



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:  
**25.06.2014 Bulletin 2014/26**

(51) Int Cl.:  
**B61L 27/00** <sup>(2006.01)</sup> **H04L 29/08** <sup>(2006.01)</sup>

(21) Application number: **12785365.3**

(86) International application number:  
**PCT/CN2012/075574**

(22) Date of filing: **16.05.2012**

(87) International publication number:  
**WO 2012/155843 (22.11.2012 Gazette 2012/47)**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(30) Priority: **16.05.2011 CN 201110125309**

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(54) **METHOD AND DEVICE FOR SENDING TEMPORARY SPEED RESTRICTION COMMAND IN C3 SYSTEM**

(57) The present invention provides a method and a device for sending temporary speed restriction command in C3 system. The method comprises: a TSRS receives a temporary speed restriction command issued by a CTC; the TSRS, according to the speed restriction zone starting point, the speed restriction zone end point, and the jurisdiction of each speed restriction of each TCC and/or RBC on the railway line corresponding to the line number, automatically splits, and then sends a corresponding temporary speed restriction command to the related TCC and/or RBC, and the TCC sends the C2 speed restriction information to a C2 onboard device via an active transponder, and the RBC sends the C3 speed restriction information via a GSM-R. Through setting a TSRS in a railway system and connecting the TSRS to the CTC to obtain a temporary speed restriction command, and distribute the temporary speed restriction command to related TCC, RBC, so as to realize automatic distribution of each TCC, RBC and a centralized management train control speed restriction command within a full-line management and control range; through the TSRS, C2 and C3 speed restriction commands can be set and cancelled simultaneously, so as to guarantee consistency of two train control modes.

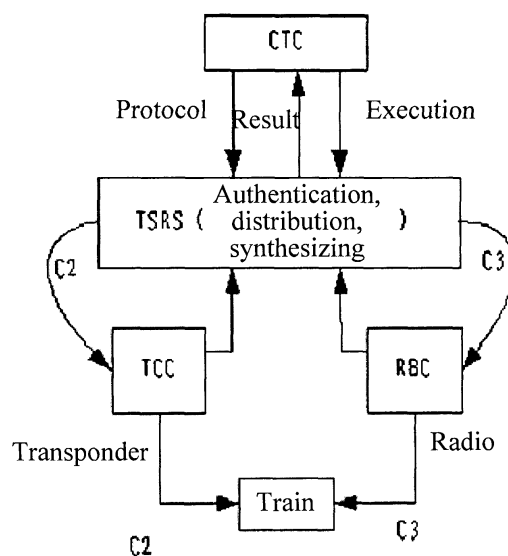


FIG. 1

**Description**

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims priority to Chinese Patent Application No. 201110125309.X, filed with the Chinese Patent Office on May 16, 2011, entitled "method and device for sending temporary speed restriction command in C3 system", which is incorporated herein by reference in its entirety.

## TECHNICAL FIELD

**[0002]** The present invention relates to a railway vehicle speed restriction technology, in particular to a method and a device for sending a temporary speed restriction command in a China Train Control System-3.

## BACKGROUND

**[0003]** Temporary speed restriction solutions of existing railway vehicles mainly can be divided into the following two types, one of which is for rail lines with a running speed less than 160km/h, the dispatcher prints out a text format, and phones the driver to control train operation by a text speed restriction dispatching command. Another is for 200km/h rail lines equipped with China Train Control System-2 (CTCS-2 or C2) train control equipment, each station attendant, respectively, issues a speed restriction command to the local train control center (TCC) device, and then the TCC selects the speed restriction packet with timing scene and send them to the active transponder, for obtaining, by C2 motor train unit, speed restriction data when passing through.

**[0004]** Solution one uses manual management speed restriction mode, prone to speed restriction accidents caused by poor management. Although solution two adopts equipment management and control, timing of issuing speed restriction is also controlled by each station attendant, and it easily leads to risk of omitting speed restriction.

**[0005]** With the demand for rapid development of railway, China Train Control System-3 (CTCS-3 or C3) train control equipment is needed for rail lines with a running speed reaching 350km/h. Mainly, a radio block center (RBC) device is added, where RBC sends speed restriction commands to a C3 onboard equipment. Where, CTCS-2 should be used as a backup mode for supporting simultaneously running C3 and C2 trains on the same line. However, if the above-mentioned decentralized control of prior art is still used, the consistency of C2 and C3 speed restriction cannot be guaranteed.

## SUMMARY

**[0006]** In view of the above defects in the prior art, the present invention provides a method and a device for sending a temporary speed restriction command in a C3 system.

**[0007]** The present invention provides a method for sending a temporary speed restriction command in C3 system, including:

receiving, by a temporary speed restriction server TSRS, a temporary speed restriction command issued by a centralized traffic control system CTC, wherein the temporary speed restriction command at least includes a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a scheduling command number and a station number;

automatically splitting, by the TSRS, the temporary speed restriction command for the related TCC and / or RBC according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the railway line corresponding to the line number ;

sending, by the TSRS, the corresponding temporary speed restriction command to the TCC and/or the RBC, and carries a command identifier for identifying the temporary speed restriction command.

**[0008]** The present invention provides a temporary speed restriction server, including:

a receiving module, configured to receive a temporary speed restriction command issued by a centralized traffic control system CTC, wherein the temporary speed restriction command at least includes a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a scheduling command number and a station number;

a distribution module, configured to automatically split the temporary speed restriction command for the related TCC and/or RBC according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the railway line;

a sending module, configured to send the corresponding temporary speed restriction command to the TCC and /

or the RBC, and carry a command identifier for identifying the temporary speed restriction command.

**[0009]** The present invention provides a control system, including a temporary speed restriction server according to the embodiments of the present invention, a centralized traffic control system CTC, a train control center TCC, and a radio block center RBC respectively connected to the temporary speed restriction server.

**[0010]** In the method and a device for sending a temporary speed restriction command in a C3 system provided by the present invention, a TSRS receives a temporary speed restriction command issued by a CTC; the TSRS automatically splits the temporary speed restriction command according to the speed restriction zone starting point, the speed restriction zone end point, and the jurisdiction of each TCC and/or RBC on the railway line corresponding to the line number, and then it sends the corresponding temporary speed restriction command to the TCC and/or the RBC, and further sends the C2 speed restriction information to C2 onboard by the TCC via an active transponder, and sends C3 speed restriction information by the RBC via GSM-R. Through setting a TSRS in a railway system, connecting to a CTC to obtain a temporary speed restriction command, and distributes the temporary speed restriction command to the related TCC, RBC, each embodiment of the present invention realize automatic distribution and collective management train control speed restriction commands for each TCC and RBC within the range of all line management and control without participation of attendants of each station; in addition, CTCS-2 and CTCS-3 speed restriction commands can also be set and cancelled simultaneously through the TSRS, which is beneficial to ensure consistency of two vehicle control modes.

#### BRIEF DESCRIPTION OF DRAWINGS

**[0011]**

FIG. 1 is a schematic diagram of the principle for realizing a speed restriction function for a CTCS-3 train control system according to the present invention;

FIG. 2 is a flow diagram of a method for sending a temporary speed restriction command in a C3 system method according to the embodiment of the present invention;

FIG. 3 is a diagram of a usage of coverage speed restriction sign according to the embodiment of the present invention;

FIG. 4 is a transition graph of a life-cycle maintenance state including a speed restriction TSR command according to the embodiment of the present invention;

FIG. 5 is a transition graph of a life-cycle maintenance state without a speed restriction TSR command according to the embodiment of the present invention;

FIG. 6 is a schematic diagram of a temporary speed restriction server according to the embodiment of the present invention;

FIG. 7 is a hardware frame diagram of a general safety platform of a temporary speed restriction server according to the embodiment of the present invention;

FIG. 8 is a software frame diagram of a general safety platform according to the embodiment of the present invention;

FIG. 9 is a schematic diagram of a software frame of a general safety platform according to the embodiment of the present invention.

#### DESCRIPTION OF EMBODIMENTS

**[0012]** Further description of the technical solutions according to the embodiments of the present invention will be provided in conjunction with the accompanying drawings.

**[0013]** Aiming at the existing defects of the distributed control mode in the speed restriction control in the prior art, embodiments of the present invention deliver a solution, i.e., a new train control equipment: a temporary speed restriction server (TSRS), which adopts a control system based on a signal failure safety computer. It realizes centralized management of the train control speed restriction command of whole line for guaranteeing the safety of the train control speed restriction device, so as to ensure successful implementation of planned construction speed restriction.

**[0014]** FIG. 1 is a schematic diagram of the principle for realizing a speed restriction function for a CTCS-3 train control system according to the present invention. As shown in FIG. 1, the TSRS provided by the embodiment of the present invention obtains the temporary speed restriction command from a central dispatcher by connecting to a centralized traffic control system (CTC), so as to realize automatic distribution and centralized management of train control speed restriction command for each TCC and RBC within the scope of full line management and control without participation of each station attendant, and efficiently guarantee the consistency of speed restriction for C3 and C2.

**[0015]** FIG. 2 is a flow diagram of a method for sending a temporary speed restriction command in a C3 system method according to the embodiment of the present invention, as shown in FIG. 2, the method includes:

step 100, receiving, by a temporary speed restriction server TSRS, a temporary speed restriction command issued

by a centralized traffic control system CTC, wherein the temporary speed restriction command at least includes a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a dispatching command number and a station number;

**[0016]** The TSRS in this embodiment can be described as an example of C3 temporary speed restriction server. The temporary speed restriction command is uniformly set up by the central dispatcher on the CTC, and the train control speed restriction function need to be completed together by an ATP onboard device and a ground device (including ground devices such as CTC, TSRS, TCC, and RBC).

**[0017]** The CTC system proposes contents of the temporary speed restriction planning dispatching command, and then sends a temporary speed restriction command (TSR), where at least the following information are carried: the speed restriction value, the speed restriction zone starting point, the speed restriction zone ending point, the line number, the dispatching command number and the station number.

**[0018]** In this embodiment, the TSRS can also execute an executable check for the speed restriction value, the speed restriction zone starting point, the speed restriction zone ending point, the line number, the dispatching command number and the station number in the TSR signaling.

**[0019]** Step 101, automatically splitting, by the TSRS, the temporary speed restriction command for the related TCC and/or RBC according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the track line corresponding to the line number;

**[0020]** After the TSRS receives the temporary speed restriction command issued by the CTC system, according to the speed restriction zone starting point, the speed restriction zone ending point, and related TCC and/or RBC jurisdiction it carried, automatically splits the temporary speed restriction command and distributes it to the related TCC and RBC for execution. The specific distribution rule includes:

if a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point and the speed restriction zone end point, before field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command sent, adding a coverage speed restriction sign used for indicating the speed restriction zone is located within the jurisdiction;

if a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point but fails to cover the speed restriction zone end point, before the speed restriction zone starting point in the temporary speed restriction command sent, adding a first sign used to indicate the speed restriction zone is located within the jurisdiction, and before the field information of the speed restriction zone end point, adding a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction;

if a TCC and/or RBC's jurisdiction does not cover the speed restriction zone starting point but covers the speed restriction zone end point, before the speed restriction zone starting point in the temporary speed restriction command sent, adding a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction, and before the field information of the speed restriction zone end point, adding a first sign used to indicate the speed restriction zone is located within the jurisdiction;

if a TCC and/or RBC's jurisdiction does not cover the speed restriction zone starting point or the speed restriction zone end point, before the speed restriction zone starting point in the temporary speed restriction command sent, adding a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction, and before the field information of the speed restriction zone end point, adding a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction.

**[0021]** The TSRS resets the field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command that are sent to a particular TCC and/or the RBC, realizing the distribution to TCC and/or RBC of the temporary speed restriction command.

**[0022]** Step 102, sending, by the TSRS, the corresponding temporary speed restriction command to the TCC and / or the RBC, and carrying a command identifier for identifying the temporary speed restriction command.

**[0023]** After resetting the temporary speed restriction command, the TSRS sends the corresponding temporary speed restriction command to the TCC and/or the RBC. In particular, the TCC system is responsible for controlling the active transponder to send the corresponding TSR information to a C2 vehicle; the RBC system is responsible for sending corresponding TSR information to the C3 train through GSM-R. After the train with an ATP onboard device receives TSR information, it controls the train to run according to the requirement of speed restriction.

**[0024]** In the sending method of the temporary speed restriction command provided by the embodiment, a TSRS receives a temporary speed restriction command issued by a CTC; the TSRS, according to the speed restriction zone starting point, the speed restriction zone end point, and speed restriction jurisdiction of each TCC and/or RBC on the railway line corresponding to the line number, automatically splits the temporary speed restriction command, then it sends the corresponding temporary speed restriction command to the TCC and/or the RBC, and the TCC sends the C2

speed restriction information to C2 onboard via an active transponder, and the RBC sends C3 speed restriction information via GSM-R. According to each embodiment of the present invention, through setting a TSRS in a railway system, a temporary speed restriction command can be obtained through connection with a CTC, and automatic distribution and collective management train control speed restriction commands for each TCC and RBC within the range of all line management and control can be realized by distributing the temporary speed restriction command to the related TCC, RBC, without train attendants of each station; in addition, CTCS-2 and CTCS-3 speed restriction commands can be set and cancelled simultaneously through the TSRS, which is beneficial to ensure consistency of two vehicle control modes.

**[0025]** In the above embodiments, after the TSRS sends the corresponding speed restriction command to the TCC and/or RBC, further includes the following steps: reporting, by the TSRS, the final actual speed restriction status result to the CTC after a synthetical judgment of the speed restriction command execution status by acquiring speed restriction receipt information of the TCC and/or RBC.

**[0026]** In the above embodiment, the temporary speed restriction command, i.e., the TSR information can also carry a CTC number and an operator ID. The TSRS uses the CTC number and the operator ID to the TSR information so as to carry out validity verification, verifying if the CTC and the operator have control permission. Based on the guaranteed safety of train control speed restriction settings, the TSRS system carries out executable verification to the speed restriction parameters, which is beneficial for guaranteeing the validity and safety of the speed restriction plan.

**[0027]** Next, examples will be given to demonstrate the distribution principle of the temporary speed restriction command. FIG. 3 is a diagram of a usage of covering a speed restriction sign according to the embodiment of the present invention. As shown in FIG. 3, TCC, for example, realizes TSR command splits by adding modes of coverage of speed restriction signs in the interface protocol.

**[0028]** When the covered modes of the starting and end milestones (i.e. the speed restriction zone starting point and the speed restriction zone end point) of the temporary speed restriction command exceeds the line jurisdiction, it is required to add coverage speed restriction signs so as to inform the TCC to recognize the validity of the speed restriction point mileage exceeding the station jurisdiction. For station B as shown in FIG. 3, it can be considered to execute full line speed restriction. If the milestones of the speed restriction zone starting point and the speed restriction zone end point are within the line jurisdiction of the station TCC, the coverage speed restriction sign is only allowed to use 00b. In the figure,

00b represents the milestone is located within the range of the TCC line jurisdiction;

01b represents the milestone is located on the forward side of the outside of the TCC line jurisdiction (the upward direction of the downward line or the downward direction of the upward line);

10b represents the milestone is located on the reverse side of the outside of the TCC line jurisdiction (the downward direction of the downward line or the upward direction of the upward line).

**[0029]** After covering the speed restriction signs, the original command information can be preserved, making it easy to match the speed restriction command, and then integrate speed restriction status.

**[0030]** The adaptive adjustment for the C2 and C3 train control systems of the embodiment is that, because the C3 train control system additionally has a RBC device comparing to the C2 train control system, if only the C2 line does not match the RBC, the TSRS does not have to split the issued speed restriction command to the RBC.

**[0031]** FIG. 4 is a transition graph of a life-cycle maintenance state including a speed restriction TSR command according to the embodiment of the present invention. FIG. 5 is a transition graph of a life-cycle maintenance state without a speed restriction TSR command according to the embodiment of the present invention. As shown in the figures, the TSR commands are assigned as the "with speed restriction" setting and the "without speed restriction" setting. The CTC dispatcher takes the TSR setting command mode with speed restriction value of "without speed restriction" as the speed restriction cancellation command of the original TSR.

**[0032]** As seen from the figures, before the TSRS sends the corresponding temporary speed restriction command to the related TCC and/or RBC, it has to receive the activation command and the execution command sent by the CTC in sequence, and then sending. If the CTC has to cancel the temporary speed restriction command sent before, it sends the cancellation command to the TSRS; after the TSRS receives the cancellation command sent by the CTC, it sends the cancellation command to the TCC and/or the RBC, and carries the corresponding command identifier so as to identify which temporary speed restriction command is cancelled.

**[0033]** The classification description related to the TSR command status is shown in Table 1.

Table 1

| Main class     | Subclass                     | Description                                        |
|----------------|------------------------------|----------------------------------------------------|
| To be executed | Not yet activated            | Pass the verification during the proposed period   |
|                | Verification setting succeed | Pass the verification during the activation period |

(continued)

| Main class   | Subclass                                                        | Description                                                                                                      |
|--------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Reminded     | Can be activated reminded                                       | Close to the plan execution starting time point, remind once every 10 minutes as a default                       |
|              | Can be set reminded                                             | Remind when the line is empty                                                                                    |
|              | Being still partly executed and needed to be processed reminded | Because of the connection fault of partial device communications, confirm and examination on the scene is needed |
|              | Execution cancellation succeed                                  | Cancel the successful set speed restriction command, only remind once                                            |
|              | Execution withdrawing succeed                                   | Cancel the not-yet-set speed restriction command, only remind once                                               |
|              | Timeout not set reminded                                        | Exceed the plan execution end time point, still no setting, continue reminding                                   |
| In execution | Execution setting succeed                                       | Setting is valid                                                                                                 |
|              | Verification cancellation succeed                               | Pass verification, cancel verification                                                                           |

**[0034]** The distribution embodiment also provides a processing strategy for not losing the train control system speed restriction, including the file storage technology and automatic reissuing technology, wherein,

**[0035]** Regarding the file storage technology:

When initializing the TSRS, the application data alternated by the external device can be responded only after completing reading the speed restriction command storage file. For example, successful reading or reading failure of continuous 20 cycles can be regarded as read completes.

**[0036]** When the TSRS loads the command, it should verify the version of the head of the storage file and the last storage date, if they do not match, it should not load the file data into the memory. It is not compatible with the old format version; the storage date is only valid that day.

**[0037]** When the TSRS completes reading all TSR command parameters, it should make TCC and RBC attribution splits for each command, so as to enter the complete TSR command state maintenance cycle.

**[0038]** The TSRS should set all speed restriction commands successfully loaded from the file as not-yet-activated status.

**[0039]** A detecting that there is command status change in the cycle, and there is need to update the storage, it should write all speed restriction commands into a cache one-time. Then send it to a NVH module (a local hard disk) for storing, and stores according to the predefined file storage format, where the file storage format includes the current date and version number. However, it does not store the speed restriction command in withdrawing status and cancellation status.

**[0040]** The head of the storage cache need to fill the current system date and version number, so as to read back and verify: if the read back date conforms to the current system date, permit all loading; if the version number does not conform to the current format version, delete all.

**[0041]** Regarding automatic reissuing technology:

When any of the following circumstances appears, acknowledge that the temporary speed restriction command statuses of the TSRS and TCC and/or RBC are inconsistent, and then the TSRS automatically reissues the stored temporary speed restriction command to the TCC and/or RBC. After completing the reissuing, it can automatically issue the speed restriction status initial confirmation command, so that the TCC and RBC sends all speed restriction information to related vehicles:

When restarting the TSRS, TCC, RBC devices on power, or recovering after interrupting the communication, or the TSRS detects that the total TSR command number given feedback by the TCC and RBC and the total command number stored locally by the TSRS are inconsistent for continuous 5s, or the TSRS sends an all refresh request on the hour to the TCC and the RBC.

**[0042]** If restarting with the TCC or RBC executing the TSR command, and the TSRS is already in initial status, the TSRS can automatically reissue the execution of TSR command to the TCC or RBC.

**[0043]** If there is inconsistency between the TSRS and TSR command status of the TCC and RBC, it should remind

the dispatcher to confirm all the current inconsistent speed restriction status; the dispatcher should retrigger the TSR setting and cancel the process according to actual situation. Once the dispatcher completes confirming all speed restriction status, the TSRS is informed to issue line speed restriction initialization confirmation command to the TCC and the RBC.

**[0044]** If the TSRS has completed the line speed restriction initialization confirmation, and the status of TSRS are consistent with the status of the TCC and the RBC, the TSRS can automatically reissue the line speed restriction initialization confirmation command, and then can reissue the temporary speed restriction command need to be stored.

**[0045]** If the TSRS considers a TSR command is under execution status, however, the TCC and RBC has not executed the speed restriction command, the TSRS should not issue the line speed restriction initialization confirmation command to the TCC and RBC.

**[0046]** According to the present invention, the method for sending a temporary speed restriction command in C3 system can provide activation reminder and set reminder to the temporary speed restriction command, which is beneficial to guarantee the timeliness of the speed restriction validity; it can store train control speed restriction command parameters, which is beneficial to guarantee the completeness of the speed restriction command, even blackout occurs and the device is restarted, it cannot be lost; it can carry out synthetical determination to the speed restriction command execution status, so as to correctly guide the dispatcher the validity of the speed restriction command; it can also automatically reissue speed restriction command and initialization command to the TCC and RBC, which is beneficial to guarantee the completeness of the speed restriction command, and improve the usability of the train control system.

**[0047]** FIG. 6 is a schematic diagram of a temporary speed restriction server according to the embodiment of the present invention. As shown in FIG. 6, the TSRS includes a receiving module 11, a distribution module 12, and a sending module 13. Wherein the receiving module 11 is configured to receive a temporary speed restriction command issued by a centralized traffic control system CTC, wherein the temporary speed restriction command at least includes a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a scheduling command number and a station number; the distribution module 12 is configured to, according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the track line corresponding to the line number, automatically split the temporary speed restriction command for the related TCC and/or RBC; the sending module 13 is configured to send the corresponding temporary speed restriction command to the TCC and/or the RBC, and carry a command identifier for identifying the temporary speed restriction command.

**[0048]** In particular, the CTC system protocols the contents of the temporary speed restriction command, and then sends a temporary speed restriction command (TSR), where at least the following information are carried: the speed restriction value, the speed restriction zone starting point, the speed restriction zone ending point, the line number, the scheduling command number and the station number. The TSRS receives TSR information through the receiving module 11, and the distribution module 12 splits the TSR information, i.e., after the receiving module 11 receives the temporary speed restriction command issued by the CTC system, the distribution module 12, according to the speed restriction zone starting point, the speed restriction zone end point, and the jurisdiction of related TCC and/or RBC carried, distributes the temporary speed restriction command to the related TCC and RBC for execution. The distribution module 12 resets through the field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command sent to a specific TCC and/or RBC, and the sending module 13 sends the temporary speed restriction command to the TCC and/or RBC. The TCC system is responsible for controlling the transponder to send the corresponding TSR information to the C2 train; the RBC system is responsible for sending the corresponding TSR information to the C3 train through GSM-R. After the train equipped with the ATP vehicle device receives the TSR information, the train is controlled to run according to the speed restriction requirement.

**[0049]** According to the present embodiment, through setting a temporary speed restriction server in a railway system, a temporary speed restriction command can be obtained through connection with a CTC, and automatic distribution and collective management train control speed restriction commands for each TCC and RBC within the range of all line management and control can be realized by distributing the temporary speed restriction command to the related TCC, RBC, without train attendants of each station; in addition, CTCS-2 and CTCS-3 speed restriction commands can be set and cancelled simultaneously through the TSRS, which is beneficial to ensure consistency of two vehicle control modes.

**[0050]** Based on the above embodiment, the distribution module 12 in the TSRS includes:

a first distribution unit, configured to add a coverage speed restriction sign used for indicating the speed restriction zone is located within the jurisdiction before field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command sent, when a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point and the speed restriction zone end point;

a second distribution unit, configured to add a first sign used to indicate the speed restriction zone is located within the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction

before the field information of the speed restriction zone end point when a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point but the speed restriction zone end point;

a third distribution unit, configured to add a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a first sign used to indicate the speed restriction zone is located within the jurisdiction before the field information of the speed restriction zone end point when a TCC and / or RBC's jurisdiction does not cover the speed restriction zone starting point but covers the speed restriction zone end point;

a fourth distribution unit, configured to add a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction before the field information of the speed restriction zone end point when a TCC and / or RBC's jurisdiction does not cover the speed restriction zone starting point or the speed restriction zone end point.

**[0051]** The TSRS may also include an authentication module configured to authenticate legitimacy of the speed restriction value, the speed restriction zone starting point, the speed restriction zone end point, the line number, and the station number. And it can include a storage module configured to stores the temporary speed restriction command to a local hard disk according to a predetermined file storage format, wherein the file storage format comprises a current date and a version number. And it can also include an automatic reissuing module configured to reissue the stored temporary speed restriction command to the TCC and/or the RBC when a detection indicates that status of the temporary speed restrictions of the TSRS and the TCC and/or the RBC are inconsistent. The function of the temporary speed restriction server provided by the embodiment can refer to the processing process provided by the above method embodiment, which will not be repeated.

**[0052]** FIG. 7 is a hardware frame diagram of a general safety platform of a temporary speed restriction server according to the embodiment of the present invention. As shown in FIG. 7, a C3 temporary speed restriction server includes two independent subsystems, a first subsystem and a second subsystem. Each subsystem includes an internal communication server, a first server, a second server and a third server respectively connected to the internal communication server, the internal communication server in the first subsystem is connected to the internal communication server in the second subsystem; wherein the receiving module 11 and the sending module 13 disclosed in the above embodiments can be integrated in the first server, and the second server and the third server may constitute the distribution module 12.

**[0053]** FIG. 8 is a software frame diagram of a general safety platform according to the embodiment of the present invention. The TSRS host is realized based on the fault safety computer platform of the Double 2-Vote-2 off-the-shelf general server, where each series is composed of three general servers, respectively called as a first server A, a second server B, and a third server C, and interactively communicated through an internal communication server. Wherein, A and B form 2-Vote-2 used for comparison between two machines, which use different CPU chips and operation systems, so as to improve the comparison reliability; only C connects to the external exchange machine, and it makes the TSRS host exchange information with the outside through different network segments by dividing the VLAN to the external exchange machine, so as to satisfy the expansion of external interface quantities and information safety separation between different systems.

**[0054]** FIG. 9 is a schematic diagram of a control system according to the embodiment of the present invention. As shown in FIG. 9, the control system includes a temporary speed restriction server TSRS1, a centralized traffic control system CTC 2, a train control center TCC3 and a radio block center RBC4 respectively connected to the TSRS1. The TSRS1 according to the embodiment may use the temporary speed restriction server provided by the above apparatus embodiment, and the processing process can refer to the processing process provided by the above method embodiment which will not be repeated.

**[0055]** In the control system provided by the embodiment, the interface devices between each device are arranged as follows.

**[0056]** Regarding the interface of the TSRS and the CTC:

When the dispatcher operates and protocols the temporary speed restriction command, the CTC should send the parameter information of the temporary speed restriction command to the TSRS, at least including the CTC number, the operator ID, the dispatching command number, the train number, the speed restriction value, the speed restriction zone starting point, the speed restriction zone end point, the line number, and the speed restriction reason code;

When the TSRS receives the verification command, the execution command, and the cancellation command, issued by the CTC, the TSRS should send back the corresponding result to the CTC within 2 seconds;

the temporary speed restriction command status sent back by the TSRS should completely include the temporary speed restriction parameter information;

when the TSRS sends back the wrong code of the temporary speed restriction command to the CTC, the CTC should analyze the display according to the arranged meaning of the wrong code;

the TSRS should simultaneously return the command execution result to the CTC for displaying.

**[0057]** Regarding the interface between the TCC and RBC:

The TSRS should use timely modes to issue operation commands of setting execution, cancellation verification, and cancellation execution to the TCC and RBC, and indicate a corresponding command identifier.

**[0058]** When the communications between the TSRS and TCC, RBC recover, the TSRS should send a refreshing request commands to the TCC and RBC, and the TCC and RBC should return all the temporary speed restriction commands at execution status.

**[0059]** Regarding the interface between adjacent TSRSs:

The adjacent TSRSs should timely exchange temporary speed restriction commands related to the jurisdiction border and corresponding execution result information.

**[0060]** If the TSRS considers there is communication interruption between adjacent TSRSs, the TSRS should send warning to the CTC.

**[0061]** According to the system in the embodiment of the present invention, the hardware system of the TSRS uses redundant structure established by a Double 2-Vote-2 safety general server; uses network redundant connection to all the interface of the peripheral system, and uses the exchanger as an external interface of the whole system; in order to guarantee the validity of the speed restriction command plan, a full-cycle maintenance means for speed restriction command is used, from the early stage of command proposing, verification, execution, until cancellation, an overall valid detection is performed, and an exchange is implemented according to the arranged status mechanism, and corresponding status display is given through maintaining the terminal interface; in order to prevent the loss of the train control system speed restriction command, a file storage technology is used in the present invention, when the TSRS device restarts due to its own fault, all the speed restriction commands can still be read back; a automatic reissuing technology is also used in the present invention, when any of TCC and RBC fault restarts, the TSRS will automatically reissue all the speed restriction commands to the TCC and RBC; the system according to the present invention is not only used for the CTCS-3 train control system line, but also for the CTCS-2 train control system line.

**[0062]** Finally, it should be noted that the above embodiments are merely provided for describing the technical solutions of the present invention, but not intended to limit the present invention. It should be appreciated by persons skilled in the art that although the present invention has been described in detail with reference to the foregoing embodiments, modifications can be made to the technical solutions described in the foregoing embodiments, or equivalent replacements can be made to some technical features in the technical solutions; however, such modifications or replacements do not cause the essence of corresponding technical solutions to depart from the spirit and scope of the embodiments of the present invention.

## Claims

1. A method for sending a temporary speed restriction command in C3 system, comprising:

receiving, by a temporary speed restriction server TSRS, a temporary speed restriction command issued by a centralized traffic control system CTC, wherein the temporary speed restriction command at least comprises a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a scheduling command number and a station number;

automatically splitting, by the TSRS, the temporary speed restriction command for the related TCC and/or RBC according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the railway line corresponding to the line number;

sending, by the TSRS, the corresponding temporary speed restriction command to the TCC and/or the RBC, and carrying a command identifier for identifying the temporary speed restriction command.

2. The method for sending a temporary speed restriction command in C3 system according to claim 1, wherein the TSRS, according to the speed restriction zone starting point, the speed restriction zone end point, and the jurisdiction of each train control center TCC and/or radio block center RBC on the railway line corresponding to the line number, automatically splitting the temporary speed restriction command for the related TCC and/or RBC, comprising:

if a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point and the speed restriction

zone end point, adding, before field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command sent, a coverage speed restriction sign used for indicating the speed restriction zone is located within the jurisdiction;

if a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point but fails to cover the speed restriction zone end point, adding, before the speed restriction zone starting point in the temporary speed restriction command sent, a first sign used to indicate the speed restriction zone is located within the jurisdiction, and adding, before the field information of the speed restriction zone end point, a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction;

if a TCC and/or RBC's jurisdiction does not cover the speed restriction zone starting point but covers the speed restriction zone end point, adding, before the speed restriction zone starting point in the temporary speed restriction command sent, a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction, and adding, before the field information of the speed restriction zone end point, a first sign used to indicate the speed restriction zone is located within the jurisdiction of coverage;

if a TCC and/or RBC's jurisdiction does not cover the speed restriction zone starting point or the speed restriction zone end point, adding, before the speed restriction zone starting point in the temporary speed restriction command sent, a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction, and add, before the field information of the speed restriction zone end point, a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction.

3. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the temporary speed restriction command further comprises: a CTC number and an operator ID.

4. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the TSRS sending the corresponding temporary speed restriction command to the TCC and/or the RBC comprises:

sending, by the TSRS, the corresponding temporary speed restriction command to the TCC and/or the RBC after receiving activation command and execution command sent by the CTC.

5. The method for sending a temporary speed restriction command in C3 system according to claim 4, wherein the method further comprises:

sending, by the TSRS, a cancellation command to the TCC and / or the RBC, and carries a corresponding command identifier after receiving the cancellation command sent by the CTC.

6. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the method further comprises:

storing, by the TSRS, the temporary speed restriction command to a local hard disk according to a predetermined file storage format after receiving the temporary speed restriction command sent by the CTC, wherein file storage format comprises a current date and a version number.

7. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the method further comprises:

if a detection indicates that statuses of the temporary speed restriction of the TSRS and the TCC and/or the RBC are inconsistent, the TSRS automatically reissues the stored temporary speed restriction command to the TCC and/or the RBC.

8. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the method further comprises:

reporting, by the TSRS, the final actual speed restriction status result to the CTC after implementing a comprehensive judgment of the speed restriction command execution status by means of acquiring speed restriction receipt information of the TCC and/or RBC.

9. The method for sending a temporary speed restriction command in C3 system according to claim 1 or 2, wherein the method further comprises:

implementing, by the TSRS, executable check for the speed restriction value, the speed restriction zone starting point, the speed restriction zone end point, the line number, and the station number.

**10. A temporary speed restriction server, comprising:**

a receiving module, configured to receive a temporary speed restriction command issued by a centralized traffic control system CTC, wherein the temporary speed restriction command at least comprises a speed restriction value, a speed restriction zone starting point, a speed restriction zone end point, a line number, a scheduling command number and a station number;

a distribution module, configured to automatically split the temporary speed restriction command for the related TCC and/or RBC according to the speed restriction zone starting point, the speed restriction zone end point, and jurisdiction of each train control center TCC and/or radio block center RBC on the railway line corresponding to the line number;

a sending module, configured to send the corresponding temporary speed restriction command to the TCC and/or the RBC, and carry a command identifier for identifying the temporary speed restriction command.

**11. The temporary speed restriction server according to claim 10, wherein the distribution module comprises:**

a first distribution unit, configured to add a coverage speed restriction sign used for indicating the speed restriction zone is located within the jurisdiction before field information of the speed restriction zone starting point and the speed restriction zone end point in the temporary speed restriction command sent, when a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point and the speed restriction zone end point;

a second distribution unit, configured to add a first sign used to indicate the speed restriction zone is located within the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction before the field information of the speed restriction zone end point, when a TCC and/or RBC's jurisdiction covers the speed restriction zone starting point but the speed restriction zone end point;

a third distribution unit, configured to add a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a first sign used to indicate the speed restriction zone is located within the jurisdiction before the field information of the speed restriction zone end point when a TCC and/or RBC's jurisdiction does not cover the speed restriction zone starting point but covers the speed restriction zone end point;

a fourth distribution unit, configured to add a third sign used to indicate the speed restriction zone is located on the reverse side of the jurisdiction before the speed restriction zone starting point in the temporary speed restriction command sent, and add a second sign used to indicate the speed restriction zone is located on the forward side of the jurisdiction before the field information of the speed restriction zone end point, when a TCC and / or RBC's jurisdiction does not cover the speed restriction zone starting point or the speed restriction zone end point.

**12. The temporary speed restriction server according to claim 10, wherein it further comprises:**

an authentication module, configured to authenticate legitimacy of the speed restriction value, the speed restriction zone starting point, the speed restriction zone end point, the line number, and the station number.

**13. The temporary speed restriction server according to claim 10, wherein it further comprises:**

a storage module, configured to stores the temporary speed restriction command to a local hard disk according to a predetermined file storage format, wherein the file storage format comprises a current date and a version number.

**14. The temporary speed restriction server according to claim 10, wherein it further comprises:**

an automatic reissuing module, configured to reissue the stored temporary speed restriction command to the TCC and/or the RBC when a detection indicates that statuses of the temporary speed restriction of the TSRS and the TCC and/or the RBC are inconsistent.

**15. The temporary speed restriction server according to any of claims 10 to 14, wherein the temporary speed restriction server comprises two independent subsystems, each subsystem comprises an internal communication server, a**

first server, a second server and a third server respectively connected to the internal communication server, the internal communication servers of two separate subsystems connected to each other; wherein the receiving module and the sending module are integrated in the first server, and the second server and the third server constitute the distribution module.

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16. A control system, comprising a temporary speed restriction server according to any of claims 10 to 15, a centralized traffic control system CTC, a train control center TCC, and a radio block center RBC respectively connected to the temporary speed restriction server.

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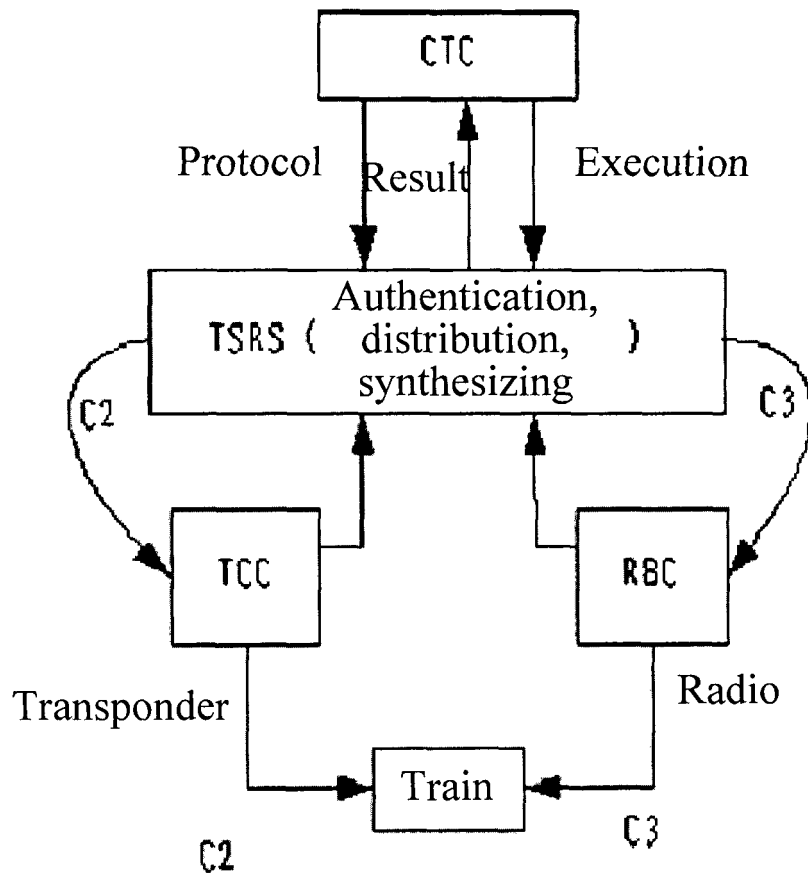


FIG. 1

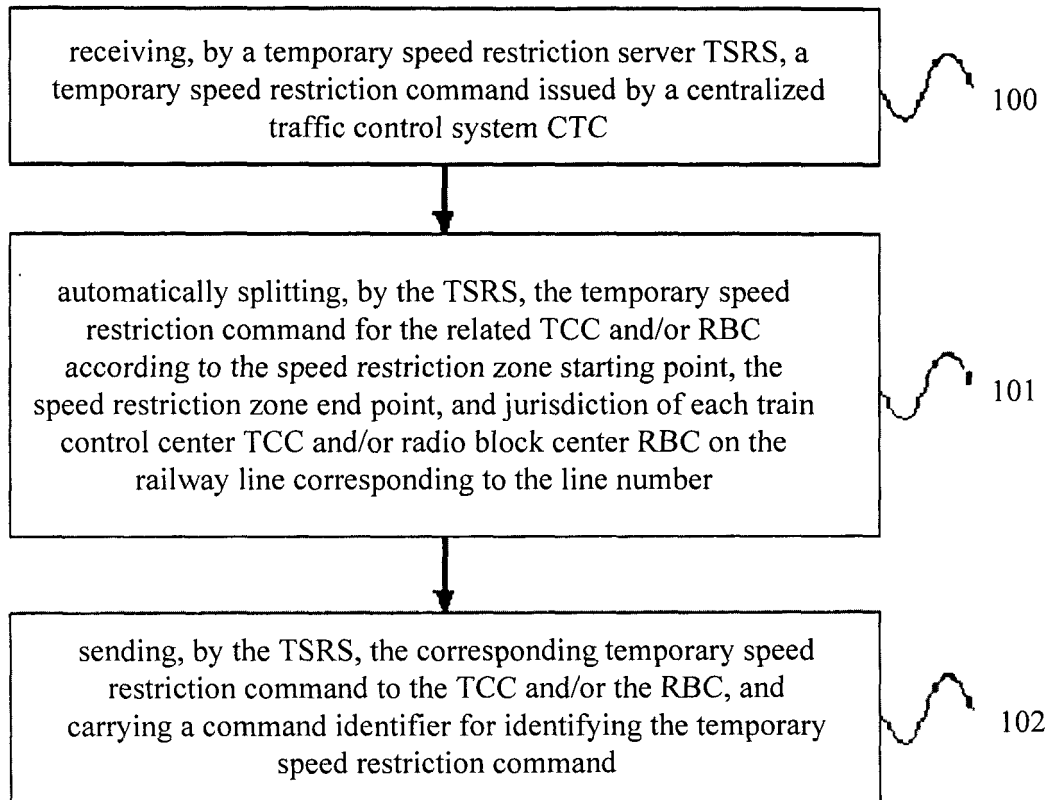


FIG. 2

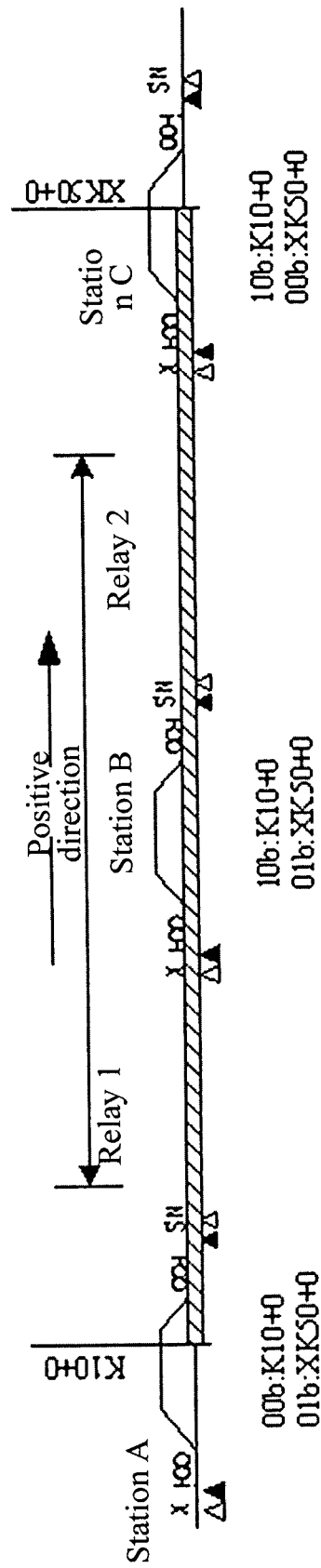


FIG. 3

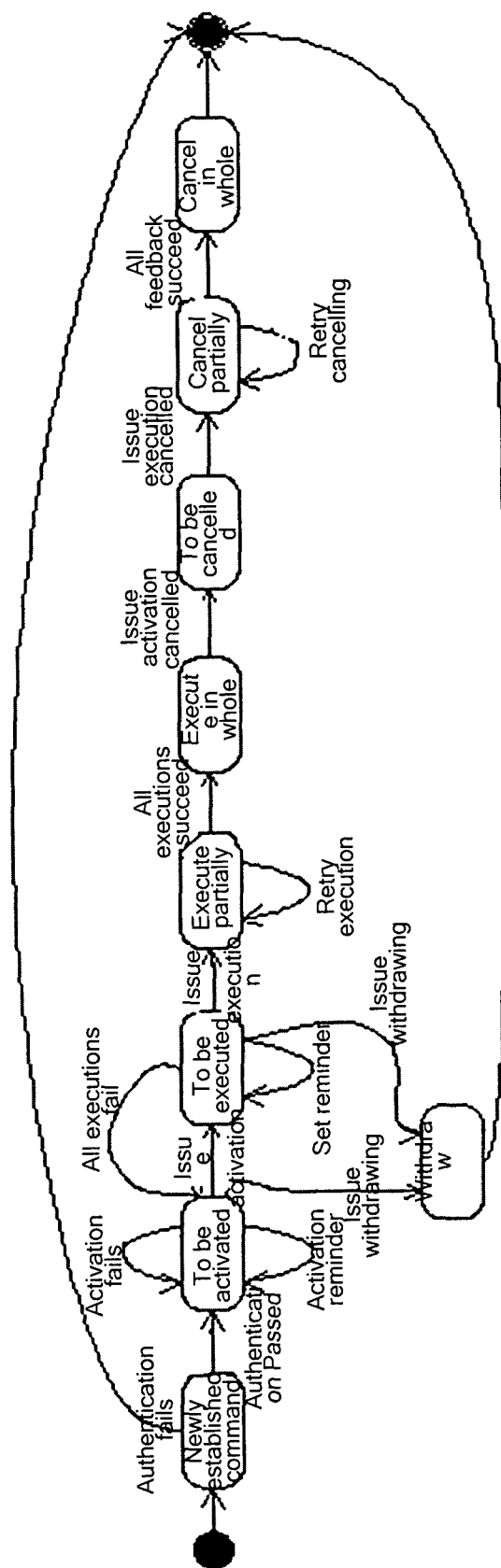


FIG. 4

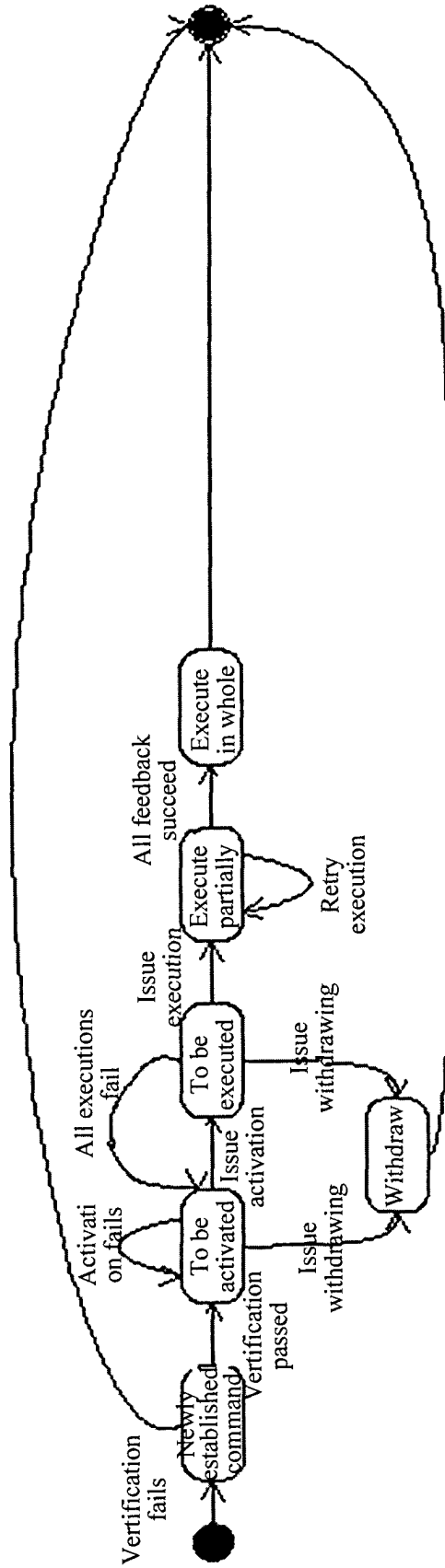


FIG. 5

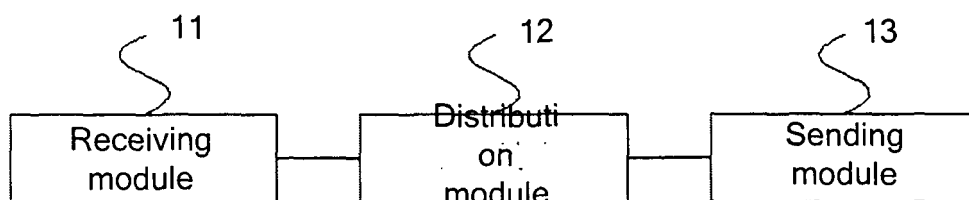


FIG. 6

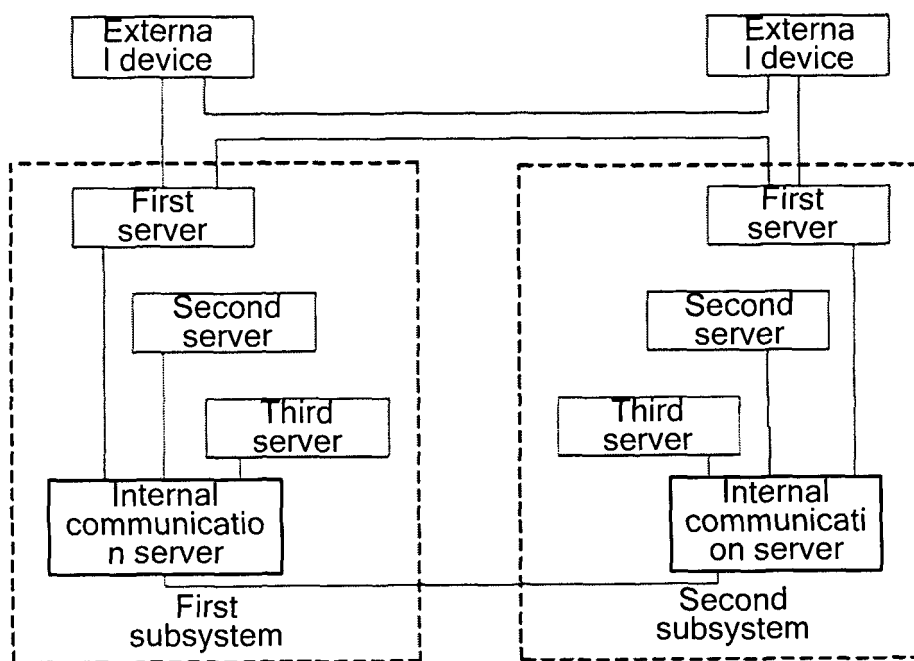


FIG. 7

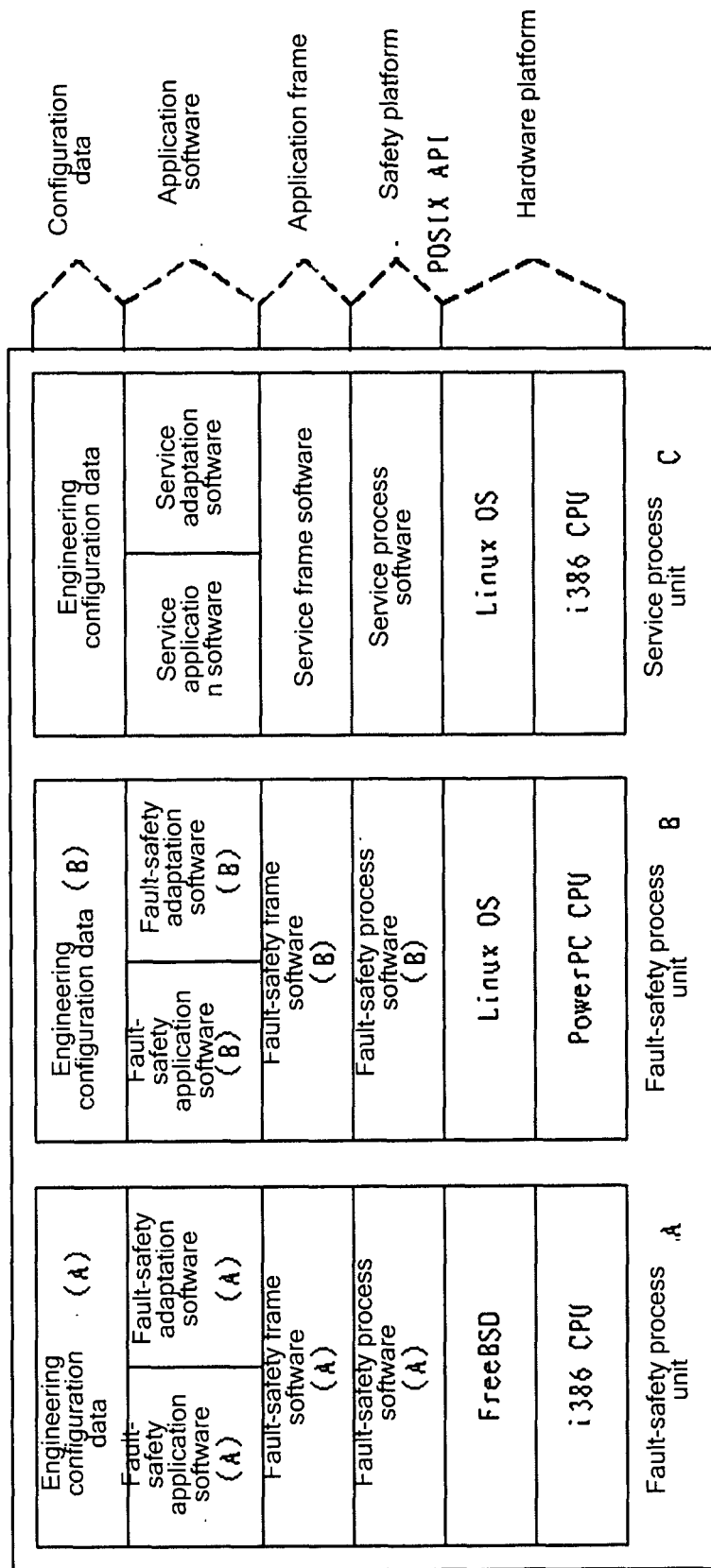


FIG. 8

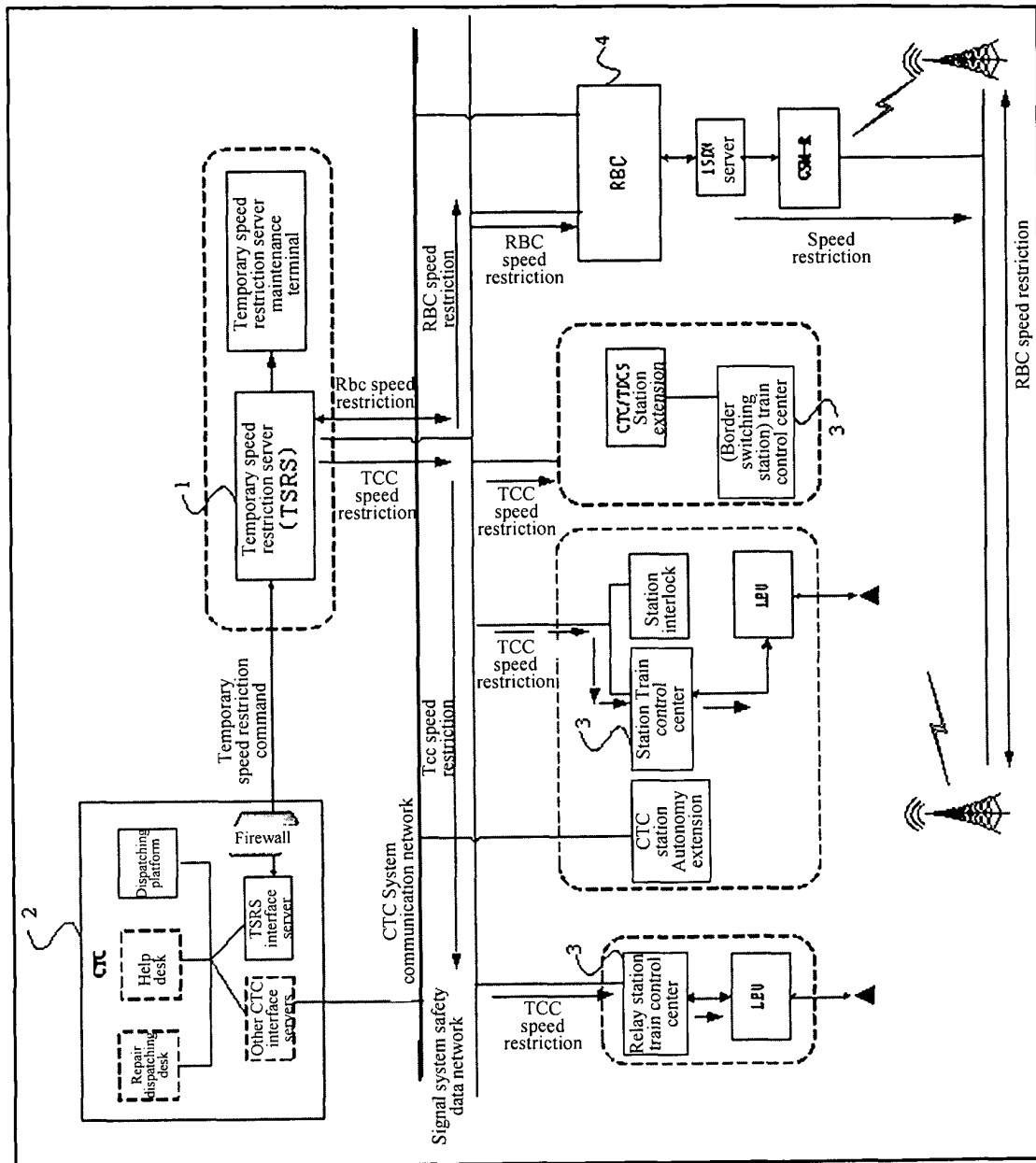


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/075574

## A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B61L, H04B, H04L, H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CPRS; CNTXT; CNKI; VEN: temporary speed restriction, release, train control centre, radio block centre, TSRS, TSR, limit+ s speed, restrict+ s speed, revision s speed, receiv+, reception, split+, resolution, distribut+, divide?, division, allot+, partition+, allocat+, send+, transmit+, transfer+, activat+, execut+, cancel+, centraliz+ s control+, CTC, TCC, train s control+, RBC, radio s block+, label+, mark+, sign?, tag?, symbol?, ID, identif+

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                             | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| PX        | CN 102267477 A (BEIJING NATIONAL RAILWAY RESEARCH & DESIGN INSTITUTE OF SIGNAL & COMMUNICATION CO., LTD.), 07 December 2011 (07.12.2011), claims 1-16                                          | 1-16                  |
| PX        | CN 102211600 A (BEIJING HOLLYSYS SYSTEM ENGINEERING CO., LTD.), 12 October 2011 (12.10.2011), description, paragraphs 23-53                                                                    | 1                     |
| Y         | YUE, Chaopeng et al., Exploration of the Development of TSR Setting Technology, RAILWAY SIGNALLING & COMMUNICATION, May 2010, vol. 46, no. 5, pages 12-15, ISSN 1000-7458                      | 1, 3-6, 8-10, 13, 16  |
| Y         | HUANG, Yuanyuan et al., Simulation Study of the Impact of Temporary Speed Restriction on Trains, RAILWAY SIGNALLING & COMMUNICATION, January 2011, vol. 47, no. 1, pages 13-15, ISSN 1000-7458 | 1, 3 -6, 8-10, 13, 16 |

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                                                                     |
| "E" earlier application or patent but published on or after the international filing date                                                                               | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" document member of the same patent family                                                                                                                                                                                                    |
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| "P" document published prior to the international filing date but later than the priority date claimed                                                                  |                                                                                                                                                                                                                                                  |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Date of the actual completion of the international search<br>18 July 2012 (18.07.2012)                                                                                                                             | Date of mailing of the international search report<br>09 August 2012 (09.08.2012) |
| Name and mailing address of the ISA/CN:<br>State Intellectual Property Office of the P. R. China<br>No. 6, Xitucheng Road, Jimenqiao<br>Haidian District, Beijing 100088, China<br>Facsimile No.: (86-10) 62019451 | Authorized officer<br><br>LIU, Jin<br><br>Telephone No.: (86-10) 62085726         |

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/075574

| Category | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                       | Relevant to claim No. |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y        | WU, Jiangjiao et al., Research on Execution Time of Temporary Speed Restriction in Train Control System, RAILWAY SIGNALLING & COMMUNICATION, May 2008, vol. 44, no. 5, pages 8-9, ISSN 1000-7458         | 1, 3-6, 8-10, 13, 16  |
| A        | AI, Wu, Analysis and Treatment of Temporary Speed Limit Fault of Large-Span Passenger Dedicated Lines with CTCs-2 Level, SHANGHAI RAILWAY SCIENCE & TECHNOLOGY, 2010, no. 1, pages 22-23, ISSN 1671-699X | 2                     |
| A        | WANG, Yunzhu et al., Application of FTA in the risk analysis of C3 train control system, INFORMATION TECHNOLOGY, 2009, no. 10, pages 10-12 and 16, ISSN 1009-2552                                        | 1-16                  |
| A        | JP 2010-95217 A (KYOSAN ELECTRIC MFG), 30 April 2010 (30.04.2010), the whole document                                                                                                                    | 1-16                  |
| A        | US 5950966 A (WESTINGHOUSE AIRBRAKE COMPANY), 14 September 1999 (14.09.1999), the whole document                                                                                                         | 1-16                  |

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

PCT/CN2012/075574

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/075574

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CONTINUATION: CLASSIFICATION OF SUBJECT MATTER

B61L 27/00 (2006.01) i  
H04L 29/08 (2006.01) i

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- CN 201110125309X [0001]