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MODELLING OF PROCESSES AND MACHINES FOR THE SUPPORT TO HYDROENGINE COMPONENTS PRODUCTION

Abstract: *Approach of integrated design represents the bridge that connects individual stages of the product designing and the technology and has a significant role in the reduction of the overall design time, as well as the production costs. That means that the technological processes design should be connected with production planning as well,, that is the choice of tools, equipment, pressing devices and machine tool.*
Key words: *Technological process, Pressing, Additional axis, Machine tools*

1. INTRODUCTION

Integrated product and processes design is basically intended to form a competitive product. In the cycle of conceptual design variant and variable product solutions and adopted technologies have a dominant influence on the choice of machine tools for the support in the realization of the adopted technology. In the activities of the centre for integrated product and processes development, Faculty of mechanical engineering Kraljevo, special attention is given to reviatalization of the existing traditional technologies in the massive part production. In other words, it is about partial re-engineering of the existing production plants of big companies which haven't been made private yet. Taking into consideration this approach, this work shows the achieved results in the modelling of the machine tool in a narrower sense (hardware) as a support to the adopted technology of part processing , back lid of the hydroengine, in the factory Hydraulics, Trstenik.

2. FUNCTIONAL-TECHNOLOGICAL PART ANALYSIS [1], [2], [3], [4]

The process of forming the competitive product is partly connected with the technological process design of part production. Taking into consideration the fact that in this case the production process is completely defined by traditional production technology, the possibilities of machine composing with significant reduction in production costs are analysed. Special attention in the analysis is paid to the choice and adoption of the technological process parametres, that is to the correct choice of tools, the way of pressing and positioning of the part, machine. Technological analysis of the parts showed that re-engineering of pressing devices represents a significant parametre in the cost reduction in the production process. That is why special attention is paid to modelling of the machine tool with a special pressing device which in this case represents an additional fourth control axis.

Re-selection of the cutting tools is defined using the base of the necessary tools specified in the traditional production approach as well as using the production process on the machine with tool store according to the matrix of following for the adopted technology. Tools made of hard metal are usually taken and it is necessary that they have stability of 480 min.

These general observations represent the basis for the initial evaluation of production methods for part production. Based on the rules of priority through dimensional, geometrical, technological and economic limitations the matrix of dependence is acquried. Using the dependences established in this way the matrix of following is formed. As the way out of the matrix of following a logical order of moves appears (theoretical moves).

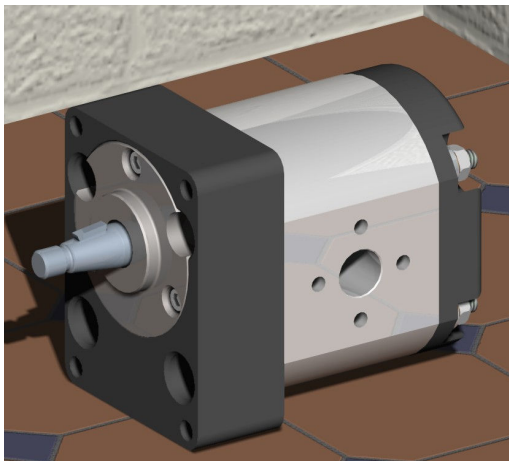


Fig. 1. Hydroengine.

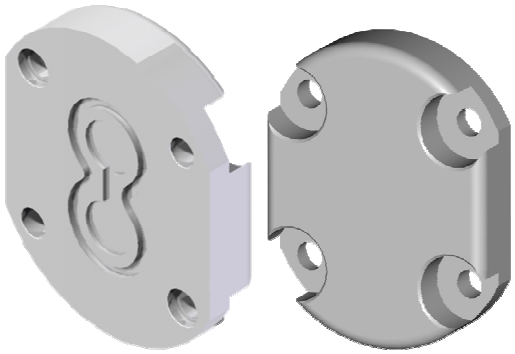


Fig. 2. Prepared and finished part.

3. SPECIFIC QUALITY OF THE PROCESS IN THE PRODUCTION OF THE BACK LID [3], [4]

The processing of a mechanically correct part requires qualitative prepared part, its correct pressing and location definition (of the position and orientation) in the space. As an addition to the definition of spesific surface positioning, it is necessary to design the way of firmly holding the part in the given position under the influence of outer forces like gravitation force, cutting force, vibrations, centrifugal forces, etc. It must not influence the previously determined function of positioning, but it has the function of providing stability of the part. The pressing devices must have the appropriate pressing force so as not to damage the part in the points of contact with its excessive pressure.

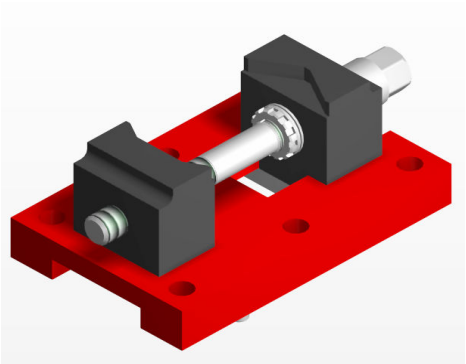
3.1. Types of pressing in cases of miling and drilling

Pressing tools design and devices for pressing the working part on the machine design are realized by the application of contemporary CAD/CAM programme packages. The position of pressing, previously described, has to follow the rules of the precision of the production and respect the relation between the segments of the part. It also has to ensure that the part doesn't move during the processing, that the parts of the pressing equipment don't interrupt the movements of the tools or cause increase in the tool operation and that it is easy to remove filing.

4. MODELLING OF THE INSTALLATION STRUCTURE OF THE MACHINE TOOL [1], [2]

The concept of the machine tool in the narrower sense is defined to support the adopted production process. In order to perform the necessary operations while processing the back lid of the hydroengine, machine variants have to have the appropriate movements which provide independent wholes – modules. For every movement, whether main or additional, there has to be the right module that provides such a movement. In order to press the processing part it is necessary to design a pressing device. Thus modular analysis is done based on which the pressing device design is done with certain modifications in relation to the already existing vices, and in particular pressing prism. From the available modules CIRPP those that meet the given demands are chosen.

4.1. Vice module



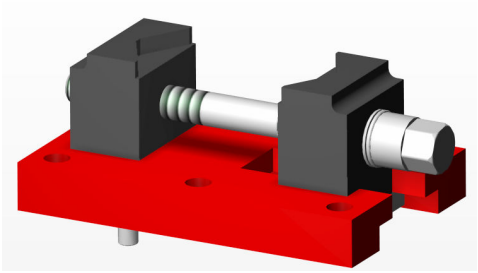


Fig. 3. Vice module

Vice module assembled with the holder, bearing and rotation desk represents an additional axis on the tool machines. For the processing of the back lid of the hydroengine, three-axis verticall drill/miling machine and three-axis horizontal drill/miling machine are chosen, so that the assembly of the vice represents the fourth additional axis. This additional axis increases the productivity, in one pressing, 16 hydroengine lids are processed. The number of simultaneously processed lids is conditioned by maximum tool stability, so that the tool can process all 16 lids, without changing the tool in the meantime. After the processing, the changing of tools and working objects is done. The vice is modelled parametrically and variantly so that it can be used for pressing of the hydroengine's back lid of different dimensions and for the appropriate number of parts that can be accepted.

4.2 Realization of the adopted technological process on variantly chosen machine tools

The prepared part for the production of the back lid of the hydroengine is an extradited aluminium pole and it's shown in fig. 2. Based on the technology that represents a way out of the matrix of following, the process of the hydroengine's back lid production is done in two pressing moves. In the first pressing move the prepared parts are put into the vice, one by one, and the look of the prepared parts is shown in fig. 4. and 5.

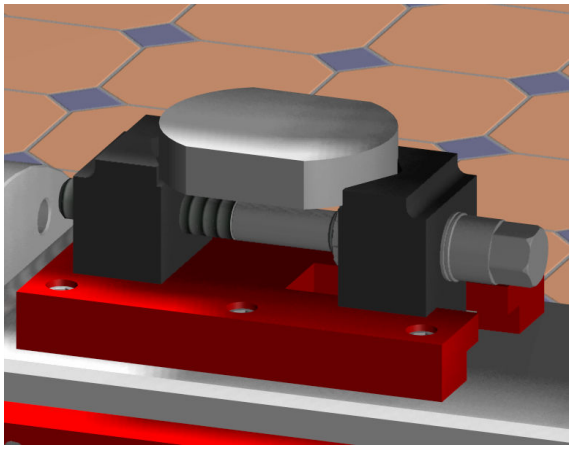
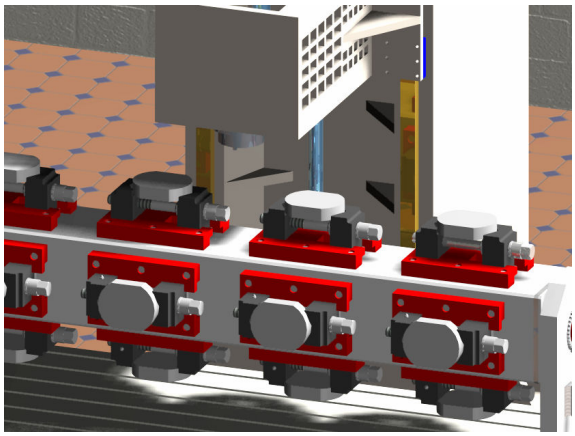
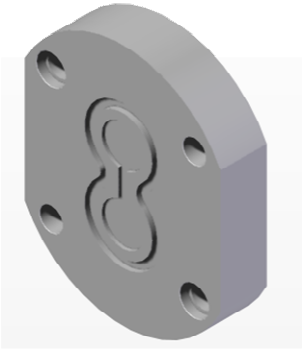


Fig. 4. The look of the prepared part in the vice.



Picture 5. The look of the prepared part in the vice.

After the finished operations in the first pressing move the working object is rotated and then the operations in the second pressing move are performed. The working object after finished operations in pressing A is shown in picture 6.



Picture 6. The back lid of the hydroengine after pressing A.

The look of the prepared part in the vice, pressing B is shown in fig. 7.

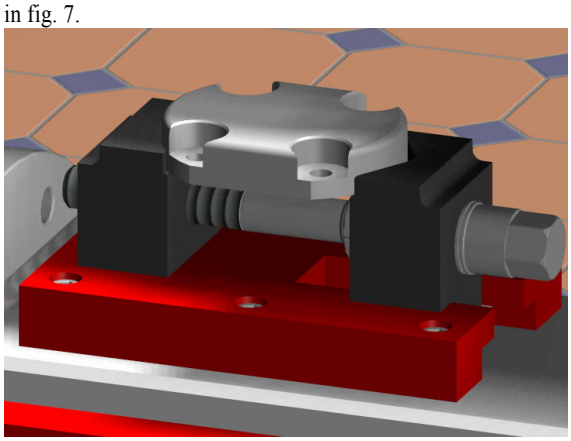


Fig. 7. The look of the prepared part in the vice. –Pressing B

The final product of the back lid of the hydroengine after the processing using technology, after pressing B, is shown in fig. 2.

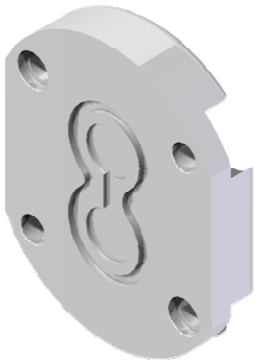


Fig. 8. The final shape of the hydroengine back lid

5. CONCLUSION

Achieved results in this work are reflections of the research of variant option in the technological production process of the hydroengine back lid using already existing tool machines. The need to introduce an additional axis on the existing three-axis processing centres appeared.
The results of the research come from a very large theoretical analysis of the individual parametres which directly influence generating of technological process. The following parametres are mentioned here:

- order of technological operations,
- the choice of tools,
- specific vice design,
- installation structures of machine tools based on the available modules.

6. LITERATURE

[1] Babić A., Pršić, D., Pljakić, M.,Ilić, N., Jedan pristup modelovanja dodatne ose mašina alatki, Savetovanje Proizvodnog Mašinstva, str. 147-150, Beograd, Mašinski fakultet Beograd, Beograd, Jun 2009.,
[2] Babić, A., Tehnologija montaže, Mašinski fakultet Kraljevo, 2005.
[3] Babić, A., Projektovanje tehnoloških procesa, Mašinski fakultet Kraljevo, 2005.
[4] Halevi, G., Weill, R., Principles of Process Planning, Alogical approach, Chapman&Hall, London, 1995.

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