also coupled to respond to the passage of each train coil for recording the sequence of the identity signal digits,
  e. a bank of registry relays for each identity signal digit,
  f. translation circuit means controlled by said receiver relays and said stepping means for successively translat-