

A LAUNCH ROCKET LAUNCHING SUPPORT EQUIVALENT DEVICE AND A CONTROL SYSTEM

Technical Field

5 The present invention relates to the field of launching of launch rocket, in particular, to a launch rocket launching support equivalent device and a control system.

Background Art

10 With the rapid development of the aerospace industry in China, of the testing and launching mode for launch rocket, a "three-level" testing and launching mode gradually appears. During the development process of the "three-level" testing and launching mode, the development process and cycle of an actual launch rocket launching support system equipment are long, and for the control system equipment
15 thereof, during the development process, there is no actual launch rocket launching support system equipment that can be used for system debugging and delivery acceptance. If the test is performed on the actual launch rocket launching support system, it will not only waste time but also increase the development cost.

 In view of this, there is an urgent need to design a launch rocket launching
20 support equivalent device that can avoid a long development cycle and save the actual launch rocket launching support system joint adjustment time.

Summary of the Invention

 The purpose of the present invention is to overcome the shortcomings of the
25 prior art, and provide a launch rocket launching support equivalent device and a control system.

 The present invention provides a launch rocket launching support equivalent device, comprising: a simulation launching platform disposed on at least three movable legs and mounted with a first inclination sensor; a simulation erecting arm
30 disposed at one end of the simulation launching platform, connected to the simulation launching platform by a rotatable hinge point, and mounted with a second inclination sensor; and a proximity switch simulation plate configured for mounting proximity switches for the simulation erecting arm, an upper clamp and a windproof device.

In an aspect of the present invention, the launch rocket launching support equivalent device further comprising: a take-off simulation button provided at the other end of the simulation launching platform and configured for simulating a take-off signal of the launch rocket.

5 In an aspect of the present invention, the launch rocket launching support equivalent device further comprising: a displacement sensor, one end of the displacement sensor being mounted on a bottom surface of the simulation launching platform, and the other end being mounted on the movable leg for feeding back a length of the movable leg.

10 In an aspect of the present invention, the proximity switch simulation plate is provided with a plurality of mounting holes for securing the proximity switches.

 In an aspect of the present invention, the proximity switch simulation plate is provided with four kinds of proximity switches for the simulation erecting arm, the four kinds of proximity switches are an erect in-place proximity switch, a
15 back-to-level in-place proximity switch, a pre-fall in-place proximity switch, and a fast fall in-place proximity switch, respectively.

 In an aspect of the present invention, the proximity switch simulation plate is provided with two kinds of proximity switches for the upper clamp, the two kinds of proximity switches are an upper clamp open in-place proximity switch and an upper
20 clamp clasp in-place proximity switch, respectively.

 In an aspect of the present invention, the proximity switch simulation plate is provided with two kinds of proximity switches for the windproof device, the two kinds of proximity switches are a windproof device unlock in-place proximity switch and a windproof device lock in-place proximity switch, respectively.

25 In an aspect of the present invention, the simulation erecting arm is capable of achieving a location restriction ranged from an angle of -2 degrees to an angle of 92 degrees, and has a locking function.

 In an aspect of the present invention, the movable leg is a servo electric leg or a hydraulic leg.

30 In an aspect of the present invention, the proximity switch simulation plate further comprises an output indicator light connected in parallel with corresponding proximity switch control output signal.

In another aspect of the present invention, provided is a launch rocket launching support equivalent control system, comprising: the above-described launch rocket launching support equivalent device, and a control device being electrically connected to the simulation launching platform, the simulation erecting arm and the proximity switch simulation plate, and configured for controlling the actions of the simulation launching platform, the simulation erecting arm and the proximity switch simulation plate.

According to the launch rocket launching support equivalent device provided by the present invention, through the arrangement of the simulation launching platform, the simulation erecting arm and the proximity switch simulation plate, the same sensor products as the actual launch rocket launching support system can be adopted, and owing to experimenting on the launch rocket launching support equivalent device, the development period can be shortened, the debugging time of the actual launch rocket launching support system can be saved, and meanwhile, the development cost can be greatly saved.

It is to be understood that the above general description and the following detailed description are exemplary and explanatory only and are not intended to limit the scope of the present invention as claimed.

Brief Description of the Drawings

The accompanying drawings, which are part of the specification of the present invention, illustrate exemplary embodiments of the present invention and, together with the description of the specification, serve to explain the principles of the present invention.

FIG. 1 is a schematic diagram of a launch rocket launching support equivalent device according to an embodiment of the present invention;

FIG. 2 is a schematic diagram of a launch rocket launching support equivalent device according to another embodiment of the present invention.

List of reference numerals:

101, simulation launching platform; 102, movable leg; 103, first inclination sensor; 104, simulation erecting arm; 105, second inclination sensor; 106, proximity switch simulation plate; 201, take-off simulation button; 202, displacement sensor.

Detailed Description of Embodiments

Features of various aspects and exemplary embodiments of the present invention will be described in detail below. In order to make the objectives, technical solutions and advantages of the present invention clearer, the present invention will be further described in detail below with reference to the accompanying drawings and specific embodiments. It should be understood that the specific embodiments described herein are only configured to explain the present invention, and are used to exemplify the principles of the present invention and are not configured to limit the present invention. In addition, the mechanisms in the drawings are not necessarily drawn to scale. For example, the dimensions of some of the structural members or regions in the drawings may be exaggerated with respect to other structural members or regions to help understand the embodiments of the present invention.

All of the nouns of locality appearing in the following description are directions shown in the drawings, and are not used for limiting the specific structures of the embodiments of the present invention. In the description of the present invention, it should be noted that, unless otherwise stated, the terms "mount", "connect" and "couple" are to be understood broadly, for example, may be fixedly connected or detachably connected or integrally connected; may be directly connected or indirectly connected through an intermediate medium. For those skilled in the art, the specific meanings of the above terms in the present invention may be understood according to specific situations.

In addition, the terms "comprise", "include", "have", or any other variation thereof are intended to cover a non-exclusive inclusion, such that it includes not only those elements but also other mechanisms not expressly listed or inherent to structural members, components. In the absence of more restrictions, an element defined by the term "comprise..." does not exclude the presence of additional identical elements in an article or apparatus that comprises the element.

Spatially relational terms, such as "lower", "below", "under", "beneath", "upper", "above", "high" and the like are used to facilitate the description to explain the positioning of one element relative to a second element, which is intended to encompass different orientations of the device in addition to the different orientations than those shown in the figures. In addition, for example, "an element is above/under another element" may mean that the two elements are in direct contact, and may also

mean that there are other elements between the two elements. Moreover, terms such as "first", "second" and the like are also used to describe various elements, regions, portions, etc. and should not be taken as limiting. Like terms denote like elements throughout the description.

5 It will be apparent to those skilled in the art that the present invention may be practiced without some of these specific details. The following description of the embodiments is provided merely to provide a better understanding of the present invention by showing examples of the invention.

FIG. 1 is a schematic diagram of a launch rocket launching support
10 equivalent device according to an embodiment of the present invention, and FIG. 2 is a schematic diagram of a launch rocket launching support equivalent device according to another embodiment of the present invention.

As shown in FIG. 1, the present invention provides a launch rocket launching support equivalent device, comprising: a simulation launching platform 101 disposed
15 on at least three movable legs 102 and mounted with a first inclination sensor 103; a simulation erecting arm 104 disposed at one end of the simulation launching platform 101, connected to the simulation launching platform 101 by a rotatable hinge point, and mounted with a second inclination sensor 105; and a proximity switch simulation plate 106 configured for mounting proximity switches for the simulation erecting arm
20 104, a upper clamp and a windproof device.

Specifically, the launch rocket launching support equivalent device of this embodiment is used to solve the problem of debugging and delivery acceptance of the control system under a condition without a real launching support system or before the simulation of a launching task. The launch rocket launching support equivalent
25 device may be an equivalent device adopting a completely consistent interface with the actual launching support system equipment. The simulation launching platform 101 simulates a real launching platform, adopts lightweight aluminium, and meanwhile can be used as a platform for mounting other simulation devices. The simulation launching platform 101 is disposed on at least three movable legs 102, and
30 the levelness of the simulation launching platform 101 is adjusted by the movable legs 102.

In the present embodiment, the movable leg 102 selects the same type of small model product used in the actual system, and the control logic and method

thereof are consistent with the actual system. The first inclination sensor 103 is mounted on the simulation launching platform 101, for feeding back the levelness of the simulation launching platform 101 (i.e., the perpendicularity information of the launch rocket) in real time. The first inclination sensor 103 may be the one used by
5 the actual launching support system, ensuring the consistency of the sensor elements in the simulation launching process, and improving the accuracy of the equivalent simulation. In an aspect of the present invention, the movable leg 102 is a servo electric leg or a hydraulic leg. For example, the servo electric leg may select an electric lead screw, and the levelling of the simulation launching platform 101 is
10 achieved by controlling the extension and retraction of the lead screw.

The simulation erecting arm 104 is capable of simulating an actual erecting process of the launch rocket. The simulation erecting arm 104, for example, uses aluminium and can realize the simulation of the erecting process manually. The simulation erecting arm 104 is disposed at one end of the simulation launch platform
15 101 and is connected by a rotatable hinge point with a locking device. In an aspect of the present invention, the simulation erecting arm 104 is capable of achieving a location restriction of any angle from -2 degrees to 92 degrees, and has a locking function. The second inclination sensor 105 is mounted on the simulation erecting arm 104 for feeding back an erecting angle of the simulation erecting arm 104 in real
20 time. The second inclination sensor 105 adopts the same product as the actual launching support system.

In addition, the proximity switch simulation plate 106 in the launch rocket launching support equivalent device is used to mount proximity switches for other devices. As one of the embodiments, the other devices include: a simulation erecting
25 arm 104, an upper clamp and a windproof device, wherein the upper clamp and the windproof device do not have actual simulation products, and only the proximity switches for the upper clamp and the windproof device are adopted to simulate the transmission signals of the upper clamp and the windproof device. The position of the proximity switch simulation plate 106 is not limited. In this embodiment, in order to
30 facilitate operation, the proximity switch simulation plate 106 is disposed on the simulation launching platform 101.

As shown in FIG. 2, in an aspect of the present invention, the launch rocket launching support equivalent device further includes: a take-off simulation button 201

provided at the other end of the simulation launching platform 101 and configured for simulating a take-off signal of the launch rocket. Specifically, the take-off simulation button 201 can simulate the take-off signal of the launch rocket launching support equivalent device, and perform a fast-fall operation of the simulation erecting arm 104 after receiving the take-off signal.

As shown in FIG. 2, in an aspect of the present invention, the launch rocket launching support equivalent device further includes: a displacement sensor 202, one end of the displacement sensor 202 is mounted on the bottom surface of the simulation launching platform 101, and the other end of the displacement sensor 202 is mounted on the movable leg 102 for feeding back the length of the movable leg 102. The displacement sensor 202 is responsible for detecting movement displacement of the movable leg 102, and employs the same product as the actual launching support system. In the present embodiment, one end of the displacement sensor 202 is mounted on the bottom surface of the simulation launching platform 101, and the other end of the displacement sensor 202 is mounted on a leg seat position of the movable leg 102. In practical applications, the ends of the displacement sensor 202 can be placed at different positions according to the operational mechanism of the displacement sensor 202 as long as the movement displacement detection of the movable leg 102 can be realized.

In an aspect of the present invention, the proximity switch simulation plate 106 is provided with a plurality of mounting holes for securing the proximity switches. In an aspect of the present invention, the proximity switch simulation plate 106 further includes an output indicator light connected in parallel with the corresponding proximity switch control output signal.

Here, the proximity switch simulation plate 106 is used as a mounting bracket of the proximity switches, and can also be used as a mounting bracket for the controlling output indicator lamp. The proximity switch simulation plate 106 is equipped with corresponding auxiliary apparatuses for simulating an ON/OFF state of the proximity switches, including proximity switch signals of the simulation erecting arm 104, the upper clamp and the windproof device. All proximity switches use the same product as the actual launching support system, the controlling output indicator light is in parallel connection with the corresponding proximity switch control output

signal, and the status of each proximity switch is reflected by the output indicator light.

In an aspect of the present invention, the proximity switch simulation plate 106 is provided with four kinds of proximity switches for the simulation erecting arm 104, which are an erect in-place proximity switch, a back-to-level in-place proximity switch, a pre-fall in-place proximity switch, and a fast fall in-place proximity switch, respectively.

Specifically, the four kinds of proximity switches for the simulation erecting arms 104 are applied in two scenarios. One scenario is: the erect in-place proximity switch and the back-to-level in-place proximity switch are used in the simulation of erecting progress of the simulation erecting arm 104, when the simulation erecting arm 104 is set in a horizontal state, the back-to-level in-place proximity switch turns in the OFF state; when the erection angle of the simulation erecting arm 104 during a slow erecting process is greater than 1 degree, the back-to-level in-place proximity switch turns in the ON state; and when the erection angle is greater than 89.5 degrees, the erect in-place proximity switch turns in the OFF state. The other scenario is: when the simulation erecting arm 104 starts from 90 degrees and performs a pre-fall in-place operation until reaches 87 degrees, the pre-fall in-place proximity switch turns in the OFF state; and after receiving the take-off signal, the simulation erecting arm 104 continues to start from 87 degrees and then performs a fast fall in-place operation until reaches 75 degrees, the fast fall in-place proximity switch turns in the OFF state.

In an aspect of the present invention, the proximity switch simulation plate 106 is provided with two kinds of proximity switches for the upper clamp, which are an upper clamp open in-place proximity switch and an upper clamp clasp in-place proximity switch, respectively. In this embodiment, when the upper clamp receives an upper clamp clasp instruction, the upper clamp clasp in-place proximity switch turns in the OFF state, and when the upper clamp receives an upper clamp opening instruction, the upper clamp open in-place proximity switch turns in the OFF state. During this process, the control output signal of the upper clamp is checked. In some cases, based on the structural features of the upper clamp, the number of the upper clamp open in-place proximity switches is provided to be two or more, and the number of the upper clamp clasp in-place proximity switches is provided to be two or

more. For example, the number of proximity switches, the number of corresponding indicator lights may match the number of jaws of the upper clamp, thereby more accurately reacting the action of the upper clamp.

5 In an aspect of the present invention, the proximity switch simulation plate 106 is provided with two kinds of proximity switches for the windproof device, which are a windproof device unlock in-place proximity switch and a windproof device lock in-place proximity switch, respectively. In this embodiment, when the windproof device receives a windproof device locking instruction, the windproof device lock in-place proximity switch turns in the OFF state, and when the windproof device 10 receives a windproof device unlocking instruction, the windproof device unlock in-place proximity switch turns in the OFF state. During this process, the control output signal of the windproof device is observed. In some cases, based on the structural features of the windproof device, the number of the windproof device unlock in-place proximity switches is provided to be two or more, and the number of 15 the windproof device lock in-place proximity switches is provided to be two or more.

In order to ensure the authenticity of the launch rocket launching support equivalent device in the present invention, and to improve the credibility of the test result, all the sensors in the equivalent device adopt the actual products consistent with the actual launch rocket launching support system. The equivalent device can 20 also use buttons, signal simulation board cards or PLC modules to achieve similar functions in the case that some sensors and apparatuses not in place as planned. The device not mentioned in this embodiment includes a sensor data collection device, a simulation quantity input/output control device and a digital quantity input/output control device. Such devices are well known in the art, and the design thereof can be 25 improved on the basis of the present invention according to actual use requirements.

In another aspect, the present invention provides a launch rocket launching support equivalent control system, comprising the above-mentioned launch rocket launching support equivalent device and a control device, the control device electrically connected to the simulation launching platform 101, the simulation 30 erecting arm 104 and the proximity switch simulation plate 106, and configured for controlling the actions of the simulation launching platform 101, the simulation erecting arm 104 and the proximity switch simulation plate 106. The control device belongs to the brain of the launch rocket launching support equivalent control system,

can effectively control the levelling action of the simulation launching platform 101, control the erecting action or the fast-falling action of the simulation erecting arm 104, and control the ON/OFF action of the proximity switches on the proximity switch simulation plate 106, through built-in logic programs.

5 After the rocket is transported to a launching site by a vehicle for transporting and erecting the rocket, the main work is as follows:

- 1) The erecting vehicle erects the rocket and unloads the rocket to a launching platform;
- 2) Opening the upper clamp of the erecting arm;
- 10 3) Pressuring the rocket windproof device tight;
- 4) Starting to adjust the perpendicularity of the rocket;
- 5) Releasing the rocket windproof device;
- 6) Making the erecting arm to pre-fall at a certain angle; and
- 7) Starting the fast falling of the erecting arm upon receiving a take-off
- 15 signal of the rocket.

Such launch rocket launching support equivalent control system mainly completes the following equivalent functions:

- 1) Simulating the erecting and unloading process of the simulation erecting arm 104;
- 20 2) Simulating the opening and clasping process of the upper clamp of the simulation erecting arm 104;
- 3) Simulating the locking and unlocking process of the windproof device;
- 4) Simulating the levelling of the launching platform 101, i.e., the perpendicularity adjustment process of the rocket;
- 25 5) Simulating the pre-falling and pre-falling in-place process of the simulation erecting arm 104;
- 6) Simulating the fast falling and fast falling in-place process of the simulation erecting arm 104.

Therefore, the present invention provides a launch rocket launching support
30 equivalent test method, the method being used for a launch rocket launching support equivalent control system. The control system comprises a simulation launching platform 101, a simulation erecting arm 104, a proximity switch simulation plate 106 and a control device, wherein the control device is electrically connected to the

simulation launching platform 101, the simulation erecting arm 104 and the proximity switch simulation plate 106. The test method comprises: erecting the simulation erecting arm 104 from the horizontal state to a vertical state, and transmitting an inclination signal of the simulation erecting arm 104 to the control device by the first
5 inclination sensor 103 provided on the simulation erecting arm 104; adjusting the levelness of the simulation launching platform 101, and transmitting a levelness signal to the control device by the second inclination sensor 105 provided on the simulation erecting platform 101; monitoring a signal output of the proximity switches on the proximity switch simulation plate 106; the control device receives different proximity
10 switch signals and sends corresponding instructions.

Specifically, the launch rocket launching support equivalent test method includes the erecting process of the simulation erecting arm 104, the levelling process of the simulation launching platform 101, the opening and clasp process of the upper clamp, the locking and unlocking process of the windproof device, and the fast
15 falling process of the simulation erecting arm 104 upon receiving a take-off signal.

In the erecting process of the simulation erecting arm 104, the simulation erecting arm 104 erects from the horizontal state to the vertical state, and the first inclination sensor 103 provided on the simulation erecting arm 104 transmits the inclination signal of the simulation erecting arm 104 to the control device. In the
20 levelling process of the simulation launching platform 101, the levelness of the simulation launching platform 101 is adjusted, and the second inclination sensor 105 disposed on the simulation launching platform 101 transmits the levelness signal to the control device; the opening and clasp process of the upper clamp and the locking and unlocking process of the windproof device are all performed on the
25 proximity switch simulation plate 106, and tested by detecting the proximity switch signal output of the upper clamp and the windproof device, and the control device receives different proximity switch signals and sends corresponding instructions.

According to an aspect of the present invention, the launch rocket launching support equivalent test method further comprises: when the simulation erecting arm
30 104 erects greater than 91.5 degrees relative to the simulation launching platform 101, the control device sends an alarm signal and an instruction of shutting down the simulation erecting arm 104.

According to an aspect of the present invention, adjusting the levelness of the simulation launching platform 101 includes: controlling the length of the at least three movable legs 102 supporting the simulation launching platform 101, such that the absolute value of the levelness of the second inclination sensor 105 is between 0
5 degree and 0.5 degree.

According to an aspect of the present invention, monitoring the signal output of the proximity switches on the proximity switch simulation plate 106 includes: monitoring the four kinds of proximity switches for the simulation erecting arms 104 on the proximity switch simulation plate 106. The four kinds of proximity switches
10 are a erect in-place proximity switch, a back-to-level in-place proximity switch, a pre-fall in-place proximity switch, and a fast fall in-place proximity switch, respectively.

According to an aspect of the present invention, the simulation erecting arm 104 is set in the horizontal state, when the simulation erecting arm 104 erects and the erection angle is greater than 1 degree, the signal output of the back-to-level in-place
15 proximity switch is monitored, and when the erection angle of the simulation erecting arm 104 is greater than 89.5 degrees, the signal output of the erect in-place proximity switch is monitored. When the simulation erecting arm 104 is set in the horizontal state, the back-to-level in-place proximity switch turns in the OFF state, when the
20 simulation erecting arm 104 erects and the erection angle is greater than 1 degree, the back-to-level in-place proximity switch turns in the ON state, when the erection angle of the simulation erecting arm 104 is greater than 89.5 degrees, the erect in-place proximity switch turns in the OFF state.

According to an aspect of the present invention, the control system comprises
25 a take-off simulation button for simulating a take-off signal of the launch rocket, and the test method further comprises: pressing the take-off simulation button and sending the take-off signal of the launch rocket, the control device sending a fast falling instruction for the simulation erecting arm 104 after receiving the take-off signal, and monitoring the signal output of the fast falling in-place proximity switch. The
30 simulation erecting arm 104 starts from 90 degrees and performs a pre-fall in-place operation until reaches 87 degrees, the pre-fall in-place proximity switch turns in the OFF state; and after receiving the take-off signal, the simulation erecting arm 104 continues to start from 87 degrees and then performs a fast fall in-place operation

until reaches 75 degrees, while the fast fall in-place proximity switch turns in the OFF state.

According to an aspect of the present invention, monitoring a signal output of the proximity switches on the proximity switch simulation plate 106 includes:
5 monitoring two kinds of proximity switches for the upper clamp on the proximity switch simulation plate 106, which are the upper clamp open in-place proximity switch and the upper clamp clasp in-place proximity switch, respectively.

According to an aspect of the present invention, the control device sends an upper clamp unlocking instruction to monitor the signal output of the upper clamp
10 unlock in-place proximity switch; and the control device sends an upper clamp clasp instruction to monitor the signal output of the upper clamp clasp in-place proximity switch.

According to an aspect of the present invention, monitoring a signal output of the proximity switches on the proximity switch simulation plate 106 includes:
15 monitoring two kinds of proximity switches for the windproof device on the proximity switch simulation plate 106, which are the windproof device unlock in-place proximity switch and the windproof device lock in-place proximity switch, respectively.

According to an aspect of the present invention, the control device sends a
20 windproof device unlocking instruction to monitor the signal output of the windproof device unlock in-place proximity switch; and the control device sends a windproof device locking instruction to monitor the signal output of the windproof device lock in-place proximity switch.

In the present invention, the launch rocket launching support equivalent test
25 method comprises five simulation test processes, and the specific operation processes are as follows:

I) An erecting process of the simulation erecting arm 104 is specifically as follows:

S101: setting the simulation erecting arm 104 to the horizontal state, and
30 adjusting the levelness between 0 degree and plus or minus 0.5 degrees according to the inclination signal of the first inclination sensor;

S102: adjusting the back-to-level in-place proximity switch for the simulation erecting arm 104 to the OFF state;

S103: sending, by the control device, an erecting instruction to slowly erect the simulation erecting arm 104, and monitoring the real-time follow-up and accuracy of the inclination signal of the first inclination sensor collected by the control device;

5 S104: when the erection angle is greater than 1 degree, if the back-to-level in-place proximity switch still shows the OFF state, detecting whether the control device gives a prompt that the back-to-level in-place proximity switch for the simulation erecting arm is malfunctioning;

S105: monitoring whether the signal output of the back-to-level in-place proximity switch is normal, and monitoring whether an output of an erection control
10 instruction disappears when an erect in-place signal of the simulation erecting arm 104 is OFF; and

S106: continue erecting the simulation erecting arm 104 until it is greater than 91.5 degrees, monitoring whether the control device gives alarm information and closes the erection control instruction.

15 II) A levelling process of the simulation launching platform 101 is specifically as follows:

S201: manually controlling at least three movable legs 102 to adjust the simulation launching platform 101, so that the angle shown by the second inclination sensor is between 0 degree and plus or minus 0.5 degrees;

20 S202: sending, by the control device, a levelling instruction of the simulation launching platform 101, i.e., a rocket perpendicularity adjustment instruction, to monitor the levelling condition of the simulation launching platform 101;

S203: monitoring whether the action condition of the movable leg 102 of the simulation launching platform 101 is consistent with the control output instruction for
25 the movable leg 102;

S204: checking whether giving a fault prompt if the rocket perpendicularity adjustment is not finished within a specified time; and

S205: checking, after the perpendicularity adjustment ends normally, whether the levelness of the simulation launching platform 101, i.e., the rocket
30 perpendicularity result satisfies the precision requirement.

III) The opening and clasp process of the upper clamp is specifically as follows:

S301: setting the upper clamp open in-place proximity switch in the OFF state;

S302: sending, by the control device, an upper clamp clasp instruction;

S303: monitoring whether the control system outputs the upper clamp clasp instruction normally;

S304: monitoring, when the upper clamp clasp in-place proximity switch is in the OFF state, whether the output of the upper clamp clasp instruction in the control device disappears;

S305: setting the upper clamp clasp in-place proximity switch in the OFF state;

S306: sending, by the control device, an upper clamp opening instruction;

S307: monitoring whether the control device outputs the upper clamp opening instruction normally; and

S308: monitoring, when the upper clamp open in-place proximity switch is in the OFF state, whether the output of the upper clamp opening instruction in the control device disappears.

IV) The locking and unlocking process of the windproof device is specifically as follows:

S401: setting the windproof device unlock in-place proximity switch in the OFF state;

S402: sending, by the control device, a windproof device locking instruction;

S403: monitoring whether the control device outputs the windproof device locking instruction normally;

S404: monitoring, when the windproof device lock in-place proximity switch is in the OFF state, whether the output of the windproof device locking instruction in the control device disappears;

S405: setting the windproof device lock in-place proximity switch in the OFF state;

S406: sending, by the control device, a windproof device unlocking instruction;

S407: monitoring whether the control device outputs the windproof device unlocking instruction normally; and

S408: monitoring, when the windproof device unlock in-place proximity switch is in the OFF state, whether the output of the windproof device unlocking instruction in the control device disappears.

5 V) The fast falling process of the simulation erecting arm 104 upon receiving a take-off signal:

S501: pressing the take-off simulation button 201;

S502: sending, by the control device, a simulation erecting arm 104 fast falling instruction;

10 S503: monitoring whether the control device outputs the erecting arm fast falling instruction;

S504: monitoring, when the take-off simulation button 201 is pressed, whether the control device outputs the fast falling instruction;

S505: evaluating a response time of the control device to receive the take-off signal;

15 S506: evaluating a response time of the control for the fast falling and a fast falling process response time; and

S507: monitoring, when the fast fall in-place proximity switch is in the OFF state, whether the fast falling instruction in the control device disappears.

20 The launch rocket launching support equivalent device of the present invention has an interface that is completely consistent with the actual launch rocket launching support system equipment. After the actual launch rocket launching support system scheme is preliminarily determined, it ensures that the development of the control system of the actual launch vehicle launching support system is carried out in sync with the development of the overall apparatus, thus the development cycle is greatly shortened, the debugging time of the actual launch rocket launching support system is saved, and meanwhile, the development cost is greatly reduced. The launch rocket launching support equivalent control system can conveniently complete debugging and comprehensive test of the control subsystem of the actual launch rocket launching support system, the delivery acceptance and the system fault separation, which provides guarantee for synchronous development and advance
25
30 delivery of the control system of the actual launch rocket launching support system.

The above is only the preferred embodiments of the present invention and is not intended to limit the present invention. Any modifications, equivalent

substitutions, improvements and the like made within the spirit and principle of the present invention shall fall within the protection scope of the present invention.

Claims

1. A launch rocket launching support equivalent device, characterized by comprising:

5 a simulation launching platform disposed on at least three movable legs and mounted with a first inclination sensor;

a simulation erecting arm disposed at one end of the simulation launching platform, connected to the simulation launching platform by a rotatable hinge point, and mounted with a second inclination sensor; and

10 a proximity switch simulation plate configured for mounting proximity switches for the simulation erecting arm, an upper clamp and a windproof device, wherein the proximity switch simulation plate is provided with a plurality of mounting holes for securing the proximity switches,

the proximity switch simulation plate is provided with four kinds of proximity switches for the simulation erecting arm, the four kinds of proximity switches are an
15 erect in-place proximity switch, a back-to-level in-place proximity switch, a pre-fall in-place proximity switch, and a fast fall in-place proximity switch, respectively.

2. The launch rocket launching support equivalent device according to claim 1, further comprising:

20 a take-off simulation button provided at the other end of the simulation launching platform and configured for simulating a take-off signal of the launch rocket.

3. The launch rocket launching support equivalent device according to claim 1, further comprising:

25 a displacement sensor, one end of the displacement sensor being mounted on a bottom surface of the simulation launching platform, and the other end being mounted on the movable leg for feeding back a length of the movable leg.

4. The launch rocket launching support equivalent device according to claim 1, wherein:

the proximity switch simulation plate is provided with two kinds of proximity switches for the upper clamp, the two kinds of proximity switches are an upper clamp

open in-place proximity switch and an upper clamp clasp in-place proximity switch, respectively.

5. The launch rocket launching support equivalent device according to claim 1, wherein:

5 the proximity switch simulation plate is provided with two kinds of proximity switches for the windproof device, the two kinds of proximity switches are a windproof device unlock in-place proximity switch and a windproof device lock in-place proximity switch, respectively.

6. The launch rocket launching support equivalent device according to claim 1,
10 wherein:

the simulation erecting arm is capable of achieving a location restriction ranged from an angle of -2 degrees to an angle of 92 degrees, and has a locking function.

7. The launch rocket launching support equivalent device according to claim 1, wherein:

15 the movable leg is a servo electric leg or a hydraulic leg.

8. The launch rocket launching support equivalent device according to claim 1, wherein:

the proximity switch simulation plate further comprises an output indicator light connected in parallel with corresponding proximity switch control output signal.

20 9. A launch rocket launching support equivalent control system, characterized by comprising:

the launch rocket launching support equivalent device according to any of claims 1-8, and

25 a control device being electrically connected to the simulation launching platform, the simulation erecting arm and the proximity switch simulation plate, and configured for controlling the actions of the simulation launching platform, the simulation erecting arm and the proximity switch simulation plate.