 Novel Automatic Demoulding and Feeding Device for Oil Seal  
Transfering Molding Press and Simulation Analysis

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Abstract—The production equipment of the small volume rubber oil seal is mainly the transfering molding press. To solve the problems of low efficiency, high production cost and low cleanliness in the process of transference molding vulcanizing at present, this study designed a novel type of automatic demoulding and feeding device for oil seal transference molding press, which was composed of start button, stop button, guide rail bracket, elevating mechanism, middle template, holder, frame box and skeleton releaser. The holder clamped the middle template, and the oil seal demoulding could be achieved by rotating the holder, which made the labor intensity of the workers is effectively reduced, and the labor force is liberated. Multiple skeletons can be placed simultaneously using skeleton releasers on the frame box, which avoids the impurity adsorption on the surface of the skeleton, ensures the quality of the oil seal, and effectively improves the work efficiency. The simulation analysis of the automatic demoulding and feeding device for oil seal transference molding press was carried out in this study. The analysis results show that the deformation condition and stress distribution are consistent with the design results, and the the maximum stress is less than the expected result.

Keywords—transference molding press; automatic demoulding; feeding device; ANSYS

I. INTRODUCTION

The structure of the oil seal is the most complex in the seal parts, at the same time the oil seal is the most widely used rubber components [1]. The oil seal is one of the indispensable parts of industrial machinery and equipment by the virtues of the good sealing performance, simple structure and low cost. The oil seal has been widely used in the large areas, such as aerospace, aviation, petroleum, chemical equipment and so on, and the small aspects, for example household pump tube valve, bearing and other parts [2-4]. With the development of the machinery industry, the transference molding press is used in the production of the rubber seal with the small volume and high quality requirements. At present, the main work process of the oil seal production by transference molding vulcanizing is that the mold plate is installed in vulcanizing machine at first, and then the skeletons are put in the corresponding position of the framework cavity, finally, start the vulcanizing machine to the oil seal vulcanization [5, 6]. In order to avoid artificial scratches and impurities when workers pick the oil seal, the template is removed from the transference molding press after the oil seal vulcanization is completed, and the automatic demoulding is realized by rotating the holder, which makes oil seals are poured into the oil seal product box. The skeletons are placed into the framework cavity of the template after oil seals are demoulded, and then put the template back to the transference molding press, the oil seal vulcanization is started again. Among the process of oil seal production, the skeletons are put in the corresponding position of the framework cavity and oil seals are poured into the oil seal product box, which need manual operation. Furthermore, a number of oil seals can be produced at the same time in a vulcanization, which requires multiple skeletons are placed by artificial. The skeleton is put into the cavity by manual operation, which makes the impurities are absorbed on the surface of the skeleton easily, so that the cleanness of the skeleton can not be guaranteed, and the quality of the oil seal is affected. In addition, the labor intensity of the worker is
increased by multiple reciprocating taking or putting the template because of the quality of the template is relatively heavy. Therefore, the current production process of the oil seal consumes a lot of manpower, the working efficiency is low, and the production cost is high due to manual operation. To overcome the above defects, this study proposes a novel type of the automatic demoulding and feeding device for oil seal transfering molding press. The oil seal demoulding could be achieved by rotating the holder of the automatic demoulding and feeding device. Multiple skeletons can be placed simultaneously using skeleton releasers on the frame box, which avoids the impurity adsorption on the surface of the skeleton. The quality of the oil seal can be ensured and the work efficiency can be effectively improved by the automatic oil seal demoulding and skeleton feeding.

II. METHODOLOGY

2.1. Structure of the automatic demoulding and feeding device
The automatic demoulding and feeding device is installed on one side of the oil seal transfering molding press. The schematic diagram of the automatic demoulding and feeding device is shown in Figure 1.

![Schematic diagram of automatic demoulding and feeding device](image)

In Figure 1, the device is mainly composed of start button, stop button, guide rail bracket, elevating mechanism, middle template, holder, frame box and skeleton releaser. The skeleton releaser includes upper baffle and lower baffle which can stretch out and draw back, the plurality of skeleton releaser forms the interference connection with the frame box through the frame box hole, the frame box and the elevating mechanism are fixed on the guide rail bracket, the lifting mechanism can move up and down along the guide rail bracket, and the elevating mechanism is connected with the holder which can stretch out, draw back and rotate. The movement of the lifting mechanism and the extension and rotation of the holder are controlled by PLC.

2.2. The principle of the automatic demoulding and feeding device
Firstly, after the oil seal is vulcanized by the transfering molding press, the middle template is moved from the transfer molding press using the holder which is extended from the lifting mechanism by pressing the start button. Secondly, oil seals in the template are poured into the oil seal product box by rotating the holder 180 degrees in a clockwise direction, and then the holder is rotated 180 degrees in a counterclockwise direction to return to the original horizontal position after the oil seal is released. Thirdly, the lifting mechanism rises a certain height along the guide rail bracket, so that
the skeleton releaser is just in contact with the cavity of the middle mould plate. Next, the lower baffle of the skeleton releaser draws back, and at the same time the upper baffle stretches out for putting the skeleton which is entered into the skeleton releaser through the frame box hole into the cavity of the template. Moreover, the lower baffle of the skeleton releaser stretches out, and at the same time the upper baffle draws back to convenient to next release the skeleton after the skeleton is placed. Then, the lifting mechanism falls the middle position between the upper template and the lower template along the guide rail bracket after the completion of putting the skeleton, the holder extends from the elevating mechanism, the holder draws back after the middle mould is placed in the transferring molding press. Finally, the upper template and the injection chamber are successively decreased, which cooperate with lower template to sart the vulcanization of the oil seal. The use of stop button is to stop working of the automatic demoulding and feeding device.

III. SIMULATION ANALYSIS

According to the structural characteristics of the automatic demoulding and feeding device, the solid model of the demoulding and feeding device is established by SolidWorks software as is shown in Figure 2.

![Solid model of automatic demoulding and feeding device](image)

Figure 2. Solid model of automatic demoulding and feeding device

The solid model of the automatic demoulding and feeding device is imported into the finite element simulation software ANSYS. The elastic modulus of the material of the automatic demoulding and feeding device is 2.2e5 Mpa, the poisson ratio of the material is 0.3. The three-dimensional model of the automatic demoulding and feeding device is meshed by solid187 element and free division method, the finite element model of the automatic demoulding and feeding device is shown in Figure 3.

To establish contact pairs in the lifting mechanism and the guide rail bracket, the clamp holder and the lifting mechanism, and the skeleton box and the guide rail bracket. The corresponding displacement constraints and load constraints are imposed on the finite element model of the automatic demoulding and feeding device, and the finite element analysis is carry out for the device. The deformation condition picture of the automatic demoulding and feeding device is shown in Figure 4.
In Figure 4, the deformation of the automatic demoulding and feeding device is mainly concentrated in frame box and holder at the maximum load, and the maximum deformation of the device presents on the position of frame box. This is coincident with the practical working condition and the designed result.

To acquire the stress distribution of the automatic demoulding and feeding device, the Von Mises stress cloud picture automatic demoulding and feeding device is shown in Figure 5.
Figure 5. Von Mises stress cloud picture of the automatic demoulding and feeding device

In Figure, the stress distribution is consistent with the design results, and the maximum stress is less than the expected result.

IV. CONCLUSIONS

In order to solve the problems of low working efficiency, high production cost and low cleanliness of oil seals when the oil seal is produced by transferring molding press, this study designed a novel type of the automatic demoulding and feeding device for oil seal transferring molding press which was composed of start button, stop button, guide rail bracket, elevating mechanism, middle template, holder, frame box and skeleton releaser. The simulation analysis of the automatic demoulding and feeding device for oil seal transferring molding press was carried out in this study. The conclusions were obtained:

(1) The oil seal demoulding can be achieved by rotating the holder which clamped the middle template, and which make the labor intensity of the workers is effectively reduced, and the labor force is liberated.

(2) Multiple skeletons can be placed simultaneously using skeleton releasers on the frame box, which avoids the impurity adsorption on the surface of the skeleton, ensures the quality of the oil seal, and effectively improves the work efficiency.

(3) The analysis results show that the deformation condition and stress distribution are consistent with the design results, and the maximum stress is less than the expected result.

The present study is important in finding an ideal method to research automatic demoulding and feeding device for improving problems of low working efficiency, high production cost and low cleanliness. However, the method cannot be directly applied to other type transferring molding press.

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REFERENCES