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Development of a Technological Process for Manufacturing Cast Iron Parts of the "Cover" Type by Stamping

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Abstract:

In this work, a technological process for the production of the "Cover" part by hot stamping under medium-volume production conditions is designed. The purpose of the work is to improve the technological level of production of the "Cover" part based on the analysis of the existing technological process.

Keywords: Cast iron cover, stamping, cast iron, die casting, stamp, press, blank.

The main criteria for developing a new technological process are: the use of modern, high-performance, technological equipment and reduction of time standards, and achieving an economic effect. High-tech equipment and professional tools corresponding to high quality standards were selected and installed. To improve the efficiency of manufacturing parts, optimal cutting modes were determined and technical time standards for the production of one part were established. An important element of developing a technological process is the calculation of economic indicators and the cost of manufacturing a part.

Foundry production makes it possible to produce castings similar to parts, which reduces the time of machining. There are several types of foundry processes:

- ✓ die casting;
- ✓ casting into metal molds;

- ✓ centrifugal casting;
- ✓ investment casting;
- ✓ sand casting;
- ✓ shell mold casting.

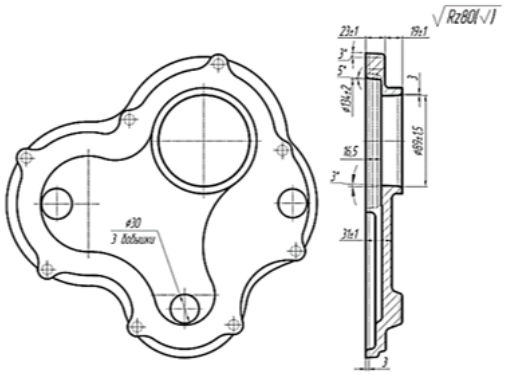
Each type of process has its own advantages and is used depending on specific production conditions. It is important to choose the right method and type of casting process for each part to achieve the best results in production. Using these methods in production allows you to create higher quality products in more efficient conditions, which has a positive effect on technical progress and production development.

For example, die casting is used to produce complex shapes of parts from refractory metals with high dimensional accuracy. Casting into metal molds allows for the production of castings of high precision and quality, and also increases production efficiency.

Casting processes have high technical and economic efficiency due to the possibility of obtaining complex-shaped blanks with excellent geometric accuracy and using the material in the most rational volume. Pressure processing is a group of processes that are used to transform plastic metals or other materials into products with a new shape, size or specified properties. During these processes, the original blank, being in a heated or cold state, is subjected to plastic deformation under the action of pressure. To meet the needs, it is necessary not only to create new structural materials, but also to develop advanced methods for their processing. Instead of conventional machines, outdated equipment, the use of high-performance and flexible ones is becoming the standard of modern industry. Such machines, in combination with microprocessor technology and robots, allow the creation of automated production, thereby contributing to a significant increase in productivity and product quality.

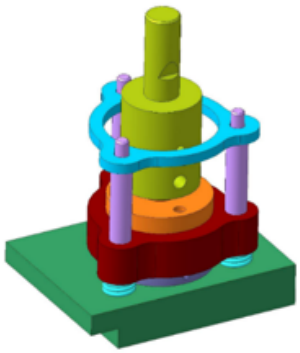
Cast iron is an essential material in instrument making, construction and tool making. Cast iron is a complex alloy consisting of a variety of elements, including iron and carbon, as well as alloying elements and impurities such as manganese, silicon, sulfur, phosphorus and gases. Cast iron is classified by several parameters: by chemical composition (carbon, alloyed), by purpose (structural, tool, special purpose) and by quality (ordinary, quality, high-quality and especially high-quality). Each of these parameters has its own appurtenance and determines how and where a particular type of cast iron can be used. Cast iron is an important material in many industries, and the correct choice of its type and composition can significantly affect the performance and durability of the products made from it.

The object of the study is a cast iron cover. Currently, it is manufactured by casting in a metal mold.



Drawing of the part

Solid model of a cast iron cover



Solid model of the stamp

Solid model of die setup

The mass of the solid model of the cast iron lid is 4.475 kg (with an average density of 7.8 g/sm^3), the volume after stamping is 573 sm^3.

Dimensions of the blank for stamping :

- ✓ Workpiece height 22 mm ;
- ✓ Diameter 317.5 mm;

Heating temperature – 1200 °C ;

Heating time for stamping – 112 min.

It is important to note that stamping is a widely used method of manufacturing various metal products. Liquid stamping is one of the variations of this process that uses metal alloys in a liquid state. Liquid stamping dies are made using the latest technologies and equipment. Developing an accurate die that takes into account all the features of the product, the required quality and environmental protection requirements is not an easy task, requiring high qualifications and experience. In addition, liquid stamping has a fairly high productivity and allows for the production of complex-shaped parts with large dimensions. It also ensures accuracy and repeatability in production.

The use of stamps for liquid stamping allows to obtain high-quality products with a low percentage of defects. This allows to save effort, time and materials in the production of metal products. Thus, liquid stamping using stamps is a high-tech and effective method of producing metal parts.

The optimal way to obtain a workpiece

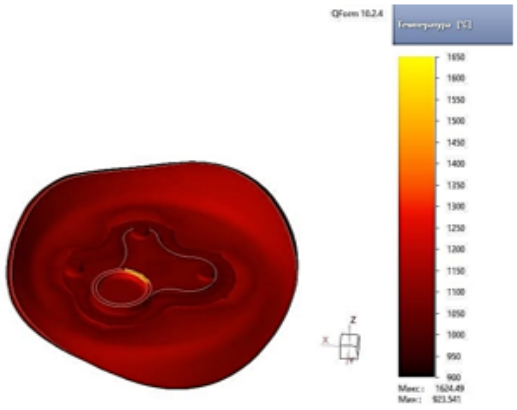
A workpiece is an intermediate product obtained by various methods, such as electrolysis, casting, plastic deformation and powder metallurgy. It is intended for further processing or use without it. A workpiece differs from a finished part in weight, size, configuration, surface quality and accuracy. The dimensions of workpieces are determined by the presence of allowances, and their configuration is affected by the allowances, which are assigned according to GOSTs and designer's reference books for each method of obtaining a workpiece. However, the larger the allowances and allowances, the more metal goes into chips and the lower the material utilization coefficient of the workpiece.

To improve the quality of blanks and reduce the unevenness of stresses during their production, various heat treatment methods are used. Heat treatment before molding can improve the mechanical properties of the material and increase its resistance to distortion and cracks. Heat treatment after molding reduces stresses in the material and improves its characteristics. An important aspect when choosing a blank production technology is also the choice of material.

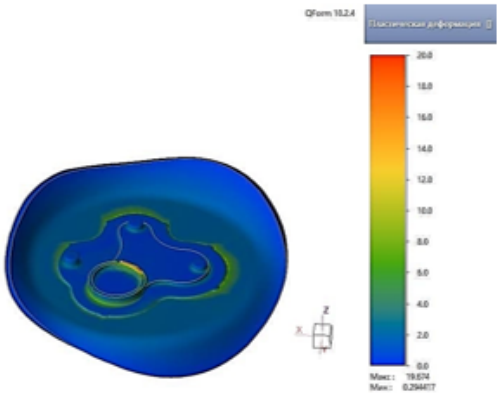
$$P_1 = 86.7 \cdot \left[\left(1.5 + 0.5 \cdot \frac{6}{3} \right) \cdot 1157 + \left(2 \cdot 0.5 \cdot \frac{6}{3} - 0.375 + 1.25 \cdot \ln\left(\frac{145}{3} \right) \right) \cdot 16504 \right] = 0.734 \ MH,$$

$$P_2 = 86.7 \cdot \left[\left(1.5 + 0.5 \cdot \frac{6}{3} \right) \cdot 1157 + \left(2 \cdot 0.5 \cdot \frac{6}{3} - 0.375 + 1.25 \cdot \ln\left(\frac{145}{3} \right) \right) \cdot 33008 \right] = 1.425 \ MH,$$

calculation of stamping force



Temperature distribution



Strain distribution

Conclusion

1. A route of technological operations for manufacturing the “Cover” part using the hot stamping method has been developed.
2. The choice of material is justified, the stamping method is selected.
3. Finite element modeling of the process was carried out in Q - FORM.
4. The technological parameters of the process for the stamp have been determined.

Based on the obtained value of the stamping force, a hydraulic press TS0501-1 is selected with a force of 20 kN, since the technological stamping force must be less than 85% of the nominal force of the press.

The equipment and stamp design have been selected for production.

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