

AUTOMATIC SELF-EXTINGUISHING AND SHUTDOWN SYSTEM AND METHOD FOR FOUNDATION ENGINEERING LARGE EQUIPMENT

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TECHNICAL FIELD

[0001] The present application relates to a field of firefighting technology for large equipment and in particular, relates to an automatic self-extinguishing and shutdown system and method for foundation engineering large equipment.

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BACKGROUND ART

[0002] During the normal construction, the large equipment mainly used in foundation engineering such as double wheel slotting machine, crawler crane, large crane and so on is always in a harsh environment. Some construction locations are far away from the fire brigade or the firefighting facilities. This kind of large equipment
15 has a large power and is required to operate for a long time once in operation. The machine is carried with various types of oil in a large amount (around 1200 L diesel, around 800 L hydraulic oil, engine oil, etc.). The pumps, motors and engines have a high temperature due to the long-time operation. Once the spontaneous combustion of the large equipment occurs, it may lead to a huge loss. Therefore, fire prevention
20 during construction has also become a crucial issue.

SUMMARY

[0003] The technical problem of the present application is to make up the above-mentioned deficiency in the existing technology, and the present application
25 provides an automatic self-extinguishing and shutdown system for foundation engineering large equipment, and the design thereof is new and rational. The automatic dry powder extinguisher is mounted at each easily ignited point of the large equipment, realizing an automatic detection of the environment temperature and an automatic extinguishment. The power supply control module of the large equipment
30 may realize shutting down the power supply for the large equipment in case of fire, completely preventing the spread and occurrence of the fire, protecting the equipment, and ensuring the safety on site, which is convenient for popularization and use.

[0004] In order to solve the above technical problem, the present application adopts the following technical solution: an automatic self-extinguishing and shutdown system for foundation engineering large equipment includes a plurality of automatic dry powder extinguishers provided in large equipment and a large equipment power supply control module connected to the automatic dry powder extinguishers. The automatic dry powder extinguisher includes an extinguisher housing pressurized filled with extinguishing dry powder and two extinguisher automatic control valves provided at two ends of the extinguisher housing. A contact switch for indicating the operation state of the automatic dry powder extinguisher is connected to the extinguisher automatic control valve.

[0005] The large equipment power supply control module includes a first relay (K6) and a second relay (K7). One end of a coil of the first relay (K6) is connected to the ground via a plurality of contact switches in parallel of the automatic dry powder extinguishers. The other end of the coil of the first relay (K6) is divided to two branches, in which one branch is connected to a +24V power supply and the other branch is connected to one end of a coil of the second relay (K7) by a normally-closed contact of the first relay (K6). The other end of the coil of the second relay (K7) is connected to the ground. One end of a normally-open contact of the second relay (K7) is connected to the +24V power supply, and the other end is connected a positive power supply port of the large equipment.

[0006] The extinguisher automatic control valve includes a spraying pipe threadedly connected to the extinguisher housing, a valve body assembly provided in the spraying pipe, and a temperature sensitive valve body control mechanism provided on an outer sidewall of the spraying pipe. The temperature sensitive valve body control mechanism is configured for controlling the opening and closing of the valve body assembly and the contact switch.

[0007] At least five dry powder extinguishers are provided. At least one dry powder extinguisher is provided around an oil tank of the large equipment and at least four dry powder extinguishers are provided around the engine of the large equipment.

[0008] In addition, the present application further discloses a method, which has simple steps and rational design, realizing an automatic extinguishment and shutdown of large equipment. The method includes the following steps.

[0009] Step one: debugging and assembling of the automatic dry powder extinguishers.

[0010] The extinguisher automatic control valve of the dry powder extinguisher is adaptably debugged before filling the extinguishing dry powder. The detail steps are as follows.

[0011] Step 101: determining an environment ignition temperature threshold of the equipment, in which the environment ignition temperature threshold of the equipment is larger than a normal operation temperature at an automatic dry powder extinguisher mounting points of the large equipment, and a boiling point of temperature sensitive liquid is equal to an ignition temperature of a material used in mounting the equipment.

[0012] Step 102: adjusting a temperature threshold adjusting knob of the extinguisher automatic control valve unmounted to the extinguisher housing, so that an inflatable bladder is moved in a direction away from a valve plate limiting rod until a distance between a mounting plate and the valve plate limiting rod reached a maximum.

[0013] Step 103: placing the extinguisher automatic control valve after adjusting the position of the inflatable bladder in a testing environment with the environment temperature equaling to the environment ignition temperature threshold of the equipment, waiting the inflatable bladder to bloat to a limit, then rotating the temperature threshold adjusting knob, so as to drive the inflatable bladder to move in a direction close to the valve plate limiting rod until a top of a valve rod pushing the valve plate limiting rod to tilt up, so that a limitation of the valve plate to separate from a hook is relieved and a pressing rod on the valve rod is pressed to close the contact switch at the same time, in which the positions of the temperature threshold adjusting knob and the inflatable bladder at this time are target mounting positions of the current equipment under the environment ignition temperature threshold.

[0014] Step 104: placing the extinguisher automatic control valve in a normal temperature environment, waiting the inflatable bladder to return to the original state, then connecting this extinguisher automatic control valve to the extinguisher housing filled with the extinguishing dry powder, inflating and pressurizing the extinguisher housing, so as to finish the assembly of the automatic dry powder extinguisher.

[0015] Step two: mounting the automatic dry powder extinguisher and large equipment power supply control module.

[0016] At least one dry powder extinguisher is provided around the oil tank of the large equipment and at least four dry powder extinguishers are provided around the engine of the large equipment.

[0017] The contact switch of each automatic dry powder extinguisher is coupled in parallel to the large equipment power supply control module, and a storage battery is connected to the power supply port of the large equipment via the large equipment power supply control module.

[0018] Step three: automatic extinguishing and shutting down the large equipment.

[0019] A capsule-shaped temperature detector monitors the environment temperature of a mounting position thereof in real time. When the environment temperature of the mounting position is equal to or larger than the environment ignition temperature threshold of the equipment, the temperature sensitive liquid in the capsule-shaped detector is evaporated, and the inflatable bladder is bloated due to the vapor pressure. The top of the valve rod pushed the valve plate limiting rod to tilt up, so that the limitation of the valve plate to separate from a hook is relieved and the pressurized dry powder is sprayed out through the spraying pipe, realizing the automatic extinguishing.

[0020] At the same time of the top of the valve rod pushing the valve plate limiting rod to tilt up, the pressing rod on the valve rod is pressured to close the contact switch. The coil of the first relay (K6) is energized, the normally-closed contact is opened, the coil of the second relay (K7) losses energy and the normally-open contact of the second relay (K7) is opened, so as to shut down the power supply of the large equipment, realizing the shutdown of the large equipment.

[0021] Step four: recycling the automatic dry powder extinguisher.

[0022] After the automatic dry powder extinguishers are used, uncorroded and undamaged extinguisher housings are selected. The extinguisher automatic control valves on two ends of these extinguisher housings are detached and checked to check whether the structure of the extinguisher automatic control valve is damaged. When it is damaged, the extinguisher automatic control valve may be replaced. When it is undamaged, the valve plate in the spraying pipe is pushed in a direction towards the hook. The valve plate extrudes the hook, and a pushing resetting spring is retracted to

free up a space. After the valve plate is trapped in the hook, the pushing resetting spring is returned immediately, realizing a reclose of a spraying chamber.

[0023] After refilling the extinguishing dry powder in the extinguisher housing, the reset extinguisher automatic control valve is connected to the extinguisher housing.

5 **[0024]** The extinguisher housing is inflated and pressurized so as to finish the reassembly of the automatic dry powder extinguisher, realizing the recycling of the automatic dry powder extinguisher.

[0024] In the above method, the environment ignition temperature threshold of the equipment is configured to 65°C~85°C.

10 **[0025]** The present application has the following advantages compared to the existing technology.

[0026] In the present application, the automatic dry powder extinguisher is mounted at each easily ignited point of the large equipment, realizing the automatic detection of the environment temperature and the automatic extinguishment. The large
15 equipment power supply control module realizes the shutdown of the large equipment power supply in case of fire, completely preventing the spread and occurrence of the fire, protecting the equipment, and ensuring the safety on site.

[0027] The technical solution of the present application is further described in detail below in combination with the figures and embodiments

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BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIG. 1 is a system principle diagram of an automatic self-extinguishing and shutdown system for foundation engineering large equipment according to the present application.

25 **[0029]** FIG. 2 is an electrical principle diagram of a large equipment power supply control module according to the present application.

[0030] FIG.3 is a structural schematic diagram of an automatic dry powder extinguisher according to the present application.

[0031] FIG.4 is a structural schematic diagram of an extinguisher automatic control
30 valve in FIG.3.

[0032] FIG.5 is a flow chat diagram of a method according to the present application.

DETAILED DESCRIPTION

[0033] Referring to FIG.1 - FIG.4, an automatic self-extinguishing and shutdown system for foundation engineering large equipment provided in the present application includes a plurality of automatic dry powder extinguishers 31 provided in the large equipment 1 and a large equipment power supply control module 2 connected to the automatic dry powder extinguishers 31. The automatic dry powder extinguisher 31 includes an extinguisher housing 3 pressurized filled with extinguishing dry powder and two extinguisher automatic control valves provided at two ends of the extinguisher housing 3. A contact switch 4 for indicating the operation state of the automatic dry powder extinguisher 31 is connected to the extinguisher automatic control valve.

[0034] The large equipment power supply control module 2 includes a first relay (K6) and a second relay (K7). One end of a coil of the first relay (K6) is connected to the ground via a plurality of contact switches 4 in parallel of the automatic dry powder extinguisher 31. The other end of the coil of the first relay (K6) is divided to two branches, in which one branch is connected to a +24V power supply and the other branch is connected to one end of a coil of the second relay (K7) via a normally-closed contact of the first relay (K6). The other end of the coil of the second relay (K7) is connected to the ground. One end of a normally-open contact of the second relay (K7) is connected to the +24V power supply, and the other end is connected a positive power supply port of the large equipment 1.

[0035] The extinguisher automatic control valve includes a spraying pipe 5 threadedly connected to the extinguisher housing 3, a valve body assembly provided in the spraying pipe 5, and a temperature sensitive valve body control mechanism provided on an outer sidewall of the spraying pipe 5. The temperature sensitive valve body control mechanism is configured for controlling the opening and closing of the valve body assembly and the contact switch 4.

[0036] At least five dry powder extinguishers 31 are provided. At least one dry powder extinguisher 31 is provided around an oil tank of the large equipment 1 and at least four dry powder extinguishers 31 are provided around the engine of the large equipment 1.

[0037] In this embodiment, a gas injection pressurization check valve 33 is provided in the extinguisher housing 3. An injection device injects gas into the extinguisher housing 3 through the gas injection pressurization check valve 33.

[0038] It should be noted that, in practical installation, at least four automatic dry powder extinguishers 31 are arranged at the position with a relatively high temperature around the engine of the large equipment, which has a better effect.

[0039] In this embodiment, five automatic dry powder extinguishers 31 are provided. Each automatic dry powder extinguisher 31 has two contact switches 4. Ten contact switches 4 are provided, and ten contact switches 4 are a contact switch S1, a contact switch S2, a contact switch S3, a contact switch S4, a contact switch S5, a contact switch S6, a contact switch S7, a contact switch S8, a contact switch S9, and a contact switch S10.

[0040] In this embodiment, +24V power supply is a storage battery 30.

[0041] It should be noted that, after the extinguishing dry powder is filled, the extinguisher housing 3 is inflated and pressurized, which facilitates the automatic spraying of the extinguishing dry powder when the extinguisher automatic control valve is open, realizing the extinguishment.

[0042] It should be noted that, the structural components in the automatic dry powder extinguisher 31 should be overhauled and replaced regularly, ensuring an ideal extinguishing effect. In addition, the fitting relationship between the contact switch 4 and the extinguisher automatic control valve should also be overhauled regularly, ensuring the normal close of the contact switch 4 after the automatic dry powder extinguisher 31 starting extinguishing, so that the large equipment power supply control module 2 may control the shutdown of the large equipment 1, ensuring the safety on site.

[0043] It should be noted that, the automatic dry powder extinguisher 31 is mounted at each easily ignited point of the large equipment 1, realizing the automatic detection of the environment temperature and the automatic extinguishment. The large equipment power supply control module 2 realizes the shutdown the power supply of the large equipment 1 in case of fire, completely preventing the spread and occurrence of the fire, protecting the equipment, and ensuring the safety on site.

[0044] In this embodiment, the valve body assembly includes a partition plate 8 provided on the internal wall of the spraying pipe 5, which divides the interior of the

spraying pipe 5 into a spraying chamber 6 and a control chamber 7, a valve plate 9 for closing a discharging opening of the spraying chamber, which is hinged with the internal wall of the spraying pipe 5, and a valve plate limiting rod 10 provided in the control chamber 7. The valve plate limiting rod 10 is perpendicular to the valve plate 9 in a close state. A hook 11 for compressing the valve plate 9 at the discharging opening of the spraying chamber 6 is provided on an end of the valve plate limiting rod 10 close to the valve plate 9. The middle portion of the valve plate limiting rod 10 is hinged with the internal wall of the spraying pipe 5.

[0045] The temperature sensitive valve body control mechanism includes a temperature sensitive housing 12 arranged on the outer wall of the spraying pipe 5, a transition housing 13 arranged between the temperature sensitive housing 12 and the spraying pipe 5, a temperature sensitive assembly and a valve body control assembly.

[0046] The valve body control assembly includes a valve rod 14 abutting against an end of the valve plate limiting rod 10 away from the valve plate 9 and a pushing reset spring 15 abutting against an end of the valve plate limiting rod 10 close to the valve plate 9. The valve rod 14 is arranged perpendicular to the valve plate limiting rod 10. An end of the valve rod 14 away from the valve plate limiting rod 10 is inserted in the temperature sensitive housing 12. The contact switch 4 is arranged in the transition housing 13. A pressing rod 16 for controlling the opening and closing of the contact switch 4 is fixedly connected to the valve rod 14.

[0047] The temperature sensitive assembly includes an inflatable bladder arranged in the temperature sensitive housing 12 for pushing the valve rod 14 in a direction towards the valve plate limiting rod 10, a capsule-shaped temperature detector 17 arranged outside the temperature sensitive housing 12, and a capillary 18 for communicating the capsule-shaped temperature detector 17 with the inflatable bladder. The temperature sensitive liquid is filled in the capsule-shaped temperature detector 17, the inflatable bladder and the capillary 18.

[0048] A mounting plate 19 for mounting the inflatable bladder, and a temperature threshold adjusting knob 20 for driving the inflatable bladder to move in the direction close to or away from the valve rod 14 are arranged in the temperature sensitive housing 12. The mounting plate 19 is slidably connected to the internal wall of the temperature sensitive housing 12. One end of temperature threshold adjusting knob 20 is rotatably connected to the mounting plate 19. The other end of the temperature

threshold adjusting knob 20 penetrates out of the temperature sensitive housing 12 and is threadedly connected to the temperature sensitive housing 12.

5 [0049] It should be noted that, the partition plate 8 divides the interior of the spraying pipe 5 into the spraying chamber 6 and the control chamber 7, so that the associated control structures in the control chamber 7 are not influenced by the extinguishing dry powder, so as to ensure a reuse and a smooth action, facilitating the cost saving.

10 [0050] The valve plate limiting rod 10 and the hook 11 are fitted with each other in a hinged connection by the pushing reset spring 15, so as to realize the recycling of the automatic dry powder extinguisher 31, saving the cost and the resource.

15 [0051] The capsule-shaped temperature detector 17, the inflatable bladder and the capillary 18 are fitted with each other, so that the inflatable bladder bloats under the environment with abnormal high temperature. The inflatable bladder pushes the valve rod 14, and drives the valve plate limiting rod 10 to tilt up, so that the limitation of the valve plate 9 to separate from the hook 11 is relieved. The pressurized extinguishing dry powder is automatically sprayed out, realizing the automatic spraying and extinguishing, which improves the extinguishing efficiency extremely, reduces the economic loss, and protects the safety of the working operators, having a good using effect.

20 [0052] By designing a pure mechanical temperature sensitive valve body control mechanism, the working principle is clear, so that it is convenient and fast to overhaul and maintain. The components not satisfied with the using standard could be replaced at any time, which has a high reliability.

25 [0053] By setting the temperature threshold adjusting knob 20, a fine adjustment of the temperature threshold could be conducted when the valve plate 9 is opened. The specific principle is: when it is required to increase the temperature threshold, the temperature threshold adjusting knob 20 is rotated, so that the inflatable bladder drives the valve rod 14 away from the valve plate limiting rod 10. At this time, the required bloat amount of the inflatable bladder is increased when the valve rod 14 pushes the valve plate limiting rod 10 to tilt up, and the environment temperature is increased when the valve plate 9 is opened. In the contrary situation, the principle is the same. This design makes the operability of the temperature sensitive assembly higher. An adaptable adjustment may be conducted according to the different

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situations on site or the actual size of the temperature sensitive assembly, so that the entire automatic dry powder extinguisher 31 may be adapted to different environments and requirements.

5 [0054] It should be noted that, when the valve rod 14 presses the valve plate limiting rod 10 to make the valve plate 9 open, the pressing rod 14 presses the contact switch 4 to close.

[0055] In this embodiment, the temperature sensitive valve body control mechanism and the valve body assembly are both made of fire-resistant metal material.

10 [0056] In this embodiment, the discharging opening of the spraying pipe 5 could be configured as a nozzle 21, facilitating the extinguishing dry powder to spray around, so as to increase the extinguishing scope.

15 [0057] In this embodiment, the partition plate 8 is arranged along the length direction of the spraying pipe 5. Two ends of the partition plate 8 in the width direction abut against and are fixedly connected to the internal wall of the spraying pipe 5. The spraying chamber 6 is communicated with the extinguisher housing 3. A baffle 22 for preventing the valve plate limiting rod 11 from contacting the extinguishing dry powder is provided on an end of the partition plate 8 close to the extinguisher housing 3. The baffle 22 is arranged between the partition plate 8 and the internal wall of the spraying pipe 5.

20 [0058] In this embodiment, the capsule-shaped temperature detector 17 and the inflatable bladder are both made of copper, which has a good thermal conductivity effect, and a faster temperature sensitive speed. After the inflatable bladder made of thin copper plate is bloated, when the temperature returns to the normal state, the inflatable bladder is retracted to the flat state due to the factors such as negative
25 pressure and recooling, which is convenient for the reuse.

[0059] It should be noted that, although the capsule-shaped temperature detector 17 has the same material as the inflatable bladder, due to the special capsule shape thereof, the capsule-shaped temperature detector 17 won't be bloated caused by the heating and evaporating of the temperature sensitive liquid. The vaped gas could
30 flow into the inflatable bladder through the capillary 18 as much as possible, so that the inflatable bladder is bloated to drive the valve rod 14 to abut against the valve plate limiting rod 10, so as to open the valve plate 9.

[0060] It should be noted that, a spraying extension pipe may be connected to the discharging opening of the spraying pipe 5. The length of the capillary 18 could be determined as 3 cm~3 m according to the actual requirement on site. The discharging opening of the spraying extension pipe and the capsule-shaped temperature detector 17 are mounted at the position close to the easily ignited point, so that the extinguisher housing 3 could be mounted away from the easily ignited point, preventing the extinguisher housing 3 from being damaged, so as to realize a reuse.

[0061] In this embodiment, the temperature sensitive liquid has a boiling point equaling to the ignition temperature of the material for mounting the equipment, such as the temperature sensitive liquid with temperature between 65°C~85°C.

[0062] It should be noted that, the temperature of the large equipment in the normal operation is around 50°C. When the temperature at the mounting position of the capsule-shaped temperature detector 17 reaches 65°C~85°C, it is indicated that the large equipment is operated abnormally, the fire is possible to have occurred. At this time, a large amount of temperature sensitive liquid evaporates, the volume of the temperature sensitive liquid is increased, so that the inflatable bladder is bloated and drives the valve rod 14 to press the valve plate limiting rod 10 to tilt up. The valve plate 9 is relived from the limitation and is opened. The pressurized extinguishing dry powder in the extinguisher housing 3 sprays out from the spraying pipe 5, realizing the extinguishment and cooling.

[0063] In this embodiment, the temperature sensitive liquid adopts ethanol.

[0064] In this embodiment, the pushing reset spring 15 is arranged in the transition housing 13. One end of the pushing reset spring 15 penetrates through the transition housing 13 and abuts against the valve plate limiting rod 10. A limitation guiding pipe 23 sleeved on the pushing reset spring 15 is provided in the transition pipe 13. A buffer spring 24 is sleeved on the portion of the valve rod 14 inserting in the temperature sensitive housing 12.

[0065] It should be noted that, the limitation guiding pipe 23 limits the moving direction of the pushing reset spring 15. The pushing reset spring 15 has two functions. The first function is: when the valve plate 9 is in a close state, the pushing reset spring 15 abuts against the valve plate limiting rod 10, so that the hook 11 prevents the valve plate 9 from opening, which could counteract the shake of the automatic dry powder extinguisher 31 caused in the transport and installation process, ensuring the closing

state of the valve plate 9 under the normal environment temperature. The second function is: when the valve plate 9 is required to be reused after opening, the valve plate 9 is pushed towards the hook 11. The pushing resetting spring 15 is retracted to free up a space, and then it is returned immediately, so that the valve plate 9 may be moved along a sloping edge of the hook 11 in a right-angled triangle shape smoothly, realizing the reclose of the extinguisher housing 3.

[0066] In this embodiment, the inflatable bladder includes two circular plate hollow bladder bodies 25, which are stacked and communicated with each other. Each circular plate hollow capsule body 25 has an annular sidewall protruding outwards. The circular plate hollow capsule body 25 arranged close to the valve rod 14 has a smaller diameter than the circular plate hollow capsule body 25 arranged away from the valve rod 14. The valve rod 14 is arranged at the center of a circle of a plane of the circular plate hollow capsule body 25.

[0067] In this embodiment, the valve rod 14 is connected to the circular plate hollow capsule body 25 by an expansion plate 32.

[0068] It should be noted that, when the vaped gas in the capsule-shaped temperature detector 17 enters into the inflatable bladder through the capillary 18, the interior of the inflatable bladder is stressed under a homogeneous pressure. Only a non-circular portion of the circular plate hollow capsule body 25 is bloated under this pressure, that is, the plane portion of the circular plate hollow capsule body 25 is bloated into an arc surface. The annular sidewall of the circular plate hollow capsule body 25 is configured to protrude outwards, so that the circular plate hollow capsule body 25 has no lateral bloat, reducing the consume of the pressure. This principle is similar to the principle of balloon inflation.

[0069] It should be noted that, two circular plate hollow bladder bodies 25 with different diameters are so configured that, when the vapor pressure is generated, the circular plate hollow capsule body 25 with a larger diameter is bloated firstly, and the circular plate hollow capsule body 25 with a smaller diameter is then bloated secondly, which has a better bloat effect, so that the valve rod 14 may tilt up the valve plate limiting rod 10 accurately and the limitation of the valve plate 9 to separate from the hook 11 is relieved, realizing an automatic extinguishment.

[0070] In this embodiment, the valve plate 9 is hinged with the internal wall of the spraying pipe 5 by a first hinge seat 26. The first hinge seat 26 is arranged on the

internal wall of the spraying pipe 5 away from the hook 11. A sealing strip 27 for closing the gap between the spraying pipe 5 and the valve plate 9 is provided on the internal wall of the spraying pipe 5 corresponding to the spraying chamber 6. The sealing strip 27 is arranged on the internal side of the valve plate 9. The middle of the valve plate limiting rod 10 is hinged with the internal wall of the spraying pipe 5 by a second hinge seat 28.

[0071] It should be noted that, the sealing strip 27 won't be moved with the opening or closing of the valve plate 9. When the valve plate 9 is closed. The internal side of the valve plate 6 abuts against the sealing strip 27, realizing the sealing and avoiding powder leakage.

[0072] It should be noted that, when the extinguisher automatic control valve is reused, the sealing strip 27 is required to be replaced, so as to ensure the tightness of the interior of the extinguisher housing 3 when the valve plate 9 is closed.

[0073] In this embodiment, the hook 11 has a right triangle shape.

[0074] In this embodiment, when the valve plate 9 is required to be reused after opening, it only needs to push the valve plate 9 towards the hook 11. The valve plate 9 may be moved along the sloping edge of the hook 11 in a right-angled triangle shape and be trapped on a right-angled edge of the hook 11, realizing the reclose of the extinguisher housing 3.

[0075] In this embodiment, a fire alarm module 29 is further connected to the large equipment power supply control module 2. The fire alarm system 29 includes a microcontroller, an audible and visual alarm module connected to the microcontroller, and a communication module coupled to the microcontroller for communicating with the central control. The coupling end of the normally-closed contact of the first relay (K6) and the coil of the second relay (K7) is serviced as an output port of the fire alarm signal, which is connected to the input port of the microcontroller.

[0076] It should be noted that, after the automatic self-extinguishing and shutdown system for foundation engineering large equipment is in operation, the large equipment power supply control module 2 is energized, and the coil of the second relay (K7) is connected to the +24V power supply and is energized. The normally close contact of the second relay (K7) is closed. The storage battery 30 supplies the large equipment 1 with power by a +24V power supply. When any extinguisher automatic control valve of the automatic dry powder extinguishers 31 detects that the

environment temperature is higher than the temperature threshold, it is started to conduct an automatic extinguishing operation. At this time, the corresponding contact switch 4 at this position is closed. The coil of the first relay (K6) is energized, the normally-closed contact of the first relay (K6) is opened, the coil of the second relay (K7) loses energy and the normally-open contact of second relay (K7) is return to an open state, so as to shut down the power supply of the large equipment 1. The large equipment 1 is shut down, ensuring the safety of site and equipment.

[0077] When the first relay (K6) is energized and the normally-closed contact of the first relay (K6) is open, the output port of the fire alarm signal is changed from a high level to a low level. The microcontroller detects the change signal and gives an alarm by the audible and visual alarm module, and the communication module sends the alarm signal to the center control computer, reminding the management operator to process the situation on site in time.

[0078] A method indicated in FIG.5 includes the following steps.

[0079] Step one: debugging and assembling of the automatic dry powder extinguishers.

[0080] The extinguisher automatic control valve of the dry powder extinguisher 31 is adaptably debugged before filling the extinguishing dry powder. The detail steps are as follows.

[0081] Step 101: determining an environment ignition temperature threshold of the equipment, in which the environment ignition temperature threshold of the equipment is larger than a normal operation temperature at the automatic dry powder extinguisher 31 mounting points of the large equipment 1, and a boiling point of temperature sensitive liquid is equal to an ignition temperature of a material used in mounting the equipment.

[0082] Step 102: adjusting a temperature threshold adjusting knob 20 of the extinguisher automatic control valve unmounted to the extinguisher housing 3, so that an inflatable bladder is moved in a direction away from a valve plate limiting rod 10 until a distance between a mounting plate 19 and the valve plate limiting rod 10 reached a maximum.

[0083] Step 103: placing the extinguisher automatic control valve after adjusting the position of the inflatable bladder in a testing environment with the environment temperature equaling to the environment ignition temperature threshold of the

equipment, waiting the inflatable bladder to bloat to a limit, then rotating the temperature threshold adjusting knob 20, so as to drive the inflatable bladder to move in a direction close to the valve plate limiting rod 10 until a top of a valve rod 14 pushing the valve plate limiting rod 10 to tilt up, so that a limitation of the valve plate 9 to separate from a hook 11 is relieved and a pressing rod 16 on the valve rod 14 is pressured to close the contact switch 4 at the same time, in which the positions of the temperature threshold adjusting knob 20 and the inflatable bladder at this time are target mounting positions of the current equipment under the environment ignition temperature threshold.

5 **[0084]** Step 104: placing the extinguisher automatic control valve in a normal temperature environment, waiting the inflatable bladder to return to the original state, then connecting this extinguisher automatic control valve to the extinguisher housing 3 filled with the extinguishing dry powder, inflating and pressurizing the extinguisher housing 3, so as to finish the assembly of the automatic dry powder extinguisher 31.

15 **[0085]** Step two: mounting the automatic dry powder extinguisher and large equipment power supply control module.

[0086] At least one dry powder extinguisher 31 is provided around an oil tank of the large equipment 1 and at least four dry powder extinguishers 31 are provided around the engine of the large equipment 1.

20 **[0087]** The contact switch 4 of each automatic dry powder extinguisher 31 is coupled in parallel to the large equipment power supply control module 2, and a storage battery 30 is connected to the power supply port of the large equipment 1 via the large equipment power supply control module 2.

[0088] Step three: automatic extinguishing and shutting down the large equipment.

25 **[0089]** A capsule-shaped temperature detector 17 monitors the environment temperature of a mounting position thereof in real time. When the environment temperature of the mounting position is equal to or larger than the environment ignition temperature threshold of the equipment, the temperature sensitive liquid in the capsule-shaped detector 17 is evaporated, the vaped gas enters into the inflatable bladder through capillary 18 and the inflatable bladder is bloated due to the vapor pressure. The top of the valve rod 14 pushed the valve plate limiting rod 10 to tilt up, so that the limitation of the valve plate 9 to separate from a hook 11 is relieved and

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the pressurized dry powder is sprayed out through the spraying pipe 5, realizing the automatic extinguishing.

[0090] At the same time of the top of the valve rod 14 pushing the valve plate limiting rod 10 to tilt up, the pressing rod 16 on the valve rod 14 is pressured to close the contact switch 4. The coil of the first relay (K6) is energized, the normally-closed contact is opened, the coil of the second relay (K7) losses energy and the normally-open contact of the second relay (K7) is opened, so as to shut down the power supply of the large equipment 1, realizing the shutdown of the large equipment 1.

10 **[0091]** Step four: recycling the automatic dry powder extinguisher.

[0092] After the automatic dry powder extinguishers 31 are used, uncorroded and undamaged extinguisher housings 3 are selected. The extinguisher automatic control valves on two ends of these extinguisher housings are detached and checked to check whether the structure of the extinguisher automatic control valve is damaged. When it is damaged, the extinguisher automatic control valve may be replaced. When it is undamaged, the valve plate 9 in the spraying pipe 5 is pushed in a direction towards the hook 11. The valve plate 9 extrudes the hook 11, and a pushing resetting spring 15 is retracted to free up a space. After the valve plate 9 is trapped in the hook 11, the pushing resetting spring 15 is returned immediately, realizing a reclose of a spraying chamber 6.

[0093] After refilling the extinguishing dry powder in the extinguisher housing 3, the reset extinguisher automatic control valve is connected to the extinguisher housing 3. The extinguisher housing 3 is inflated and pressurized so as to finish the reassembly of the automatic dry powder extinguisher 31, realizing the recycling of the automatic dry powder extinguisher 31.

[0094] The environment ignition temperature threshold of the equipment is configured to 65°C~85°C.

[0095] The above are the preferred embodiments of the present application, which are not intended to limit the protection scope of the present application. Therefore, all equivalent changes made according to the structure, shape and principle of the present application should be failed within the protection scope of the present application.

WHAT IS CLAIMED IS:

1. An automatic self-extinguishing and shutdown system for foundation engineering large equipment, comprising: at least five automatic dry powder extinguishers (31) provided in a large equipment (1) and a large equipment power supply control module (2) coupled to the automatic dry powder extinguishers (31);
5 characterized in that, the automatic dry powder extinguisher (31) comprises an extinguisher housing (3) pressurized filled with extinguishing dry powder and two extinguisher automatic control valves provided at two ends of the extinguisher housing (3), a contact switch (4) for indicating the operation state of the automatic dry powder extinguisher (31) is coupled to each of the extinguisher automatic control
10 valves;

the large equipment power supply control module (2) comprises a first relay (K6) and a second relay (K7), one end of a coil of the first relay (K6) is coupled to ground via a plurality of contact switches (4) in parallel of the automatic dry powder
15 extinguisher (31), other end of the coil of the first relay (K6) is divided to two branches, one branch is coupled to a +24V power supply and other branch is coupled to one end of a coil of the second relay (K7) via a normally-closed contact of the first relay (K6), other end of the coil of the second relay (K7) is coupled to ground, one end of a normally-open contact of the second relay (K7) is coupled to the +24V power
20 supply, and other end of the normally-open contact of the second relay (K7) is coupled to a positive power supply port of the large equipment (1);

the extinguisher automatic control valve comprises a spraying pipe (5) threadedly connected to the extinguisher housing (3), a valve body assembly provided in the spraying pipe (5), and a temperature sensitive valve body control mechanism
25 provided on an outer sidewall of the spraying pipe (5); the temperature sensitive valve body control mechanism is configured for controlling opening and closing of the valve body assembly and the contact switch (4);

at least one of the dry powder extinguishers (31) is provided around an oil tank of the large equipment (1) and at least four of dry powder extinguishers (4) are
30 provided around an engine of the large equipment (1).

2. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 1, characterized in that the valve body assembly comprises a partition plate (8) provided on an internal wall of the spraying

pipe (5), which divides the interior of the spraying pipe (5) into a spraying chamber (6) and a control chamber (7), a valve plate (9) for closing a discharging opening of the spraying chamber (6), which is hinged with the internal wall of the spraying pipe (5), and a valve plate limiting rod (10) provided in the control chamber (7); the valve plate
5 limiting rod (10) is perpendicular to the valve plate (9) in a close state; a hook (11) for compressing the valve plate (9) at the discharging opening of the spraying chamber (6) is provided on an end of the valve plate limiting rod (10) close to the valve plate (9); a middle portion of the valve plate limiting rod (10) is hinged with the internal wall of the spraying pipe (5);

10 the temperature sensitive valve body control mechanism comprises a temperature sensitive housing (12) provided on the outer wall of the spraying pipe (5), a transition housing (13) provided between the temperature sensitive housing (12) and the spraying pipe (5), a temperature sensitive assembly, and a valve body control assembly;

15 the valve body control assembly comprises a valve rod (14) abutting against an end of the valve plate limiting rod (10) away from the valve plate (9) and a pushing reset spring (15) abutting against an end of the valve plate limiting rod (10) close to the valve plate (9); the valve rod (14) is configured perpendicular to the valve plate limiting rod (10); an end of the valve rod (14) away from the valve plate limiting rod
20 (10) is inserted in the temperature sensitive housing (12); the contact switch (4) is provided in the transition housing (13); a pressing rod (16) for controlling opening and closing of the contact switch (4) is fixedly connected to the valve rod (14);

the temperature sensitive assembly comprises an inflatable bladder provided in the temperature sensitive housing (12) for pushing the valve rod (14) in a direction
25 towards the valve plate limiting rod (10), a capsule-shaped temperature detector (17) provided outside the temperature sensitive housing (12), and a capillary (18) for communicating the capsule-shaped temperature detector (17) with the inflatable bladder; a temperature sensitive liquid is filled in the capsule-shaped temperature detector (17), the inflatable bladder, and the capillary (18);

30 a mounting plate (19) for mounting the inflatable bladder and a temperature threshold adjusting knob (20) for driving the inflatable bladder to move in a direction close to or away from the valve rod (14) are further provided in the temperature sensitive housing (12); the mounting plate (19) is slidably connected to an internal

wall of the temperature sensitive housing (12); one end of the temperature threshold adjusting knob (20) is rotatably connected to the mounting plate (19), and other end of the temperature threshold adjusting knob (20) penetrates out of the temperature sensitive housing (12) and is threadedly connected to the temperature sensitive housing (12).
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3. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, characterized in that, the temperature sensitive liquid has a boiling point equaling to an ignition temperature of a material for mounting the equipment.

10 4. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, characterized in that, the pushing reset spring (15) is provided in the transition housing (13); one end of the pushing reset spring (15) penetrates through the transition housing (13) and abuts against the valve plate limiting rod (10); a limitation guiding pipe (23) is provided in the transition pipe
15 (13) and is sleeved on the pushing reset spring (15); a buffer spring (24) is sleeved on a portion of the valve rod (14) inserting in the temperature sensitive housing (12).

5. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, characterized in that, the inflatable bladder comprises two circular plate hollow bladder bodies (25), which are stacked
20 and communicated with each other; each circular plate hollow capsule body (25) has an annular sidewall protruding outwards; a circular plate hollow capsule body (25) provided close to the valve rod (14) has a smaller diameter than a circular plate hollow capsule body (25) provided away from the valve rod (14); the valve rod (14) is provided at a center of a circle of a plane of the circular plate hollow capsule bodies
25 (25).

6. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, characterized in that, the valve plate (9) is hinged with the internal wall of the spraying pipe (5) by a first hinge seat (26); the first hinge seat (26) is provided on the internal wall of the spraying pipe (5)
30 away from the hook (11); a sealing strip (27) for closing gap between the spraying pipe (5) and the valve plate (9) is provided on the internal wall of the spraying pipe (5) corresponding to the spraying chamber (6); the sealing strip (27) is provided on an

internal side of the valve plate (9); a middle portion of the valve plate limiting rod (10) is hinged with the internal wall of the spraying pipe (5) by a second hinge seat (28).

7. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, characterized in that, the hook (11)
5 has a right triangle shape.

8. The automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 1, characterized in that, a fire alarm module (29) is further coupled to the large equipment power supply control module (2); the fire alarm system (29) comprises a microcontroller, an audible and visual
10 alarm module coupled to the microcontroller, and a communication module coupled to the microcontroller for communicating with the central control computer; a coupling end of the normally-closed contact of the first relay (K6) with the coil of the second relay (K7) is serviced as an output port of the fire alarm signal, which is connected to an input port of the microcontroller.

9. An automatic extinguishing and shutdown method for a large equipment by using the automatic self-extinguishing and shutdown system for foundation engineering large equipment according to claim 2, comprising:

step one, debugging and assembling the automatic dry powder extinguisher; wherein

20 the extinguisher automatic control valve of the dry powder extinguishers (31) is adaptably debugged before filling extinguishing dry powder by following steps:

step 101, determining an environment ignition temperature threshold of the large equipment, wherein the environment ignition temperature threshold of the large equipment is larger than a normal operation temperature of the automatic dry powder
25 extinguisher (31) at mounting points of the large equipment (1), and a boiling point of temperature sensitive liquid is equal to an ignition temperature of a material used in mounting the large equipment;

step 102: adjusting a temperature threshold adjusting knob (20) of the extinguisher automatic control valve unmounted to the extinguisher housing (3), so
30 that the inflatable bladder is moved in a direction away from a valve plate limiting rod (10) until a distance between a mounting plate (19) and the valve plate limiting rod (10) reaches a maximum;

step 103: placing the extinguisher automatic control valve after adjusting position of the inflatable bladder in a testing environment with an environment temperature equal to the environment ignition temperature threshold of the large equipment for waiting the inflatable bladder to inflate to a limit, rotating the
5 temperature threshold adjusting knob (20) to drive the inflatable bladder to move in a direction close to the valve plate limiting rod (10) until a top of a valve rod (14) pushes the valve plate limiting rod (10) to tilt up so that the valve plate (9) is open with being off limitation from the hook (11) and the pressing rod (16) on the valve rod (14) is pressured to be close to the contact switch (4) at the same time; positions of the
10 temperature threshold adjusting knob (20) and the inflatable bladder at this time are target mounting positions of the large equipment under the environment ignition temperature threshold; and

step 104: placing the extinguisher automatic control valve in a normal temperature environment for waiting the inflatable bladder to return to an original
15 state, connecting the extinguisher automatic control valve to the extinguisher housing (3) filled with extinguishing dry powder, inflating and pressurizing the extinguisher housing (3) to finish assembly of the automatic dry powder extinguisher (31);

wherein the method further comprises:

step two, mounting the automatic dry powder extinguisher and large equipment
20 power supply control module; wherein

at least one dry powder extinguisher (31) is provided around an oil tank of the large equipment (1) and at least four dry powder extinguishers (31) are provided around the engine of the large equipment (1);

the contact switch (4) of each automatic dry powder extinguisher (31) is coupled
25 in parallel to the large equipment power supply control module (2), and a storage battery (30) is connected to the power supply port of the large equipment (1) via the large equipment power supply control module (2);

step three, automatic extinguishing and shutting down the large equipment; wherein

30 the capsule-shaped temperature detector (17) monitors the environment temperature of a mounting position thereof in real time; when the environment temperature of the mounting position is equal to or larger than the environment ignition temperature threshold of the equipment, the temperature sensitive liquid in

the capsule-shaped detector (17) is evaporated, the vaped gas enters into the inflatable bladder through capillary (18) and the inflatable bladder is bloated due to the vapor pressure; the top of the valve rod (14) pushed the valve plate limiting rod (10) to tilt up, so that the limitation of the valve plate (9) to separate from a hook (11) is relieved and the pressurized dry powder is sprayed out through the spraying pipe (5), realizing the automatic extinguishing;

at the same time of the top of the valve rod (14) pushing the valve plate limiting rod (10) to tilt up, the pressing rod 16 on the valve rod (14) is pressured to close the contact switch (4); the coil of the first relay (K6) is energized, the normally-closed contact is opened, the coil of the second relay (K7) losses energy and the normally-open contact of second relay (K7) is opened, so as to shut down the power supply of the large equipment (1), realizing the shutdown of the large equipment (1); and

step four: recycling the automatic dry powder extinguisher; wherein
after the automatic dry powder extinguishers (31) are used, uncorroded and undamaged extinguisher housings (3) are selected; the extinguisher automatic control valves on two ends of these extinguisher housings are detached and checked to check whether the structure of the extinguisher automatic control valve is damaged; when it is damaged, the extinguisher automatic control valve may be replaced; when it is undamaged, the valve plate (9) in the spraying pipe (5) is pushed in a direction towards the hook (11); the valve plate (9) extrudes the hook (11), and a pushing resetting spring (15) is retracted to free up a space; after the valve plate (9) is trapped in the hook (11), the pushing resetting spring (15) is returned immediately, realizing a reclose of a spraying chamber (6);

after refilling the extinguishing dry powder in the extinguisher housing (3), the reset extinguisher automatic control valve is connected to the extinguisher housing (3); the extinguisher housing (3) is inflated and pressurized so as to finish the reassembly of the automatic dry powder extinguisher (31), realizing the recycling of the automatic dry powder extinguisher (31).

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