

PURCHASED COMPONENTS IN MACHINE TOOL DESIGN

DOSEDLA, M[ichal]

Abstract: Nowadays there are often used purchased components in machine tool designing. We can find them at machine tool frames, headstocks but also at machine covers. Bigger-size machine tools such as vertical lathes or horizontal boring mills are not usually assembly from many purchased components whereas smaller-size machines such as CNC lathes or milling centers can be assembled from high number of purchased components. We can often find machine tool producers that assembly their machine only from purchased components except main casts or weldments.

Keywords: purchased components, machine tool, designing, optimization

1. INTRODUCTION

Every producer of machine tools manufactured almost all parts that he needed for machine assembly in past. They had to buy only special type of components such as roller bearings or motors. There is an opposite situation nowadays. Designers apply very often various kind of purchased components.

The main aim of machine tool design is to achieve long-term precision and high cutting productivity, which directly influence the operating costs of the machine (Sulitka & Kolar).

Machine tool designing process is one of the initial steps of machine tool life-cycle. It connects to the first market research and its inputs are particularly customer and marketing requirements (Dosedla, 2008). Customer requirements have usually high influence on a choice of purchased components. Some customers even request some kind of components only from one favoured supplier.

Purchased components that are apply at machine tool construction belong to high precision and high load components.

Concurrent trend in machine tool design is using of many types of purchased components and collaboration with suppliers. In many cases there are several suppliers on market that produce the same or similar components. Selection of this components usually makes designer according to function of designed machine.

2. DIVIDING OF MACHINE TOOL FROM PURCHASED COMPONENTS POINT OF VIEW

Machine tool can be divided up to several main groups from purchased components point of view. See Fig. 1. Each group has a specific kind of components. But some type of components can be used in several groups.

2.1 Frame

The frame is a main constructional part of every kind of machine. It provides rigid connection between the foundation and other moveable parts of machine.

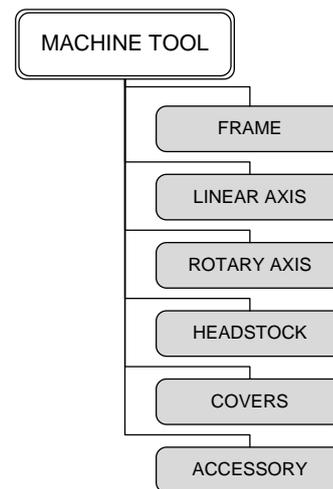


Fig. 1 Dividing of machine tool from purchased components point of view

Mostly it is a shape complicate weldment or cast. In this group of machine are not used a lot of purchased components. We can find here particularly some kind of anchor components.

2.2 Linear axis

Linear axes are used for realization of machine tool parts precise linear movement. Linear movement can be built by several approaches. These approaches usually depend on machine kinematics and used purchased components. In this group we can find a large number of various purchased components such as servomotors, ball screws, linear guideways etc.

2.3 Rotary axis

Rotary axes are used for realization of rotary movements of main or additional machine parts. The type of rotary axis structure depends on used purchased components and final rotary axis conception. The main aim is usually achieve precise rotary movement with the best possible efficiency. The most used components in this machine group are bearings, gearboxes and servomotors.

2.4 Headstock

The headstock is usually the most complicate part of the machine tool. Its task is provides high-precise rotary movement of either cutting tool or workpiece. It depends on machine type and conception. Revolution of the headstocks is mostly several times higher than revolution of any other machine rotary axis. In this machine group we can use also large number of various purchased components such as motors, belts, gears, roller bearings etc.

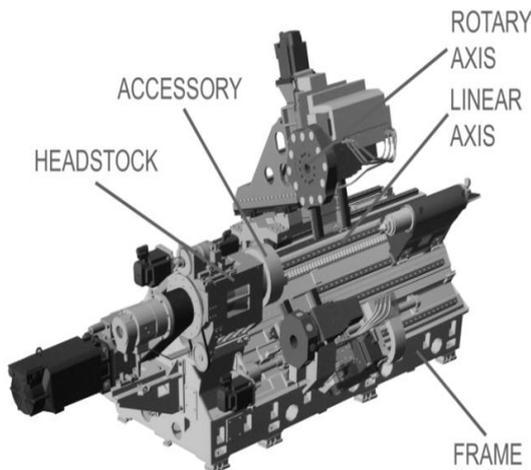


Fig. 2 Main machine tools groups

2.5 Covers

Covers of the machine tool are other important machine tool parts. They serve as a protection of machine operator and also avoid some contamination of a machine neighborhood by chips and cooling liquid. Every machine producer approach to the machine covers in different way. We can also use some purchased components in the covers design even some kind of covers are sold like a purchased components.

2.6 Accessory

The machine tool accessory is very various. Some type of accessory can be used in many kind of machine tools whereas another type is used only in one kind of machine. For example chip conveyor can be apply at lathes, milling centers, boring machines etc. whereas a spindle support can be used only at horizontal boring and milling machines.

Real example of main machine tools groups is shown on

3. SELECTION OF PURCHASED COMPONENTS

Selection of purchased components should be systematic process. We can usually buy similar components from several suppliers in many cases. These components can have different properties, function and also price. Is suitable to use some optimization method during machine tool designing and also during selection of purchased components.

The optimization at building a machining centre cannot be understood as a purely mathematic task; therefore it is not easy to use mathematic methods to select its optimum building. The optimization at designing a machining centre is a task, whose target is most of all to find the best possible functional machine structure to select suitable components and to perform the right selection of a proposed design solution. The diagram of particular optimization types is shown in Fig. Fig. 3. (Dosedla, Marek 2008)

Technical-economic optimization represents the mostly used type (Dosedla, Marek 2008).

Designer has to select best possible purchased components according to technical and economical point of view after machine tool structure choosing. Fig. 4 shows proceeding of spindle bearing selecting (Marek 2006).

Machine tool is one of the few types of machines that can pass also through the retrofitting stage and another using stage before final machine disposal. Especially bigger size milling and turning machines after retrofitting are very popular by concurrent customers. (Dosedla 2009) Therefore designers should use timeless components that can make easy future retrofitting process.

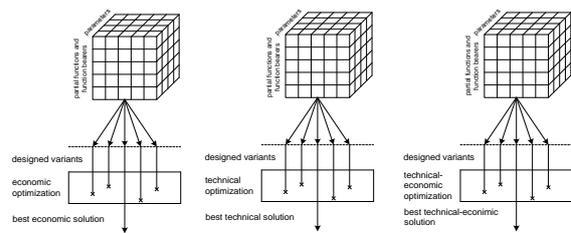


Fig.

Fig. 3. Diagram of economic, technical and technical-economic optimization (Dosedla, Marek 2008)

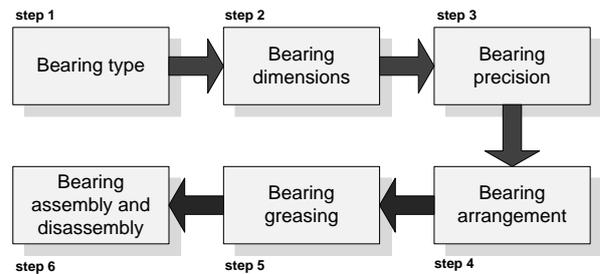


Fig. 4 Example of suitable spindle bearing selecting (Marek 2006)

4. CONCLUSION

Purchased components that are used in machine tool construction are very popular by designers and machine tool producers. They are very often used in construction because of their high quality and easy accessible. Some kind of simple machine tools can be assembly only from purchased components.

There are several recommendation that should be followed during selection of purchased components.

- Component has to adequately keep all designer's and customer's requirements.
- To reduce final machine costs is necessary to inquire one component from several suppliers.
- Every purchased component should be evaluated from technical and economic point of view

Nowadays arise many new small companies that are focused on production of one kind of components. From this reason the number of used purchased components in machine tool design will probably still increase.

5. ACKNOWLEDGEMENTS

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