

1.9 DESIGN OF MACHINE TOOLS

One part of the total machine quality is also its outside appearance and ergonomics of the operator's place. The designer's participation in development brings new views which enhance the resulting machine concept with artistic impressive processing and suitable arrangement of the working area. And last but not least, a good design contributes to increase competitiveness.

During the second half of the 20th century design became in industrial companies a part of activities almost in all fields of human work. One of the most important design roles is to increase esthetical and functional quality of our environment. Consumer goods, transport means and industrial equipment form our perception of the environment and the human attitude to its acceptance. Design expresses cultural values in the world which becomes still more and more rationalized. It brings content to our lives and in such a way it increases quality of our interaction with the material world.

By means of the feedback industrial design influences our way of life, development of industry and of the whole society. For example, Alexander Manu, influential Canadian design theorist reminds that designers have great power in their hands which should be used with great responsibility. He writes in one of his essays: *"If you as a designer take into account client's requirements during your work on the product, you will add to these requirements human dimension and worth of personal responsibility and ethics, then you will create design reflecting the correct conceptual framework. Good design addresses all of five senses. It is evaluated by sight, touch, hearing, smell and even by taste. Therefore it reflects human thinking and behaviour so expressively. If we overestimate technology to that extent that it begins to manage our lives and to determine the design direction, then we will lose a human element in our products and, due to this, our culture."* [Růžička 2013]

Besides our senses, products having good design address also our thinking. Norio Ohga, former president of Sony, says to it: *"The product itself must be good, but at the same time it must make a customer think: 'I am glad that I have bought it', 'I am glad that I use it', 'I am glad that I own it'."* [Järvinen 2001]

Design application in the branch of machines and industrial devices differs in some aspects from design importance at consumer products. Especially that important function of forming the working environment and making the machine functionality

available to its user as suitable as possible comes to the foreground. Working comfort of machine operators is created by direct ergonomic criteria, which can be assessed objectively, as well as indirect criteria of total composition of materials, colours and implementation of details. The target is to create such working environment for operating staff which will not tire or distract them excessively and which enables a man to operate the machine in optimum conditions.

The contribution of good design for a machine user is represented most of all by increase of work productivity and by improvement of working environment and manufacturing facilities. Machine "beauty" is not the primary design target; from the standpoint of utility properties it is another value added in the complex of criteria:

- functionality;
- reliability;
- easy use;
- safety.

At the current time good design is for machine manufacturers the almost indispensable matter which helps in strong competition to have better influence on the market. Such machine tools have a chance where the top-quality design is connected with good functionality and power output. The unified company style, by means of which the manufacturer presents itself in graphic communication as well as in design of its products, is the obvious feature of the own identification and it contributes to the establishment of the appropriate place on the market. If a machine looks well, at first sight it announces the feeling of trust in its overall quality and it demonstrates the comprehensive approach devoted to its development. Of course, nice protective covers cannot cover failures in the technical level of the machine; however, these protective covers are a very important element of differentiation and increasing of the total value of products having the comparable technical quality.

Much experience shows that those companies which integrate industrial design

to the development reach higher profit and turnover. For example, in 2003 Gildemeister company made price neutral design changes at the most of its milling and turning centres. Subsequently, the enterprise was able to obtain the price increase by two per cent. On the other hand, if protective covers were not redesigned, the company would have to expect slump in prices by five per cent within the same time period. [Beaujean 2011]

This section in its introductory part presents the development of machine tool shaping in the Czech Republic followed by some examples of current design. The subsequent parts deal with the bases of ergonomics, solutions of control elements and control panels as well as with the layout of the machine operator's cabin. The next sections speak about rules of artistic designing, the designing process, the design technologic aspect and application of non conventional materials in building of protective covers.

Historical development of machine tool shaping in the Czech Republic

The beginning of artistically treated shaping of machines can be found in the time period of the World War II and it is connected with Bafa company and with Zlín town. The impulse to obtain industrial designers – artists for Bafa company was the experience of unsuccessful participation of the company in the world exhibition in Paris in 1937. Tomáš Bafa became aware after this exhibition that commercial success can be obtained only through such products which also have esthetical qualities in addition to functional qualities. The first attempts to get artists were oriented to graduates from the Academy of Fine Arts in Prague, but the desirable result was not reached. Therefore, the idea originated to establish the own school dealing with education of industrial artists. The school became to act in 1939 and its academic staff consisted of outstanding personalities, including Vincenc Makovský, sculptor as the chief of the sculpting atelier [Lamarová 1996].

Just in the first year of his work in Zlín Makovský was entrusted by the director of newly originating MAS engineering plant with the task to shape the turret lathe R50. Inspiration for pioneering invitation of the sculptor to design the machine was the example of American Monarch company which represented the greatest competitor of MAS engineering plant. At the end of the

forties the experience showed clearly, that "neater and nicer machines have a bigger change on the market", as the paper in *České slovo* quoted in the interview with Makovský in 1940 [Lamarová 1996]. The shape of the newly designed lathe resulting from the design type of the box as an iron casting is made as a prism of the basic bed body which the rounded crown of the spindle cover rises from (Fig. 1.9.1). The shape character evokes the impression of an organism having huge force. Makovský paid great attention to shaping of all operating levers whose handles and heads are designed very sensitively to enable their suitable gripping. At the same time the handles and heads represent the expressive element of the artistic detail at the machine having the robust character in other respects. Makovský expressed his work at the lathe model as "the lathe is the whole which many details and the total perfect solution are subordinated to" [Lamarová 1996]. Organic rendition of the lathe shape foreshadowed the later predominant approach to industrial shaping and it was also connected with changes at that time which replaced the existing purely utilitarian functionalistic opinions.

If the invitation of the sculptor to design the lathe shape solution was a pioneering step, under the circumstances at that time, another even more courageous event was the public appearance at the 5th Salon of fine arts in Zlín in 1940, where the lathe model was presented as a work of art. This exhibition step can be considered to be the more general recognition of the new artistic discipline of machine shaping and the confirmation of its importance regarding to the human position related to the machine and improvement of the working ambient in industrial manufacture.

Another job of Makovský was cooperation at the development of the radial drilling machine MAS VR8 in 1941–1943 (Fig. 1.9.2, Fig. 1.9.3). The radial drilling machine was manufactured according to the design by Makovský, but unfortunately without the shaped levers, at whose design – in the same way as previously at the lathe R50 – Makovský used sensitive modelling observing ergonomic rules for gripping by a human hand (Fig. 1.9.4). The drilling machine model was shown at the Salon of fine arts in Zlín in 1941. 1941.

Zdeněk Kovář was a learner of Makovský at the School of arts in Zlín. Zdeněk Kovář



Fig. 1.9.1: Model of the lathe MAS R50 by Vincenc Makovský at the 5th Salon of fine arts in Zlín, 1940.

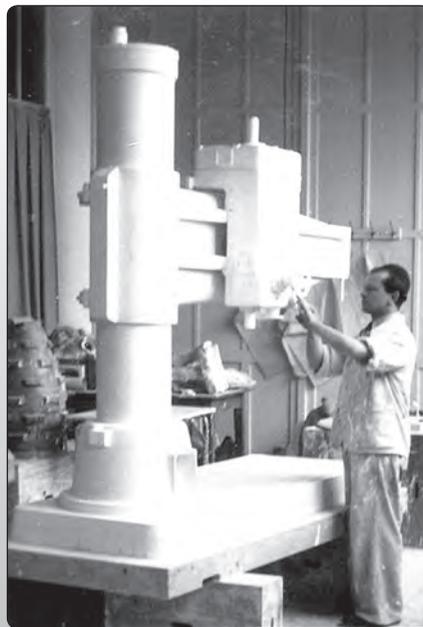


Fig. 1.9.2: Modeller making the plaster model of the drilling machine designed by Vincenc Makovský, beginning of the forties.

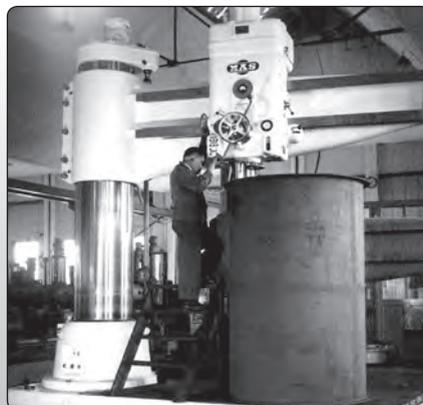


Fig. 1.9.3: Implementation of the drilling machine VR8, Vincenc Makovský, 1941–43

already participated partly in work at the model of the lathe R50. Kovář was previously trained to be a machine and manual shoemaker and a miller and he had work experience with various machine tools. This enabled Kovář to know perfectly the technical substance of machines and the character of work with them. As his school leaving work at the School of arts Kolář elaborated the model of the shape design of the vertical milling machine in 1943, the model of the horizontal milling machine is from 1945 (Fig. 1.9.5) [Lamarová 1996], [Malaniuk 1996]. Both models show the clear influence by Makovský in the sculptor's approach to shaping of materials and their structure following thoroughly the machine functionality expression. But the approach by Kovář even more accentuates the organic expression, which – also thanks to his later pedagogical and public activity – became the typical feature of industrial product shaping during the fifties and the sixties in Czechoslovakia. At the beginning of the fifties, e. g. the automatic copy milling machine MAS Fk08h was made according to the design by Kovář (Fig. 1.9.6, Fig. 1.9.7).

The machines shaped by Makovský and Kovář brought the considerably cultivated

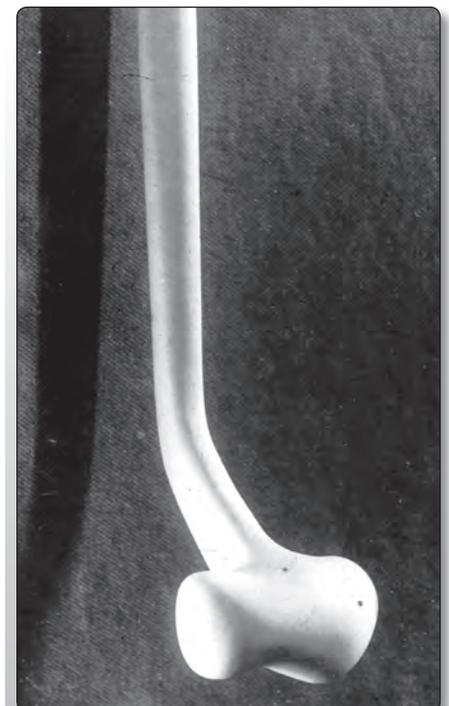


Fig. 1.9.4: Plaster model of the drilling machine lever, Vincenc Makovský, 1941–43

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Fig. 1.9.5: Plaster model of the horizontal milling machine by Zdeněk Kovář, 1945

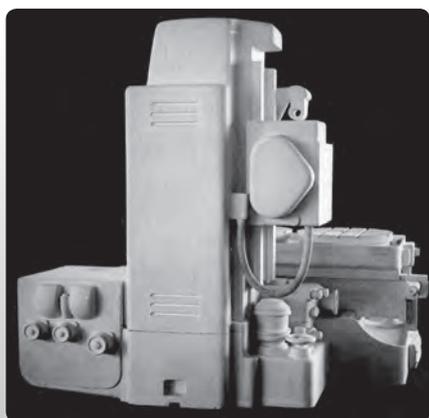


Fig. 1.9.6: Plaster model of the automatic copy milling machine MAS Fk08h, Zdeněk Kovář, at the beginning of the fifties



Fig. 1.9.7: Implementation of the copy milling machine Fk08h, Zdeněk Kovář, at the beginning of the fifties



Fig. 1.9.8: Original appearance of the centre lathe made by TOS Čelákovice at the end of the fifties

VÚOSO in 1946. The first Král's work was a design of a bench drilling machine. While he was elaborating documentation of the box, he met with the impractical complicated shape at the existing sample. Therefore, he designed the complete box as a narrow prism with straight surfaces. The standard used pea green colour was replaced by him with combination of two grey shades. This courageous step was unambiguously accepted by the VÚOSO management and later it was declared to be the standard which should be systematically developed [Král 1996].

The new system with straight surfaces brought considerable designing and manufacturing advantages. The casting bodies could be mechanically ground, or it was possible to use sheet metal covering mounted on a carrying frame. The new approach to shaping meant the important

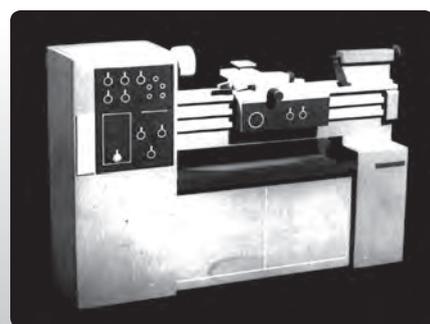


Fig. 1.9.10: More precise Král's model of the lathe S32 with the essential graphic solution

look which combined artistic quality with the naturally perceived ergonomic approach. From the technologic point of view, these designs resulted from the existing usual practice – modelling of castings with complicated shapes. However, it was very difficult to record complicated shapes to the manufacturing documentation and to transfer them to the casting mould and this procedure was not proven very well in practice, because it required careful, accurate and patient work of the designer as well as of the modeller. Besides other things, dirt settled down on castings with worse quality of surface machining. This dirt could be removed only very badly, which considerably decreased the effect of machine shaping in operation.

The new style of the fifties and the sixties was characteristic with functional simplification of

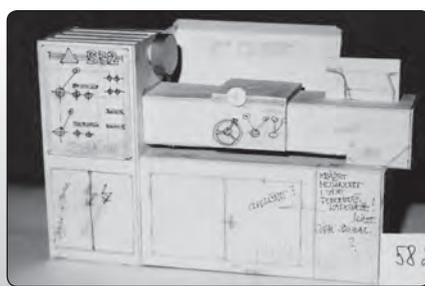


Fig. 1.9.9: Work model at development of new shaping of the the centre lathe S32 by Svatopluk Král, beginning of the sixties



Fig. 1.9.11: Implemented new appearance of the lathe S32, Svatopluk Král, beginning of the sixties

shaping. It was born at the same time with the establishment of the future Research Institute of Machine Tools and Machining (VÚOSO). Svatopluk Král, a school leaver of the secondary engineering school came as a designer together with the first employees to

movement towards improvement of the total esthetical level of machines. The concept of this esthetical level included design aspects, ergonomics and operation of machines and of course, it also meant economic contribution. Artistic economy of simple