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(54) **TRAIN WATER SUPPLY APPARATUS AND CONTROL METHOD THEREFOR**

(57) The present invention discloses a train water supply device and a control method thereof. The train water supply device includes a clear water tank, a water tank I, a water tank II, an ejector, a connecting pipeline and valve elements, wherein the water tank I is connected with the clear water tank and the water tank II through a water suction pipeline and an intermediate pipeline respectively, the water tank II is connected with a water consumption appliance through a water supply pipeline, an upper part of the water tank I is connected with a vacuumizing opening of the ejector and an air source of a train through a vacuumizing pipeline and a vacuumizing air supply pipeline I respectively; the upper part of the water tank II is connected with the atmosphere and the air source of the train through an exhaust pipeline I and a water supply and air supply pipeline II respectively; the water tank I is provided with a liquid level switch I and a liquid level switch II from top to bottom, and the water tank II is provided with a liquid level switch III, a liquid level switch IV and a liquid level switch V from top to bottom; and the train water supply device can continuously supply water, is reliable in operation and low in maintenance cost, has no special pressure bearing re-

quirements on the clear water tank, and can be installed at the bottom of the train according to demand.

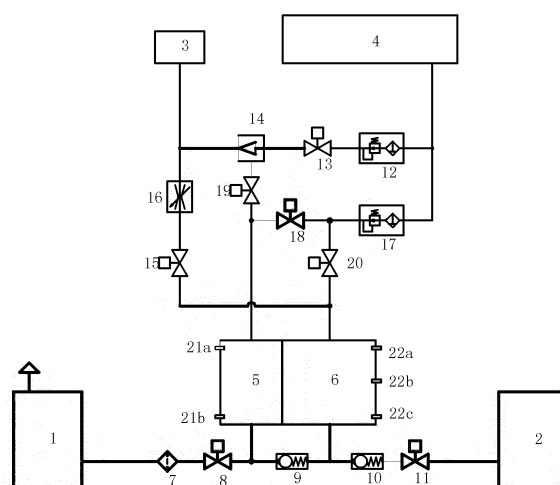


Fig. 1

Description

Field of the Invention

[0001] The present invention relates to a water supply device and a control method thereof, and in particular, to a train water supply device for continuous water supply on trains via compressed air.

Background of the Invention

[0002] A train water supply system is used for providing clear water for toilets, kitchens and electric water boilers and the like on a train. The traditional train water supply system generally adopts such a water supply method that the train is provided with a large clear water tank is arranged at the bottom and with a small clear water tank at the top, water in the large clear water tank at the bottom of the train is pumped by a water pump to the small clear water tank at the top of the train, and then the water is supplied to water consumption points from the small water tank in manner of flow by gravity. With the development of high-speed trains, to reduce the section of the train and reduce the center of gravity of the train, there is not enough space for placing the small clear water tank capable of meeting the demands on the top of the train. Therefore, in the design of the high-speed trains, all clear water tanks are generally placed at the bottom of the train, which not only reduces the center of gravity of the train, but also is conducive to improving the stability of the train. The water supply at the bottom of the train is realized in two manners of electric pumps and air pressure in the prior art. Wherein, in the electric pump manner, pressurized water supply is realized through an electric water pump, which has the defects that the electric pump is sensitive to a conveying medium and a relatively complex system needs to be configured to guarantee the normal operation of the electric pump, and thus the equipment investment and the maintenance cost are relatively high. Nevertheless, the electric pump system often has the problem that the water pump is frequently started and blocked to result in burning loss, unsmooth startup exhaust, water leakage, idle running and other problems of the water pump. Meanwhile, since the self-suction capacity of the electric pump is poorer, the electric pump is generally hung under the train floor together with the clear water tank. When the electric pump has a fault during the travelling of the train, the electric pump cannot be maintained online. For example, the Chinese patent document CN200820115114.0 discloses a water shortage protection control device and method for a water pump of a railway passenger car water supply system, wherein the device includes a water tank, a water pump, a water pump control device, a water suction pipeline, a water supply pipeline, a water supply pressure sensor, a water supply flow sensor, a water level detection sensor, an air suction pressure sensor and a pressure buffer tank. Water shortage protection of the water pump is carried out

in a manner of combining water level detection with air pressure detection in the pipeline. Although this water supply system realizes the pressurized water supply at the bottom of the train, the system is relatively complex, the fault rate of the electric pump system is high, and in the case of fault of the electric pump, the electric pump can be only maintained by stopping the train.

[0003] In the air pressure water supply manner, the clear water in the clear water tank at the bottom of the train is directly pressurized through the compressed air of a train air supply system, which has the defects that the manner has pressure bearing requirements on the clear water tank, the pipeline and related valve elements, since the volume of the clear water tank is generally large, the weight of the clear water tank on which having the pressure bearing requirements are proposed will be greatly increased, a hidden trouble of leakage is present, and when the train is stopped for injecting water into the clear water tank, the water supply will be interrupted accordingly, which does not conform to the water use habit of users. For example, the international patent document WO2010070075A1 discloses a pump-less water supply device for mobile use, including a clear water tank for storing clear water and a connecting pipeline for conveying the water to the users, and two intermediate buffer containers are arranged on the connecting pipeline and are connected with the clear water tank. A pressure control device is respectively connected with the clear water tank and the two intermediate buffer containers, the water is conveyed from the clear water tank to the intermediate buffer containers by the pressure difference of the clear water tank and the intermediate buffer containers, and then the water is conveyed from the intermediate buffer containers to the users. Although this water supply device can convey the water from the clear water tank to the users, the clear water tank needs to be pressurized, and the water supply will be interrupted when water is injected into the clear water tank.

Summary of the Invention

[0004] The main object of the present invention is to overcome the shortcomings in the above prior art and provide a train water supply device, which can be installed at the bottom of a train, is low in maintenance cost and reliable to operate, has no special pressure bearing requirements on a clear water tank and can continuously supply water.

[0005] To realize the above object, the present invention adopts the following technical solutions:

a train water supply device includes a clear water tank, a water tank I, a water tank II and an ejector, wherein the water tank I is connected with the clear water tank through a water suction pipeline, and the water tank I is connected with the water tank II through an intermediate pipeline, the water tank II is connected with a water consumption appliance

through a water supply pipeline, an upper part of the water tank I is connected with a vacuumizing opening of the ejector through a vacuumizing pipeline, and an air source interface of the ejector is connected with an air source of a train through a vacuumizing air supply pipeline; the upper part of the water tank I is connected with the air source of the train through a water supply and air supply pipeline I, and the upper part of the water tank II is communicated with the atmosphere through an exhaust pipeline; the water tank II is connected with the air source of the train through a water supply and air supply pipeline II; the water tank I is provided with a liquid level switch I and a liquid level switch II from top to bottom, and the water tank II is provided with a liquid level switch III, a liquid level switch IV and a liquid level switch V from top to bottom.

[0006] The top of the clear water tank is communicated with the atmosphere.

[0007] A one-way valve I is arranged on the intermediate pipeline.

[0008] A one-way valve II and a two-way valve II are arranged on the water supply pipeline. An exhaust port of the ejector is communicated with the atmosphere outside of the train.

[0009] A two-way valve VI is arranged on the vacuumizing pipeline; and a vacuumizing filtering pressure relief valve and a two-way valve III are arranged on the vacuumizing air supply pipeline.

[0010] A two-way valve V and a water supply filtering pressure relief valve are arranged on the water supply and air supply pipeline I; and a two-way valve VII is arranged on the water supply and air supply pipeline II, and the water supply and air supply pipeline II shares the water supply filtering pressure relief valve with the water supply and air supply pipeline I.

[0011] A two-way valve I and a water filter are arranged on the water suction pipeline; and a throttle valve and a two-way valve IV are arranged on the exhaust pipeline.

[0012] A control method of the train water supply device is as follows:

the control method of the water tank I is as follows:

step 1-1: after the system starts working, judging whether a liquid level in the water tank I reaches an upper liquid level indicated by the liquid level switch I at first; if the liquid level does not reach the upper liquid level, setting the water tank II to a water supply state, setting the water tank I to a preparation state, meanwhile, opening the two-way valve VII, closing the two-way valve V, and going to step 1-3; if the liquid level reaches the upper liquid level, going to step 1-2; step 1-2: judging whether the liquid level in the water tank I is lower than a lower liquid level indicated by the liquid level switch II; if so, setting

the water tank II to the water supply state, setting the water tank I to the preparation state, meanwhile, opening the two-way valve VII, closing the two-way valve V, and going to step 1-3; if not, setting the water tank I to the water supply state, setting the water tank II to the preparation state, meanwhile, opening the two-way valve V, closing the two-way valve VII, and returning to step 1-2;

step 1-3: opening the two-way valve VI, delaying for t_1 , and exhausting the compressed air in the water tank I; opening the two-way valve III, and then starting to vacuumize the water tank I by the ejector; opening the two-way valve I after delaying for t_2 to cause water in the clear water tank to flow into the water tank I through the water suction pipeline under the action of the barometric pressure, and closing the two-way valve VI until the liquid level in the water tank I reaches the upper liquid level indicated by the liquid level switch I; closing the two-way valve III after delaying for t_3 to stop working of the ejector; as when the ejector is just closed; closing the two-way valve I after delaying for t_4 to stop flowing of the water in the water suction pipeline, and going to step 1-4;

step 1-4: judging whether the control system receives a stop instruction, if not, returning to step 1-2, and if so, ending the flow;

the control method of the water tank II is as follows:

step 2-1: after the system starts working, judging whether the liquid level in the water tank II reaches the upper liquid level indicated by the liquid level switch III at first; if so, going to step 2-2; if not, indicating that remaining water in the water tank II is little, when the water tank I is in the water supply state, opening the two-way valve IV to exhaust the air in the water tank II, and after the liquid level H_2 in the water tank II reaches the upper liquid level indicated by the liquid level switch III, then going to step 2-2;

step 2-2: judging whether the liquid level in the water tank II is lower than an intermediate liquid level indicated by the liquid level switch IV; if not, opening the two-way valve II to supply water, and returning to 2-1; if so, judging whether the liquid level in the water tank II reaches the lower liquid level indicated by the liquid level switch V; if not, indicating that the water in the water tank II is insufficient, then closing the two-way valve II, pausing the water supply and sending an alarm of "low water level of the water supply device", and going to step 2-3; if so, opening the two-way valve II to supply water, and going to step 2-3;

step 2-3: judging whether the water tank I is in

the water supply state at the moment; if not, returning to step 2-2; if so, opening the two-way valve IV to exhaust the air in the water tank II through the exhaust pipeline, so that the water in the water tank I enters the water tank II through the intermediate pipeline, and the liquid level in the water tank II rises; judging whether the liquid level in the water tank II reaches the intermediate liquid level indicated by the liquid level switch IV; if not, returning to step 2-2; if so, judging whether the two-way valve II is in an open state; if not, opening the two-way valve II, clearing the alarm of "low water level of the water supply device", and going to step 2-4; if so, directly going to step 2-4;

step 2-4: judging whether the liquid level in the water tank II reaches the upper liquid level indicated by the liquid level switch III; if not, returning to step 2-2, and continuing to exhaust the air; if so, closing the two-way valve IV, stopping exhausting the air, and going to step 2-5; and

step 2-5: judging whether the control system receives the stop instruction, if not, returning to step 2-2, and if so, ending the flow.

[0013] Preferably, the ejector adopts a multilevel mode and has the characteristics of high ultimate vacuum and high efficiency.

[0014] Preferably, the vacuumizing filtering pressure relief valve, the two-way valve III, the ejector, the two-way valve IV, the throttle valve, the water supply filtering pressure relief valve, the two-way valve V, the two-way valve VI and the two-way valve VII are integrated on an integrated air path board, so that the structure is more compact and is convenient to maintain.

[0015] The present invention has the following beneficial effects:

1. The water tank does not need to be arranged at the top of the train, so the center of gravity of the train is reduced, the operation stability of the train is improved, and the present invention is particularly suitable for high-speed trains.
2. Compared with the existing electric pump mode, the system composition is simpler, the system is composed of the ejector with no moving component and the valve elements with high reliability, the inherent motor fault, the transmission fault or the sealing fault of a rotating component of the electric pump mode is not present, so the reliability is better, and the maintenance cost is low.
3. Compared with the existing electric pump mode, the system layout is more reasonable, the clear water tank can be arranged below the train floor according to demand (for example, on such occasions with high requirements on the water supply reliability as dining cars and the like), and other water tanks and valve elements and the like are arranged on the train

floor. In the case of fault of the water supply device in the travelling process of the train, the train does not need to be stopped for maintenance.

4. Compared with the existing air pressure mode, the clear water tank does not need to be pressurized, there's no special pressure bearing requirements for the clear water tank, so that the weight of the clear water tank is light, the operation and use are safe and reliable, and the present invention is particularly suitable for the high-speed trains. Particularly, the water supply is not interrupted in the case of train stopping and water injection into the clear water tank, so passengers can conveniently use water at any time.

Brief Description of the Drawings

[0016]

Fig.1 is a schematic diagram of a structure of the present invention;

Fig.2 is a working flowchart of a water tank I of the present invention;

Fig.3 is a working flowchart of a water tank II of the present invention.

[0017] In the figures, 1 represents a clear water tank, 2 represents a water consumption appliance, 3 represents atmosphere outside of a train, 4 represents an air source, 5 represents a water tank I, 6 represents a water tank II, 7 represents a water filter, 8 represents a two-way valve I, 9 represents a one-way valve I, 10 represents a one-way valve II, 11 represents a two-way valve II, 12 represents a vacuumizing filtering pressure relief valve, 13 represents a two-way valve III, 14 represents an ejector, 15 represents a two-way valve IV, 16 represents a throttle valve, 17 represents a water supply filtering pressure relief valve, 18 represents a two-way valve V, 19 represents a two-way valve VI, 20 represents a VII, 21a represents a liquid level switch I, 21b represents a liquid level switch II, 22a represents a liquid level switch III, 22b represents a liquid level switch IV, and 22c represents a liquid level switch V.

Detailed Description of the Embodiments

[0018] The present invention will be further illustrated below in combination with the accompany drawings and specific embodiments.

[0019] As shown in Fig.1, a train water supply device includes a clear water tank 1, a water tank I 5, a water tank II 6 and an ejector 14.

[0020] The top of the clear water tank 1 is communicated with the atmosphere to keep an atmospheric pressure, and no pressure bearing requirement is proposed, so the weight of the clear water tank is relatively small.

[0021] The water tank I 5 is connected with the clear water tank 1 through a water suction pipeline for tempo-

rarily storing clear water flowing out from the clear water tank 1. The water suction pipeline is used for conveying the clear water from the clear water tank 1 to the water tank I 5, and a water filter 7 and a two-way valve I 8 are arranged on the water suction pipeline.

[0022] The water tank I 5 is connected with the water tank II 6 through an intermediate pipeline. A one-way valve I 9 is arranged on the intermediate pipeline, which can prevent the water from flowing from the water tank II 6 to the water tank I 5.

[0023] The water tank II 6 is connected with a water consumption appliance 2 through a water supply pipeline. A one-way valve II 10 and a two-way valve II 11 are arranged on the water supply pipeline. The one-way valve II 10 can prevent the water from flowing back from the water consumption appliance 2 to the water supply device.

[0024] An upper part of the water tank I 5 is connected with a vacuumizing opening of the ejector 14 through a vacuumizing pipeline. An air source interface of the ejector 14 is connected with an air source 4 (for example, with a pressure of 0.5-1.0 MPa) of a train through a vacuumizing air supply pipeline. The exhaust port of the ejector 14 is communicated with atmosphere 3 outside of the train. The ejector 14 is used for generating a negative pressure in the water tank I 5, so that the water flows from the clear water tank 1 to the water tank I 5 through the water suction pipeline. A two-way valve VI 19 is arranged on the vacuumizing pipeline. A vacuumizing filtering pressure relief valve 12 and a two-way valve III 13 are arranged on the vacuumizing air supply pipeline. The vacuumizing filtering pressure relief valve 12 is used for filtering compressed air and adjusting the compressed air to a pressure (for example, 0.4-0.7MPa) necessary for the working of the ejector 14. The upper part of the water tank I 5 is further connected with an outlet of a water supply filtering pressure relief valve 17 through a water supply and air supply pipeline I. An inlet of the water supply filtering pressure relief valve 17 is connected with the air source 4 of the train for removing oil mist and impurities therein, cleaning the compressed air and adjusting the compressed air to the pressure (for example, 50-200KPa) necessary for water supply. A two-way valve V 18 is arranged on the water supply and air supply pipeline I.

[0025] The upper part of the water tank II 6 is connected with the outlet of the water supply filtering pressure relief valve 17 through a water supply and air supply pipeline II. A two-way valve VII 20 is arranged on the water supply and air supply pipeline II. The upper part of the water tank II 6 further exhausts others to the atmosphere 3 outside of the train through an exhaust pipeline. A throttle valve 16 and a two-way valve IV 15 are arranged on the exhaust pipeline. The throttle valve 16 is used for controlling the exhaust speed of the water tank II 6 and guaranteeing a relatively stable water supply pressure during exhaust.

[0026] The water tank I 5 is provided with a liquid level

switch I 21a and a liquid level switch II 21b from top to bottom for respectively detecting an upper liquid level and a lower liquid level of the water tank I 5. The water tank II 6 is provided with a liquid level switch III 22a, a liquid level switch IV 22b and a liquid level switch V 22c from top to bottom for respectively detecting the upper liquid level, an intermediate liquid level and the lower liquid level of the water tank II 6.

[0027] The working flow of the present invention is divided into a working flow of the water tank I 5 and a working flow of the water tank II 6. The two parts are executed in parallel and are relatively independent and associated functionally. Both of the water tank I 5 and the water tank II 6 are in a preparation state when being started, and only one is in a water supply state in an operation process.

[0028] The control method of the water tank I is as follows: during startup, if the liquid level in the water tank I 5 is lower than the upper liquid level of the water tank I 5, the ejector works to generate a negative pressure in the water tank I 5 to suck the water in the clear water tank 1 into the water tank I 5, until the liquid level in the water tank I 5 reaches the upper liquid level of the water tank I 5, and then a subsequent flow is carried out. In the subsequent flow, when the liquid level in the water tank I 5 is lower than the lower liquid level of the water tank I 5, the water tank II 6 is set to the water supply state, the water tank I 5 is set to the preparation state, the ejector works to generate the negative pressure in the water tank I to suck the water in the clear water tank into the water tank I, until the liquid level in the water tank I 5 reaches the upper liquid level of the water tank I 5. When the liquid level in the water tank I 5 is not lower than the lower liquid level of the water tank I 5, the water tank I 5 is set to the water supply state, the water tank II 6 is set to the preparation state, and the water flows from the water tank I 5 to the water consumption appliance;

the working flow of the water tank II is as follows: during startup, if the liquid level in the water tank II 6 is lower than the upper liquid level of the water tank II 6, and the water tank I 5 is in the water supply state, the two-way valve IV 15 is opened to exhaust the air in the water tank II 6 through the exhaust pipeline, until the liquid level in the water tank II 6 reaches the upper liquid level of the water tank II 6, and then the two-way valve IV 15 is closed to go to the subsequent flow. In a subsequent working process, if the liquid level in the water tank II 6 is not lower than the intermediate liquid level of the water tank II 6, the two-way valve II 11 is opened to supply water through the water supply pipeline. If the liquid level in the water tank II 6 is lower than the lower liquid level of the water tank II 6, the two-way valve II 11 is closed, the water supply is paused, and an alarm of "low water level of the water supply device" is sent. If the liquid level in the water tank II 6 is lower than the intermediate liquid level of the water tank II 6, but is not lower than the lower liquid level, the two-way valve II 11 is opened to supply water through the water supply pipeline, when the water tank I 5 is in the water supply state, the two-way valve

IV is opened to exhaust the air in the water tank II 6 through the exhaust pipeline, and the liquid level in the water tank II 6 rises. After the liquid level in the water tank II 6 rises to the intermediate liquid level of the water tank II 6, if the two-way valve II 11 is in a closed state, the two-way valve II 11 is opened, and the possible alarm of "low water level of the water supply device" is removed until the liquid level in the water tank II 6 rises to the upper liquid level of the water tank II 6, then the two-way valve IV 15 is closed to stop the exhaust.

[0029] As shown in Fig.2, the specific working flow of the water tank I 5 is as follows:

step 1-1: after the system starts working, judging whether a liquid level H_1 in the water tank I 5 reaches an upper liquid level indicated by the liquid level switch I 21 a at first; if the liquid level does not reach the upper liquid level, setting the water tank I 5 to a water supply state, setting the water tank I 5 to a preparation state, meanwhile, opening the two-way valve VII 20, closing the two-way valve V 18, and going to step 1-3; if the liquid level reaches the upper liquid level, going to step 1-2;

step 1-2: judging whether the liquid level H_1 in the water tank I 5 is lower than a lower liquid level indicated by the liquid level switch II 21b; if so, setting the water tank II 6 to the water supply state, setting the water tank I 5 to the preparation state, meanwhile, opening the two-way valve VII 20, closing the two-way valve V 18, and going to step 1-3; if not, setting the water tank I 5 to the water supply state, setting the water tank II 6 to the preparation state, meanwhile, opening the two-way valve V 18, closing the two-way valve VII 20, and returning to step 1-2; step 1-3: opening the two-way valve VI 19, delaying for t_1 (for example, $t_1=2s$) and exhausting the compressed air in the water tank I 5; opening the two-way valve III 13, and then starting to vacuumize the water tank I 5 by the ejector 14; opening the two-way valve I 8 after delaying for t_2 (for example, $t_2=2s$) to cause water in the clear water tank 1 to flow into the water tank I 5 through the water suction pipeline under the action of the barometric pressure, and closing the two-way valve VI 19 until the liquid level H_1 in the water tank I 5 reaches the upper liquid level indicated by the liquid level switch I 21a; closing the two-way valve III 13 after delaying for t_3 (for example, $t_3=2s$) to stop working of the ejector 14; as a certain negative pressure still exists in the water tank I 5 when the ejector 14 is just closed, enabling the water in the clear water tank 1 to still flow into the water tank I 5 under the action of the barometric pressure and consume the negative pressure in the water tank I 5; closing the two-way valve I 8 after delaying for t_4 (for example, $t_4=2s$) to stop flowing of the water in the water suction pipeline, and going to step 1-4; and step 1-4: judging whether the control system receives a stop instruction, if not, returning to step 1-2,

and if so, ending the flow.

[0030] As shown in Fig.3, the specific working flow of the water tank II 6 is as follows:

step 2-1: after the system starts working, judging whether the liquid level H_2 in the water tank II 6 reaches the upper liquid level indicated by the liquid level switch III 22a at first; if so, going to step 2-2; if not, indicating that remaining water in the water tank II 6 is little, when the water tank I 5 is in the water supply state, opening the two-way valve IV 15 to exhaust the air in the water tank II 6, and after the liquid level H_2 in the water tank II 6 reaches the upper liquid level indicated by the liquid level switch III 22a, going to step 2-2;

step 2-2: judging whether the liquid level H_2 in the water tank II 6 is lower than an intermediate liquid level indicated by the liquid level switch IV 22b; if not, opening the two-way valve II 11 to supply water, and returning to 2-2; if so, judging whether the liquid level H_2 in the water tank II 6 is lower than the lower liquid level indicated by the liquid level switch V 22c; if not, indicating that the water in the water tank II 6 is insufficient, then closing the two-way valve II 11, pausing the water supply and sending an alarm of "low water level of the water supply device", and going to step 2-3; if so, opening the two-way valve II 11 to supply water, and going to step 2-3;

step 2-3: judging whether the water tank I 5 is in the water supply state at the moment; if not, returning to step 2-2; if so, opening the two-way valve IV 15 to exhaust the air in the water tank II 6 through the exhaust pipeline, so that the water in the water tank I 5 enters the water tank II 6 through the intermediate pipeline, and the liquid level in the water tank II 6 rises; judging whether the liquid level H_2 in the water tank II 6 reaches the intermediate liquid level indicated by the liquid level switch IV 22b; if not, returning to step 2-2; if so, judging whether the two-way valve II 11 is in an open state; if not, opening the two-way valve II 11, clearing the alarm of "low water level of the water supply device", and going to step 2-4; if so, directly going to step 2-4;

step 2-4: judging whether the liquid level H_2 in the water tank II 6 reaches the upper liquid level indicated by the liquid level switch III 22a; if not, returning to step 2-2, and continuing to exhaust the air; if so, closing the two-way valve IV 15, stopping exhausting the air, and going to step 2-5; and

step 2-5: judging whether the control system receives the stop instruction, if not, returning to step 2-2, and if so, ending the flow.

[0031] The liquid level switch I 21a, the liquid level switch II 21b, the liquid level switch III 22a, the liquid level switch IV 22b and the liquid level switch V 22c have anti-interference function, and when the switch state chang-

es, a control action can be triggered by a certain time delay (for example, 0.5s).

[0032] Although the embodiments of the present invention have been described above in combination with the accompany drawings, the protection scope of the present invention is not limited thereto. Those skilled in the art should understand that, a variety of medications or variations made by those skilled in the art on the basis of the technical solutions of the present invention without any creative effect shall fall into the protection scope of the present invention.

Claims

1. A train water supply device, comprising a clear water tank, a water tank I, a water tank II and an ejector, wherein the water tank I is connected with the clear water tank through a water suction pipeline, and the water tank I is connected with the water tank II through an intermediate pipeline, the water tank II is connected with a water consumption appliance through a water supply pipeline, an upper part of the water tank I is connected with a vacuumizing opening of the ejector through a vacuumizing pipeline, and an air source interface of the ejector is connected with an air source of a train through a vacuumizing air supply pipeline; the upper part of the water tank I is connected with the air source of the train through a water supply and air supply pipeline I, and the upper part of the water tank II is communicated with the atmosphere through an exhaust pipeline; the water tank II is connected with the air source of the train through a water supply and air supply pipeline II; the water tank I is provided with a liquid level switch I and a liquid level switch II from top to bottom, and the water tank II is provided with a liquid level switch III, a liquid level switch IV and a liquid level switch V from top to bottom.
2. The train water supply device of claim 1, wherein the top of the clear water tank is communicated with the atmosphere.
3. The train water supply device of claim 1, wherein one-way valve I is arranged on the intermediate pipeline.
4. The train water supply device of claim 1, wherein a one-way valve II and a two-way valve II are arranged on the water supply pipeline.
5. The train water supply device of claim 1, wherein an exhaust port of the ejector is communicated with the atmosphere outside of the train.
6. The train water supply device of claim 1, wherein a two-way valve VI is arranged on the vacuumizing

pipeline; and a vacuumizing filtering pressure relief valve and a two-way valve III are arranged on the vacuumizing air supply pipeline.

7. The train water supply device of claim 1, wherein a two-way valve V and a water supply filtering pressure relief valve are arranged on the water supply and air supply pipeline I; and a two-way valve VII is arranged on the water supply and air supply pipeline II, and the water supply and air supply pipeline II shares the water supply filtering pressure relief valve with the water supply and air supply pipeline I.
8. The train water supply device of claim 1, wherein a two-way valve I and a water filter are arranged on the water suction pipeline; and a throttle valve and a two-way valve IV are arranged on the exhaust pipeline.
9. A control method of the train water supply device of claim 1, comprising a control method of the water tank I and the water tank II, wherein:

the control method of the water tank I is as follows:

step 1-1: after the system starts working, judging whether a liquid level in the water tank I reaches an upper liquid level indicated by the liquid level switch I at first; if the liquid level does not reach the upper liquid level, setting the water tank II to a water supply state, setting the water tank I to a preparation state, meanwhile, opening the two-way valve VII, closing the two-way valve V, and going to step 1-3; if the liquid level reaches the upper liquid level, going to step 1-2; step 1-2: judging whether the liquid level in the water tank I is lower than a lower liquid level indicated by the liquid level switch II; if so, setting the water tank II to the water supply state, setting the water tank I to the preparation state, meanwhile, opening the two-way valve VII, closing the two-way valve V, and going to step 1-3; if not, setting the water tank I to the water supply state, setting the water tank II to the preparation state, meanwhile, opening the two-way valve V, closing the two-way valve VII, and returning to step 1-2; step 1-3: opening the two-way valve VI, delaying for t_1 , and exhausting the compressed air in the water tank I; opening the two-way valve III, and then starting to vacuumize the water tank I by the ejector; opening the two-way valve I after delaying for t_2 to enable water in the clear water tank to flow into the water tank I through the water

suction pipeline under the action of the barometric pressure, and closing the two-way valve VI until the liquid level in the water tank I reaches the upper liquid level indicated by the liquid level switch I; closing the two-way valve III after delaying for t_3 to stop working of the ejector; as when the ejector is just closed; closing the two-way valve I after delaying for t_4 to stop flowing of the water in the water suction pipeline, and going to step 1-4; step 1-4: judging whether the control system receives a stop instruction, if not, returning to step 1-2, and if so, ending the flow;

the control method of the water tank II is as follows:

step 2-1: after the system starts working, judging whether the liquid level in the water tank II reaches the upper liquid level indicated by the liquid level switch III at first; if so, going to step 2-2; if not, indicating that remaining water in the water tank II is little, when the water tank I is in the water supply state, opening the two-way valve IV to exhaust the air in the water tank II, and after the liquid level H_2 in the water tank II reaches the upper liquid level indicated by the liquid level switch III, going to step 2-2; step 2-2: judging whether the liquid level in the water tank II is lower than an intermediate liquid level indicated by the liquid level switch IV; if not, opening the two-way valve II to supply water, and returning to 2-1; if so, judging whether the liquid level in the water tank II reaches the lower liquid level indicated by the liquid level switch V; if not, indicating that the water in the water tank II is insufficient, then closing the two-way valve II, pausing the water supply and sending an alarm of "low water level of the water supply device", and going to step 2-3; if so, opening the two-way valve II to supply water, and going to step 2-3; step 2-3: judging whether the water tank I is in the water supply state at the moment; if not, returning to step 2-2; if so, opening the two-way valve IV to exhaust the air in the water tank II through the exhaust pipeline, so that the water in the water tank I enters the water tank II through the intermediate pipeline, and the liquid level in the water tank II rises; judging whether the liquid level in the water tank II reaches the intermediate liquid level indicated by the liquid level switch IV; if not, returning to step 2-2; if so, judging whether the two-way valve II

is in an open state; if not, opening the two-way valve II, clearing the alarm of "low water level of the water supply device", and going to step 2-4; if so, directly going to step 2-4; step 2-4: judging whether the liquid level in the water tank II reaches the upper liquid level indicated by the liquid level switch III; if not, returning to step 2-2, and continuing to exhaust the air; if so, closing the two-way valve IV, stopping exhausting the air, and going to step 2-5; and step 2-5: judging whether the control system receives the stop instruction, if not, returning to step 2-2, and if so, ending the flow.

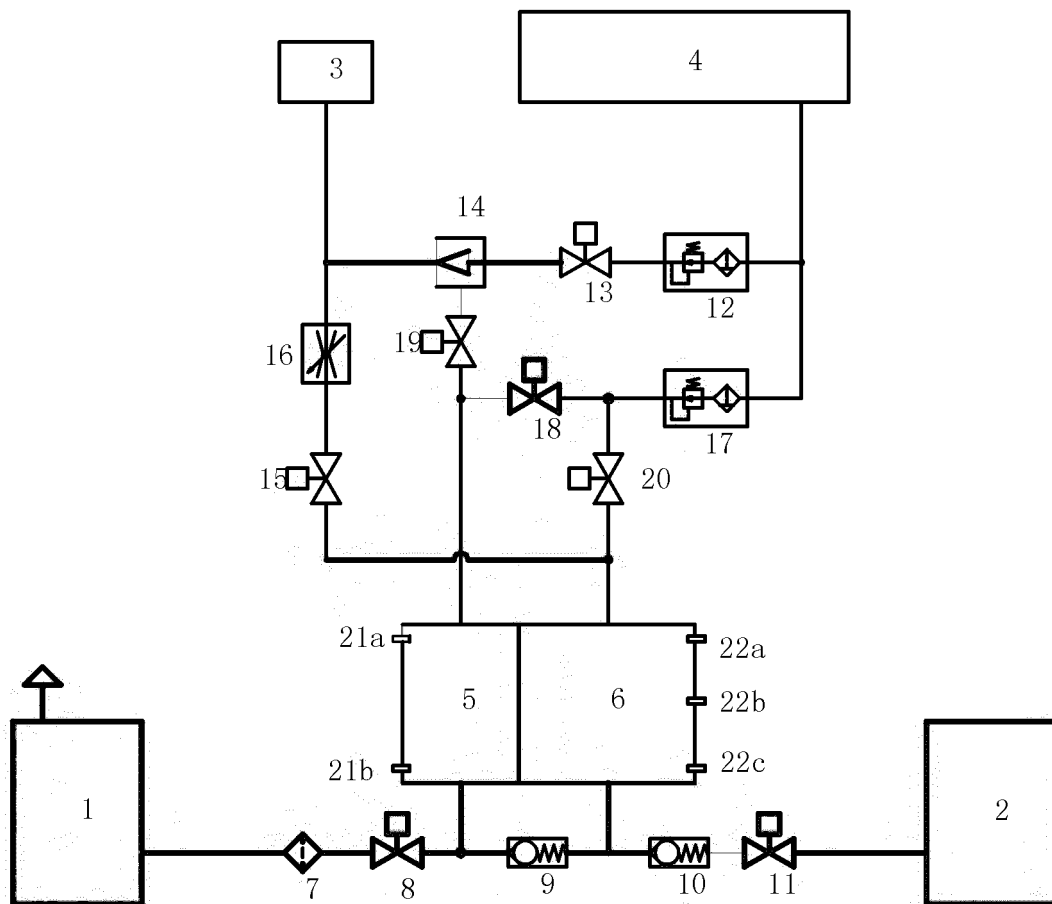


Fig. 1

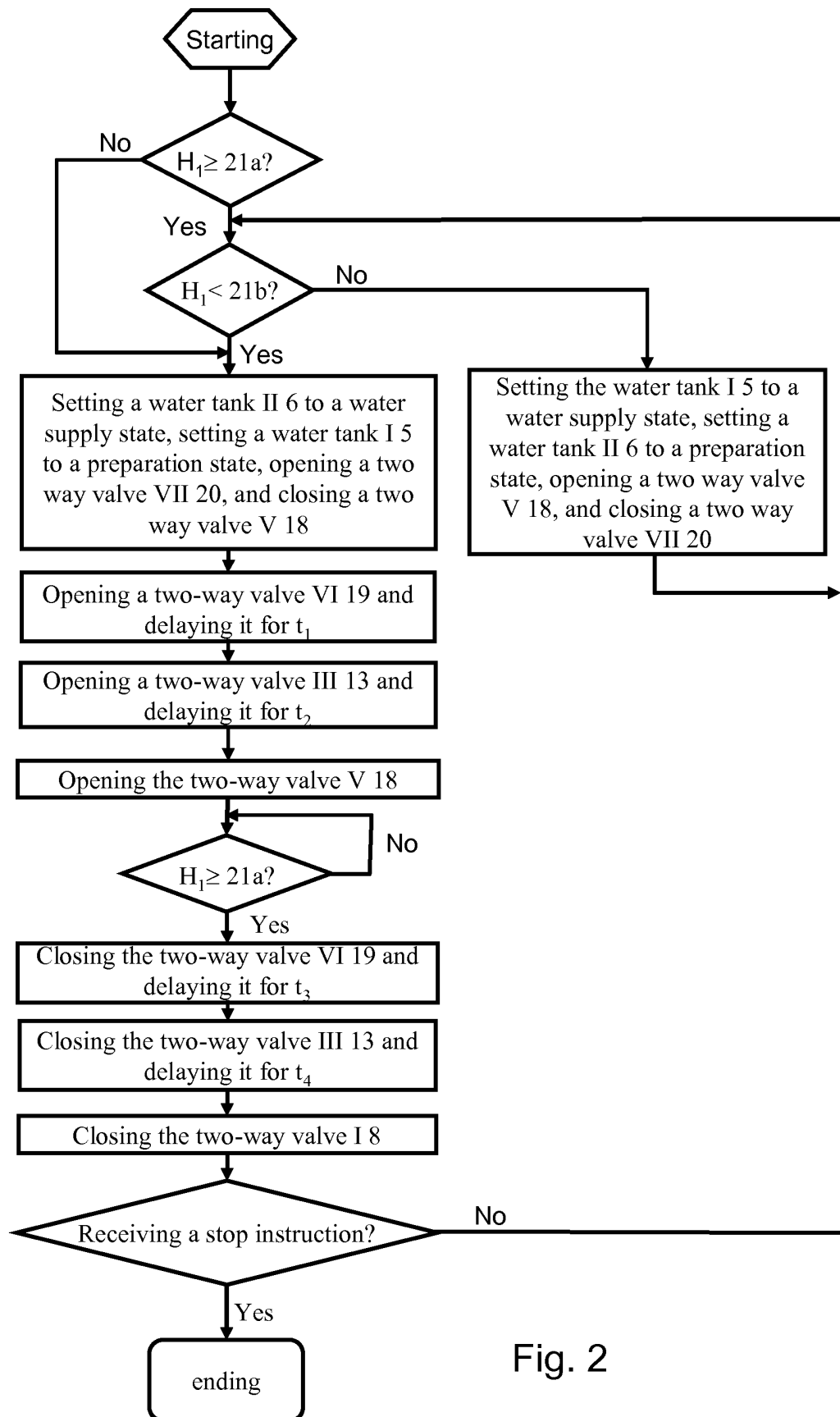


Fig. 2

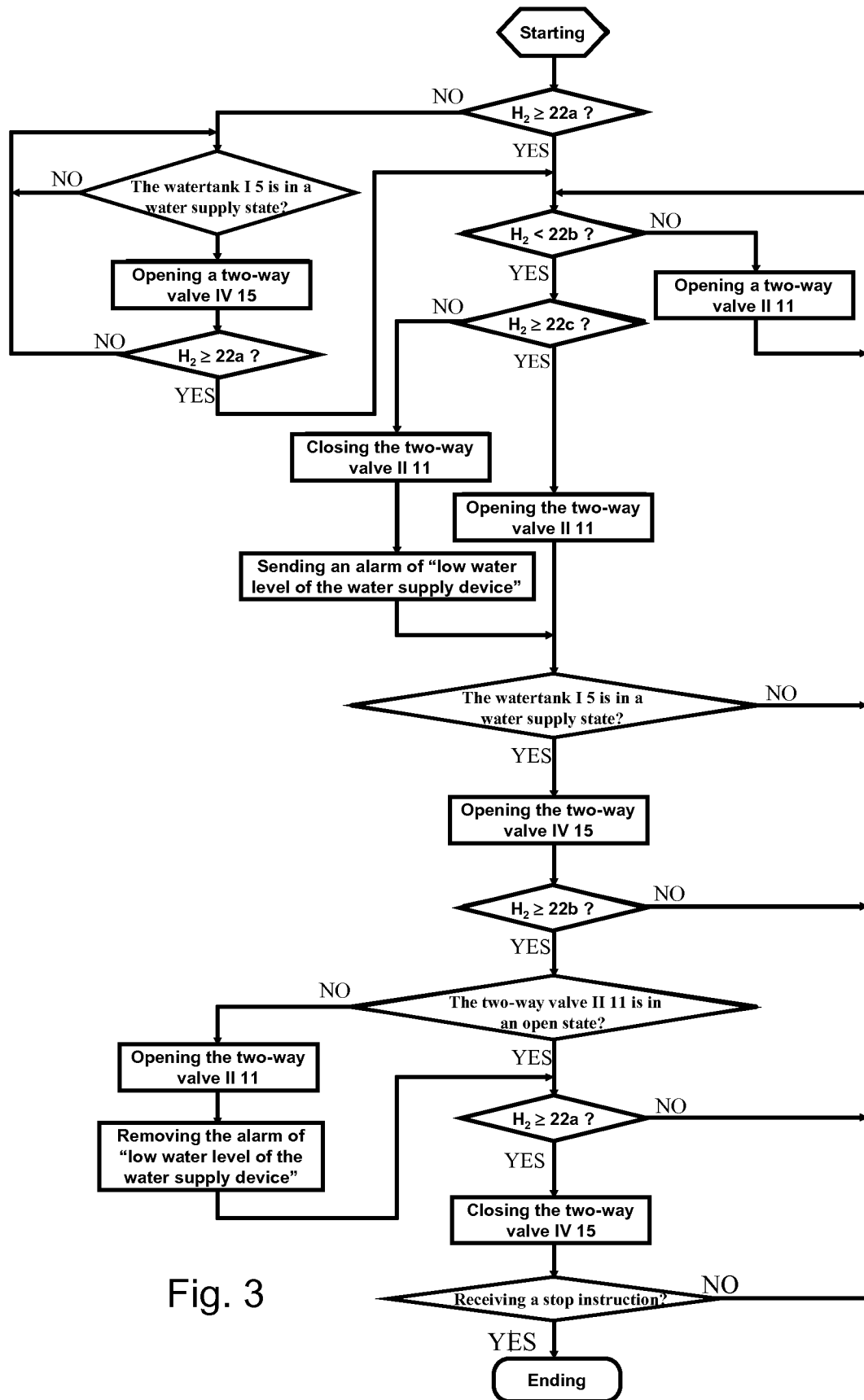


Fig. 3

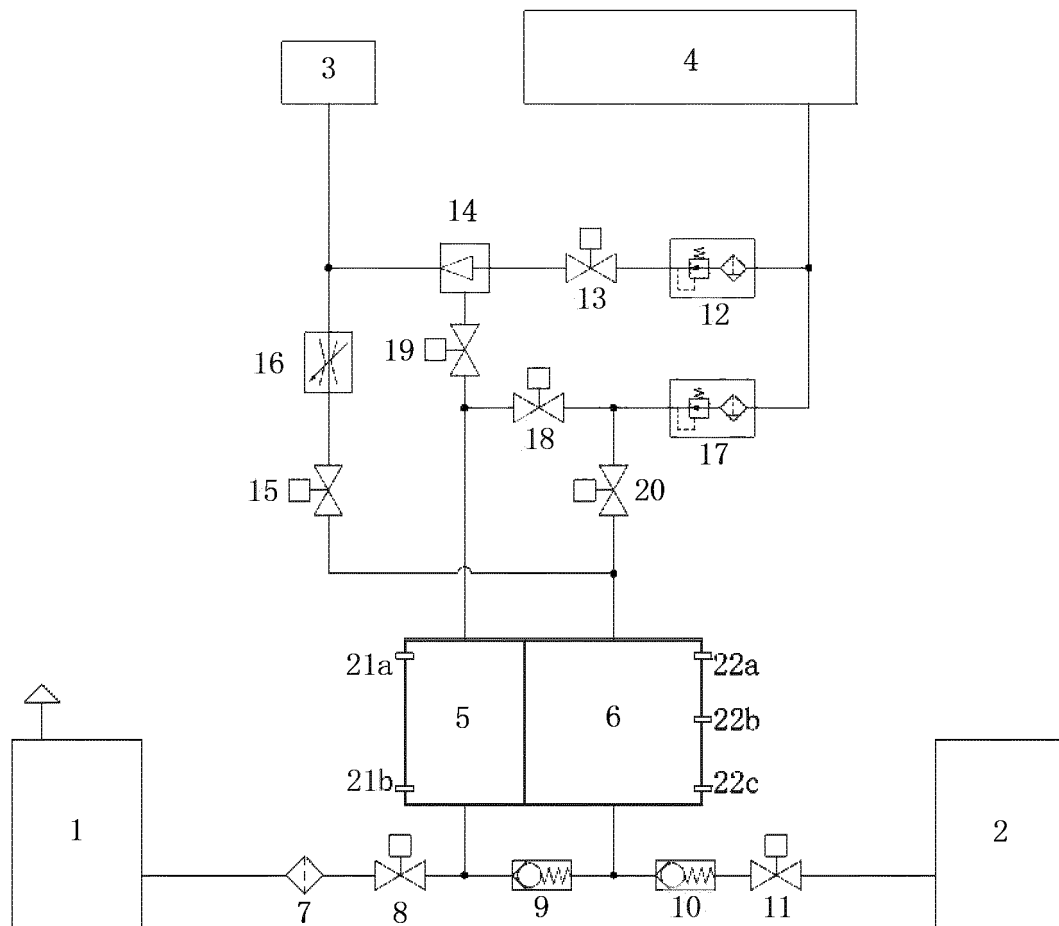


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/001472

A. CLASSIFICATION OF SUBJECT MATTER

E03B 1/02 (2006.01) i

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)

E03B 1/02, 1/00, 11/00, B61C 17/02

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)

WPI; EPODOC; CNKI; CNPAT: water, supply, vacuum, pressure, storage, tank, jet, spray, spout

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010/070075 A1 (EVAC GMBH) 24 June 2010 (24.06.2010) the whole document	1-9
A	GB 904568 A (DRYSDALE & CO LTD CHARLES HENDERSON CARSLAW) 29 August 1962 (29.08.1962) the whole document	1-9
A	CN 202850125 U (CHONGQING GEPAI PORCELAIN INSULATOR CO LTD) 03 April 2013 (03.04.2013) the whole document	1-9
A	CN 1868792 A (ZHAO, Yanfeng) 29 November 2006 (29.11.2006) the whole document	1-9

☐ 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
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 25 July 2014	Date of mailing of the international search report 30 July 2014
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer WU, Jie Telephone No. (86-10) 62085542

INTERNATIONAL SEARCH REPORT
Information on patent family membersInternational application No.
PCT/CN2013/001472

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2010/070075 A1	24 June 2010	DE 202008016607 U1	05 March 2009
GB 904568 A	29 August 1962	None	
CN 202850125 U	03 April 2013	None	
CN 1868792 A	29 November 2006	None	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 200820115114 [0002]
- WO 2010070075 A1 [0003]