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(54) **CONTROL SYSTEM BASED ON MULTIPLE FEEDBACK SIGNALS OF SWITCH DEVICE**

(57) The present disclosure provides a control system based on multiple feedback signals of a switch device 1, comprising: a micro switch 2, a signal processing device 3 coupled to an external system 4 and the micro switch 2, and a motor control device 5 coupled to the signal processing device 3; the micro switch 2 is configured to sense a position of a movable contact of the switch device 1 to generate the multiple feedback signals; the signal processing device 3 is configured to receive a control signal of the external system 4 and the multiple feedback signals, and generate a motor control instruction of the switch device 1 according to a feedback signal finally received among the multiple feedback signals and the

control signal; and the motor control device 5 is configured to control a motor of the switch device 1 according to the motor control instruction, and the motor controls closing and opening of a main contact of the switch device 1. In which, the motor control instruction of the switch device 1 is generated according to the feedback signal finally received among the multiple feedback signals and the control signal, so as to improve the complete effectiveness of all of the feedback signals of the switch device 1 and increase the stability of the system.

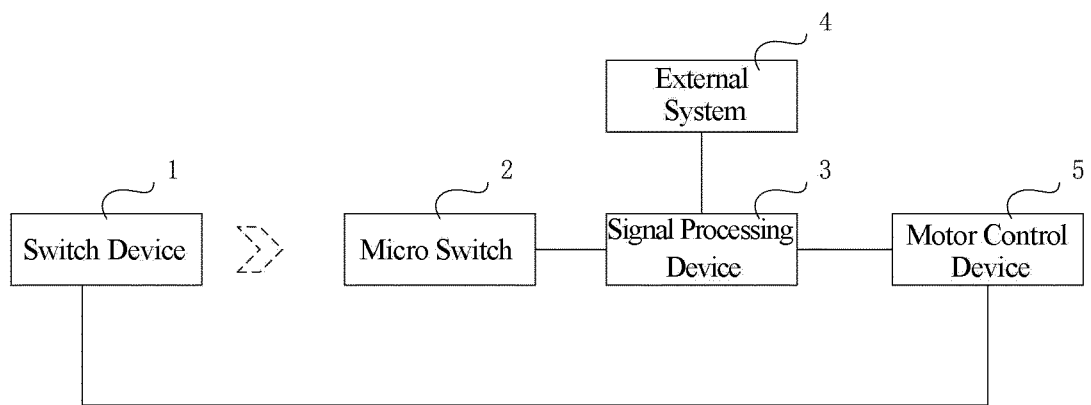


FIG. 1

Description

Technical Field

[0001] The present disclosure relates to the field of rail transit, and in particular to a control system based on multiple feedback signals of a switch device.

Background

[0002] The position of the movable contact of the switch device is an important basis for controlling by the control system. With the development of the rail transit technologies and the increasing complexity of the power system on vehicles, it is required that the movable contact of the switch device has multiple feedback signals at a set position to meet various purposes. Multiple feedback signals may be indirectly generated by controlling other contacts using one auxiliary contact at the set position, or directly generated using multiple auxiliary contacts.

[0003] In applications where multiple feedback signals are directly generated by multiple auxiliary contacts, when the purpose of the multiple feedback signals includes controlling a movement state of the movable contact of the switch device, a feedback signal for controlling the movement state of the movable contact changes earlier than feedback signals for other purposes; the control system directly updates a control command of the movement state of the movable contact according to the feedback signal; when the new control command is STOP, the movable contact is stopped, and the linkage structure is also stopped; it is possible that the state of the auxiliary contacts for other subsequent purposes cannot be changed, the corresponding feedback signals cannot be changed, the multiple feedback signals are incomplete, the control system mistakenly alarms that the switch device is failed, and the stability of the system is affected.

Summary

[0004] In view of this, the present disclosure provides a control system based on multiple feedback signals of a switch device, which can at least partially solve the problems existing in the prior art.

[0005] In order to achieve the above object, the present disclosure adopts the following technical solutions:

A control system based on multiple feedback signals of a switch device, comprising:

- a micro switch;
 - a signal processing device coupled to an external system and the micro switch; and
 - a motor control device coupled to the signal processing device,
- wherein the micro switch is configured for sensing a position of a movable contact of the switch device to generate the multiple feedback signals, wherein the signal processing device is configured

for receiving a control signal of the external system and the multiple feedback signals, and generating a motor control instruction of the switch device according to a feedback signal finally received among the multiple feedback signals and the control signal, and wherein the motor control device is configured for controlling a motor of the switch device according to the motor control instruction, and the motor controls closing and opening of a main contact of the switch device.

[0006] The signal processing device may also be integrated with the motor control device, and the micro switch directly serves as a part of a motor control loop.

[0007] Further, the micro switch comprises a retractable trigger lever and at least two auxiliary switches; in an extended state, the retractable trigger lever is located in a movement path of a linkage structure of the movable contact of the switch device, and triggers a control end of each of the auxiliary switches in sequence in a compression process.

[0008] Further, the auxiliary switch has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop.

[0009] Further, the control system based on the multiple feedback signals of the switch device further comprises: a relay;

wherein one of the auxiliary switches has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop; the other of the auxiliary switches has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a power supply common end of the signal processing device through a control coil of the relay; a contact of the relay has one end coupled to the power supply end of the signal processing device, and the other end coupled to a feedback signal input end of the signal processing device; and the other end of the contact of the relay is further coupled to the power supply common end of the signal processing device through a load loop.

[0010] Further, the micro switch comprises: at least two retractable trigger levers and at least two auxiliary switches corresponding to the retractable trigger levers one to one;

in an extended state, the at least two retractable trigger levers are disposed side by side in a movement path of a linkage structure of the movable contact of the switch device; the retractable trigger levers are sequentially compressed in a moving process of the linkage structure of the movable contact of the switch device, and trigger the control ends of the corresponding auxiliary switches

in a compression process.

[0011] Further, the auxiliary switch has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop.

[0012] Further, the retractable trigger lever comprises a trigger head, a retractable structure coupled to the trigger head, and a trigger lever; the trigger head is disposed in a movement path of a linkage structure of the movable contact of the switch device.

[0013] Further, there are at least two micro switches; at least one of the micro switches is disposed at a position of a linkage structure of the movable contact in an open state of the switch device to sense the open state of the switch device, and at least one of the micro switches is disposed at a position of the linkage structure of the movable contact in a closed state of the switch device to sense the closed state of the switch device.

[0014] The present disclosure provides a control system based on multiple feedback signals of a switch device, comprising: a micro switch, a signal processing device coupled to an external system and the micro switch, and a motor control device coupled to the signal processing device; the micro switch is configured to sense a position of a movable contact of the switch device to generate the multiple feedback signals; the signal processing device is configured to receive a control signal of the external system and the multiple feedback signals, and generate a motor control instruction of the switch device according to a feedback signal finally received among the multiple feedback signals and the control signal; and the motor control device is configured to control a motor of the switch device according to the motor control instruction, and the motor controls closing and opening of a main contact of the switch device. In which, the motor control instruction of the switch device is generated according to the feedback signal finally received among the multiple feedback signals and the control signal, so as to improve the complete effectiveness of all of the feedback signals of the switch device and increase the stability of the system.

[0015] In order that the above and other objects, features and advantages of the present disclosure can be clearer and more easily understood, the detailed description of the preferred embodiments will be given later with reference to the drawings.

Brief Description of the Drawings

[0016] In order to more clearly explain the technical solutions in the embodiments of the present disclosure or in the prior art, the drawings to be used in the description of the embodiments or the prior art will be briefly introduced as follows. Obviously, the following drawings illustrate some embodiments of the present disclosure.

Those of ordinary skill in the art can obtain other drawings from these drawings without paying any creative labor. In the drawings:

5 Fig. 1 is a structural block diagram of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure;

10 Fig. 2 illustrates a first specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure;

15 Fig. 3 illustrates a second specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure;

20 Fig. 4 illustrates a third specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure;

25 Fig. 5 illustrates a fourth specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure;

30 Fig. 6 illustrates a schematic diagram of a compression of a retractable trigger lever of a micro switch according to an embodiment of the present disclosure.

Detailed Description of the Preferred Embodiments

35 **[0017]** In order that those skilled in the art better understand the technical solutions of the present disclosure, the technical solutions in the embodiment of the present disclosure will be described clearly and completely as follows with reference to the drawings for the embodiments of the present disclosure. Obviously, those described are only parts, rather than all, of the embodiments of the present disclosure. Based on the embodiments of the present disclosure, any other embodiment obtained by those of ordinary skill in the art without paying any creative labor should fall within the protection scope of the present disclosure.

45 **[0018]** The detailed features and advantages of the present disclosure are specifically described below in the embodiments, which are sufficient to enable any person skilled in the art to understand the technical content of the present disclosure and make implementations accordingly. In addition, any person skilled in the art can easily understand the related objectives and advantages of the present disclosure according to the contents, claims and drawings disclosed in this specification. The following embodiments further describe the viewpoints of the present disclosure in detail, but do not limit the scope of the present disclosure in any viewpoint.

50 **[0019]** It should be noted that, if there is no conflict, the embodiments of the present disclosure and the features therein can be combined with each other. Hereinafter,

the present disclosure will be described in detail with reference to the drawings and in conjunction with the embodiments.

[0020] Currently, in applications where multiple feedback signals are directly generated by multiple auxiliary contacts, when the purposes of multiple feedback signals include controlling the movement state of the movable contact of the switch device, a feedback signal for controlling the movement state of the movable contact changes earlier than feedback signals for other purposes; the control system directly updates a control command of the movement state of the movable contact according to the feedback signal; when the new control command is STOP, the movable contact is stopped, and the linkage structure is also stopped; it is possible that the state of the auxiliary contacts for other subsequent purposes cannot be changed, the corresponding feedback signals cannot be changed, the multiple feedback signals are incomplete, the control system mistakenly reports that the switch device is failed, and the stability of the system is affected

[0021] In order to at least partially solve the above-mentioned technical problems in the prior art, the embodiments of the present disclosure provide a control system based on multiple feedback signals of a switch device, which generates a control instruction of the switch device according to a feedback signal finally received among the multiple feedback signals and a control signal, so as to improve the complete effectiveness of all of the feedback signals of the switch device and increase the stability of the system.

[0022] Fig. 1 is a structural block diagram of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure. As illustrated in Fig. 1, the control system based on the multiple feedback signals of the switch device includes a micro switch 2, a signal processing device 3 coupled to an external system 4 and the micro switch 2, and a motor control device 5 coupled to the signal processing device 3.

[0023] It should be noted that the external system 4 and the micro switch 2 may be in a wired connection with the signal processing device 3, and specifically by means of wires, cables, optical fibers, etc.

[0024] The micro switch 2 is configured to sense a position of the moveable contact of the switch device 1 to generate multiple feedback signals. Similarly, the motor control device 5 and the signal processing device 3 may be coupled to each other wirelessly or wiredly, and the motor control device 5 and the switch device 1 may also be coupled to each other wirelessly or wiredly.

[0025] In which, the micro switch 2 is a mechanical switch.

[0026] The signal processing device 3 receives a control signal of the external system 4 and the multiple feedback signals, and generates a motor control instruction of the switch device 1 according to a feedback signal finally received among the multiple feedback signals and

the control signal.

[0027] The motor control device 5 controls a motor of the switch device 1 according to the motor control instruction, and the motor controls closing and opening of a main contact of the switch device.

[0028] The signal processing device may also be integrated with the motor control device, and the micro switch directly serves as a part of a motor control loop.

[0029] It should be noted that after a large number of analyses and investigations on the fact that the control system mistakenly alarms that the switch device is failed, the applicant finds that among the multiple feedback signals of the switch device, the changes of the states of different auxiliary contacts have a sequence, which is inevitable, predictable and fixed. The changes of the multiple feedback signals have a fixed sequence. However, the purpose of the multiple feedback signals in the existing design is not strictly designed according to the sequence of the changes of the states of the auxiliary contact, resulting in the false alarm of the fault of the switch device.

[0030] According to the above technical solution of the present disclosure, when the movable contact of the switch device moves, the linkage structure is driven to move together, and the state of the micro switch is normal when a set position is not reached; when the movable contact moves to the set position, the linkage structure is triggered to change the micro switch into a triggered state, which is opposite to the normal state, so that the micro switch feeds back whether the movable contact of the switch device is at the set position; the micro switch is coupled to the signal processing device, thereby causing a change of the feedback signal, so as to carry out corresponding processing according to the feedback signal, such as controlling the movement state of the movable contact of the switch device, etc. Since multiple feedback signals are generated when the movable contact of the switch device moves to the set position, a control instruction of the switch device is generated according to a feedback signal finally received among the multiple feedback signals and a control signal, so as to improve the complete effectiveness of all of the feedback signals of the switch device and increase the stability of the system.

[0031] Fig. 2 illustrates a first specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure. As illustrated in Fig. 2, the switch device SW includes a motor M, a screw S, a nut N, a movable contact DC, stationary contacts SC1 and SC2, and a linkage structure L. The nut N, the movable contact DC, and the linkage structure L are fixed together and have the same movement state. The motor M rotates and drives the screw S to rotate, and the nut N drives the movable contact DC to move linearly. The movable contact DC has three movement states, i.e., stopping, moving close to the static contacts SC1 and SC2, and moving away from the static contacts SC1 and SC2, while the static contacts

SC1 and SC2 are fixed. When the motor M stops, the movable contact DC stops; when the motor M rotates forward, the movable contact DC moves close to the stationary contacts SC1 and SC2; and when the motor M rotates backward, the movable contact DC moves away from the stationary contacts SC1 and SC2. Serving as main circuit endpoints T1 and T2 of the switch device, the static contacts SC1 and SC2 are not coupled themselves. When the movable contact DC is in contact with the static contacts SC1 and SC2, the switch device SW is closed. When the movable contact DC is separated from the static contacts SC1 and SC2, the switch device SW is opened. When the movable contact DC is either in contact with or separated from the stationary contacts SC1 and SC2, there is an elastic space.

[0032] The movable contact DC has two set positions, wherein a first set position P1 is a corresponding position when the movable contact realizes the opening of the switch device, and a second set position P2 is a corresponding position when the movable contact realizes the closing of the switch device. There are at least two micro switches, wherein at least one micro switch X1 is disposed at a position of the linkage structure of the movable contact in an open state of the switch device, i.e., position P1, for sensing the open state of the switch device, and at least one micro switch X2 is disposed at a position of the linkage structure of the movable contact in a closed state of the switch device, i.e., position P2, for sensing the closed state of the switch device. At least two feedback signals are designed for each set position, and the movable contact DC can only move between the two set positions P1 and P2.

[0033] A control system CTRU includes micro switches X1 and Y1, a signal processing device SPU and a motor control device MDR. The micro switch X1 is disposed at the first set position P1 and the micro switch Y1 is disposed at the second set position P2.

[0034] The micro switch X1 includes a retractable trigger lever TRG11 and two auxiliary switches A11 and B11. The retractable trigger lever TRG11 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch A11 is in an open state and the auxiliary switch B11 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRG11 spatially interferes with the linkage structure L, is located in a movement path of the linkage structure of the movable contact of the switch device, and triggers a control end of each of the auxiliary switches in sequence in a compression process. When the motor M drives the movable contact DC and the linkage structure L to move to the first set position P1, the retractable trigger lever TRG11 will be compressed. In a process of changing the retractable trigger lever TRG11 from the extended state to a compressed state, firstly, a switch control end of the aux-

iliary switch A11 changes the auxiliary switch A11 from an open state to a closed state, and then a switch control end of the auxiliary switch B11 is triggered to change the auxiliary switch B11 from a closed state to an open state, wherein the sequence is fixed.

[0035] The micro switch Y1 includes a retractable trigger lever TRG12 and two auxiliary switches A12 and B12. The retractable trigger lever TRG12 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch A12 is in an open state and the auxiliary switch B12 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRG12 spatially interferes with the linkage structure, is located on a movement path of the linkage structure of the movable contact of the switch device, and triggers a control end of each of the auxiliary switches in sequence in a compression process. When the motor M drives the movable contact DC and the linkage structure L to move to the second set position P2, the retractable trigger lever TRG12 will be compressed. In a process of changing the retractable trigger lever TRG12 from the extended state to a compressed state, firstly, the auxiliary switch A12 changes from an open state to a closed state, and then the auxiliary switch B11 changes from a closed state to an open state, wherein the sequence is fixed.

[0036] One end of the auxiliary switch A11 is coupled to a feedback signal input end SA11 of the signal processing device SPU, and further coupled to a power supply common end COM of the signal processing device SPU via a resistor RA11; the other end thereof is coupled to a power supply end VCC of the signal processing device SPU. The feedback signal SA11 is used to detect whether the movable contact DC is at the first set position P1.

[0037] One end of the auxiliary switch B11 is coupled to a feedback signal input end SB 11 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RB11; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SB 11 is used to control the movement state of the movable contact DC in an opening process.

[0038] One end of the auxiliary switch A12 is coupled to a feedback signal input end SA12 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RA12; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SA12 is used to detect whether the movable contact DC is at the second set position P2.

[0039] One end of the auxiliary switch B12 is coupled to a feedback signal input end SB12 of the signal processing device SPU, and further coupled to the power supply

common end COM of the signal processing device SPU via a resistor RB12; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SB 12 is used to control the movement state of the movable contact DC in a closing process.

[0040] It is described a design of two feedback signals in an opening process of the switch device SW.

[0041] The control system CTRU receives an opening instruction for the switch device SW from an upper layer system (i.e. an external system) SPVR, and the signal processing device SPU detects the feedback signals SA11 and SB11. If SA11 is at a high level and SB11 is at a low level, the switch device SW is considered to have been in an open state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate backward. The movement state of the movable contact DC is moving away from the static contacts SC1 and SC2 until the linkage structure L compresses the retractable trigger lever TRG11 of the micro switch X1 at the first set position P1. Firstly, the auxiliary switch A11 changes from an open state to a closed state, the feedback signal SA11 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the first set position P1. At this time, the motor M continues to rotate backward and the movable contact DC continues to move away from the static contacts SC1 and SC2. Next, the auxiliary switch B11 changes from a closed state to an open state, the feedback signal SB 11 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the opening operation of the switch SW is finished.

[0042] It is described a design of two feedback signals in a closing process of the switch device SW.

[0043] The control system CTRU receives a closing instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU detects the feedback signals SA12 and SB 12. If SA12 is at a high level and SB 12 is at a low level, the switch device SW is considered to have been in a closed state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate forward. The movement state of the movable contact DC is moving close to the static contacts SC1 and SC2 until the linkage structure L compresses the retractable trigger lever TRG12 of the micro switch Y1 at the second set position P2. Firstly, the auxiliary switch A12 changes from an open state to a closed state, the feedback signal SA12 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the second set position P2. At this

time, the motor M continues to rotate forward and the movable contact DC continues to move close to the static contacts SC1 and SC2. Next, the auxiliary switch B12 changes from a closed state to an open state, the feedback signal SB12 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the closing operation of the switch SW is finished.

[0044] Fig. 3 illustrates a second specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure. As illustrated in Fig. 3, the structure of the switch device SW is the same as that of the switch device SW illustrated in Fig. 2, and will not be repeated here.

[0045] The control system CTRU includes two micro switches, a signal processing device SPU and a motor control device MDR, wherein one of the micro switches is disposed at a set position P1 and composed of micro sub-switches X21 and X22; the other of the micro switches is disposed at a set position P2 and composed of micro sub-switches Y21 and Y22.

[0046] The micro sub-switch X21 includes a retractable trigger lever TRGX21 and an auxiliary switch A21. The retractable trigger lever TRGX21 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch A21 is in an open state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRGX21 spatially interferes with the linkage structure L. When the motor M drives the movable contact DC and the linkage structure L to move to the first set position P1, the retractable trigger lever TRGX21 will be compressed. The retractable trigger lever TRGX21 changes from the extended state to a compressed state, and the auxiliary switch A21 changes from the open state to a closed state.

[0047] The micro sub-switch X22 includes a retractable trigger lever TRGX22 and an auxiliary switch A22. The retractable trigger lever TRGX22 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch A22 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRGX22 spatially interferes with the linkage structure L. When the motor M drives the movable contact DC and the linkage structure L to move to the first set position P1, the retractable trigger lever TRGX22 will be compressed. The retractable trigger lever TRGX22 changes from the extended state to a compressed state, and the auxiliary

switch A22 changes from the closed state to an open state.

[0048] In the process where the movable contact DC moves away from the stationary contacts SC1 and SC2 (the switch device is opened) to the first set position P1, X21 is triggered firstly, and then X22 is triggered.

[0049] The micro sub-switch Y21 includes a retractable trigger lever TRGY21 and an auxiliary switch B21. The retractable trigger lever TRGY21 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch B21 is in an open state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRGY21 spatially interferes with the linkage structure L. When the motor M drives the movable contact DC and the linkage structure L to move to the second set position P2, the retractable trigger lever TRGY21 will be compressed. The retractable trigger lever TRGY21 changes from the extended state to a compressed state, and the auxiliary switch B21 changes from the open state to a closed state.

[0050] The micro sub-switch Y22 includes a retractable trigger lever TRGY22 and an auxiliary switch B22. The retractable trigger lever TRGY22 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch B22 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRGY22 spatially interferes with the linkage structure L. When the motor M drives the movable contact DC and the linkage structure L to move to the second set position P2, the retractable trigger lever TRGY22 will be compressed. The retractable trigger lever TRGY22 changes from the extended state to a compressed state, and the auxiliary switch B22 changes from the closed state to an open state.

[0051] In the process where the movable contact DC moves close to the stationary contacts SC1 and SC2 (the switch device is closed) to the second set position P2, Y21 is triggered firstly, and then Y22 is triggered.

[0052] It should be noted that retractable trigger levers of respective micro sub-switches comprised in a micro switch are arranged side by side in a movement path of the linkage structure of the movable contact of the switch device in an extended state, wherein the respective retractable trigger levers are sequentially compressed in the moving process of the linkage structure of the movable contact of the switch device, and trigger the control ends of corresponding auxiliary switches in the compressing process.

[0053] One end of the auxiliary switch A21 is coupled to a feedback signal input end SA21 of the signal processing device SPU, and further coupled to a power supply

common end COM of the signal processing device SPU via a resistor RA21; the other end thereof is coupled to a power supply end VCC of the signal processing device SPU. The feedback signal SA21 is used to detect whether the movable contact DC is at the first set position P1.

[0054] One end of the auxiliary switch A22 is coupled to a feedback signal input end SA22 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RA22; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SA22 is used to control the movement state of the movable contact DC in an opening process.

[0055] One end of the auxiliary switch B21 is coupled to a feedback signal input end SB21 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RB21; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SB21 is used to detect whether the movable contact DC is at the second set position P2.

[0056] One end of the auxiliary switch B22 is coupled to a feedback signal input end SB22 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RB22; the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The feedback signal SB22 is used to control the movement state of the movable contact DC in a closing process.

[0057] It is described a design of two feedback signals in an opening process of the switch device SW.

[0058] The control system CTRU receives an opening instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU detects the feedback signals SA21 and SA22. If SA21 is at a high level and SA22 is at a low level, the switch device SW is considered to have been in an open state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate backward. The movement state of the movable contact DC is moving away from the static contacts SC1 and SC2 until the linkage structure L firstly compresses the retractable trigger lever TRGX21 of the micro sub-switch X21 at the first set position P1. The auxiliary switch A21 changes from an open state to a closed state, the feedback signal SA21 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the first set position P1. At this time, the motor M continues to rotate backward and the movable contact DC continues to move away from the static contacts SC1 and SC2. Next, the linkage structure L compresses the retractable trigger lever TRGX22 of the micro sub-switch X22 at the first set position P1. The auxiliary switch A22 changes from a closed

state to an open state, the feedback signal SA22 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the opening operation of the switch SW is finished.

[0059] It is described a design of two feedback signals in a closing process of the switch device SW.

[0060] The control system CTRU receives a closing instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU detects the feedback signals SB21 and SB22. If SB21 is at a high level and SB22 is at a low level, the switch device SW is considered to have been in a closed state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate forward. The movement state of the movable contact DC is moving close to the static contacts SC1 and SC2 until the linkage structure L firstly compresses the retractable trigger lever TRGY21 of the micro sub-switch Y21 at the second set position P2. The auxiliary switch B21 changes from an open state to a closed state, the feedback signal SB21 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the second set position P2. At this time, the motor M continues to rotate forward and the movable contact DC continues to move close to the static contacts SC1 and SC2. Next, the linkage structure L compresses the retractable trigger lever TRGY22 of the micro sub-switch Y22 at the second set position P2. The auxiliary switch A22 changes from a closed state to an open state, the feedback signal SB22 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the closing operation of the switch SW is finished.

[0061] Fig. 4 illustrates a third specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure. As illustrated in Fig. 4, the structure of the switch device SW is the same as that of the switch device SW illustrated in Fig. 2, and will not be repeated here.

[0062] The control system CTRU includes micro switches X3 and Y3, relays Q31 and Q32, a signal processing device SPU and a motor control device MDR. The micro switch X3 is disposed at the first set position P1 and the micro switch Y3 is disposed at the second set position P2.

[0063] The micro switch X3 includes a retractable trigger lever TRG31 and two auxiliary switches A31 and B31. The retractable trigger lever TRG31 is retractable and is maintained in an extended state by an elastic structure

when there is no external force. At this time, the auxiliary switch A31 is in a closed state and the auxiliary switch B31 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRG31 spatially interferes with the linkage structure L, is located in a movement path of the linkage structure of the movable contact of the switch device, and triggers a control end of each of the auxiliary switches in sequence in a compression process. When the motor M drives the movable contact DC and the linkage structure L to move to the first set position P1, the retractable trigger lever TRG31 will be compressed. In a process of changing the retractable trigger lever TRG31 from the extended state to a compressed state, firstly, the auxiliary switch A31 changes from an open state to a closed state, and then the auxiliary switch B31 changes from an open state to a closed state, wherein the sequence is fixed.

[0064] The micro switch Y3 includes a retractable trigger lever TRG32 and two auxiliary switches A32 and B32. The retractable trigger lever TRG32 is retractable and is maintained in an extended state by an elastic structure when there is no external force. At this time, the auxiliary switch A32 is in a closed state and the auxiliary switch B32 is in a closed state (when there is no external force acting on the retractable trigger lever, the state of the auxiliary switch can be configured according to actual needs, and an example is only given here). In the extended state, the retractable trigger lever TRG32 spatially interferes with the linkage structure L, is located in a movement path of the linkage structure of the movable contact of the switch device, and triggers a control end of each of the auxiliary switches in sequence in a compression process. When the motor M drives the movable contact DC and the linkage structure L to move to the second set position P2, the retractable trigger lever TRG32 will be compressed. In a process of changing the retractable trigger lever TRG32 from the extended state to a compressed state, firstly, the auxiliary switch A32 changes from an open state to a closed state, and then the auxiliary switch B32 changes from an open state to a closed state, wherein the sequence is fixed.

[0065] One end of the auxiliary switch A31 is coupled to a feedback signal input end SA31 of the signal processing device SPU, and further coupled to a power supply common end COM of the signal processing device SPU via a resistor RA31; the other end thereof is coupled to a power supply end VCC of the signal processing device SPU. The feedback signal SA31 is used to detect whether the movable contact DC is at the first set position P1.

[0066] One end of the auxiliary switch B31 is coupled to one end of a control coil CL1 of the relay Q31, and the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The other end of the control coil CL1 of the relay Q31 is coupled to the power supply common end COM of the signal processing

device SPU. One end of the contact C31 of the relay Q31 is coupled to a feedback signal input end SC31 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RC31, and the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. When the auxiliary switch B31 is opened, the control coil CL1 of the relay Q31 is de-energized and the contact C31 is closed. When the auxiliary switch B31 is closed, the control coil CL1 of the relay Q31 is energized and the contact C31 is open. The feedback signal SC31 is used to control the movement state of the movable contact DC in an opening process.

[0067] One end of the auxiliary switch A32 is coupled to a feedback signal input end SA32 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RA32; the other end thereof is coupled to a power supply end VCC of the signal processing device SPU. The feedback signal SA32 is used to detect whether the movable contact DC is at the second set position P2.

[0068] One end of the auxiliary switch B32 is coupled to one end of a control coil CL2 of the relay Q32, and the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. The other end of the control coil CL2 of the relay Q32 is coupled to the power supply common end COM of the signal processing device SPU. One end of the contact C32 of the relay Q32 is coupled to a feedback signal input end SC32 of the signal processing device SPU, and further coupled to the power supply common end COM of the signal processing device SPU via a resistor RC32, and the other end thereof is coupled to the power supply end VCC of the signal processing device SPU. When the auxiliary switch B32 is opened, the control coil CL2 of the relay Q32 is de-energized and the contact C32 is closed. When the auxiliary switch B32 is closed, the control coil CL2 of the relay Q32 is energized and the contact C32 is open. The feedback signal SC32 is used to control the movement state of the movable contact DC in a closing process.

[0069] It is described a design of two feedback signals in an opening process of the switch device SW.

[0070] The control system CTRU receives an opening instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU detects the feedback signals SA31 and SC31. If SA31 is at a high level and SC31 is at a low level, the switch device SW is considered to have been in an open state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate backward. The movement state of the movable contact DC is moving away from the static contacts SC1 and SC2 until the linkage structure L compresses the retractable trigger lever TRG31 of the micro switch X3 at the first set position P1. Firstly, the auxiliary switch A31 changes from an open state to a closed state, the feedback signal SA31 changes from a low level to a high level, and the signal processing

device SPU receives that the movable contact DC of the switch device SW is at the first set position P1. At this time, the motor M continues to rotate backward and the movable contact DC continues to move away from the static contacts SC1 and SC2. Next, the auxiliary switch B31 changes from an open state to a closed state, the control coil CL1 of the relay Q31 is energized, the contact C31 is opened, the feedback signal SC31 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the opening operation of the switch SW is finished.

[0071] It is described a design of two feedback signals in a closing process of the switch device SW.

[0072] The control system CTRU receives a closing instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU detects the feedback signals SA32 and SC32. If SA32 is at a high level and SC32 is at a low level, the switch device SW is considered to have been in a closed state, and the movement state of the movable contact DC is directly controlled to be stop. Otherwise, the motor control device MDR controls the motor M to rotate forward. The movement state of the movable contact DC is moving close to the static contacts SC1 and SC2 until the linkage structure L compresses the retractable trigger lever TRG32 of the micro switch Y3 at the second set position P2. Firstly, the auxiliary switch A32 changes from an open state to a closed state, the feedback signal SA32 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the second set position P2. At this time, the motor M continues to rotate forward and the movable contact DC continues to move close to the static contacts SC1 and SC2. Next, the auxiliary switch B32 changes from an open state to a closed state, the control coil CL2 of the relay Q32 is energized, the contact C32 is opened, the feedback signal SC32 changes from a high level to a low level, the signal processing device SPU updates the movement state of the movable contact DC to be stop, the motor control device MDR controls the motor M to stop, and the movable contact DC stops. The two feedback signals are complete and effective, and the closing operation of the switch SW is finished.

[0073] In which, by disposing the relay, the functions such as signal inversion and signal strength adjustment can be realized, and the flexibility and stability of the control system are increased.

[0074] In addition, in the control system provided by the embodiment of the present disclosure, a plurality of micro switches can be directly triggered to change their states in the process where the movable contact of the switch device moves to a set position, and the control system directly selects a feedback signal which finally changes among the multiple feedback signals to control the movement state of the movable contact of the switch

device. It can also be that a plurality of micro switches are directly triggered to change their states in the process where the movable contact of the switch device moves to a set position, a micro switch which finally changes controls other contact to indirectly generate other feedback signal, and the control system selects the indirectly generated feedback signal to control the movement state of the movable contact of the switch device. That is, the feedback signals with their states changed earlier are used for other purposes, and the feedback signal with its state changed finally is directly or indirectly used to control the movable contact movement state of the switch device, so as to improve the complete effectiveness of all of the feedback signals of the switch device and increase the stability of the system.

[0075] Fig. 5 illustrates a fourth specific structure of a control system based on multiple feedback signals of a switch device according to an embodiment of the present disclosure. As illustrated in Fig. 5, the structure of the switch device SW is the same as that of the switch device SW illustrated in Fig. 3, and will not be repeated here.

[0076] The control system CTRU includes two micro switches, a signal processing device SPU and a double-pole double-throw switch DP, wherein one of the micro switches is disposed at a set position P1 and composed of micro sub-switches X21 and X22; the other of the micro switches is disposed at a set position P2 and composed of micro sub-switches Y21 and Y22. The characteristics of the micro switches are the same as those of the second specific structure and will not be repeated here.

[0077] When the switch device SW needs to be opened, the signal processing device SPU controls movable contacts d21 and d22 of the double-pole double-throw switch DP to be coupled to a first set of static contacts d11 and d12. When the switch device SW needs to be closed, the signal processing device SPU selects the movable contacts d21 and d22 of the double-pole double-throw switch DP to be coupled to a second set of static contacts d31 and d32. The movable contacts d21 and d22 of the double-pole double-throw switch DP are necessarily coupled to the first set of stationary contacts d11 and d12 or the second set of stationary contacts d31 and d32, and are further coupled to power ports n and p of the motor M. The first set of static contacts d11 are coupled to a power supply VCC, the first set of static contacts d12 are coupled to one end of the auxiliary switch A22, and the other end of the auxiliary switch A22 is coupled to a power supply common end COM. The second set of static contacts d32 are coupled to the power supply VCC, the second set of static contacts d31 are coupled to one end of the auxiliary switch B22, and the other end of the auxiliary switch B22 is coupled to the power supply common end COM.

[0078] The signal processing device SPU is responsible for controlling the movable contacts d21 and d22 of the double-pole double-throw switch DP to be coupled to the first set of static contacts d11 and d12 or the second set of static contacts d31 and d32, rather than the on-off

of the power supply of the motor M which is controlled by corresponding auxiliary switch.

[0079] It is described a design of working of the motor M and the feedback signals in an opening process of the switch device SW.

[0080] The control system CTRU receives an opening instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU controls the movable contacts d21 and d22 of the double-pole double-throw switch DP to be coupled to the first set of stationary contacts d11 and d12. The power supply forms a loop through the double-pole double-throw switch DP, the motor M and the auxiliary switch A22, and the power supply of the motor M is negative at this time.

The signal processing device SPU simultaneously detects the feedback signal SA21. If the auxiliary switch A22 is in an open state, the loop of the power supply of the motor M is disconnected by the auxiliary switch A22, and the motor M stops. Otherwise, the closed auxiliary switch A22 applies the negative power supply to the motor M, so that the motor M rotates backward. The movement state of the movable contact DC is moving away from the static contacts SC1 and SC2 until the linkage structure L firstly compresses the retractable trigger lever TRGX21 of the micro sub-switch X21 at the first set position P1. The auxiliary switch A21 changes from an open state to a closed state, the feedback signal SA21 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the first set position P1. At this time, the motor M continues to rotate backward, and the movable contact DC continues to move away from the stationary contacts SC1 and SC2. Next, the linkage structure L compresses the retractable trigger lever TRGX22 of the micro sub-switch X22 at the first set position P1, the auxiliary switch A22 changes from a closed state to an open state, the loop of the power supply of the motor M is opened by the auxiliary switch A22, and the motor M stops. The control of the motor M is completed, the feedback signal SA21 is complete and effective, and the opening operation of the switch device SW is finished.

[0081] It is described a design of working of the motor M and the feedback signals in a closing process of the switch device SW.

[0082] The control system CTRU receives a closing instruction for the switch device SW from an upper layer system SPVR, and the signal processing device SPU controls the movable contacts d21 and d22 of the double-pole double-throw switch DP to be coupled to the second set of stationary contacts d31 and d32. The power supply forms a loop through the double-pole double-throw switch DP, the motor M and the auxiliary switch B22, and the power supply of the motor M is positive at this time. The signal processing device SPU simultaneously detects the feedback signal SB21. If the auxiliary switch B22 is in an open state, the loop of the power supply of the motor M is disconnected by the auxiliary switch B22, and the motor M stops. Otherwise, the closed auxiliary

switch B22 applies the positive power supply to the motor M, so that the motor M rotates forward. The movement state of the movable contact DC is moving close to the static contacts SC1 and SC2 until the linkage structure L firstly compresses the retractable trigger lever TRGY21 of the micro sub-switch Y21 at the second set position P2. The auxiliary switch B21 changes from an open state to a closed state, the feedback signal SB21 changes from a low level to a high level, and the signal processing device SPU receives that the movable contact DC of the switch device SW is at the second set position P2. At this time, the motor M continues to rotate forward, and the movable contact DC continues to move close to the stationary contacts SC1 and SC2. Next, the linkage structure L compresses the retractable trigger lever TRGY22 of the micro sub-switch Y22 at the second set position P2, the auxiliary switch B22 changes from a closed state to an open state, the loop of the power supply of the motor M is opened by the auxiliary switch B22, and the motor M stops. The control of the motor M is completed, the feedback signal SB21 is complete and effective, and the closing operation of the switch device SW is finished.

[0083] In an alternative embodiment, referring to Fig. 6, the retractable trigger lever includes a trigger head G1, a retractable structure G2 coupled to the trigger head, and a trigger lever G3;

the trigger head G1 is disposed in the movement path of the linkage structure of the movable contact of the switch device.

[0084] In addition, the retractable structure can be implemented by a spring.

[0085] The principle and implementation of the present disclosure are described in the specific embodiments, and those described are only used to help the understanding of the method and the core ideas of the present disclosure. Meanwhile, for those of ordinary skill in the art, the specific implementation and the application scope may be changed according to the ideas of the present disclosure. To sum up, the content of this specification should not be construed as limitations to the present disclosure.

[0086] It should also be noted that the terms 'comprise', 'include' or any other variation thereof is intended to cover a non-exclusive inclusion, so that a process, method, article, or apparatus that includes a series of elements includes not only those elements, but also other elements not explicitly listed, or elements inherent to such process, method, article, or apparatus. When there is no further restriction, an element defined by a statement 'comprising a ...' does not exclude the presence of another identical element in the process, method, article or apparatus that includes the element.

[0087] Each embodiment in this specification is described in a progressive manner. The same and similar parts between the embodiments can refer to each other. Each embodiment focuses on its difference from other embodiments. In particular, for the system embodiment, since it is similar to the method embodiment substantially,

its description is simple, and relevant content may refer to the corresponding description of the method embodiment.

[0088] Those described above are only preferred embodiments of the present disclosure and not intended to limit the present disclosure in any way. Although the preferred embodiments have revealed the present disclosure as above, the present disclosure is not limited thereto. According to the above revealed technical content, any person skilled in the art can make some amendments, modifications or equivalent changes to obtain equivalent embodiments within a scope not deviating from the technical solution of the present disclosure. Any simple amendment, equivalent change or modification made to the above embodiments without deviating from the content of the technical solution of the present disclosure should still fall within the scope of the technical solution of the present disclosure.

Claims

1. A control system based on multiple feedback signals of a switch device, comprising:

a micro switch;
a signal processing device coupled to an external system and the micro switch; and
a motor control device coupled to the signal processing device,
wherein the micro switch is configured for sensing a position of a movable contact of the switch device to generate the multiple feedback signals,
wherein the signal processing device is configured for receiving a control signal of the external system and the multiple feedback signals, and generating a motor control instruction of the switch device according to a feedback signal finally received among the multiple feedback signals and the control signal, and
wherein the motor control device is configured for controlling a motor of the switch device according to the motor control instruction, and the motor controls closing and opening of a main contact of the switch device.

2. The control system based on the multiple feedback signals of the switch device according to claim 1, wherein the micro switch comprises a retractable trigger lever and at least two auxiliary switches, wherein the retractable trigger lever is located in a movement path of a linkage structure of the movable contact of the switch device in an extended state, and triggers a control end of each of the auxiliary switches in sequence in a compression process.

3. The control system based on the multiple feedback

signals of the switch device according to claim 2, wherein the auxiliary switch has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop.

4. The control system based on the multiple feedback signals of the switch device according to claim 2, further comprising: a relay, wherein one of the auxiliary switches has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop, wherein the other of the auxiliary switches has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a power supply common end of the signal processing device through a control coil of the relay; a contact of the relay has one end coupled to the power supply end of the signal processing device, and the other end coupled to a feedback signal input end of the signal processing device; and the other end of the contact of the relay is further coupled to the power supply common end of the signal processing device through a load loop.
5. The control system based on the multiple feedback signals of the switch device according to claim 1, wherein the micro switch comprises: at least two retractable trigger levers and at least two auxiliary switches corresponding to the retractable trigger levers one to one, wherein the at least two retractable trigger levers are disposed side by side in a movement path of a linkage structure of the movable contact of the switch device in an extended state, the retractable trigger levers each are sequentially compressed in a moving process of the linkage structure of the movable contact of the switch device, and trigger the control ends of the corresponding auxiliary switches in a compression process.
6. The control system based on the multiple feedback signals of the switch device according to claim 5, wherein the auxiliary switch has a first end coupled to a power supply end of the signal processing device, and a second end coupled to a feedback signal input end of the signal processing device, and the second end is further coupled to a power supply common end of the signal processing device through a load loop.

7. The control system based on the multiple feedback signals of the switch device according to any one of claims 2 to 6, wherein the retractable trigger lever comprises a trigger head, a retractable structure coupled to the trigger head, and a trigger lever, wherein the trigger head is disposed in a movement path of a linkage structure of the movable contact of the switch device.
8. The control system based on the multiple feedback signals of the switch device according to any one of claims 1 to 6, wherein there are at least two micro switches; at least one of the micro switches is disposed at a position of a linkage structure of the movable contact in an open state of the switch device to sense the open state of the switch device, and at least one of the micro switches is disposed at a position of the linkage structure of the movable contact in a closed state of the switch device to sense the closed state of the switch device.

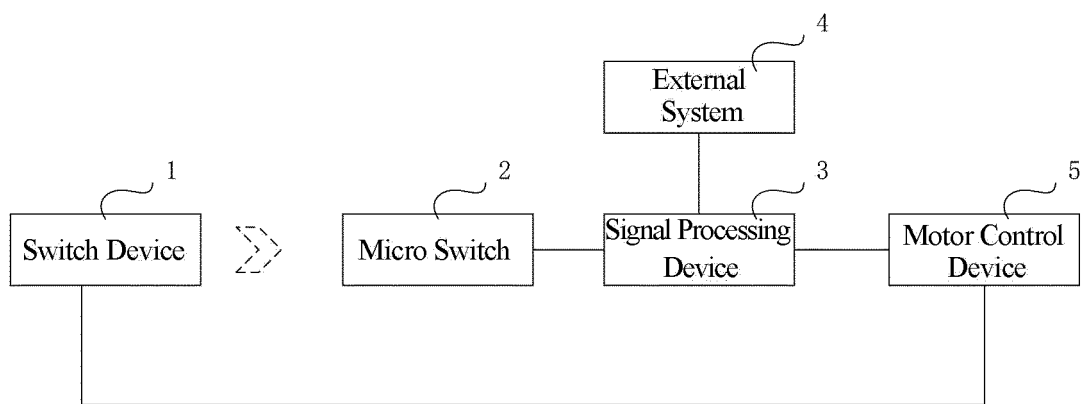


FIG. 1

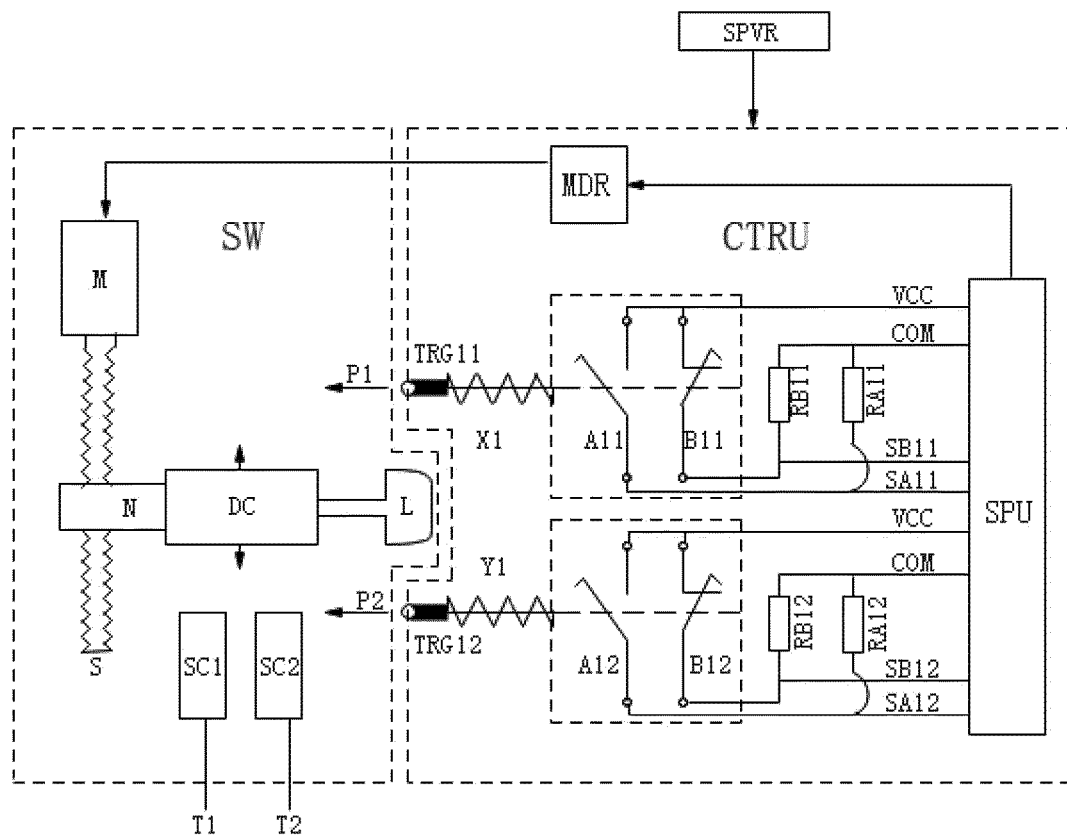


FIG. 2

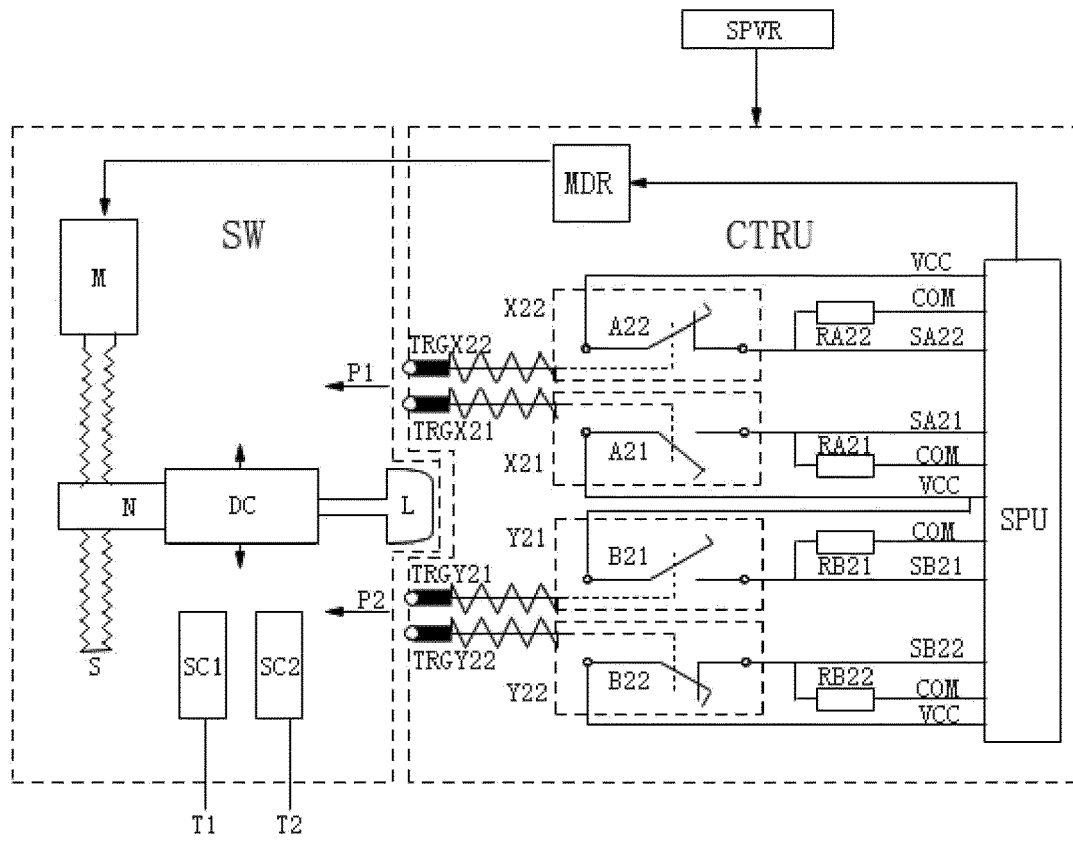


FIG. 3

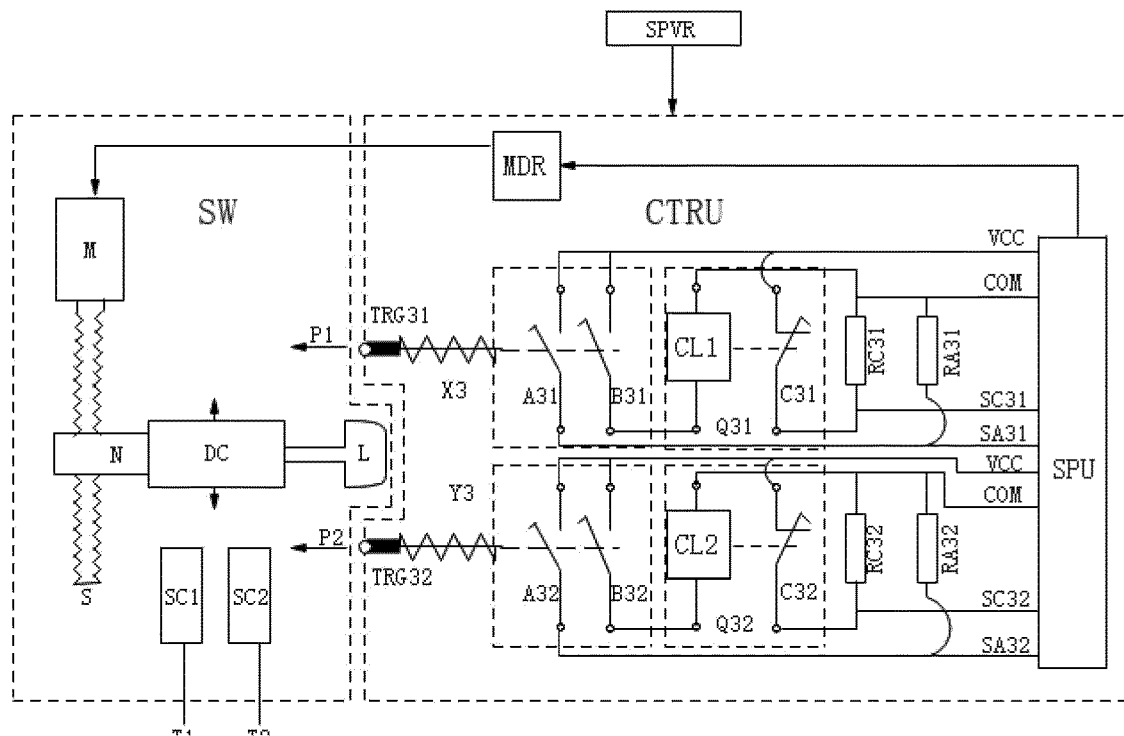


FIG. 4

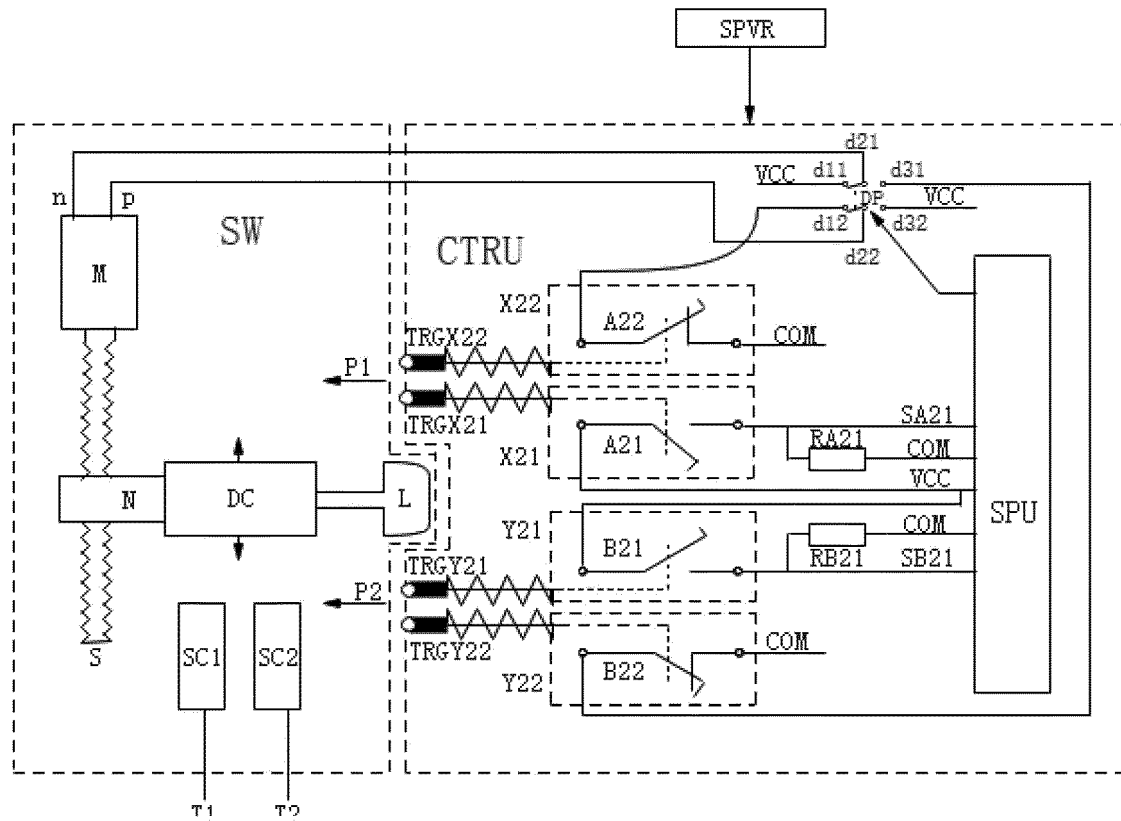


FIG. 5

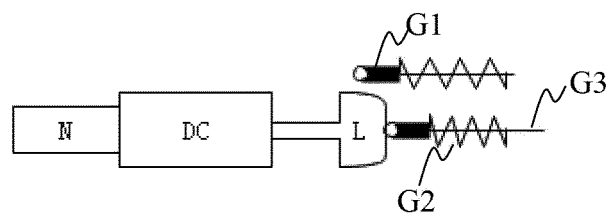


FIG. 6



EUROPEAN SEARCH REPORT

Application Number
EP 20 17 5531

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			H01H
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Place of search Munich		Date of completion of the search 21 September 2020	Examiner Findeli, Luc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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