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(54) **POWER PLUG WITH LEAKAGE PROTECTION FUNCTION**

(57) A power plug with leakage protection function includes a housing (1), a reset button (11) and a testing button (12) provided on the top surface of the housing, a live line pin (2), a neutral line pin (4) and a ground line pin provided on the bottom of the housing. A circuit board (5) is provided inside the housing. A leakage protection circuit for testing the cable leakage fault of power output is provided on the circuit board. A trip device (7) for making a movable contact (742) and a static contact (723) contact or disconnect each other is provided inside the housing. The power plug can detect the cable leakage fault of power supply in real time and cut off the power supply in time.

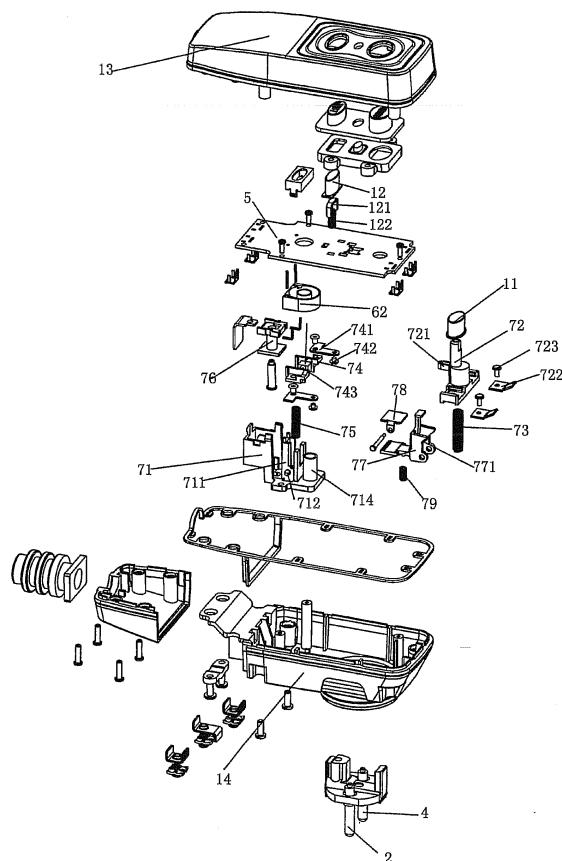


Figure 1

Description

Technical Field

[0001] The present utility model relates to a power plug with leakage protection functionality (referred to as European standard PRCD), in particular to a power plug with leakage protection functionality for installation on such household electrical appliances as air conditioners, refrigerators and televisions.

Background art

[0002] At present, people connect household electrical appliances to the mains supply via power plugs, the majority of power plugs currently on the market having the following structure: comprising a shell on which are mounted two or three pins exposed to the outside and power supply cable leads connected to the pins; during the manufacture of an electrical appliance, the power supply cable leads of a power plug are fixedly connected to the power supply contacts on a circuit board inside the electrical appliance directly, forming an electric connection. When it is necessary to use a household electrical appliance, all that needs to be done is to insert the pins of this power plug into a socket, thereby achieving the connection of the household electrical appliance to the mains supply. Since such a power plug has no internal leakage protection structure, when a leakage fault occurs among the live wire, neutral wire and earth wire on the output side of the pins, or when a short circuit fault occurs between the live wire and neutral wire on the output side of the pins, damage to the household electrical appliance will be the direct result. At present, a number of power plugs with leakage protection functionality have appeared, and although they are capable of cutting off the power supply when a fault occurs, serving to protect the household electrical appliances, at the present time the internal structure of these power plugs is comparatively complex, and not convenient for mass production, hence there is a necessity to solve the above problems.

Contents of the utility model

[0003] The present utility model overcomes the deficiencies of the above technology, providing a power plug with leakage protection functionality that has strong safety protection performance, simple structure and rational design, is easy to manufacture in batches, and is able to detect power supply cable leakage faults in real time and promptly cut off the power supply and load connection.

[0004] The present utility model employs the following technical solution to achieve the above objectives:

A power plug with leakage protection functionality comprises a shell, a reset button and test button being disposed on the top surface of the shell, a power supply live wire pin and neutral wire pin being dis-

posed at the bottom of the shell, a circuit board being disposed inside the shell, and a leakage protection circuit for detecting cable leakage faults in the power supply output being disposed on the circuit board; a tripping device capable of connecting or disconnecting a moving contact and static contact is disposed inside the shell, the tripping device comprising a shroud fixed inside the shell, a rod that is fixedly connected to the reset button being vertically slidably mounted at one side of the shroud; a drive lug is disposed at the upper end of the rod, each of the two sides of the lower end of the rod having fixed thereon a static contact-piece connected to the load cable, the static contact-pieces having static contacts disposed thereon, and a rod return spring being connected to the bottom of the rod; a cross arm which can slide downwards in engagement with the drive lug is disposed on the shroud, each end of the cross arm having fixed thereon a moving contact-piece connected to the power supply live wire pin and neutral wire pin respectively, the moving contact-pieces having disposed thereon moving contacts, which are disposed above the static contacts in positions corresponding to those of the static contacts; a cross arm return spring is connected to the bottom of the cross arm, and a snap stop is further disposed on the cross arm; a tripping coil that is electrically connected to the circuit board is fixed in a cavity on another side of the shroud, a static armature being disposed inside the tripping coil; a rotating member is hinge-connected in the middle of the shroud, the free end of the rotating member being located directly below the tripping coil, and an armature plate capable of being attracted into contact with the static armature being provided thereon; snap hooks which match the snap stop on the cross arm are disposed above the hinge end of said rotating member, and a rotating member spring is connected below said rotating member.

[0005] Said shell consists of a top cover and a bottom cover that are snap-fitted together, said reset button and test button being disposed in holes in the upper surface of the top cover and exposed to the outside, and said power supply live wire pin and neutral wire pin extending to the outside through holes in the lower surface of the bottom cover.

[0006] A fixed leg is disposed in the middle of the shroud, a hinge shaft being disposed at the lower end of the fixed leg, each side of the rotating member being provided with a hinge hole that is hinge-connected to each end of the hinge shaft respectively, and a sliding groove for allowing the cross arm to slide up and down being disposed at the upper end of the fixed leg.

[0007] A guide sleeve is disposed on the shroud at one side of the fixed leg, the lower end of said rod fitting over the guide sleeve and being able to slide vertically along the same, and said rod return spring being disposed in-

side the guide sleeve.

[0008] A U-shaped metal needle and a test return spring are disposed below said test button, two test solder points being correspondingly disposed below the U-shaped metal needle on the circuit board and constituting a simulated test switch together with the U-shaped metal needle.

[0009] Said leakage protection circuit comprises a tripping coil, a zero-sequence transformer, a control chip and a silicon-controlled rectifier, the metal ring of said zero-sequence transformer being looped over the power supply cable connected to a load, the secondary coil of the zero-sequence transformer being connected to the input end of the control chip, the output end of the control chip being connected to the gate of the silicon-controlled rectifier, and the anode of the silicon-controlled rectifier being connected to one end of the tripping coil.

[0010] The beneficial effects of the present utility model are as follows: 1. when a leakage incident accidentally occurs during the use of a household electrical appliance, the power supply can be cut off when the leakage current reaches 5 - 10 mA, serving to protect the household electrical appliance; 2. when an open circuit occurs in any phase of the power supply live wire or neutral wire, the power supply can be cut off, serving to protect the household electrical appliance; 3. the internal structure of the present utility model is comparatively simple, the design is rational, and it is easy to mass produce.

Description of the accompanying drawings

[0011]

Fig. 1 is a three-dimensional exploded view of the present utility model;

Fig. 2 is a plane figure of the present utility model;

Fig. 3 is a section taken along the line A-A in Fig. 2;

Fig. 4 is a structural diagram of the present utility model after the top cover is removed;

Fig. 5 is a first three-dimensional diagram of a tripping device of the present utility model;

Fig. 6 is a second three-dimensional diagram of the tripping device of the present utility model;

Fig. 7 is a third three-dimensional diagram of the tripping device of the present utility model;

Fig. 8 is an exploded view of the tripping device of the present utility model; and

Fig. 9 is a circuit diagram of a leakage protection circuit of the present utility model.

Particular embodiments

[0012] Hereinafter, a further detailed description will be given in conjunction with the accompanying drawings and the embodiments of the present utility model.

[0013] Referring to Figs. 1 - 8, disclosed in the present utility model is a power plug with leakage protection functionality, comprising a shell 1, a reset button 11 and test button 12 being disposed on the top surface of the shell 1, a power supply live wire pin 2 and neutral wire pin 4 being disposed at the bottom of the shell 1, a circuit board 5 being disposed inside the shell 1, and a leakage protection circuit for detecting cable leakage faults in the power supply output being disposed on the circuit board 5; a tripping device 7 capable of connecting or disconnecting a moving contact 742 and static contact 723 is disposed inside the shell 1, the tripping device 7 comprising a shroud 71 fixed inside the shell 1, a rod 72 that is fixedly connected to the reset button 11 being vertically slidably mounted on one side of the shroud 71; a drive lug 721 is disposed at the upper end of the rod 72, each of the two sides of the lower end of the rod 72 having fixed thereon a static contact-piece 722 connected to the load cable, the static contact-pieces 722 having static contacts 723 disposed thereon, and a rod return spring 73 being connected to the bottom of the rod 72; a cross arm 74 which can slide downwards in engagement with the drive lug 721 is disposed on the shroud 71, each end of the cross arm 74 having fixed thereon a moving contact-piece 741 connected to the power supply live wire pin 2 and neutral wire pin 4 respectively, the moving contact-pieces 741 having disposed thereon moving contacts 742, which are disposed above the static contacts 723 in positions corresponding to those of the static contacts 723; a cross arm return spring 75 is connected to the bottom of the cross arm 74, and a snap stop 743 is further disposed on the cross arm 74; a tripping coil 76 that is electrically connected to the circuit board 5 is fixed in a cavity on another side of the shroud 71, a static armature being disposed inside the tripping coil 76; a rotating member 77 is hinge-connected in the middle of the shroud 71, the free end of the rotating member 77 being located directly below the tripping coil 76, and an armature plate 78 capable of being attracted into contact with the static armature being provided thereon; snap hooks 771 which match the snap stop 743 on the cross arm 74 are disposed above the hinge end of said rotating member 77, and a rotating member spring 79 is connected below said rotating member 77.

[0014] When it is necessary to use a household electrical appliance, the pins of the power plug have to be inserted into a socket; at this moment, the moving contacts are not in contact with the static contacts, and if it is desired to connect the household electrical appliance to the mains supply, the reset button 11 needs to be pressed down, which drives the rod 72 to move downwards and at the same time compresses the rod return spring 73, the drive lug 721 on the rod 81 pressing on

the cross arm 74 while sliding downwards and at the same time compressing the cross arm return spring 75; at this moment the snap stop 743 on the cross arm 74 separates from the snap hooks 771 on the rotating member 77, no longer snapping the snap hooks 771; since the tripping coil 76 is energized, it causes the static armature therein to become magnetized to attract the armature plate 78; the armature plate 78 together with the free end of the rotating member 77 rotates in the direction of the static armature until the armature plate 78 is in attractive contact with the static armature; during the rotation of the rotating member 77, the position of the snap hooks 771 falls, causing the cross arm 74 to continue sliding downwards; once the hand is relaxed, the rod return spring 73 is released to push the rod upwards, causing the static contacts to be in contact with the moving contacts, and achieving electric connection between the load and the pins; thus the mains supply can now supply electricity to the household electrical appliance via this plug.

[0015] Said shell 1 consists of a top cover 13 and a bottom cover 14 that are snap-fitted together, said reset button 11 and test button 12 being disposed in holes in the upper surface of the top cover 13 and exposed to the outside, and said power supply live wire pin 2 and neutral wire pin 4 extending to the outside through holes in the lower surface of the bottom cover 14.

[0016] A fixed leg 711 is disposed in the middle of the shroud 71, a hinge shaft 712 being disposed at the lower end of the fixed leg 711, each side of the rotating member 77 being provided with a hinge hole that is hinge-connected to each end of the hinge shaft 712 respectively, and a sliding groove 713 for allowing the cross arm 74 to slide up and down being disposed at the upper end of the fixed leg 711.

[0017] A guide sleeve 714 is disposed on the shroud 71 at one side of the fixed leg 711, the lower end of said rod 72 fitting over the guide sleeve 714 and being able to slide vertically along the same, and said rod return spring 73 being disposed inside the guide sleeve 714.

[0018] A U-shaped metal needle 121 and a test return spring 122 are disposed below said test button 12, two test solder points being correspondingly disposed below the U-shaped metal needle 121 on the circuit board 5 and constituting a simulated test switch TEST together with the U-shaped metal needle 121. When the test button 12 is pressed down, the U-shaped metal needle 121 momentarily comes into contact with the two test solder points on the circuit board 5; the test circuit is completed, the zero-sequence transformer 62 on the leakage protection circuit generates a test leakage current, an induction signal is generated in the secondary coil thereof, and the silicon-controlled rectifier SCR is triggered to conduct; the tripping coil 76 is short-circuited, the static armature loses its magnetism, the armature plate 78 is released, the free end of the rotating member 77 rotates downwards, and the position of the snap hooks 771 rises, causing the cross arm 74 to move upwards under the

action of the cross arm return spring 75, so that the moving contacts detach from the static contacts, achieving disconnection of the load from the pins; thus the mains supply ceases to supply electricity to the household electrical appliance, and the household electrical appliance ceases to operate.

[0019] Referring to Fig. 9, said leakage protection circuit comprises a tripping coil 76, a zero-sequence transformer 62, a control chip U 1 and a silicon-controlled rectifier SCR, the metal ring of said zero-sequence transformer 62 being looped over the power supply cable connected to a load, the secondary coil of the zero-sequence transformer 62 being connected to the input end of the control chip U1, the output end of the control chip U1 being connected to the gate of the silicon-controlled rectifier SCR, and the anode of the silicon-controlled rectifier SCR being connected to one end of the tripping coil 76. When a leakage incident accidentally occurs during the use of a household electrical appliance, a leakage current signal is induced in the secondary coil of the zero-sequence transformer 62 when the leakage current reaches 5 - 10 mA, and the silicon-controlled rectifier SCR is triggered to conduct; the tripping coil 76 is short-circuited, the static armature loses its magnetism, the armature plate 78 is released, the free end of the rotating member 77 rotates downwards, and the position of the snap hooks 771 rises, causing the cross arm 74 to move upwards under the action of the cross arm return spring 75, so that the moving contacts detach from the static contacts, achieving disconnection of the load from the pins; thus the mains supply ceases to supply electricity to the household electrical appliance, and the household electrical appliance ceases to operate.

[0020] Alternatively, when an open circuit occurs in any phase of power supply live wire or neutral wire, the tripping coil 76 has an open circuit, the static armature loses its magnetism, the armature plate 78 is released, the free end of the rotating member 77 rotates downwards, and the position of the snap hooks 771 rises, causing the cross arm 74 to move upwards under the action of the cross arm return spring 75, so that the moving contacts detach from the static contacts, achieving disconnection of the load from the pins; thus the mains supply ceases to supply electricity to the household electrical appliance, and the household electrical appliance ceases to operate.

Industrial applicability

[0021] The present invention is a power plug which has leakage protection functionality, therefore it possesses industrial exploitability.

Claims

1. Power plug with leakage protection functionality, comprising a shell (1), a reset button (11) and test

button (12) being disposed on the top surface of the shell (1), a power supply live wire pin (2) and neutral wire pin (4) being disposed at the bottom of the shell (1), a circuit board (5) being disposed inside the shell (1), and a leakage protection circuit for detecting cable leakage faults in the power supply output being disposed on the circuit board (5), **characterized in that** a tripping device (7) capable of connecting or disconnecting a moving contact (742) and static contact (723) is disposed inside the shell (1), the tripping device (7) comprising a shroud (71) fixed inside the shell (1), a rod (72) that is fixedly connected to the reset button (11) being vertically slidably mounted at one side of the shroud (71); a drive lug (721) is disposed at the upper end of the rod (72), each of the two sides of the lower end of the rod (72) having fixed thereon a static contact-piece (722) connected to the load cable, the static contact-pieces (722) having static contacts (723) disposed thereon, and a rod return spring (73) being connected to the bottom of the rod (72); a cross arm (74) which can slide downwards in engagement with the drive lug (721) is disposed on the shroud (71), each end of the cross arm (74) having fixed thereon a moving contact-piece (741) connected to the power supply live wire pin (2) and neutral wire pin (4) respectively, the moving contact-pieces (741) having disposed thereon moving contacts (742), which are disposed above the static contacts (723) in positions corresponding to those of the static contacts (723); a cross arm return spring (75) is connected to the bottom of the cross arm (74), and a snap stop (743) is further disposed on the cross arm (74); a tripping coil (76) that is electrically connected to the circuit board (5) is fixed in a cavity on another side of the shroud (71), a static armature being disposed inside the tripping coil (76); a rotating member (77) is hinge-connected in the middle of the shroud (71), the free end of the rotating member (77) being located directly below the tripping coil (76), and an armature plate (78) capable of being attracted into contact with the static armature being provided thereon; snap hooks (771) which match the snap stop (743) on the cross arm (74) are disposed above the hinge end of said rotating member (77), and a rotating member spring (79) is connected below said rotating member (77).

2. Power plug with leakage protection functionality according to Claim 1, **characterized in that** said shell (1) consists of a top cover (13) and a bottom cover (14) that are snap-fitted together, said reset button (11) and test button (12) being disposed in holes in the upper surface of the top cover (13) and exposed to the outside, and said power supply live wire pin (2) and neutral wire pin (4) extending to the outside through holes in the lower surface of the bottom cover (14).

3. Power plug with leakage protection functionality according to Claim 1 or 2, **characterized in that** a fixed leg (711) is disposed in the middle of the shroud (71), a hinge shaft (712) being disposed at the lower end of the fixed leg (711), each side of the rotating member (77) being provided with a hinge hole that is hinge-connected to each end of the hinge shaft (712) respectively, and a sliding groove (713) for allowing the cross arm (74) to slide up and down being disposed at the upper end of the fixed leg (711).
4. Power plug with leakage protection functionality according to Claim 3, **characterized in that** a guide sleeve (714) is disposed on the shroud (71) at one side of the fixed leg (711), the lower end of said rod (72) fitting over the guide sleeve (714) and being able to slide vertically along the same, and said rod return spring (73) being disposed inside the guide sleeve (714).
5. Power plug with leakage protection functionality according to Claim 1, **characterized in that** a U-shaped metal needle (121) and a test return spring (122) are disposed below said test button (12), two test solder points being correspondingly disposed below the U-shaped metal needle (121) on the circuit board (5) and constituting a simulated test switch (TEST) together with the U-shaped metal needle (121).
6. Power plug with leakage protection functionality according to Claim 1, **characterized in that** said leakage protection circuit comprises a tripping coil (76), a zero-sequence transformer (62), a control chip (U1) and a silicon-controlled rectifier (SCR), the metal ring of said zero-sequence transformer (62) being looped over the power supply cable connected to a load, the secondary coil of the zero-sequence transformer (62) being connected to the input end of the control chip (U1), the output end of the control chip (U1) being connected to the gate of the silicon-controlled rectifier (SCR), and the anode of the silicon-controlled rectifier (SCR) being connected to one end of the tripping coil (76).

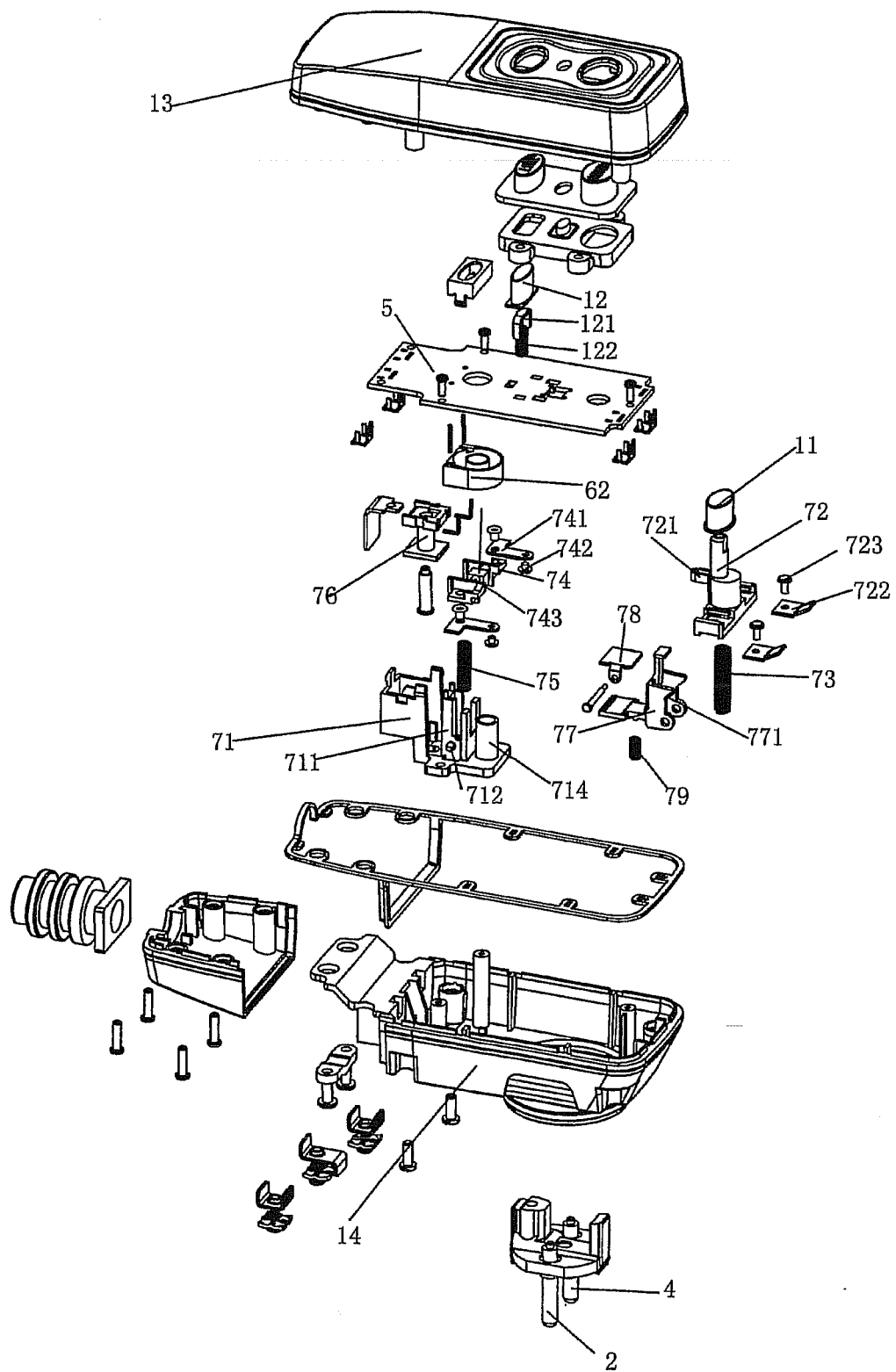


Figure 1

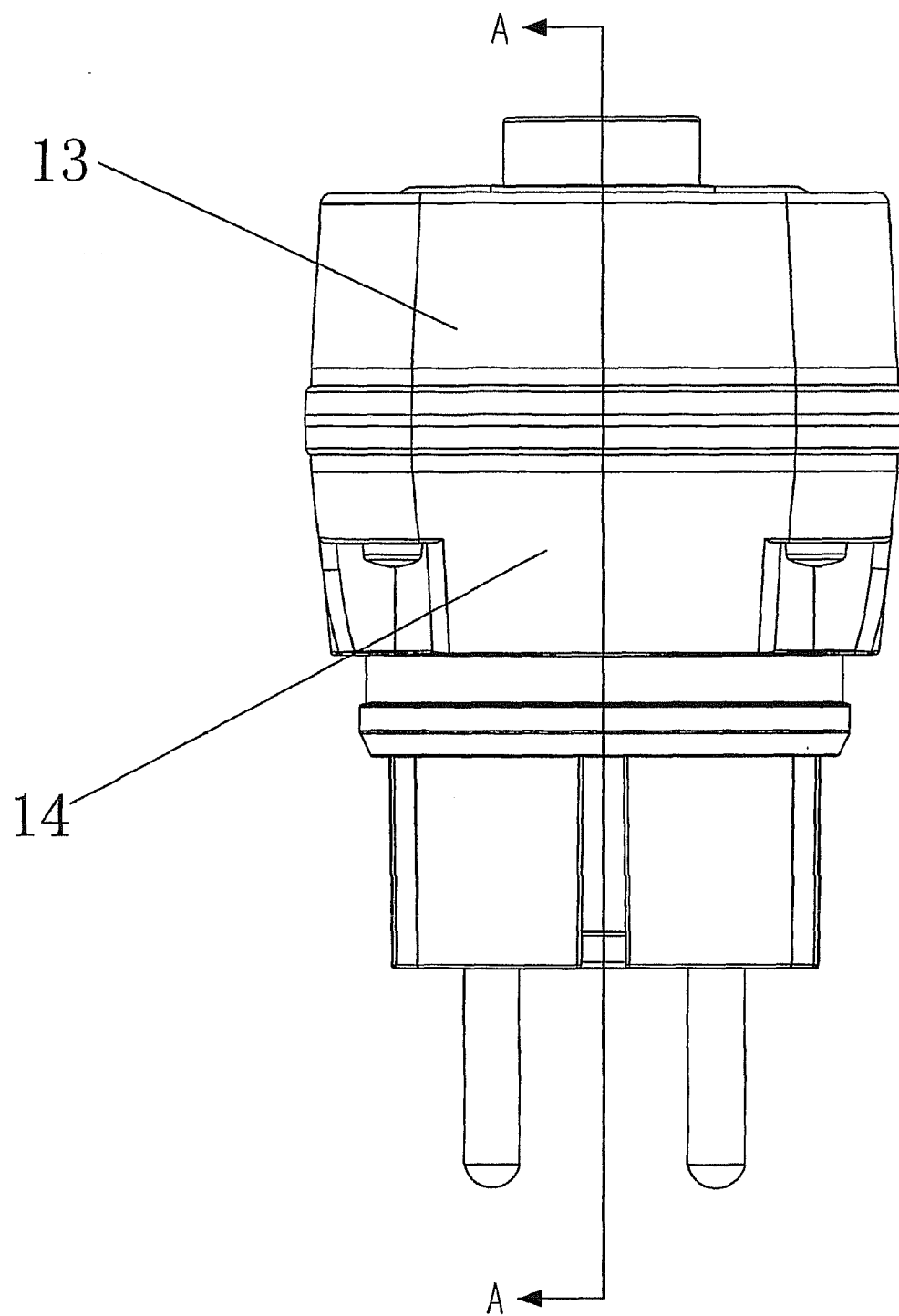


Figure 2

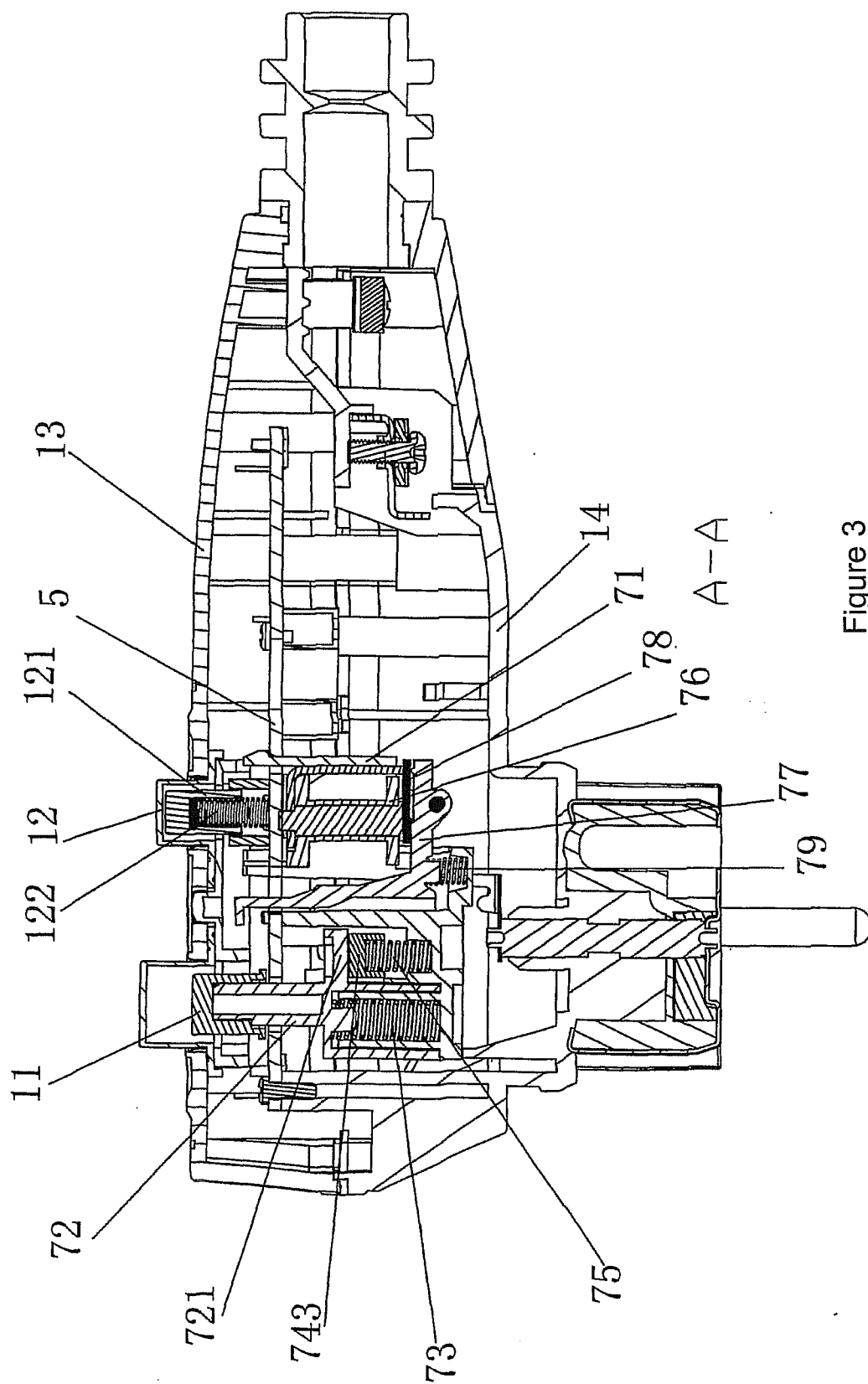


Figure 3

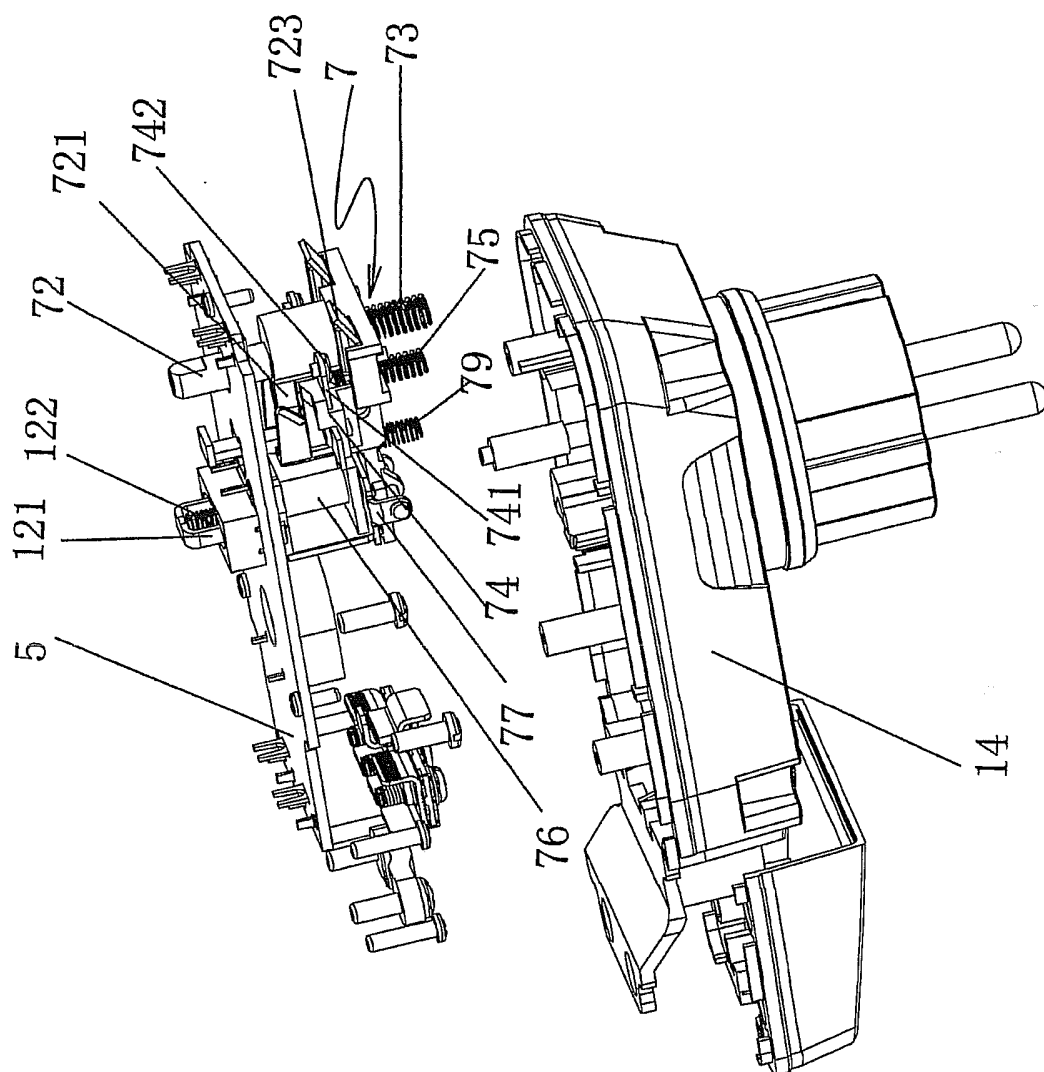


Figure 4

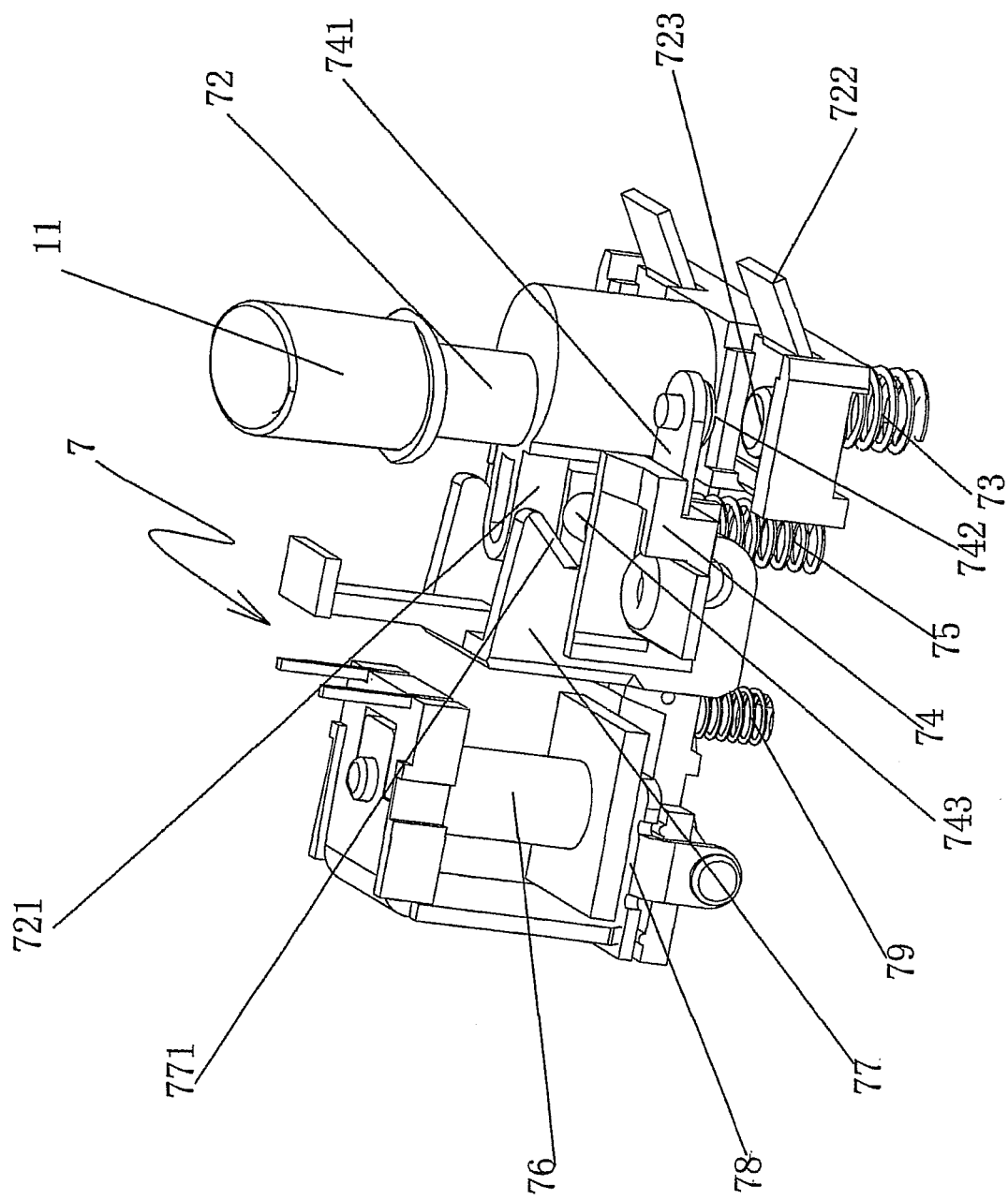


Figure 5

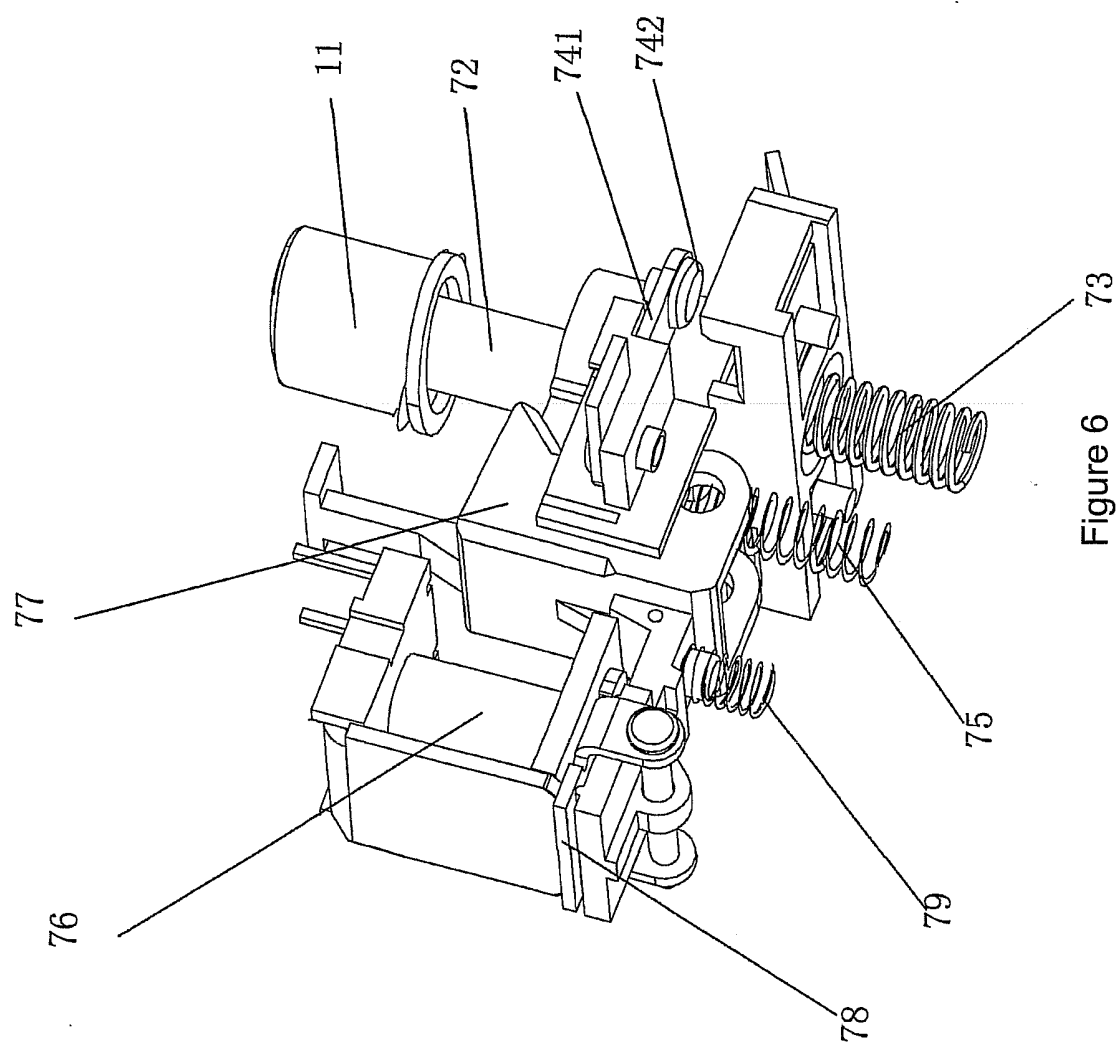


Figure 6

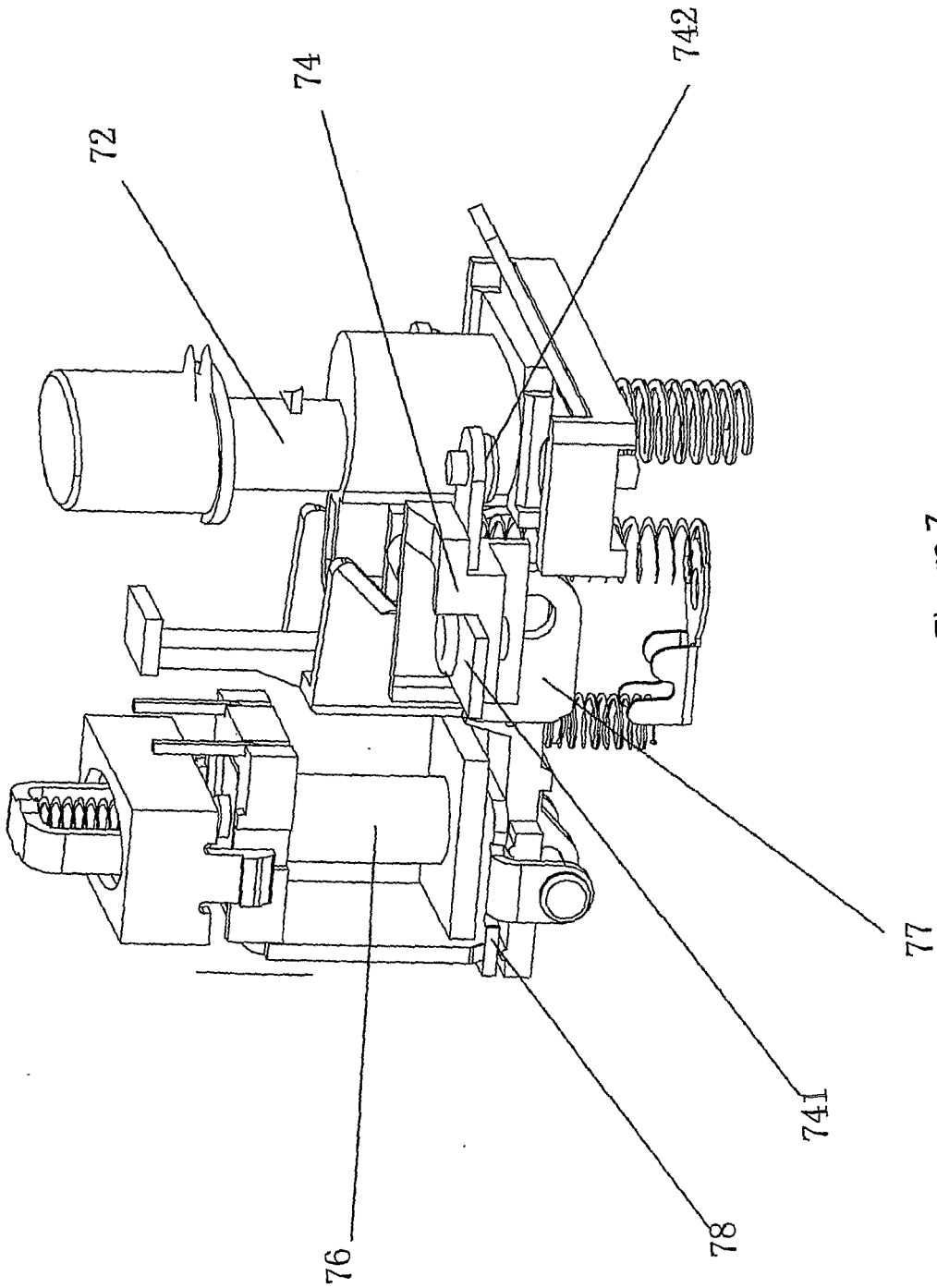


Figure 7

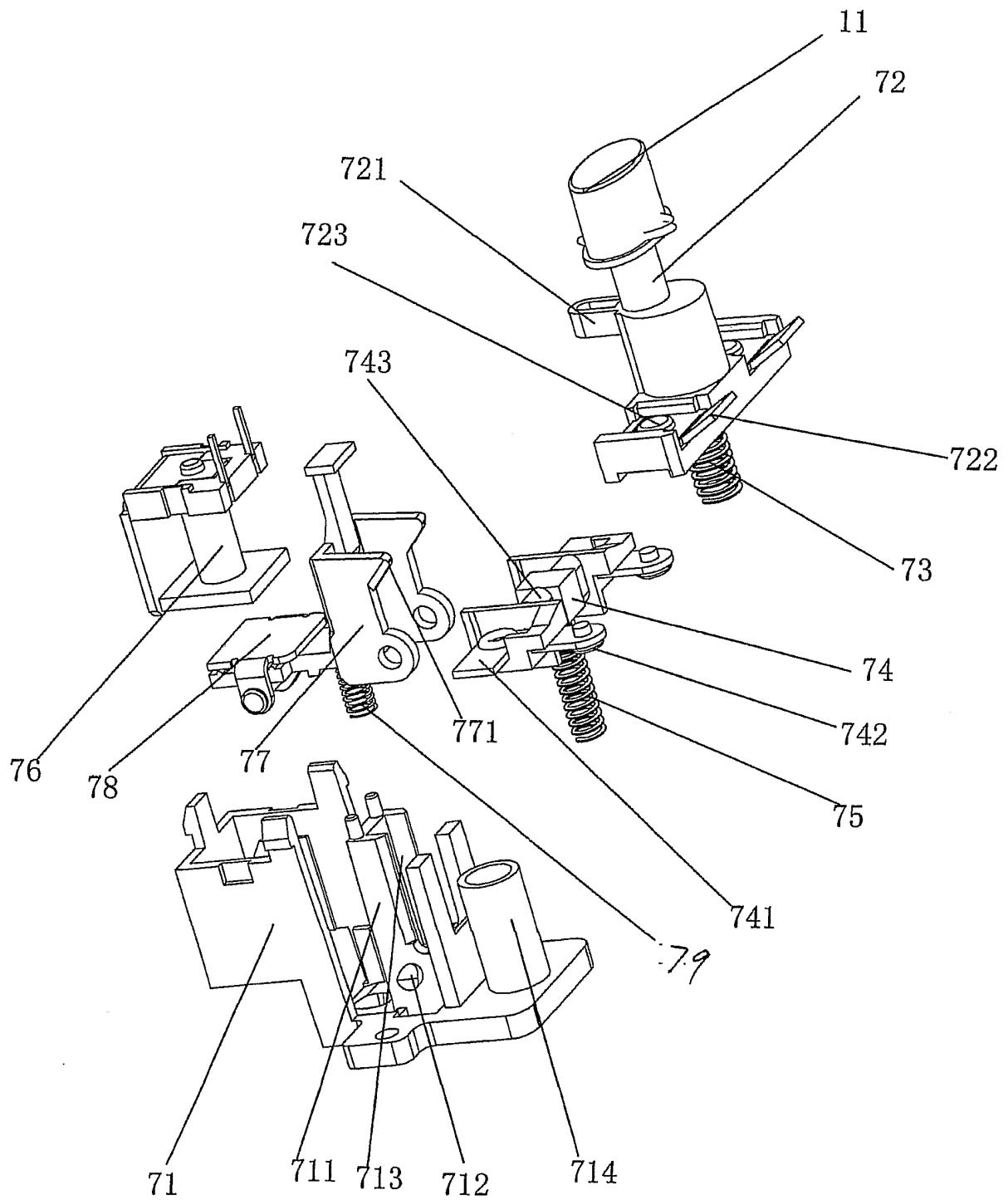


Figure 8

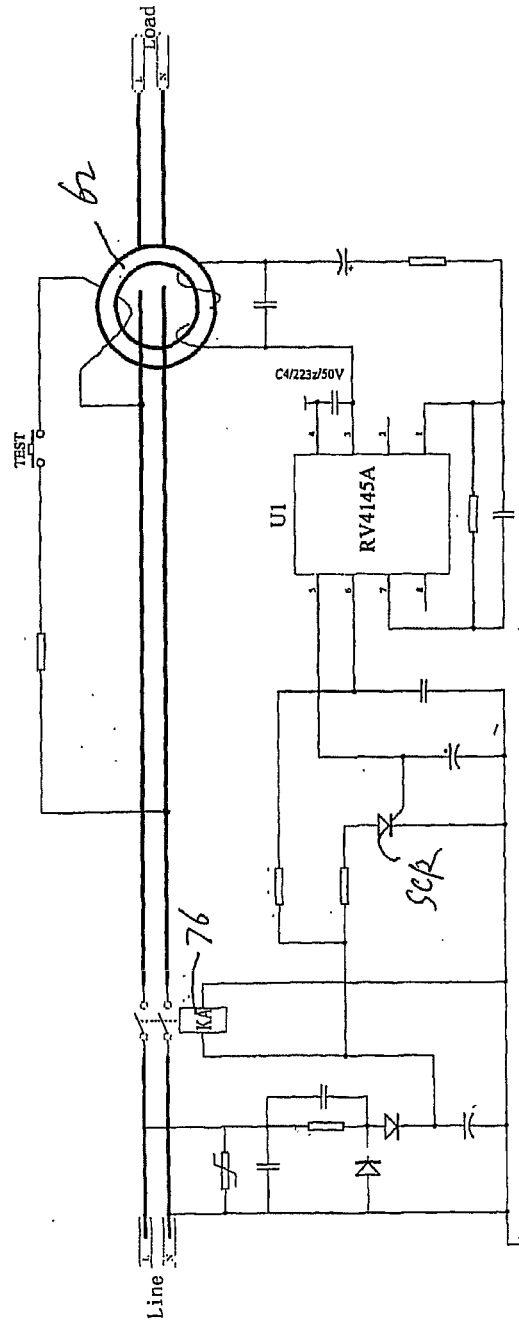


Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/000060

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNPAT, WPI, EPODOC: leakage, protect, plug, socket, adapter, reset, push, button, movable, static, test, detect, trip

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN201425994Y(ZHONGSHAN KAPER ELECTRICAL CO.,LTD) 17 Mar. 2010(17.03.2010) claims 1-6	1-6
A	CN200965956Y(SHANGHAI ELE MFG CORP) 24 Oct. 2007(24.10.2007) the whole document	1-6
A	CN201185273Y(SU CHUNWEN) 21 Jan. 2009(21.01.2009) the whole document	1-6
A	CN200950504Y(SHANGHAI ELE MFG CORP) 19 Sep. 2007(19.09.2007) the whole document	1-6
A	CN201185279Y(ZHANG KEQING) 21 Jan. 2009(21.01.2009) the whole document	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&” document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
22 Mar. 2010(22.03.2010)

Date of mailing of the international search report
22 Apr. 2010 (22.04.2010)

Name and mailing address of the ISA/CN
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Telephone No. (86-10)62411730

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/000060

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN201425994Y	17.03.2010	None	
CN200965956Y	24.10.2007	US2008094764A1	24.04.2008
CN201185273Y	21.01.2009	None	
CN200950504Y	19.09.2007	None	
CN201185279Y	21.01.2009	WO2009109106A1	11.09.2009

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/000060

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/66 (2006.01) i

H01R 13/70 (2006.01) i

H02H 3/14 (2006.01) i