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[54] **AUTOMATIC TRAIN DISPATCHER**
8 Claims, 1 Drawing Fig.

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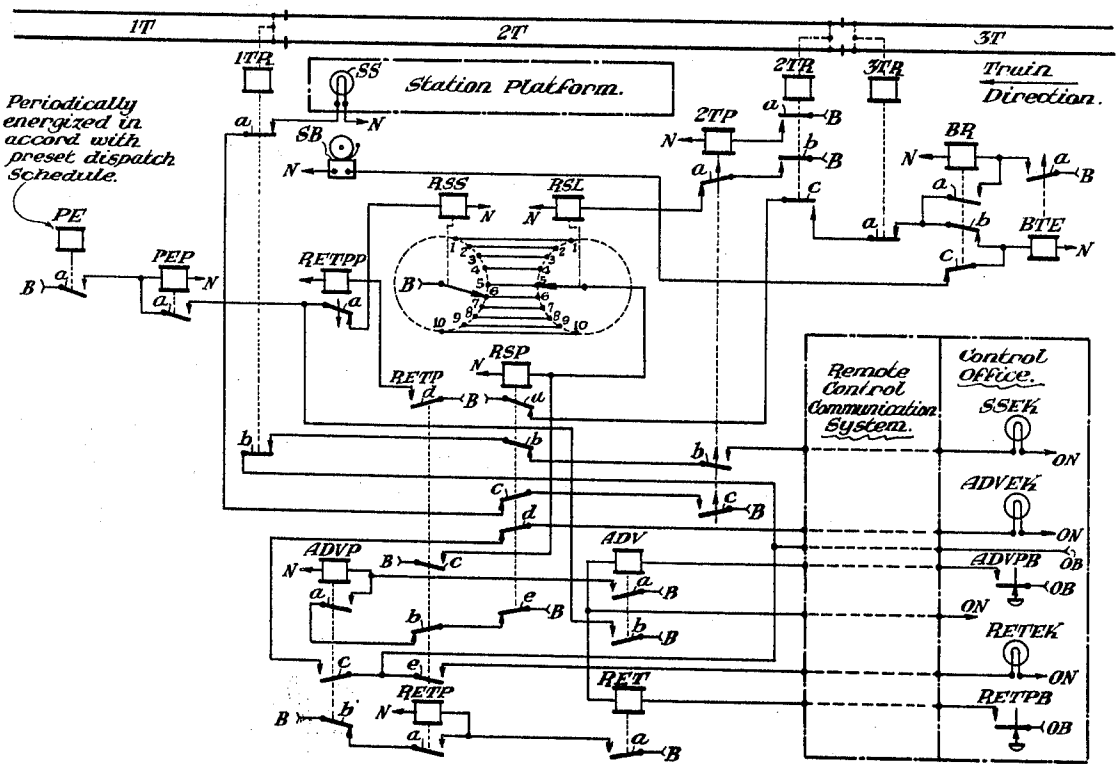
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ABSTRACT: An automatic train dispatcher for directing the departure of railroad trains from a station in accordance with prescheduled departure times. Control apparatus responds to readout from a prerecorded schedule and to train arrivals to normally authorize departures by the schedule. Remote control by the system supervisor is superposed on this normal operation to advance or retard departure times to meet unusual operating situations. Advance and retard control functions are separately received and registered at the station. An advance control immediately activates the departure signal. A retard control interrupts the prescheduled readout control and inhibits the activation of the departure signal until released. The release action is specifically an advance control which is effective only to cancel the interrupt and inhibit conditions.



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AUTOMATIC TRAIN DISPATCHER

This invention pertains to an automatic train dispatcher for railroads. More specifically, my invention deals with the remote control of automatic train dispatching apparatus by which the departure of trains from a station location may be advanced or retarded from a prescheduled time sequence of departures.

The use of automatic train dispatchers at stations in rapid transit and other railroad systems is already known. In such apparatus, a prescheduled sequence of desired train departures from that station is recorded in any known type of information storage means. This list of prescheduled departures is then read out by the automatic train dispatching apparatus and the departure signal for the station activated at the selected times. In this operation, a train which may be running behind the normal schedule receives an immediate departure signal upon arrival at the station so that no further delay of the train occurs at that station. It has become apparent, however, that unusual situations do occur in the operation of such railroad, rapid transit systems. For example, trains are delayed, trains occasionally break down, and extra crowds occur on special occasions which slow the trains or which require extra trains to be run. The need arises, therefore, to vary from the prescheduled and prerecorded time table of departures at a particular station. As further examples, the known presence of extra heavy passenger loads at a station may require an advance in the departure times of trains at the approach stations in order to decrease the headway between trains and thus reduce the waiting period for the extra passenger load. At other times, when following trains are delayed, it is desirable to retard the departure of a particular train in order to allow extra passengers to board and thus eliminate their waiting an extra time period before the next train can arrive at that station. The control of such advancing and retarding of train departures at a station by the supervisor of the system who has an overall picture of the system operation is most advantageous. Therefore, in order to provide more efficient operation in such railroad systems, it is desirable to provide remote control of the automatic train dispatcher so that the departure of trains may at times be advanced or retarded from the normal daily sequences already prescheduled.

Accordingly, it is an object of my invention to provide an automatic train dispatching arrangement with overriding manual control to at times modify the normal prescheduled operation of the dispatching apparatus.

Another object of my invention is an improved automatic train dispatching apparatus with external controls for at times advancing or retarding the prescheduled departure of the trains from the corresponding station.

A further object of this invention is an arrangement for superposing remote control on an automatic train dispatching system to selectively advance or retard the scheduled departure of trains from a station as the railroad system operation requires.

Still another object of the invention is an arrangement modifying the normal operation of automatic train dispatching apparatus to change the departure time of the trains from a station as unusual operating conditions occur in the railroad system.

Yet another object of my invention is the addition of remote control to an automatic train dispatching arrangement at a station in a railroad system to allow a centrally located system supervisor to vary the prescheduled departure of trains from that station when unusual operating conditions within the railroad system make such modifications of the train operation desirable.

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

The basic automatic train dispatching apparatus which is included in the system of my invention is one in which the train departures from a particular station are normally

controlled in accordance with a prerecorded sequence of departure times. These prescheduled times are based on normal or usual requirements for operating that railroad or rapid transit system. The recorded data is in whatever form the specific type of apparatus requires for readout to control the system. The prescheduled sequence of departure times as read out from the stored record is translated into a control for one-half of a dual rotary stepping switch. The readout, of course, is clockwork controlled so that it is conformed to the daily operations. A specific arrangement for readout may be a photocell activated by a light beam through a punched tape. The other half of the dual stepping switch responds to the arrival or the entry of trains into the station area with the switch advancing a single step only through track circuit control. Under normal conditions, the forward stepping of the second half of the switch in response to a train arrival establishes correspondence between the positions of the two stepping switches. This correspondence in positions inhibits the operation of the train starting signals. In other words, the operation of the starting signal is delayed for a preset time after a train's arrival at the station. The next signal readout from the prerecorded time table or schedule actuates the first part of the stepping switch and steps it to an out-of-correspondence position. This condition removes the inhibit control and, with the train in the station, the starting signal arrangement is activated to direct that train to depart and to provide an indication to passengers on the station platform that they should immediately board the train if they wish to use it.

If the system supervisor at a remote location desires an early departure for a particular train from that station, he actuates a conventional remote control system to transmit an advance control function to the station dispatching apparatus. When received, this advance function actuates the first half of the stepping switch arrangement to advance forward one step or position. This is the same type of action that occurs in response to the prescheduled record but occurs prior to the next scheduled departure time. By transmitting this control, the starting signal is activated to direct the train departure as soon after the train enters the station as is desired. Conversely, if a retardation of the departure time is desired, a retard control function is transmitted by the remotely located supervisor to that station. This results in inhibiting the actuation of the first portion of the dual stepping switches by the recorded schedule sequence. For example, the operating circuit for that portion of the stepping switch may be interrupted. With the control thus interrupted, no stepping action in the first switch occurs after the arrival of the train has stepped forward the second portion of the switch into a corresponding position. Thus the in-correspondence condition of the dual stepping switches is retained to inhibit the actuation of the starting signal. This inhibit condition remains in effect while the retarding control function is stored. In addition, the starting signal control circuits are held open. This retard function may be cancelled and the apparatus reset by the transmission of a single advance control function by the same supervisor. Under these conditions, the advance function, although registered at the station, does not actuate the stepping switches in order to immediately provide a starting signal. However, upon the restoration or cancellation of the retard control, the system is restored to its normal operation and the train waiting at the station assumes the next scheduled departure time with the dispatching apparatus operating in the usual manner to actuate the starting signal.

In the following specific description of the system of my invention, reference is made to the single drawing FIGURE which is a diagrammatic representation of automatic train dispatcher apparatus embodying my invention.

In this single drawing, the items of apparatus are in general represented by symbols standard in the art. However, some elements of the arrangement which comprise well known apparatus, and are not a specific part of the inventive concept of my system, are illustrated in a conventional manner in order

to simplify the illustration and the description. In actual practice, the electrical circuits included in the arrangement are energized by a proper and conventional source or sources of power of whatever type is required by the apparatus. For convenience in the illustration, however, it is considered that a single local direct current source of power is provided for all apparatus. The specific source is not shown but connections to its positive and negative terminals are designated by the symbols B and N, respectively. Further, at the remote control location shown in the lower right, a separate single source of direct current energy is provided with the terminals being similarly designated by the symbols OB and ON, respectively. It is to be understood, however, that in actual practice more than one local source of energy may be provided in order to match the specific type of apparatus used. In other words, it may be necessary and desirable to also provide alternating current power for energizing lamps and particular types of signaling devices. The use of more than one type of power source where desirable is included in the disclosure of my invention.

Referring now to the single drawing, across the top in conventional two-line representation is shown a stretch of railroad track over which trains move normally from right to left as indicated by the arrow in the upper right of the drawing. This stretch of track is divided into three insulated track sections designated in the direction of train movement as sections 3T, 2T, and 1T respectively. The insulated joints at the division points which separate electrically the rails of the sections are designated by conventional symbols known in the art. Each of the track sections is provided with a track circuit shown, for simplicity, only by the track relay connected by conventional dotted line symbol across the rails at one end of the section. These track relays are designated generally by the reference character TR, each with a numerical prefix corresponding to that of the track section. Any type of track circuit known in the signaling art may be used with the system of my invention. In the following description, it is only necessary to understand that the track relay is energized and thus picked up when no train is occupying any portion of the corresponding track section. Conversely, the relay winding is shunted away from its power source when a train occupies that section and the relay releases to indicate the occupancy of that section by the train. Track relay 2TR is provided with a back contact repeater relay 2TP which has slow pickup characteristics, as indicated by the upward pointing arrow drawn through the movable portion of its conventionally shown contacts. Relay 2TP is energized when back contact *a* of relay 2TR closes upon release of this track relay when a train occupies section 2T.

A station platform at which the trains stop to load and unload passengers is shown by conventional dot-dash rectangle as being adjacent to at least part of track section 2T. At the leaving or left end of this platform is located a starting signal SS. This is conventionally shown as an electric lamp although other types of starting signals may be used and/or more than one such signal may be located along the platform at various points. It is to be noted that this signal is separate and distinct from any wayside signaling system used to control the safe movement of the trains. Associated with signal SS is a starting bell SB designated by the standard symbol. As will be described later, these two signal devices are actuated simultaneously in the operation of the automatic train dispatching system although the bell or other audible signal exists only for a preset timed period. Starting signal SS is primarily to direct the operator of the train to depart from the station at the end of the bell signal. The starting bell or other audible signal is used to warn the passengers that the train is about to depart from the station platform and will leave upon the termination of the audible signal. It is particularly noted that no indication given by either of these starting signals can supersede the safety signal indications displayed by any wayside or cab signal arrangement provided for the railroad system. It is also to be understood that other starting signal arrangements can obviously be provided which will provide equivalent indications to the train operator and to the waiting passengers and the use of such signals is included in the disclosure of my invention.

The automatic operation of the train dispatching system as shown is normally initiated or controlled by the preschedule entry relay PE, shown at the upper left of the drawing FIGURE. Control circuits for this relay PE are not shown since they are not part of the specific inventive concept disclosed herein and any one of several known types of control may be used. The explanatory note associated with relay PE describes briefly its operation. As a specific example, relay PE may be controlled in the manner shown in the U.S. Pat. No. 2,318,048 issued to W. N. Bodkin on May 4, 1943 for an Automatic Program Control Mechanism. Said in another way to briefly summarize, relay PE picks up each time a recorded train departure time is read out of the schedule recording medium which, for example, in the Bodkin patent is punched tape or film strip. Each operation of relay PE to close its front contact *a* is repeated by a relay PEP which is utilized so that the operating pulse provided to the train dispatcher unit will be of very short duration. However, if the timing of the operating pulse is not critical, relay PEP may be eliminated from the system.

The main or central portion of the automatic train dispatcher used in the disclosed system is the dual rotary stepping switch shown in the center of the drawing FIGURE. The left switch is actuated by a train departure command normally received from the prerecorded schedule. This switch and in particular its operating magnet, illustrated by a conventional relay symbol, are designated by the reference RSS. The right-hand switch is actuated by the arrival of a train at the station, or in other words, by the detection of a train at the station ready to leave on order. This switch and its operating magnet are designated by the reference RSL. Each of these switches operates in the conventional manner of a rotary stepping switch, advancing the rotary contact arm to the next stationary contact position for each energization of the corresponding operating magnet. It is also an operating requirement that the magnet be deenergized and released and then reenergized in order to actuate a subsequent stepping action. Conventional symbols have been used to illustrate the rotating contact arm and the circular stationary contact positions. Only some of the stationary contacts of each switch, identified by reference numbers, are shown. A dotted line indicates the operating control of each stepping or rotary arm by the associated operating magnet.

The principle control circuit for magnet RSS may be traced from terminal B of the power source over front contacts *a*, in series, of relays PE and PEP, back contact *a* of a retardation control repeater relay RETPP, which will be described later, and thence through the winding of magnet RSS to terminal N of the source. An alternate circuit for magnet RSS includes front contact *b* of the advance control function relay ADV, also to be described shortly, and back contact *a* of relay RETPP. The only operating circuit for magnet RSL of the other portion of the dual stepping switch includes back contact *b* of track relay 2TR, back contact *a* of repeater relay 2TP, and the winding of magnet RSL. Reviewing briefly, any time one of these control circuits is completed so that the corresponding magnet winding is energized, the rotating arm of that rotary switch is stepped forward one position along the stationary contacts.

The correspondingly numbered stationary contacts of each portion of the dual rotary stepping switch are connected directly to one another. Several of these connections are shown in the circuit drawing and all other stationary contacts are similarly connected to the corresponding contact in the other switch. The positioning of the rotary contact arms of these stepping switches is repeated by the rotary switch repeater relay RSP. Relay RSP is energized when the two portions of the switch have their rotary contact arms in corresponding positions. For example, if the right-hand switch

rotary contact is stepped forward one position from that shown so that it also occupies the number 6 position, a circuit is completed from terminal B of the source over the rotating contact arm of the left switch, the direct connection between the corresponding stationary contacts 6 of the two switches, the rotating contact arm of the right-hand switch, and thence through the winding of relay RSP to terminal N of the source. Obviously, and as specifically shown, when the rotating arms are occupying out-of-correspondence positions, this circuit for relay RSP is interrupted, the relay winding is thus deenergized, and the relay releases. An alternate circuit for relay RSP is completed at times by the closing of front contact *c* of the first retardation control repeater relay RETP, which is to be described shortly.

The starting bell SB is controlled timewise by the bell relay BR and the bell timing relay BTE. The energizing circuit for relay BTE includes back contact *a* of relay RSP, back contact *c* of relay 2TR, front contact *a* of relay 3TR, back contact *b* of relay BR, and the winding of relay BTE. Relay BTE is of the time element type so that, when energized, it does not pick up to close its front contact for a preset time period. Such relays are well known in the art and the timing period may be preset from relatively short periods on the order of 1 or 2 seconds to such longer periods as up to a full minute of operation. Such relays thus distinguish from more conventional slow pickup relays such as used for relay 2TP where the period prior to the closing of front contacts after energization of the relay winding is relatively short and is merely to provide a slight delay, on the order of less than 1 second, in the closing of circuits controlled by such front contacts. In systems such as disclosed herein, the operating times of relay BTE will normally be selected to be on the order of 5 to 10 seconds duration. When relay BTE does pick up to close its front contact *a*, the winding of relay BR is then energized over an obvious circuit and this relay picks up. When front contact *a* of relay BR closes, it completes a stick circuit for this relay to bypass front contact *a* of relay BTE, the stick circuit further including front contact *a* of relay 3TR, back contact *c* of relay 2TR, and back contact *a* of relay RSP. Since the opening of back contact *b* of relay BR, when this relay picks up, deenergizes relay BTE which immediately releases, this stick circuit is necessary in order to retain relay BR energized.

The operating circuit for starting bell SB extends from terminal SB at back contact *a* of relay RSP over back contact *c* of relay 2TR, front contact *a* of relay 3TR, back contacts *b* and *c* in series of relay BR, and the operating coil of bell SB to terminal N. It is to be seen that, with the circuit otherwise completed, the period of operation of bell SB is determined by the period of time during which back contacts *b* and *c* of relay BR remain closed. Since the energizing circuit for relay BTE is quite similar and includes a major portion of the operating circuit for bell SB, as previously described, it is then obvious that the preset operating time of relay BTE determines the period of time during which bell SB operates in providing an audible signal to the passengers on the station platform. The series connection through back contacts *b* and *c* of relay BR in this circuit for bell SB is necessary to isolate the winding of relay BTE from the coil of the bell. The energizing circuit for lamp signal SS is not dependent upon the timing period but rather includes front contact *c* of relay 2TP, back contact *c* of relay RSP, and front contact *a* of relay 1TR. As will be explained later, this circuit thus requires that a train be occupying the station track section 2T and that relay RSP be released. The circuit for signal SS is interrupted when the train departs from this station platform and occupies track section 1T.

I shall now describe the apparatus used in the system of my invention to modify the normal operation of the automatic train dispatcher apparatus when changes are desired in the prescheduled movements of the trains. This apparatus includes, first, the advance control function relay ADV, and its repeater relay ADVP. The apparatus also includes the retard control function relay RET and its two sequential repeater relays RETP and RETPP. The last named relay is provided with slow release characteristics to slightly retard the release of the relay upon deenergization, such characteristics being indicated by the downward pointing arrow drawn through the movable portion of the single contact controlled by this relay. Control for relays ADV and RET is provided from a remotely located control office shown by the conventional dot-dash rectangle in the lower right of the drawing figure. Within this control office and assigned to the particular station shown in the drawing are certain control and indication devices. An advance pushbutton ADVPB and a retard pushbutton RETPB are provided for the corresponding control function relay, each of these control devices being a conventional spring release, push-to-close pushbutton as designated by the standard symbols used in the drawing. Each control pushbutton has associated therewith an indication light which provides an indication that the corresponding control function has been registered at the station location. Thus the advance indication lamp ADVEK and the retard indication lamp RETEK are designated by standard symbols adjacent to the corresponding control devices. A third indication lamp SSEK is used to repeat the indication shown by the corresponding start signal SS on the associated station platform.

Each of these control devices and indication units at the control office, as described, is particularly assigned to control and indicate the automatic train dispatching apparatus at the particular station shown in the remainder of the drawing. Operation of an office control device, that is, one of the pushbuttons, transmits a control function to the field station through a remote control communication system which is conventionally designed by the dot-dash rectangle shown adjacent to the block for the control office. These control function transmissions and the return of indication functions are illustrated only by dotted lines since any suitable remote control system may be used and the specific details are not a part of the invention disclosed herein. The operation of such remote control systems of various types is well understood by those skilled in the art and thus the details are not necessary for an understanding of the manner in which the control and indication functions are transmitted. Any one of several known types of remote control systems may be used, the only requirement being that the control function delivery to the corresponding function relay at the station must be of a short-time span, that is, the control delivery pulse must be on the order of 0.5 second. The previously described office direct current power source is used to complete the conventional control and indication direct circuits shown, it being understood that the transmission of these functions through the remote control system is not actually by such directly connected circuitry but through the operation of the system. However, for simplicity, these direct connections and the separate office power source are used in the following description.

Describing now the conventionally shown, direct remote control circuits for the advance and retard control function relays, relay ADV is energized over the circuit between terminals OB and ON of the office source which is completed by the closing of the normally open contact of pushbutton ADVPB when this control device is actuated by the system operator. A similar circuit is completed for relay RET when pushbutton RETPB is actuated by the system supervisor to close its single, normally open contact. Although shown for simplicity as directly connected control circuits between the pushbuttons and the corresponding function relays at the station, actually each of the relays remains energized only for a period of time on the order of 0.5 second for the delivery of a desired control function. Since these relays pick up and release in a relatively short period of time, function stick relays are therefore needed at the station to register the reception of control functions from the office. A circuit for relay ADVP is completed, each time relay ADV picks up, by the closing of front contact *a* of this latter relay, thus

completing the circuit between terminals B and N of the station source including the winding of relay ADVP. This latter relay closes its front contact *a* upon pickup to complete stick circuit which further includes back contact *b* of relay RETP and back contact *e* of relay RSP. The operation of relay RET is repeated by relay RETP, whose energizing circuit is obviously completed by the closing of front contact *a* of relay RET. The stick circuit for relay RETP includes its own front contact *a* and back contact *b* of relay ADVP. This cross connection over back contacts of the opposing function stick relay thus assures that only one of these control functions can be stored at any one time at the station. The second repeater relay for relay RET has an energizing circuit including front contact *d* of relay RETP and the winding of relay RETPP. As previously defined, this latter relay has slow release characteristics to slightly retard the closing of its back contact *a* upon deenergization of the relay winding.

The circuit for indication lamp ADVEK extending between terminals OB and ON of the office power source includes, at the station, back contact *d* of relay RSP and front contact *c* of relay ADVP. The circuit for the retard indication lamp RETEK likewise extends between the terminals of the office power source and at the station includes only front contact *e* of relay RETP. The indication control circuit for indication lamp SSEK extending between the terminals of the office source includes, at the station, front contact *b* of relay 2TP, back contact *b* of relay RSP, and front contact *b* of relay 1TR.

I shall now describe the operation of the system illustrated under both normal and special conditions. It is assumed that initially the apparatus is in the condition shown in the drawing, especially with reference to the position of the rotating contact arm of each portion of the dual stepping switches RSS and RSL. In other words, it is assumed that the two contact arms are positioned out-of-correspondence so that no completed circuit exists through the rotary switch contact elements. If trains moving along the stretch of track are operating on time, the next train will arrive at the station prior to the next operation of relay PE. As the train approaches, relay 3TR releases followed, as the train enters the station section, by the release of relay 2TR. The opening of front contact *a* of relay 3TR to interrupt the circuits for relay BTE and starting bell SB obviously occurs prior to the release of relay 2TR to close its back contact *c* in this operating circuit.

The release of relay 2TR closes its back contact *a* to complete the energizing circuit for repeater relay 2TP which, at the expiration of its relatively short delay time, picks up to open its back contact and close front contacts. As previously indicated, the closing of back contact *c* of relay 2TR completes a portion of the operating circuit for relay BTE otherwise open at this time at front contact *a* of relay 3TR. The closing of back contact *b* of relay 2TR completes the energizing circuit for operating magnet RSL of the right portion of the stepping switch. Thus energized, magnet RSL causes the rotating contact arm of this switch to step forward one position, assumed to be the position closing with contact 6 of that switch. When relay 2TP picks up shortly thereafter, opening its back contact *a*, the circuit for magnet RSL is interrupted and no further action of the stepping switch occurs. When the contact arm of switch RSL steps forward to position 6, it comes into correspondence with the rotary contact arm of switch RSS and thus completes a circuit through the two arms of the dual rotary switches to energize relay RSP which immediately picks up.

When relay RSP picks up, it opens its back contact *a* to interrupt the control circuit for relay BTE and starting bell SB at another point. This occurs prior to the reenergization of relay 3TR upon the clearing of section 3T by the train. Thus when front contact *a* of relay 3TR recloses, relay BTE and start bell SB remain deenergized. Back contact *c* of relay RSP interrupts the control circuit for start signal SS prior to the time that relay 2TP, which has a slow pickup characteristic, closes its front contact *c* in this control circuit. Thus the train arrives at the station, stopping at the platform adjacent section 2T and awaits a signal to depart from this location.

When the control arrangement for relay PE reads out the next prescheduled departure time for trains from this station, relay PE is, as indicated, energized and picks up to close its front contact *a*. This energizes relay PEP which picks up quickly and closes its front contact *a* to complete the circuit over front contact *a* of relay RETPP to energize operating magnet RSS of the rotary switch. When magnet RSS is energized, it steps the rotary contact arm of this switch forward to the next stationary contact position, that is, position 7 as specifically illustrated. The rotating contact arms of switches RSS and RSL are now out-of-correspondence with each other and the circuit for holding relay RSP energized is interrupted and this relay releases. Release of this relay closes its back contacts *a* and *c*, the former contact completing the circuits for energizing relay BTE and start bell SB while contact *c*, since front contact *c* of relay 2TP is already closed, completes the circuit for energizing start signal SS which displays a departure indication to the train operator. Also at this time, the closing of back contact *b* of relay RSP completes the circuit for transmitting an indication function to the remote office which will cause lamp SSEK to be lighted to indicate that the departure signal is being displayed at this particular station.

Thus energized, relay BTE starts its timing sequence, at the end of which it picks up to close its front contact *a* to energize relay BR. Relay BR picks up, completing the previously traced stick circuit over its front contact *a*. Relay BR also opens its back contacts *b* and *c*, thus deenergizing relay BTE which immediately releases and also deenergizing starting bell SB which ceases operation and thus halts the audible warning to passengers on the platform. As previously mentioned, this occurs at a preselected time period after the initiation of the starting signal, generally on the order of 5 to 10 seconds. The bell signal having stopped, and the lamp signal SS being displayed, the train operator has signal authority to depart from the station providing the safety conditions are proper. He therefore starts the train and leaves the station, entering track section 1T to release the corresponding track relay 1TR. The opening of front contact *a* of this latter relay interrupts the circuit for signal SS which is thus extinguished. Further, its front contact *b* interrupts the circuit for transmitting an indication to the control office so that lamp SSEK is extinguished to indicate that the train has departed from the station. When the rear of the train clears section 2T, relay 2TR picks up, opening its back contact *a* to deenergize relay 2TP which releases. The opening of back contact *c* of relay 2TR interrupts the stick circuit for relay BR which shortly releases. However, back contact *c* of relay 2TR has also interrupted the control circuits for relay BTE and starting bell SB. The release of relay 2TP, of course, further interrupts the control circuit for signal SS and the indication circuit for transmitting the corresponding indication to the office. Thus these circuits remain interrupted when relay 1TR again picks up as the train clears section 1T.

It is now assumed that once again the position of the apparatus is as specifically shown on the drawing and that another train is arriving at this particular station. The same sequence of relay and switch operations as just described again occurs so that, with the train standing at the station platform and clear of section 3T, the rotary contact arms of switches RSS and RSL are occupying corresponding positions so that relay RSP is energized and picked up. Also relay 2TR is released and its repeater relay 2TP has picked up. However, relay PE has not yet picked up since the next prescheduled departure time for the train from this station has not been read out of the data storage apparatus.

It is now also assumed that, due to expected passenger loading being heavier than normal, it is desired to advance the departure of this train from the station to shorten the headway between successive trains or to add an extra train to the operation of the system. The system supervisor or operator at the remote control office therefore actuates control device or pushbutton ADVPB to initiate the transmission of an advance control function from the control office to this particular

wayside station. Transmission of this control, as previously described, energizes relay ADV which in turn closes its front contact *a* to energize relay ADVP. The closing of front contact *b* of relay ADV, with back contact *a* of relay RETPP closed, energizes operating magnet RSS which causes the rotary switch arm of that switch to step to the next position in advance without waiting for the next operation of relay PE. Although the energizing pulse over front contact *b* of relay ADV is of short length due to the designed shortness of the control function pulse from the remote control system, switch RSS nevertheless is sufficiently energized to step forward. Since the contact arms of the two rotary switches are no longer in corresponding positions, relay RSP is deenergized and releases. As before, the release of relay RSP closes its back contacts *a* and *c* to energize relay BTE, starting bell SB, and starting signal SS. Bell SB rings for the preset pickup time of relay BTE and then is shut off by the corresponding pickup of relay BR to open its back contact *c*. With starting signal SS also energized and bell SB now quiet, the train operator is authorized to start his train and depart from this station.

When relay RSP releases to close its back contact *e*, the stick circuit for relay ADVP is then complete, further including back contact *b* of relay RETP and front contact *a* and the winding of relay ADVP. Back contact *b* of relay ADVP opens to interrupt the stick circuit for relay RETP which, if previously energized by the transmission of a retard control from the office, is now deenergized and releases. With front contact *c* of relay ADVP and back contact *d* of relay RSP both closed, an indication function is transmitted to the office to energize indication lamp ADVEK which is thus illuminated to indicate to the system operator that the advance departure control function has been received and registered at the station location. Indication lamp SSEK is also illuminated at this time since its control circuit at the station location is completed upon the release of relay RSP.

It is to be noted that relay ADVP is held energized by its stick circuit at least until the next train arrives at this station to again energize relay RSP by positioning the rotary contact arms of switches RSS and RSL into correspondence, in a manner previously described. However unless the next train follows quite closely, correspondence will not be obtained between these two switches upon its arrival. In connection with this, it should be noted that, even under normal operations, if a train is late in arriving at this station so that relay PE has already picked up in accordance with the next prescheduled departure time to cause switch RSS to step forward, relay RSP will not be energized since the rotary arm of switch RSS is two steps ahead of the arm of switch RSL. In other words, switch RSS remains one position ahead even after the late train arrival steps switch RSL forward one position. Therefore a late arriving train will receive an immediate departure signal when relay 2TP picks up. The same situation occurs if the following train, after an advance departure situation, arrives at the station after the normal prescheduled departure time for the preceding train which was ordered to depart early. Under these conditions, relay PE will already have picked up and released prior to the arrival of the following train, so that switch RSS is two positions ahead of switch RSL. If, however, an extra train is inserted to fill the schedule gap, normal operation of the switches is quickly resumed.

It is now assumed that, conditions being normal and a train standing at the station platform, the system operator desires to delay the departure of that train, for example, because the succeeding train is known to have been delayed and a reduced headway at this station between such trains is desired. In order to transmit this retard control function, the operator at the control office actuates pushbutton RETPB which transmits the function to the station where relay RET is energized and picks up for a short pulse period. The closing of front contact *a* of relay RET energizes relay RETP which picks up to complete its stick circuit including its own front contact *a* and back contact *b* of relay ADVP. If any previously transmitted advance control function is still registered within the station apparatus, relay ADVP is deenergized by the opening of back contact *b* of relay RETP and releases in time to complete the stick circuit for this latter relay. Front contact *d* of relay RETP also closes to energize the second repeater relay RETPP which picks up to open its back contact *a*. This action interrupts the control circuits for operating magnet RSS of the first half of the dual stepping switch, removing the switch from any control by relay PE and thus from response to the next scheduled train departure readout from the tape or other data storage arrangement.

In the manner previously described, the present train, upon its arrival at the station, caused switch RSL to step forward one position, that is, to stationary contact 6, and thus complete the circuit for energizing relay RSP which is now picked up. Relay RSP is held energized since switch RSS is not stepped forward at this time. In addition, relay RSP is held energized by the circuit including front contact *c* of relay RETP, which is now closed. This latter circuit allows delay of the departure even if the train arrives late so that relay PE has already operated to cause switch RSS to step an additional position ahead, as previously discussed. In other words, if rotary switch RSS is already two steps ahead of switch RSL, the transmission of a retard control function prior to the arrival of the late train will hold relay RSP over this last traced circuit and thus delay the display of an immediate departure signal by unit SS.

This retarded control function, registered by holding relay RETP energized through its stick circuit, is retained at the station until a reset action is received from the control office. This reset is initiated by the transmission of an advance control function from the office through the operation of pushbutton ADVB. This causes relay ADV at the station to be briefly picked up by the short energy pulse and, during the time its front contact *a* is closed, relay ADVP is also energized and picks up. The opening of back contact *b* of relay ADVP interrupts the stick circuit for relay RETP which quickly releases. This interrupts the circuit, over its front contact *c*, for relay RSP which may then release if switches RSS and RSL are out-of-correspondence. However, since back contact *e* of relay RSP is at least initially open in the stick circuit for relay ADVP, even this sequential release of relays RETP and RSP occupies sufficient time that the energization of relay ADVP over front contact *a* of relay ADV has ceased prior to the release of relay RSP. Thus the stick circuit for relay ADVP is never completed under these reset operations and it releases.

The opening of front contact *d* of relay RETP deenergized relay RETPP which, at the end of its slow release period, releases to close its back contact *a*. This slow release period, however, is sufficient to prevent any energization of switch magnet RSS over front contact *b* of relay ADV during its brief period of energization. The closing of back contact *a* of relay RETPP restores the circuit so that magnet RSS is again placed under the control of relay PE, and thus under the control of the prescheduled departures recorded in the data storage apparatus. If the two rotary switches are in a correspondence condition at this time, i.e., have been since the arrival of the train, relay RSP, of course, remains energized to prevent the display of a starting signal until the next departure time is read out of the data storage apparatus. At that time, relay PE is controlled to close its front contact *a* and thus initiate the departure sequence. If an out-of-correspondence condition exists between the switches, a starting signal is immediately displayed. The transmission of a second advance control function, if the switch positions do correspond, will also activate the starting signal and bell.

In the operation of the system of my invention, there is no requirement that rotary switch RSS be repositioned to catch up, timewise, with the control exercised through relay PE by the prescheduled data storage. However, switches RSS and RSL should be one contact position apart, with switch RSS ahead, when the regular prescheduled control is resumed. This requirement may necessitate some manipulation by the

system operator of either the advance or retard control function transmissions in order to obtain this condition. After the exercise of an advance or retard departure control action, the next arriving train assumes the schedule position on the storage tape as it then exists. At the same time, the action of switches RSS and RSL in their normal operating sequence resumes at whatever switch contact positions exist, adjusted only to be one contact apart, and the following prescheduled departures as read out of the storage elements control the switches in the normal manner.

The automatic train dispatching system provided by my invention thus normally allows automatic control, through a preselected sequence of train departures, of the movement of trains through a particular wayside station. At the same time, the arrangement permits the system operator at the remote control office to exercise advance or retard controls upon the departure of the train in order that the sequence of train departures may be varied to meet special operating conditions which arise from time to time. This remote control as part of the apparatus provides the system operator with a readily available means for overcoming unusual operating conditions which necessitate a variance from the prescheduled train movements in order to provide the service required by the traveling public. At the same time, the normal operation of the system releases him from immediate supervision of routine matters and automatically allows the trains to arrive and receive departure signals in accordance with the prescheduled sequence. A more efficient and economical operation of a commuter railroad system is thus obtained.

Although I have herein shown and described but one form of automatic train dispatching apparatus embodying the arrangement of my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

I claim:

1. Train dispatching apparatus for a wayside station location along a stretch of railroad track, comprising in combination,

a. means for registering each prescheduled departure time of a train from said station location,

b. signaling means for directing when activated the departure of a train from said station,

c. train detection means for detecting the arrival of a train at said station,

d. an operating means comprising a first and a second portion,

1. said first portion controlled by said registering means and operable to a successive position normally in response to each registered prescheduled departure time,

2. said second portion controlled by said train detection means and operable to a successive position in response to the arrival of each train at said station,

3. said first and second portions connected for jointly activating said signaling means only when a train is at said station and said portions occupy out-of-correspondence positions,

e. a departure advance control device selectively operable to an activated condition and directly connected when activated for operating said first operating means portion to an out-of-correspondence position,

f. a departure retard control device selectively operable to an activated condition and connected when activated for interrupting all control connections to said first operating means portion and the joint control of said signaling means by said first and second portions.

2. Train dispatching apparatus as defined in claim 1 in which,

each departure control device is operated to its activated condition by a control function selectively transmitted from a remotely located control position over a function transmission communication system interconnecting the station apparatus and the remote control position, a maximum of one control device being in its activated condition at any time.

3. Train dispatching apparatus as defined in claim 2 in which,

said departure retard control device holds in its activated condition after the reception of a departure retard control function until the reception of a release control function transmitted in the form of a control function which activates said advance control device.

4. Train dispatching apparatus as defined in claim 3 which further includes,

a. a slow release relay means directly repeating the activation of said retard control device,

b. said relay means connected for interrupting all control connections to said first portion of said operating means when said retard control device is activated and for retaining said interruption beyond the period during which an advance control function received to reset said retard control device is effective to operate said first portion of said operating means.

5. A Train dispatching apparatus as defined in claim 2 in which,

a. said operating means comprises a first and a second stepping switch and a switch position repeater relay,

1. each switch having an operating magnet for stepping the switch one position for each energization of the magnet,

2. said position repeater relay being energized when both switches occupy corresponding positions,

b. said register means connected for energizing the first switch magnet when a prescheduled departure time is registered,

c. said train detection means connected for energizing the second switch magnet once for each arrival of a train at said station, to normally step said second switch into a corresponding position with said first switch,

d. said advance control device connected for energizing said first switch magnet when said device is activated,

e. said repeater relay and said train detection means connected for jointly activating said signaling means when said relay is deenergized and a train is occupying said station track,

f. said retard control device connected for interrupting all control connections to said first switch magnet and for inhibiting any activation of said signaling means when said retard device is activated.

6. Train dispatching apparatus as defined in claim 5 in which said retard control device is directly connected for holding energized said position repeater relay for inhibiting any activation of said signaling means while said retard control device is activated.

7. Train dispatching apparatus as defined in claim 6 which further includes,

a. a slow release relay means directly repeating each activation of said retard control device,

b. said device repeater relay means connected for interrupting all energizing connections to said first switch magnet to retain that magnet deenergized while said retard control device is activated and beyond the period during which an advance control function received to reset said retard control device is effective to energize said first switch magnet.

8. Train dispatching apparatus as defined in claim 7 which further includes,

a. a passenger signaling device for warning when activated that a train is scheduled to depart from said station,

b. a train signaling device for directing when activated the train operator to depart from said station when said passenger signaling device becomes inactive,

c. a timing means jointly controlled by said position repeater relay and by said train detection means for measuring a preset period of time when said relay is released and a train occupies the station track,

d. an activating circuit for said train signaling device including a released position contact of said position repeater relay and a contact closed by said train detection means when a train is occupying said station track, and

e. an activating circuit for said passenger signaling device including,

1. another released position contact of said position repeater relay,

2. another contact closed by said train detection means when a train occupies said station track,

3. a normally closed contact controlled by said timing means and opened when said preset time period has expired.