Automatic continuous manufacturing method of lamp holder vertical injection molding machine

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Abstract. The manufacuring of lamp holder usually requires the coordination of the handmade operator, which is slow and inefficient. So, the automatic continuous manufacturing method of the lamp holder vertical injection molding machine is discussed. This method is based on the sorting, feeding, mold injection and blanking technology of lamp holder. The processing technology and process flow of the lamp holder are introduced, and the collaborative control method of the lamp holder is expounded. This method improves the precision and reliability of the lamp holder injection molding and the degree of automation, and reduces the security hidden danger.

1. Introduction

The lamp holder is generally divided into plastic lamp holder, bakelite lamp holder, ceramic lamp holder and metal lamp holder etc. The ceramic lamp is easily broken, so transportation is not convenient. Bakelite lamp holder is non-recyclable, and the cost is expensive. Plastic lamp holder is more popular because the heat-resistant temperature of it is higher than 240 degrees and difficult to be damaged. Now, the world-famous plastic lamp holder in the global market is generally provided by BJB of Germany and ARDITI of Italy. There are many manufacturers of plastic lamp holder in China, but quite well known, it can't match many foreign manufacturers[1].

The plastic lamp holder is usually molded by injection molding machine and corresponding mold, its raw material is generally PET or PBT and LCP. Usually, the injection material of the plastic lamp holder is injected into the top of the metal lamp holder thus get the finished product[2]. Currently, most of the lamp holder injection molding machines only have the function of injection molding, however sorting, feeding and blanking of lamp holder usually done with the cooperation of workers which is slower, poor efficiency, and easy to cause security risks[3][4].

In view of the above problems, an automatic continuous manufacturing method of the lamp holder used to vertical injection molding machine with high speed, high precision, high efficiency and compound function is studied.

2. Automatic continuous manufacturing process of lamp holder vertical injection molding machine

The automatic continuous manufacturing method of lamp holder vertical injection molding machine is consist of sorting, automatic feeding, molding, automatic blanking, and its process flow is shown in Fig 1.
2.1. Sorting

In traditional, the separation and sorting of the metal lamp holder is usually manually. Workers separate the metal lamp holders which are clinging together, it’s inefficient and high-risk. So, the automatic sorting module is used, aim to separate and sort the lamp holders automatically. The automatic sorting module consists of the material slot, the conveyor belt, the vibrating feed plate, the supporting platform. The material slot is used to place the metal lamp holders. The lamp holders are transmitted to the vibrating feed plate by conveyor belt after receive the sort instruction from controller. The vibrating feed plate divide the clinging lamp holders and sort them. In sorting process, if the direction of the lamp holder is incorrect, it fall into the trough waiting for the next sorting. The sorted lamp holders are sent to the supporting platform through a conveyor belt and waiting in place. When the feeding manipulator have taken away the lamp holders in place, the next sorting is carried out, so it is repeated.

2.2. Feeding automatically

In traditional, the feeding is manually, workers put the lamp holders on the feeding workbay by hands, this way is not only inefficient and exist a big security risk. So, the feeding manipulator is used for replacing workers to put the lamp holders on feeding workbay. The feeding manipulator consists of the clamp of feeding manipulator, the vertical lift frame, the horizontal guide rail. The horizontal movement of the clamp is driven by a servo motor, and the loosening of the vertical movement and the fixture is pneumatically driven. The feeding manipulator receive the signal from controller which allow to feeding. Then after vertical lifting and horizontal movement, manipulator get to above of the support platform, the clamp of manipulator clip the lamp holders. And then after the vertical and horizontal movement, manipulator get to the feeding workbay on main body of injection molding machine. Then the fixture release, and
place the lamp holders in the corresponding position, feeding is completed. Then Feeding manipulator give a signal to inform the injection molding machine that it can take the next step.

2.3. Molding
The molding is completed by injection molding machine and corresponding mold. The injection molding machine consists of the feeding funnel, the melting tube, the working turntable (feeding workbay, molding workbay, blanking workbay), and the ejection device. The mold is composed of an upper mold installed on the mold clamping device and three lower molds installed on the corresponding workstations. The molding mainly complete the plastic filling, plastic melt, injection molding, mold opening, product pushing. Thereby the metal lamp holders to be finished products.
Specifically, after the injection molding machine receives the feeding completion instruction sent by the controller, the working turntable transfers the lamp holders from the feeding workbay to the molding workbay at where melted plastic will be injected into mold. After forming, cooling, open the mold. The Injection molding is completed, then the working turntable will turn the molded lamp holders to the blanking workbay where the molded lamp holders will be pushed out by the ejection device. In this moment the injection molding machine send a signal to the blanking manipulator to allow blanking, then waiting for the blanking.

2.4. Blanking automatically
The traditional process of removing the finished product is manually, and the worker takes out the finished product of the lamp at the blanking workbay. It has the same problems of inefficient and unsafe as the manual feeding.
So, the blanking manipulator is used for replacing workers to remove the lamp holders on blanking workbay. The stortcure of the blanking manipulator is the same as the feeding manipulator. The blanking manipulator receive the signal from controller which allow to blank. After vertical lifting and horizontal movement, manipulator get to above of the blanking workbay on Injection molding machine. The clamp of manipulator clip the lamp finished product. And then after the vertical and horizontal movement, manipulator get to the above of reclaimer conveyor belt. Then the clamp release, place the lamp holders in the corresponding position. Then blanking manipulator send a signal to inform the jection molding machine that it can take the next step.

3. Control strategy
The structure of the injection moulding machine results in the discrete distribution of its electrical components and the local concentration of the main control box. The long-distance transmission of IO signals is an important factor affecting accuracy. In this paper, the distributed with centralized control is used to collect and process analog signals in situ and transmit data to the main controller in the form of digital signals through bus. This control method can avoid the interference of analog signals in the long-distance transmission process, thus realizing IO remote distribution. The distributed with centralized control systems is characterized by flexibility, reliability, coordination, and ease of maintenance. Failure of a part of the system will not result in the loss of other functions of the system, and the troubleshooting can be done without affecting the entire system [5].

3.1. Control system
Here, a distributed system with centralized control is adopted. The system consists of automatic sorting module, feeding manipulator, Injection molding machine body, blanking manipulator and ejection device. Each part has its own controllers. At the same time, each part is controlled centrally by the central control unit. Each module transmits information to the central control unit through the bus. The central control unit can receive the status information of each module in real time, and coordinate and control each module according to the current status. [6][7]. The signal control is used here instead of time control. That is, only when receive the signal then take to start the next action, rather than a regular action. The benefits of doing so are more real-time and more capable of dealing with emergencies. At the same time, it avoids the time deviation which is easy to exist in timing action.
3.2. Synchronize workflow

The four processes of sorting, feeding automatically, molding, blanking automatically can run independently, and also works synergetically. The synchronize workflow is shown in Fig2.

3.2.1. Sorting and feeding simultaneously. The automatic sorting module sorts the lamp holders, after that the feeding manipulator take the lamp holders away. Then the automatic sorting module start the next sorting process, at the same time the feeding manipulator take the lamp holders to the feeding workbay on injection molding machine. The two processes work simultaneously.

3.2.2 Feeding and molding simultaneously. After the feeding manipulator finish a process, the injection molding machine then begins workbay converting, injection molding, mold opening and product pushing. At the same time the feeding manipulator move to the sorting module for the next reclaimer. The two processes work simultaneously.

3.2.3 Molding and blanking simultaneously. The blanking manipulator remove the finished product from blanking workbay on injection molding machine to reclaimer conveyor belt. At the same time,
the next batch of lamp holders are molding at molding workbay on injection molding machine. The two processes work simultaneously. The two processes work simultaneously.

3.2.4. Blanking and feeding simultaneously. The blanking manipulator remove the finished product from blanking workbay, at the same time the feeding manipulator take the lamp holders to the feeding workbay. The two processes work simultaneously.

4. Conclusion
In this paper, The automatic continuous manufacturing method of the lamp holder vertical injection molding machine is designed to solve the problems in most of the domestic injection molding processes. This method ameliorate the problems of the simple function, low injection precision, low speed, high-cost, labor intensity of workers is great, low degree of automation and production efficiency, and poor market competitiveness and so on. This method is applied to the vertical injection molding machine to realize the automatic continuous manufacturing of the lamp holder. This method enhances the degree of automation of the injection molding machine, improves the accuracy and reliability of the injection molding machine, liberates the labor, improves the production efficiency, eliminates the manual feeding and blanking work mode and reduces the potential safety hazard.

5. References
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