

METHOD AND DEVICE FOR CONTROLLING LOCOMOTIVE AIR ANTI-SLIP SYSTEM

5 **[0001]** The present application claims priority to Chinese Patent Application No. 201410171069.0, titled "METHOD AND DEVICE FOR CONTROLLING LOCOMOTIVE AIR ANTI-SLIP SYSTEM", filed on April 25, 2014 with the State Intellectual Property Office of People's Republic of China, which is incorporated herein by reference in its entirety.

10 **FIELD**

[0002] The present disclosure relates to the technical field of locomotive air anti-skid control, and in particular to a controlling method and a device for a locomotive air anti-skid system.

15 **BACKGROUND**

[0003] In practice, an air anti-skid system is normally provided to a locomotive in order to avoid a risk such as a bruise of a wheel or a collision caused by a skid of wheels of the locomotive due to a low adhesion coefficient in a brake of the locomotive. When the wheels of the locomotive are about to skid, the air anti-skid system controls an anti-skid valve to
20 interfere the magnitude of pressure of a brake cylinder pipe. Therefore, the wheels of the locomotive are avoided from skid by changing the pressure of the cylinder pipe.

[0004] However, in a case of an emergency braking procedure under a lasting bad condition of adhesion between the wheels and surfaces of rails, or in a case of a failed air anti-skid system, the air anti-skid system may reduce the pressure of the brake cylinder pipe to zero and
25 maintaining the zero pressure of the brake cylinder pipe, resulting in a continuous loss of brake force, which seriously affects the operation safety of the locomotive. Therefore, it is desired to solve the technical problem of how to ensure the operation safety in emergency braking under any conditions.

SUMMARY

[0005] In view of the above, a controlling method and a controlling device for a locomotive air anti-skid system are provided according to the present disclosure, for ensuring an emergency braking force to be effective under any conditions of cohesion between wheels of a locomotive and surfaces of rails, thereby ensuring the operation safety of the locomotive.

[0006] In order to achieve the above object, following technical solutions are provided according to the present disclosure.

[0007] A controlling method for a locomotive air anti-skid system, includes:

[0008] obtaining a current brake initial speed of a locomotive and starting a timer upon receiving an emergency brake signal for the locomotive;

[0009] calculating a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation;

[0010] determining whether a current time of the timer is less than the cut-off time; and

[0011] cutting off all functions of the locomotive air anti-skid system until the emergency brake signal disappears, if it is determined that the current time of the timer is not less than the cut-off time.

[0012] Preferably, before the obtaining a current brake initial speed of a locomotive and starting a timer upon receiving an emergency brake signal for the locomotive, the controlling method may further include:

[0013] obtaining operation monitoring data of the locomotive;

[0014] determining whether the emergency brake signal for the locomotive is received based on the operation monitoring data; and

[0015] resetting the timer if it is determined that the emergency brake signal for the locomotive is not received.

[0016] Preferably, the cutting off all functions of the locomotive air anti-skid system until the emergency brake signal disappears may include:

[0017] determining whether the emergency brake signal disappears; and

[0018] resetting the timer if it is determined that the emergency brake signal disappears; or

[0019] continuing to cut off all functions of the locomotive air anti-skid system if it is determined that the emergency brake signal does not disappear.

[0020] Preferably, the first predetermined equation may be a first order function of a brake initial speed.

5 **[0021]** Preferably, the first predetermined equation may be expressed as:

$$t = 2 \bullet \left(\frac{v}{3.6 \bullet a} + 1.5 \right) + 3$$

[0022] where v denotes the current brake initial speed, t denotes the cut-off time corresponding to the current brake initial speed, and a denotes an emergency brake deceleration of the locomotive.

10 **[0023]** Preferably, the controlling method may further include:

[0024] monitoring an operation speed of the locomotive in a real-time manner.

[0025] A controlling device for a locomotive air anti-skid system, includes:

[0026] a first obtaining module configured to obtain a current brake initial speed of a locomotive and start a timer upon receiving an emergency brake signal for the locomotive;

15 **[0027]** a first calculating module configured to calculate a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation;

[0028] a first determining module configured to determine whether a current time of the timer is less than the cut-off time; and

20 **[0029]** a first cut-off module configured to cut off all functions of the locomotive air anti-skid system until the emergency brake signal disappears, if the first determining module determines that the current time of the timer is not less than the cut-off time.

[0030] Preferably, the device may further include:

[0031] a second obtaining module configured to obtain operation monitoring data of the locomotive;

[0032] a second determining module configured to determine whether the emergency brake signal for the locomotive is received based on the operation monitoring data; and

[0033] a first resetting module configured to reset the timer if the second determining module determines that the emergency brake signal for the locomotive is not received.

[0034] Preferably, the device may further include:

[0035] a third determining module configured to determine whether the emergency brake signal received by the first obtaining module disappears, where the first resetting module is triggered if the third determining module determines that the emergency brake signal disappears, or the first cut-off module is triggered if the third determining module determines that the emergency brake signal does not disappear.

[0036] Preferably, the device may further include:

[0037] a first monitoring module configured to monitor an operation speed of the locomotive in a real-time manner.

[0038] It follows from the above technical solution that, the controlling method and the device for the locomotive air anti-skid system are provided according to the present disclosure. As compared with the conventional technology, the current brake initial speed of the locomotive is obtained and the timer is started when the emergency brake signal for the locomotive is received by the locomotive air anti-skid system. The cut-off time corresponding to the current brake initial speed is calculated by bringing the obtained current brake initial speed into the first predetermined equation. It is determined whether a current time of the timer is less than the cut-off time, and all functions of the locomotive air anti-skid system are cut off automatically if it is determined that the current time of the timer is not less than the cut-off time. Thus, the air anti-skid system temporarily fails to act on a brake cylinder pipe and therefore a braking force of the brake cylinder pipe restores, such that the locomotive is timely stopped under the action of the braking force, thereby guaranteeing the operation safety of the locomotive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] The accompanying drawings needed to be used in the description of the embodiments or the conventional technology are described briefly as follows, so that the technical solutions according to the embodiments of the present disclosure or according to the conventional technology become clearer. It is apparent that the accompanying drawings in the

following description are only some embodiments of the present disclosure. For those skilled in the art, other accompanying drawings may be obtained according to these accompanying drawings without any creative work.

[0040] Figure 1 is a flowchart of a controlling method for a locomotive air anti-skid system according to the present disclosure;

[0041] Figure 2 is a flowchart of another controlling method for a locomotive air anti-skid system according to the present disclosure; and

[0042] Figure 3 is a structural schematic diagram of a controlling device for a locomotive air anti-skid system according to the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0043] The technical solution according to the embodiments of the present disclosure is described clearly and completely as follows in conjunction with the accompanying drawings in the embodiments of the present disclosure. It is apparent that the described embodiments are only a part of the embodiments according to the present disclosure. All the other embodiments obtained by those skilled in the art based on the embodiments in the present disclosure without any creative work fall into the scope of the present disclosure.

[0044] In a controlling method and a system for a locomotive air anti-skid system according to embodiments of the present disclosure, a current brake initial speed of a locomotive is obtained and a timer is started when an emergency brake signal for the locomotive is received by the locomotive air anti-skid system. A cut-off time corresponding to the current brake initial speed is calculated by bringing the obtained current brake initial speed into a first predetermined equation. It is determined whether a current time of the timer is less than the cut-off time, and all functions of the locomotive air anti-skid system is cut off automatically if it is determined that the current time of the timer is not less than the cut-off time. Thus, the air anti-skid system temporarily fails to act on a brake cylinder pipe and a braking force of the brake cylinder pipe restores gradually, such that the locomotive is timely stopped under the action of the braking force, thereby guaranteeing the operation safety of the locomotive.

[0045] First Embodiment

[0046] Figure 1 is a flowchart of a controlling method for a locomotive air anti-skid system

according to the present disclosure. Referring to Figure 1, the controlling method may include step S101 to step S106 as follows.

[0047] Step S101 includes obtaining a current brake initial speed of a locomotive and starting a timer upon receiving an emergency brake signal for the locomotive.

5 **[0048]** In practice, an air anti-skid system of a locomotive receives an emergency brake signal when a driver performs an emergency brake on the locomotive. At this point, the locomotive air anti-skid system may obtain a current brake initial speed of the locomotive and start a timer for subsequent calculations.

10 **[0049]** In another embodiment, the air anti-skid system of the locomotive may monitor and record an operation speed of the locomotive in a real-time manner. In this way, the air anti-skid system may timely obtain the current brake initial speed of the locomotive once receiving the emergency brake signal.

15 **[0050]** In the embodiment of the present disclosure, the emergency brake signal received by the air anti-skid system is normally a level signal. If a level signal received by the air anti-skid system is of a high level, it indicates that an emergency brake is performed on the locomotive. And if the level signal received by the air anti-skid system is of a low level, it indicates that no emergency brake is performed on the locomotive, which means the air anti-skid system does not receive the emergency brake signal.

20 **[0051]** Step S102 includes calculating a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation.

[0052] The first predetermined equation may be expressed as:

$$t = 2 \bullet \left(\frac{v}{3.6 \bullet a} + 1.5 \right) + 3$$

25 **[0053]** where v denotes the obtained current brake initial speed having a unit of km/h (kilometer per hour), t denotes the cut-off time corresponding to the current brake initial speed and having a unit of s (second), and a denotes an emergency brake deceleration of the locomotive. It should be noted that a may be set a value according to the model of the locomotive and practical conditions, which is not limited herein. In an embodiment, a may be equal to 1.3m/s².

[0054] Step S103 includes determining whether a current time of the timer is less than the cut-off time. The process goes to step S104 if it is determined that the current time of the timer is not less than the cut-off time, or goes to step S105 if it is determined that the current time of the timer is less than the cut-off time.

5 **[0055]** Step S104 includes cutting off all functions of the locomotive air anti-skid system.

[0056] In an embodiment of the present disclosure, after the cut-off time corresponding to the current brake initial speed is calculated, it is determined whether the current time of the timer reaches the cut-off time. If it is determined that the current time of the timer reaches the cut-off time, all functions of the air anti-skid system are cut off automatically, that is, the air
10 anti-skid system becomes inactive and has no effect on a brake cylinder. Therefore, an emergency brake force of the brake cylinder restores to a normal state from a losing state, that is, the brake cylinder starts to perform an emergency brake on the locomotive in order to stop the locomotive timely under the function of the emergency brake force, avoiding a safety threat to the operation of the locomotive caused by continuous loss of brake force of the brake
15 cylinder due to action of the air anti-skid system.

[0057] Step S105 includes determining whether the emergency brake signal disappears. The process goes to step S106 if it is determined that the emergency brake signal disappears, or returns to step S103 if it is determined that the emergency brake signal does not disappear.

[0058] Step S106 includes resetting the timer.

20 **[0059]** In an embodiment of the present disclosure, the air anti-skid system is not always in the inactive state. When the emergency brake signal received by the air anti-skid system disappears, that is, when the received level signal becomes a low level signal, the air anti-skid system restores to be in a normal operation state and resets the timer for subsequent use.

[0060] It follows that, in the embodiment of the present disclosure, the current brake initial
25 speed of the locomotive is obtained and the timer is started when the emergency brake signal for the locomotive is received by the locomotive air anti-skid system. The cut-off time corresponding to the current brake initial speed is calculated by bringing the obtained current brake initial speed into the first predetermined equation. It is determined whether a current time of the timer is less than the cut-off time, and all functions of the locomotive air anti-skid
30 system are cut off automatically if it is determined that the current time of the timer is not less

than the cut-off time. Thus, the air anti-skid system temporarily fails to act on a brake cylinder piper and therefore a braking force of the brake cylinder pipe restores, such that the locomotive is timely stopped under the action of the braking force, thereby guaranteeing the operation safety of the locomotive.

5 **[0061]** Second Embodiment

[0062] Figure 2 is a flowchart of another controlling method for a locomotive air anti-skid system according to the present disclosure. Referring to Figure 2, the controlling method may include step S201 to step S208 as follows.

[0063] Step S201 includes obtaining operation monitoring data of a locomotive.

10 **[0064]** Step S202 includes determining whether an emergency brake signal for the locomotive is received based on the operation monitoring data. The process goes to step S203 if it is determined that the emergency brake signal for the locomotive is received, or goes to step S208 if it is determined that the emergency brake signal for the locomotive is not received.

15 **[0065]** Step S203 includes obtaining a current brake initial speed of a locomotive and starting a timer.

[0066] Step S204 includes calculating a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation.

[0067] The first predetermined equation may be expressed as:

$$20 \quad t = 2 \bullet \left(\frac{v}{3.6 \bullet a} + 1.5 \right) + 3$$

[0068] where v denotes the obtained current brake initial speed having a unit of km/h (kilometer per hour), t denotes the cut-off time corresponding to the current brake initial speed and having a unit of s (second), and a denotes an emergency brake deceleration of the locomotive.

25 **[0069]** Step S205 includes determining whether a current time of the timer is less than the cut-off time. The process goes to step S206 if it is determined that the current time of the timer is not less than the cut-off time, or goes to step S207 if it is determined that the current time of the timer is less than the cut-off time.

[0070] Step S206 includes cutting off all functions of the locomotive air anti-skid system.

[0071] Step S207 includes determining whether the emergency brake signal disappears. The process goes to step S208 if it is determined that the emergency brake signal disappears, or returns to step S205 if it is determined that the emergency brake signal does not disappear.

5 **[0072]** Step S208 includes resetting the timer.

[0073] In the embodiment of the present disclosure, the current brake initial speed of the locomotive is obtained and the timer is started when it is determined based on the obtained monitoring data of the locomotive that the emergency brake signal for the locomotive is received by the locomotive air anti-skid system. The cut-off time corresponding to the current
10 brake initial speed is calculated by bringing the obtained current brake initial speed into the first predetermined equation. All functions of the locomotive air anti-skid system are cut off automatically when the current time of the timer reaches the cut-off time. Thus, the air anti-skid system temporarily fails to act on a brake cylinder pipe and therefore a braking force of the brake cylinder pipe restores, such that the locomotive is timely stopped under the
15 action of the braking force, thereby guaranteeing the operation safety of the locomotive.

[0074] Third Embodiment

[0075] Figure 3 is a structural schematic diagram of a controlling device for a locomotive air anti-skid system according to the present disclosure. Referring to Figure 3, the device may include a first obtaining module S301, a first calculating module S302, a first determining
20 module S303 and a first cut-off module S304.

[0076] The first obtaining module S301 is configured to obtain a current brake initial speed of a locomotive and start a timer upon receiving an emergency brake signal for the locomotive.

[0077] Preferably, the device may further include a second obtaining module, a second
25 determining module and a first resetting module.

[0078] The second obtaining module is configured to obtain operation monitoring data of the locomotive.

[0079] In practice, the second obtaining module may obtain the data in a real-time manner or in a periodical manner, which is not limited herein.

[0080] The second determining module is configured to determine whether the emergency brake signal for the locomotive is received based on the operation monitoring data.

[0081] The emergency brake signal may be a level signal. If the level signal is of a high level, it indicates that an emergency brake is performed on the locomotive and the emergency brake signal is received by the second obtaining module.

[0082] The first resetting module is configured to reset the timer if the second determining module determines that the emergency brake signal for the locomotive is not received.

[0083] In practice, the timer is reset if it is determined that the emergency brake signal for the locomotive is not received, in order to facilitate timing from zero by the timer in a next brake operation.

[0084] In another embodiment of the present disclosure, the device may further include a first monitoring module.

[0085] The first monitoring module is configured to monitor an operation speed of the locomotive in a real-time manner. In this way, a current operation speed of the locomotive may be timely obtained as the current brake initial speed from the first monitoring module once the second determining module determines that an emergency brake signal is received.

[0086] The first calculating module S302 is configured to calculate a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation.

[0087] The first predetermined equation may be expressed as:

$$t = 2 \bullet \left(\frac{v}{3.6 \bullet a} + 1.5 \right) + 3$$

[0088] where v denotes the obtained current brake initial speed having a unit of km/h (kilometer per hour), t denotes the cut-off time corresponding to the current brake initial speed and having a unit of s (second), and a denotes an emergency brake deceleration of the locomotive which may be determined according to the model of the locomotive and practical conditions.

[0089] The first determining module S303 is configured to determine whether a current time of the timer is less than the cut-off time.

[0090] The first cut-off module S304 is configured to cut off all functions of the locomotive air anti-skid system until the emergency brake signal disappears, if the first determining module determines that the current time of the timer is not less than the cut-off time.

[0091] In the conventional technology, in an emergency brake, the air anti-skid system may reduce the pressure of the cylinder pipe to zero and maintain the zero pressure of the cylinder pipe, resulting in a continuous loss of brake force of the brake cylinder. Therefore, the locomotive, which should be stopped, cannot be stopped, seriously threatening the operation safety of the locomotive and personal safety of a driver.

[0092] In order to solve the above problem, it is determined in the embodiment according to the present disclosure whether the current time of the timer reaches the cut-off time after the cut-off time corresponding to the current brake initial speed is calculated. If it is determined that the current time of the timer reaches the cut-off time, the first cut-off module is triggered to cut off all functions of the locomotive air anti-skid system and thus stop acting on the brake cylinder. Therefore, a braking force of the brake cylinder restores to ensure the locomotive to be timely stopped in the emergency brake. While the emergency brake is not performed, that is, the emergency brake signal disappears, the first cut-off module stops operating to restore the air anti-skid system back to the normal operation state.

[0093] Therefore, in another embodiment of the present disclosure, the device may further include a third determining module.

[0094] The third determining module is configured to determine whether the emergency brake signal received by the first obtaining module disappears. The first resetting module is triggered if the third determining module determines that the emergency brake signal disappears. Otherwise, the first cut-off module is triggered to cut off the air anti-skid system until the received level signal becomes a low level signal.

[0095] It follows that, in the embodiment, the first obtaining module obtains the current brake initial speed of the locomotive and starts the timer upon receiving the emergency brake signal for the locomotive. Then the first calculating module is triggered to calculate the cut-off time corresponding to the current brake initial speed by bringing the obtained current brake initial speed into the first predetermined equation. And the first determining module determines whether a current time of the timer is larger than the cut-off time. The first cut-off module cuts off all functions of the locomotive air anti-skid system if the first determining

module determines that the current time of the timer is larger than the cut off time. Thus, the air anti-skid system temporarily fails to act on a brake cylinder pipe, and a braking force of the brake cylinder pipe restores gradually, such that the locomotive is timely stopped under the action of the braking force, thereby guaranteeing the operation safety of the locomotive.

5 **[0096]** The embodiments of the present disclosure are described herein in a progressive manner, with an emphasis placed on explaining the difference between each embodiment and the other embodiments. Hence, for the same or similar parts among the embodiments, they can be referred to from one another. For the device disclosed in the embodiments, the corresponding descriptions are relatively simple because the device corresponds to the
10 controlling methods disclosed in the embodiments. The relevant portions may be referred to the description for the controlling method parts.

[0097] The above description of the embodiments disclosed herein enables those skilled in the art to implement or use the present disclosure. Numerous modifications to the embodiments are apparent to those skilled in the art, and the general principle herein can be
15 implemented in other embodiments without deviation from the spirit or scope of the embodiments of the present disclosure. Therefore, the present disclosure is not limited to the embodiments described herein, but in accordance with the widest scope consistent with the principle and novel features disclosed herein.

CLAIMS

1. A controlling method for a locomotive air anti-skid system, comprising:

obtaining a current brake initial speed of a locomotive and starting a timer upon
5 receiving an emergency brake signal for the locomotive;

calculating a cut-off time corresponding to the current brake initial speed by bringing the
current brake initial speed into a first predetermined equation;

determining whether a current time of the timer is less than the cut-off time; and

cutting off all functions of the locomotive air anti-skid system until the emergency brake
10 signal disappears, if it is determined that the current time of the timer is not less than the
cut-off time.

2. The controlling method according to claim 1, wherein before the obtaining a current
brake initial speed of a locomotive and starting a timer upon receiving an emergency brake
15 signal for the locomotive, the controlling method further comprises:

obtaining operation monitoring data of the locomotive;

determining whether the emergency brake signal for the locomotive is received based on
the operation monitoring data; and

resetting the timer if it is determined that the emergency brake signal for the locomotive
20 is not received.

3. The controlling method according to claim 1, wherein the cutting off all functions of
the locomotive air anti-skid system until the emergency brake signal disappears comprises:

determining whether the emergency brake signal disappears; and

25 resetting the timer if it is determined that the emergency brake signal disappears; or

continuing to cut off all functions of the locomotive air anti-skid system if it is
determined that the emergency brake signal does not disappear.

4. The controlling method according to any one of claims 1 to 3, wherein the first predetermined equation is a first order function of a brake initial speed.

5. The controlling method according to claim 4, wherein the first predetermined equation is expressed as:

$$t = 2 \bullet \left(\frac{v}{3.6 \bullet a} + 1.5 \right) + 3$$

where v denotes the current brake initial speed, t denotes the cut-off time corresponding to the current brake initial speed, and a denotes an emergency brake deceleration of the locomotive.

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6. The controlling method according to claim 5, further comprising:
monitoring an operation speed of the locomotive in a real-time manner.

7. A controlling device for a locomotive air anti-skid system, comprising:

15 a first obtaining module configured to obtain a current brake initial speed of a locomotive and start a timer upon receiving an emergency brake signal for the locomotive;

a first calculating module configured to calculate a cut-off time corresponding to the current brake initial speed by bringing the current brake initial speed into a first predetermined equation;

20 a first determining module configured to determine whether a current time of the timer is less than the cut-off time; and

a first cut-off module configured to cut off all functions of the locomotive air anti-skid system until the emergency brake signal disappears, if the first determining module determines that the current time of the timer is not less than the cut-off time.

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8. The controlling device according to claim 7, further comprising:

a second obtaining module configured to obtain operation monitoring data of the locomotive;

a second determining module configured to determine whether the emergency brake signal for the locomotive is received based on the operation monitoring data; and

5 a first resetting module configured to reset the timer if the second determining module determines that the emergency brake signal for the locomotive is not received.

9. The controlling device according to claim 8, further comprising:

10 a third determining module configured to determine whether the emergency brake signal received by the first obtaining module disappears, wherein the first resetting module is triggered if the third determining module determines that the emergency brake signal disappears, or the first cut-off module is triggered if the third determining module determines that the emergency brake signal does not disappear.

15 10. The controlling device according to claim any one of claims 7 to 9, further comprising:

a first monitoring module configured to monitor an operation speed of the locomotive in a real-time manner.