

The Design and Research of a Creative Automatic Bouncing Socket

Yang Yaxuan, Zhang Chunyan *, Huang Yunwei, Guo Yunshan and Xu Jiayan

School of Mechanical Engineering, Shanghai University of Engineering Science

Email: keke204102@163.com

ABSTRACT

This paper analyzed the existing problems of the use of the existing socket, contrasted the structural type and safety standards of plug in the foreign developed countries, and discussed the existing problems of the existing socket structure in China. Combined with the actual characteristics of the domestic socket, we designed a creative automatic bouncing socket, changed the traditional socket plug form, enhanced the safety and convenience of the use of sockets. And the scheme is practical and feasible, contributing to further improve China's common use socket.

Keywords: Socket, Structure, Automatic bouncing, Convenient, Safety.

1. OVERVIEW

All the time, users pay much attention to the security issues of plug and socket. Among them, socket directly connected to circuit, socket security is particularly important for users, especially for family users. Investigation found that quality accidents caused by plug and socket can be divided into two aspects: First, the product does not conform to the provisions of the current national compulsory standards; Second, user misuse plug socket [1, 2]. In this paper, we analyze the unreasonable and dangerous problems caused by the use of sockets in the design. And according to the analysis results, we design a new type creative automatic bouncing socket. We hope that through the design and research of this new socket, improving the current situation of the use of China's outlet, making the daily use of the socket more safe and convenient.

2. SOME POTENTIAL PROBLEMS IN THE EXISTING HOUSEHOLD SOCKET IN CHINA

2.1 The socket has been electrified before the plug plug in it tightly.

The current internal structure of the socket is shown in Figure 1. In our country, both two hole or three holes in the household socket can be seen as that the elastic copper sheet starts working after clamping the plug and electrified. As clip, copper sheet is electrified for long time. The bolt of plug is a long strip of metal, copper sheet. But the copper sheet does not clamp the bolt tightly when the copper sheet contacts the

bolt. The plug can also be left or right to cause the power to be unstable. Now, the market is popular with a kind of socket whose each hole has an independent switch. When the switch is off, the internal copper is not electrified. So it can avoid these problems when the plug is inserted into the socket. But when users use this kind of socket, they may not be aware of inserting the plug first and then turning on the switch. It will give users inconvenience.



Figure 1. Internal structure diagram of socket

2.2 It is easy to get electric shock when the plug is pulled out from the socket.

According to the IEC60479-1: 2005, when the human body electric shock time is 1s and current path to the left hand to the feet, if the contact voltage is 110V, electric shock may cause ventricular fibrillation. If the contact voltage is 220V, the current flowing through the body is about 200mA, and the

probability of the electric shock of ventricular fibrillation is increased by about 50% [3].The bolt of our current socket is exposed in the air directly .In pulling the plug, the fingers is easy to get into the area between plug and socket and cause electric shock. And users will most likely be dangerous when the contact voltage is 220V.

2.3 The socket clamp bolt tightly. It is hard to pull out the plug.

The internal current socket clamps bolt by the elastic deformation of the copper, its clamping principle can be likened to the interference fit in the hole axis. The copper has maintained in a state of clamping tightly when inserting or pulling out the plug. The copper-bolt force is a relatively horizontal force. However, the force used to pull out the plug is a lead in the direction of the force. And the surface of plug on the market is relatively narrow. When the user holds the plug, the focus point is very little. So it is difficult to pull out the plug.

In addition, wall socket are generally in the position of the 1/3 walls, and some will be located in the more subtle corner. Such a concealed position will cause great inconvenience to pull off the plug.

3. COMPARISON OF THE STRUCTURE DESIGN OF 220V PLUG AND SOCKET IN FOREIGN COUNTRIES

In developed countries, the protective measures for the prevention of electric shock in the process that plug insert into socket are divided into two types: One is installing insulating sheath in the plug, such as British BS plug (As shown in Figure 2). When the plug insert into the socket, anti-shock test refers to the insulating sheath which can only touch the bolt of plug. The other is socket with embedded structure, such as German French socket (As shown in Figure 3). When the plug insert into the socket, Anti-electric shock test refers to the surface of insulating sheath which can only touch the bolt of plug [3].



Figure 2. British BS plug



Figure 3. German French socket

However, the domestic plug and socket is relatively weak in the protection measures .In China, the plug and socket of various electrical are directly “naked” in the air. When inserting or pulling out the plug, fingers may directly contact the conductive part of the bolt. In addition, the shell of socket commonly used in china can be simply regarded as a curved plane plastic plate with a few holes and a bit outward bulge. Such a simple case of the shell is easy to damage under the condition of breaking and knocking.

4. DESIGN A NEW TYPE HOUSEHOLD AUTOMATIC BOUNCING SOCKET

4.1 Overall design of new type household automatic bouncing socket

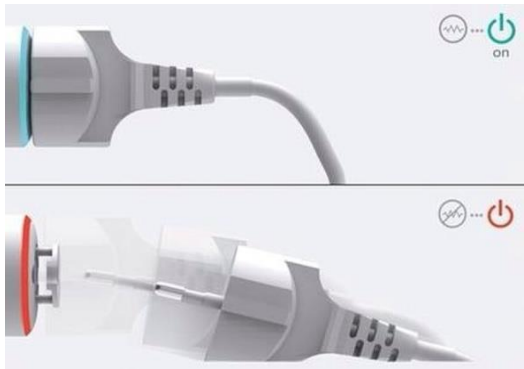


Figure 4. Sketch map for the inserting and pulling out of new type socket

This is a new creative socket not put into the market use. Give it a name “creative automatic bouncing socket”. Its biggest feature is changing the way we force when the home socket pulled out. It changed the force direction of pulling out the plug from socket into the direction in which using hand push the plug into socket. This socket use “Automatic bouncing structure “which is in its internal to change the force direction of the plug. As shown in Figure 4, exert a force on the socket. Change the pulling of plug into the insert of plug. It is very easy to pull out the plug.

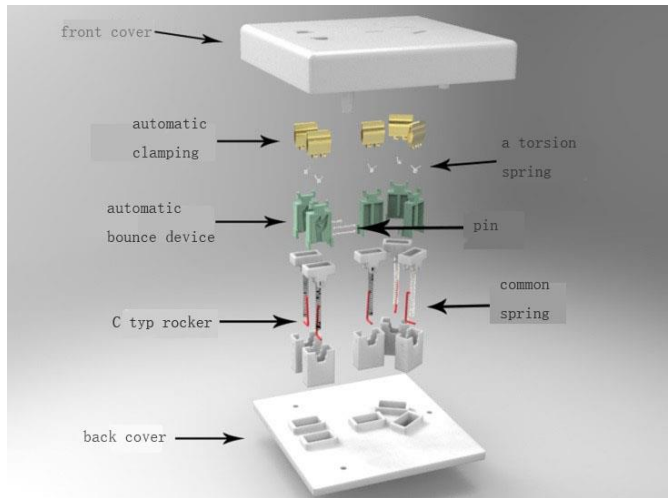


Figure 5. Overall structure diagram of the new socket

The structure of the automatic bouncing creative socket as shown in Figure 5. Its appearance is similar to other socket, and it has retained the appearance of other socket. This socket is mainly composed of a front cover, back cover and automatic bounce device. And Automatic bounce device is composed of an automatic clamping part and an automatic bouncing part.

As shown in Figure 6, it is an overall structure diagram of the automatic bouncing device, and it is the most critical structure of the automatic bouncing creative socket.

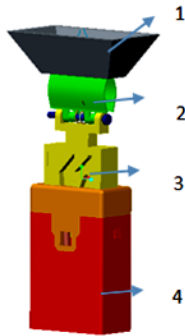


Figure 6. Overall structure diagram of the automatic bouncing device

It is used to replace the connecting device between copper and bolt which is in the socket, and it is mainly composed of a front cover 1, automatic clamping mechanism 2, eject mechanism 3 and a back cover 4. 1 in Figure 6 is a part of the front cover of the socket. It is used to limit the angle of clip opening. 2 in Figure 6 is automatic clamping mechanism. As shown in Figure 5, there are two pieces of metal and a torsion spring. It primarily responsible for conducting, and it play a clamping effect when the clip effected by 1. 3 in Figure 6 are ejecting mechanism. It mainly composed by the metal block with a fixed orbit, common spring and a “C” type of metal wire. Metal wire walks on the track of metal block and plays an effect that the plug is clamped by socket when the plug pressed first time and bounces when the plug pressed second time. 4 in Figure 6 connect with the rear cover, playing an effect fixing the bounce device.

The “lock mechanism” of this socket can ensure that the bolt can be clamped under pressure. And automatic bouncing household energy-saving sockets are electrified in a particular position in its “locking device”. It ensures the bolt is energized after being fully clamped. This makes sockets more secure.

4.2 The automatic bouncing mechanism of this new socket

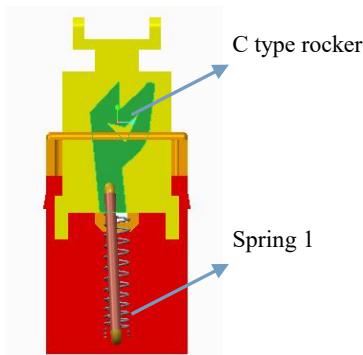


Figure 7. The principle of automatic bouncing device

As shown in Figure 7, making a circular orbit (As shown in Figure 8) on the metal block of automatic bouncing device. The lower end of the C type rocker is fixed in the back seat, and the other side is put in the track 1 in Figure 8. When the spring is compressed, the entire metal block moves with the spring. C type rocker is put in the position 1 in Figure 8. After relaxing the spring 1, the rocker is put in the position 4. When the spring is compressed second times, the rocker is put in the position 5. After relaxing the spring, the rocker is back to the beginning position 1 along with the track. Metal block move upward to achieve tightening on being pressed first time, and automatic bouncing on being pressed second times. And then completing a cycle of the insert and pulling of a socket.

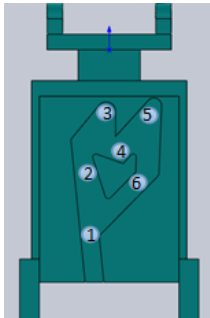


Figure 8. Demo map of the track of automatic bouncing device

4.3 Automatic clamping mechanism for new creative socket

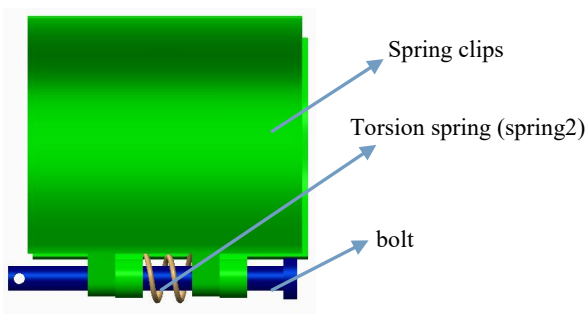


Figure 9. A positive views of the automatic clamping device

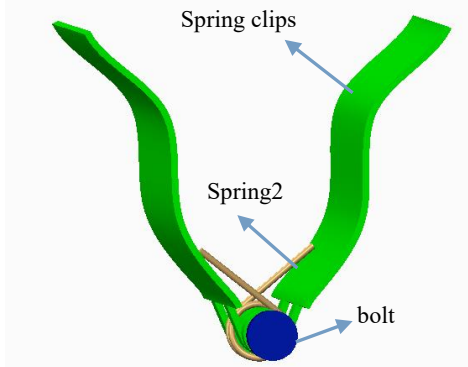


Figure 10. a side views of the automatic clamping device.

As shown in Figure 9, in automatic clamping mechanism for new creative socket, two metal sheets (spring clips) and a torsion spring (spring2) form a pin connection connected with the metal block of automatic bouncing device. Under the action of spring1, spring clips move upward. The clamping piece is squeezed by the shell and plays a clamping effect. In

addition, after the use of electrical appliances, spring 1 will hold up the automatic clamping mechanism. Clip is opened by the force of torsion spring (spring 2). And it plays an effect to power off. Finally the plug is locked tightly after being inserted into the socket. After the end of use, the plug bounces automatically. Figure 9 is a positive view of the automatic clamping device. Figure 10 is a side view.

4.4 The automatic bouncing creative socket start power after being clamped

The automatic bouncing creative socket use “automatic bouncing structure” (as shown in Figure 11) to take place of the copper-bolt electricity of the ordinary household outlet. Its “locking mechanism” can ensure that bolt is clamped tightly after being pressed. And automatic bouncing household energy-saving sockets are electrified in a particular position in its “locking device”. It ensures the bolt is energized after being fully clamped. This makes sockets more secure.

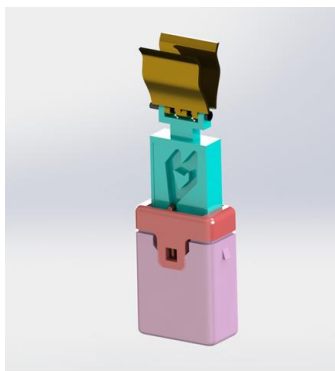


Figure 11. The structure of the automatic bouncing device

4.5 Automatic bouncing household sockets can avoid getting an electric shock

The appearance design of this socket can avoid electric shock. The appearance of this socket is design as a groove. When the plug insert into the socket, 1/3 of the plug is not insert into the groove of the socket. This will cause there is no place to catch when the plug is pulled out. But the way pulling out the plug of this socket is different from the traditional household socket. It's only force on the back of the plug. This can avoid the danger of getting an electric shock.

5. CONCLUSIONS

The structural design of the household plug and socket in China is related to the safety of the users. Therefore, the design of the plug in the socket should be all aspects of the safety and convenience of use. In order to solve a few

problems on the structure of socket, we combined with some developed countries on the design of socket and our idea, and we has created “automatic bouncing creative socket”. Its automatic bouncing structure solves the problem of difficulty pulling the plug and getting the electric shock easily on pulling the plug. Its shell is designed to ensure the safety of the use of sockets. We hope that this socket can be widely known through this paper, and it can improve the household socket to make everyone's life more convenient and safe.

REFERENCES

- [1] GB 2009, 1-2008, Plugs and sockets for household and similar use the first part: General requirements.
- [2] GB 1002-2008, Single phase plug and socket type, basic parameters and dimensions for household and similar use.
- [3] Huang Yongfu, Lin Miao and Wu Xiangfeng, “Discussion on the existing problems of the structure of plug and socket in China,” *Electronics Quantity*, vol. 11, pp. 68-72, 2011.
- [4] Ruan Liping and Yu Shun, “Discussion on some problems of plug and socket standard,” *Electrical Appliances*, vol. 4, pp. 20-25, 2014.
- [5] Zhang Jinzhuan, Hu Jianguo, Jiang Xin and Wen Yuxiou, “Fire risk of plug and socket in different contact resistance,” *Fire Science and Technology*, vol. 3, pp. 30-34, 2007.
- [6] Zhang Xiaoguang, Lv Shaoguo and Zhang Yingying, “Study on fire risk of plug and socket in different contact resistance,” *Fire Technique and Products Information*, vol. 1, pp. 47-55, 2011.
- [7] Huang Zhufeng, Han Qiang and Feng Xiaojun, “Some suggestions for the revision of the standard of plug and socket in China,” *China Appliance Technology*, vol. 3, pp. 32-40, 2013.
- [8] Chen Ruihui and Lin Miao, Wu Zhenpeng and Chen Liang, “Research on the size of the standard of the single phase plug socket and the converter in China,” *Standard Science*, vol. 3, pp. 50-60, 2014.
- [9] Zhang Jin, Liu Zhufeng and Li Xuhang, “Study on heating up of plug socket in overload condition,” *Fire Science and Technology*, vol. 3, pp. 24-29, 2007.
- [10] Cai Jun, “Research on the single use of household plug socket,” *Safety&EMC*, vol. 3, pp. 50-60, 2008.
- [11] Shi Jian, Huang Yongfu and Guo Fengqi, “Discussion on the difference between the safety standard and the international standard of safety for the domestic plug and socket outlet,” *Low Voltage Apparatus*, vol. 19, pp. 10-17, 2007.