

An Approach for Simulation design of Mechanical Assembled units

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Abstract. An approach for kinematical analysis of mechanical assembled unit is presented. The equation for study of reciprocating movement of safety overflow valve is defined. We give the values of limiting technological parameters. Base these limiting conditions for pressure and rate of transported fluids developed a simulating model. Thus we are searching for collision, between components in composed assembled unit and are grounded the values for regulation of limiting conditions of flexible element in designed product. The results could be used for training of students of master degree on for "Expert systems in automated design" and post-graduated students in this field of CAD design, as well as for creating animation models of assembled units in engineer design.

Key words: simulation, design, geometrical, mechanical, assembly units, cinematic, analysis, animation.

1. Introduction

Designers play a major role in all industries and have a unique overview of trends and developments in these sectors. They are capable of independent comparisons of competitive positions of product proposed, can determine its angle of view that the project can meet the strategic objectives of the company. Industrial design brings the knowledge of all areas of innovation [2],[7],[8].

The modern designing, analysis, exchange of information and technology changed the traditional role of the designing engineer. The designing within the industry of the advanced countries has changed radically since team-based work has been introduced and this works is incorporated within all fields of business by the use of computer technology which has become an essential tool. This brand new kind of designing and documenting with its integrated team-based character is called 'competitive engineering' [1],[6].

Designers and technologists must be able to design, analyze and exchange information using the capabilities of the powerful CAD/CAE systems; they must possess of a well developed ability for visualization, as they must also exchange information with the non-technical staff, such as managers, etc. They also ought to be specialists in geometry modeling [3],[4]. The 3D computer models submitted directly to a manufacturer are to be used for the purpose of development of programs for CNC machines and programs for automated assembling of a mechanical product within a CAD type of environment[10].

Nowadays, the future of the work of the specialists in teams consists in the contemporary CAD systems with their capabilities to pass on various types of large verbal and visual information. All activities, from analysis and simulation to the execution of a mechanical product, show how many various groups of technical and non-technical specialists exchange information which is presented in the shape of graphics. Therefore, the use of the CAD systems gathers a lot of people with different visual needs and capabilities [5].

The purpose is to provide mobility in training of students by development of contemporary approaches and technologies for computer-based designing and assembling of mechanical products.

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In order to fulfill the goal, it is necessary to solve the following tasks:

- A methodology of the designing by the use of creative technologies for the search of technical solutions;
- Geometric modeling of mechanical products by simulation designing;
- Creation of geometric models for the purpose of cinematic and animation analysis for the assembling of the compound parts of assembled units for exploration of collisions.

2. Trends in Computer Aided Design of mechanical assembling

The usage of a computer within the industrial activities leads not only to automation of the activities preliminarily executed by specialists, but also to increase of the knowledge about ‘research- designing- production- control’ of the technological process.

The Computer Aided Design systems are more and more widely applicable within industry, and the market has become wide and dynamic. It can be stated that the industrial companies make regular efforts for the development of new programs which offer decrease of the time for designing, as well as decrease of the means for production. In this respect, there can be stated a few trends for development of the CAD systems which are have important meaning in the training of students, and for the execution of research activities throughout the engineering designing. Following this point of view, it could be stated that the current project will present new approaches within the engineering designing by CAD systems, precisely as follows:

2.1 Integration in CAD modeling

In order to create models; to render details and assembled units of mechanical products, their analysis and, finally, their production by virtual designing, there have to be used types of interface as the transfer of data files must be avoided. The only model of the product includes all information for each process, and the iteration is thus accomplished in a fast, effective way. In this respect, we take into account the CAE system which includes the modules for geometric modeling, structural analysis, mechanical analysis and simulation, the method of the finite elements, the expert systems within the automated designing, the dynamical Internet data publishing for documentation management, etc. In order to accomplish the project, the following important issues must be reviewed:

- **Integration of CAD systems:** The CAD systems regard drawings as means for transfer of information between the different stages of the project but not in the 3D models. The contemporary trends in the development of the CAD systems include knowledge about the particularities of the modeled object and their use. Creation of models should provide the designers along with the different types of information not only in regard to the geometrical but also to the physical properties of the designed objects. Along with the application of skills and their use in CAD systems we have made a considerable approach to new types of intelligent CAD systems.

- **Object - oriented technology:** It has the following properties: Integration of object’s data with the procedures for preparation, which matches the natural way of description to the real object; Inheritance of the qualities and elements from one object to another as a means for creation of other new objects; Capability of activation of a proper operation with a given object in order to make a certain action in its appropriate way.

The object-oriented architecture in CAD systems ensure full creative connection between the different stages of development including the whole ‘development–analysis-technological preparation-production’ process which allows simultaneous work within a team of numerous specialists on a given project.

- **Modeling by the use of engineering components:** The geometric elements that build the geometric model are automatically generated. Products that are made by the approach of modeling by engineering components are I-DEAS, Solid Works, Pro/ENGINEER, and CATIA.

- **Parametrical modeling:** This is based on single description of an object that has been used repeatedly in the process of constructional designing by putting the precise values and their parameters. It is essential that descriptions according to given technical parameters of a given product have to be realized by sequence of fixed constructive procedures that generate the computer model and the documentation of the same product. Some CAD systems allow the user to work with certain languages of parametrical programming in two different ways. The first is a representative of ‘AutoLisp’ where the user creates a parametrical object by compilation of a program. The second is an application of interactive determination of parameters (I-DEAS).

- Modeling by restrictions:** This is an approach by which the user creates and manipulates geometry by definitions of restrictions. The new technology of sketching adds automatically restrictions to geometry through the process of its creation and extracts conclusions from the drawing particularities throughout the process of drawing. Some methods based on certain regulations are used for the purpose of automatic definition of restrictions. The usual types of application of modeling by restrictions are: creation of versions of geometry of parts and assembled units; modeling of standard parts. Parametrical modeling and defining of geometrical restrictions is realized in most 'marketable' CAD systems, like I-DEAS, etc.

2.2. Working teams and interactions

Regarding the contemporary conditions, in spite of the various systems which are used for designing of the projects have to be open and accessible. The change of activities between systems is of significant importance since they provide disposal of resources and share resources for the process of modeling. This is important for the interaction between groups within the country, and also for the interaction between groups between partner countries. This introduces the requirements of the European and the international standards for depository into one and the same library. On Fig.1 are shown CAD geometrical models of mechanical pneumatic distributor for computer simulation investigation.

If there are to be used digital inscriptions, the designer can define the real identity of the drawings. They provide information for the update of the project after it has been published, and the program does not allow forgery or modification of them. It is beneficial to use the capabilities of the Internet throughout the process of designing. The Internet allows the search for data from various parts of catalogues. This approach of designing reduces the time and the stress of the team for the execution of the task. Following this way, the change of the data could be useful for the designing team, as well as for the corporations and the distributors by inclusion of URL addresses within the model.

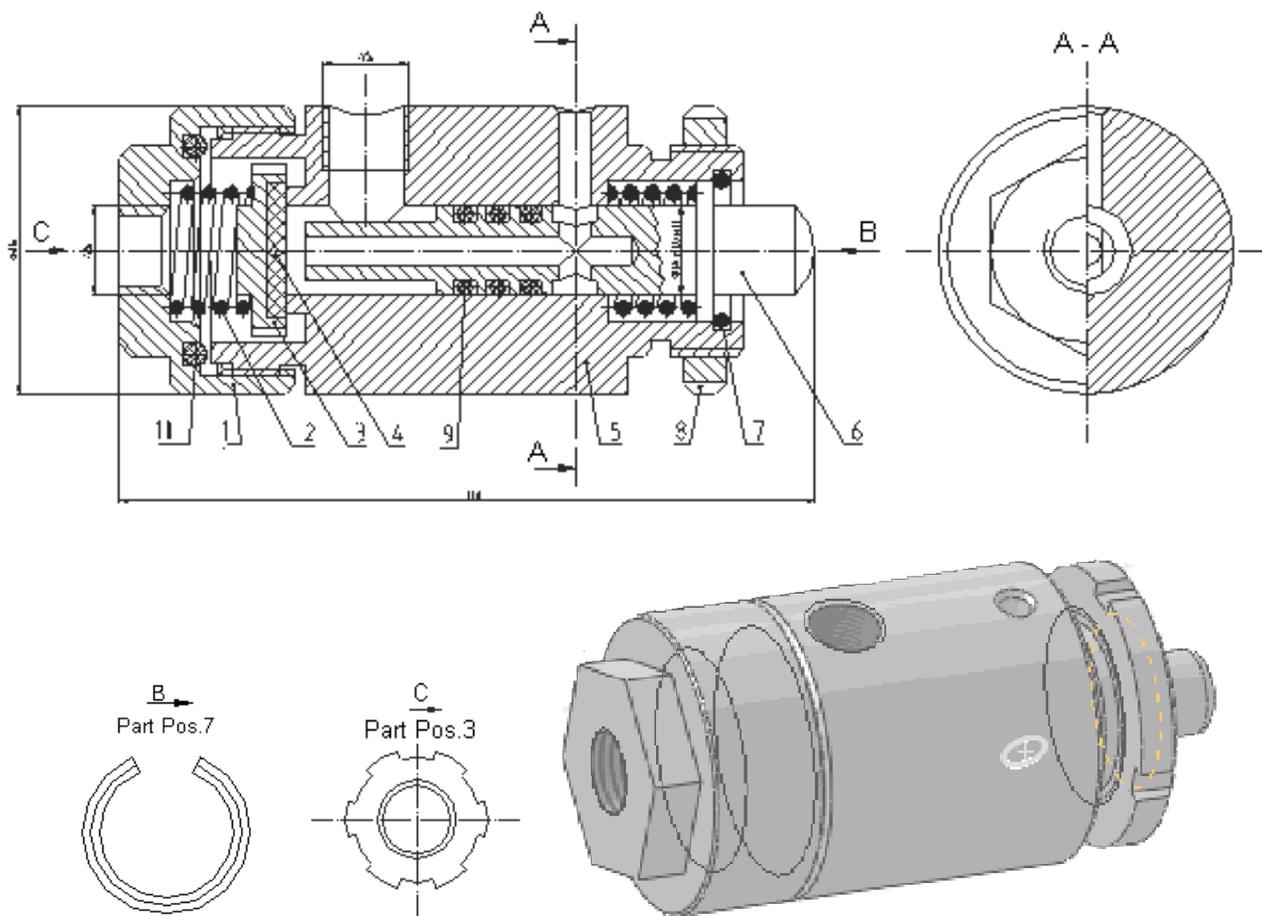


Fig. 1: Assembly drawing and 3D model of the pneumatic-distributor

2.3. Cinematic and static analysis of models

The relative motions within the created geometric model can be defined by a cinematic analysis of the moving details in order to find collision between them. If there are more complex mechanical driving systems, there can be performed a static analysis and size analysis of the geometric model of an hydro and pneumatic assembled units. That way there is a possibility to join others subassemblies in such a way that each one would have a connection system. This is especially useful when we want to achieve motion of some of the details of the safety overflow valve [3]. 3D geometrical model is converted for examination on by Autodesk Inventor.

Safety overflow valve used for output regulation and the pressure at the outlet and the inlet of system. The static and dynamic performances determine the pressure exchange in the value in accordance with [9]. The forces which have influence the plunger are: F_{spring} - spring force; F_{press} - pressure force; F_{hydro} - hydrodynamic force; F_{fric} - friction force.

In the prerequisites have changed and is ensured a fitting with windage, and the fact is a static mechanical problem is examined then can be ignored the both forces - friction and hydrodynamic. Then the simplified subordination is: $F_{spring} = F_{press}$, and $F_{spring} = c(L_0 + x)$; $F_{press} = S \cdot p$, where c is a spring constant;

- L_0 - the spring length with out impact;
- x - axial travel of plunger;
- S - section of the hoop-shaped groove;
- p - the valve pressure.

The values for $c = 0.75$ and $L_0 = 64mm$ of the spring and the axial travel of the plunger are determined by the spring performance.

The operation of safety overflow valve for pressure control under the influence of flow through plunger 2 is shown on Fig.2. The plunger pressure - p (t) is changed and is variable depending on time. If the following parameters are given: the spring constant, axial movement of the plunger and frequency step simulation, then graphical system Autodesk Inventor will automatically simulate a model of valve which is shown on Fig.3.

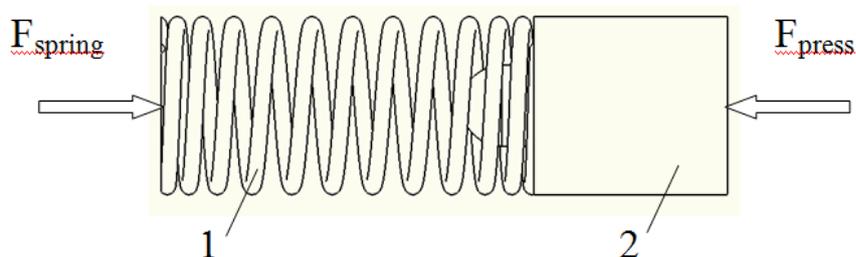


Fig. 2: Scheme of force analysis on safety overflow valve

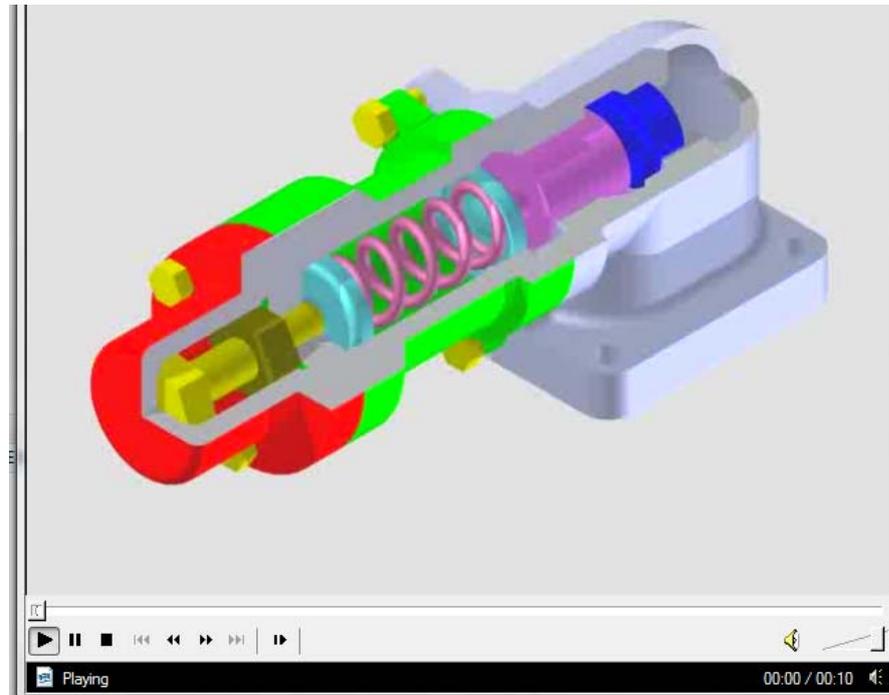


Fig. 3: 3D animation model of safety overflow valve

3. Conclusion

The main elaborations are the following:

- Application of creative methods and technologies for computer-based designing of mechanical products within the process of training;
- The new developed methodology materials for the purpose of searching for optimal, innovative technical solutions during the designing of assembled units which are to be used throughout the training of students from the Master educational degree and of PhD students;
- Geometric models and the results from investigations by a static analysis and simulation of resilient elements and fluids pressure – also spring force for the condition of the hydrodynamic products. In the conducted simulated examination for opening of the regulating element there is a deficit in collision between the elements.;
- The created computer programs for checking and evaluation of the knowledge of the students throughout the training in ‘Basics of the engineering designing’ and ‘Principles of Engineering Design’.

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5. References

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