Efficiency in Powder Compacting Technology

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Abstract: Nowadays, all PM part manufacturers are subjected to the huge pressure to reduce prices and minimize cost. Apart from the maximum utilization of the machines in multi-shift operation, the manufacturers have to select the optimum machinery in terms of pressing technology. Flat parts, for instance, are produced on mechanical high-speed presses with very high economic efficiency. Here high stroke rates that can be achieved are the focal point. Multi-level complicated components are produced on multiplaten presses providing hydraulic auxiliary movements. Both mechanical automatic presses with modular multiplaten die sets and hydraulic presses with closed-loop controlled movements, equipped with position sensors, are suitable for this application. The geometrical complexity, the requested dimensional tolerances and the density are of decisive influence of the machine to be selected. The sizing is process is carried out on machines providing optical part recognition and automatic part handling. For this wide variety of different applications DORST Technologies can offer customized plants to suit the requirements. To gain maximum economic efficiency, all machines – powder compacting presses or automatic sizing presses – are available with handling systems such as die set change systems, or linkage of the press with the furnace.

INTRODUCTION

Almost all processes in all fields of today’s society are becoming increasingly complex and fast-moving. This trend imposes challenges on every enterprise and sets new standards on the way they act. What is most important is to recognize and to take advantage of these chances and risks, and this also applies to the sector of Powder Metallurgy.

For many years, DORST Technologies has placed emphasis on advanced training of specialists, and on technical development, with the aim of continued optimum support to our customers. You may recollect that our paper two years ago dealt with our new generation of closed-loop controlled hydraulic presses, type TPA /3 HP. Meanwhile, these presses have set new global standards in the production of complicated PM parts.

Today’s paper focuses on latest developments in the domain of die set systems for DORST mechanical automatic presses and how they meet the high requirements of today’s PM industry.

Increased requirements of part makers with respect to quality tolerances and the complex shape of compacts are the reasons behind the change from mechanical presses to highly flexible hydraulic pressing systems. But there are still many compacts suitable for economically efficient high-quality production on mechanical automatic presses. This applies especially to multi-level parts produced in small or medium-size lots. DORST Technologies has developed for these
applications – apart from the known and well-reputed standard die set – a new die set system capable of producing multi-level components on mechanical automatic presses.

**Modular Multiplaten Adaptor (Die Set) - MMA**

These developments aim to improve the density distribution within the pressed part, thereby avoiding cracks and keeping dimensions and weight constant.

To ensure the necessary flexibility, the concept of our new die set system is based on a modular design, allowing easy and quick modification of the system, starting from the minimum and ending with the maximum configuration. For this modular multiplaten die set, type MMA, the press frame is made larger and an external hydraulic unit is being used. The hydraulic movements of platens are controlled by the press and quality controller PQC3, the basic version of which has been a feature on almost all mechanical presses from DORST Technologies. The adjustments of each individual platen for the pressing and the filling position are convenient and actuated by handwheels.

This presentation provides a survey over the new die set system and demonstrates its capabilities.

The basic for this concept is the well-known mechanical press type TPA.

**MECHANICAL PRESS – TYPE TPA**

**PRODUCT RANGE**

The product range of DORST Technologies comprises mechanical presses in the range 60 kN to 4500 kN.

The smallest press of this series is the 60 kN press which is available as standard version and as a high-speed press.

For pressing forces from 150kN to 700kN DORST offers a wide variety of models, in standard, high-speed and multi-platen version, depending on the application. With this product range DORST Technologies meets the requirements of part makers in a flexible and cost effective way.

The 1000 kN press exists as a standard press for one level compacts. Complex, multi-level parts in this range can be produced on our high efficiency multi-platen version the TPA 140 MMA. There is also the TPA200/2 MMA mechanical multi-platen version which can be used up to a pressing force of 2000 kN.

For higher pressing forces up to 4500 kN DORST offers standard presses.

Alternatively DORST Technologies can offer a new generation of hydraulic multi-platen presses for production of highly complex, multi-level compacts, in the range from 500kN up to max. 20000 kN. All machines of this type are designed with closed loop control.
BASIC STRUCTURE

The basic structure of the mechanical press is shown by the example of a TPA 15/4:
The press consists of three modules. On the left side there is the pneumatic switch cabinet, in
the middle the mechanical press, and on the right side there is the electrical switch cabinet with
PQC3. When a multi-platen die set is used, a hydraulic unit is added for actuating the multi-
platen die set.

A drive motor moves the connecting rods in the machine housing, which in turn actuate the
up and down movement of a frame consisting of upper crosshead, tie rods and lower crosshead
and thus carry out the upper punch movement. The die is moved via the lower T-piece with the
crosshead of the die. After the pressing position the die carries out the withdrawal movement.

The die set is connected to the machine with the two adjustable T-pieces, and is clamped by
means of clamping blocks on the die set base plate.
The above-described system of the eccentric presses comprises mechanical presses in the range
of 60 kN, 150 kN, 500 kN, 700 kN and 1000 kN.

All mechanical presses of 1400 kN and more are designed with a toggle lever system
because of the higher pressing force.

DIE SET SYSTEMS

The die sets described below are designed for use in mechanical presses of the TPA series.

On the standard and high-speed presses the simple die set version is used, whereas on the
multi-platen version with a larger mounting area the multi-platen die set MMA is being applied.

The basis for the development of this new multi-platen die set MMA was the experience
gathered with multi-platen systems over the last two decades. Well proven components were
taken over to this new system and re-engineered components with improved properties were
integrated. In the concept of the multi-platen die set particular importance was attached to
precision, rigidity and modular construction.
STANDARD DIE SET

The standard die set is suitable for the production of single-level compacts or parts with a step in the die. The die set is available for presses of 60 kN to 4500 kN. The tool can be designed with one upper punch, one lower punch and one die. If additional movements are required in the tool, these can be incorporated. Depending on the requirements, the die set is available in 2 or 4-column format. Its construction is very rigid. Low wear, high precision components are used for guiding the punch movements. This die set can be used on the standard or high-speed press version.

MODULAR MULTI-PLATEN ADAPTOR (DIE SET) MMA

With this new generation of multi-platen die sets, DORST Technologies has succeeded in developing a highly flexible multi-platen system for producing complex, multi-level compacts. This system is being applied on presses of 150 kN, 500 kN, 700 kN, 1400 kN and 2000 kN.

The following features show the outstanding advantages as compared to conventional systems:

Tool levels
The new MMA concept is provided with up to 3 tool levels each independent of the other in the lower part of the multi-platen die set. Additionally there is the movement of the core rod, which is an integrated part of the press. For the upper punch, too, up to 3 levels are provided. All levels are hydraulically controlled.

The system therefore provides up to 4 upper and 5 lower levels, taking die and core rod into account.

Modular structure
The modular structure offers maximum flexibility to the user. By sophisticated arrangement of the components, DORST Technologies has developed a system adaptable to specific customer
requirements. There are a variety of solutions available, starting from the minimum configuration of two platens in the lower part up to the maximum configuration of three platens in the upper part and three platens in the lower part and two powder transfer systems. If the customer, for the reason of initial investment, decides for the minimum configuration, the die set can be upgraded without any modification of the press at any later date.

Possibilities of adjustment
In pressing position the platens are supported by positive mechanical stops. Therefore, high forces can be generated without additional energy. The pressing position itself is exactly the same in every cycle. Reproducability of the setting and therefore of every part produced is therefore ensured. Setting of the pressing position for each tool level can be carried out very easily. The lower tool levels are adjusted by hand wheels on each platen. The range of adjustment of 5 mm allows correct positioning of tool punches without problem, even if they have been re-faced. Positioning of all tool levels in filling position, too, is actuated by hand wheels. It is therefore easy to adapt to powder variations, which may occur during production. All adjusting handwheels are equipped with digital readouts, so that their positions are easily reproducible.

In the two pictures below minimum configuration is shown on the left and maximum configuration on the right.

![Figure 3. MMA – Minimum and maximum configuration](image)

Use of the modular multi-platen die set MMA also provides other benefits influencing highly the pressing results. These are mainly: accuracy, rigidity and accessibility.

Accuracy
It is the die set, which is the basis for reproducible quality of the compacts in the forming process.

A prerequisite for the continuous pressing of identical parts is the precision of the die set. The MMA design has 4 guiding columns, all component parts are of the highest precision and the installation is extremely accurate. These important factors ensure production of the highest quality.
Rigidity

Rigidity and robustness of the die set system is a factor that is often underrated. It has great influence on the quality of the pressed parts and on the wear of tool components. The very small deflection of the die set components under full load minimizes the risk of cracks in the compact during the ejection phase. The MMA concept, due to its extreme high rigidity, has made it possible to minimize deformation. This rigidity is achieved by the central support of the platens in pressing position and also by preload of the die set itself.

Accessibility

Easy accessibility to all die set components allows the tool design engineer to incorporate part specific additional levels.

In addition, setting times for assembly of the tools can be reduced.

Example MMA 50/70

The technical data of a multi-platen die set, for example for a 500 kN or 700 kN die set, are as follows:

In the upper as well as in the lower assembly of the die set, at least one platen can bear the maximum pressing force of the press in pressing position. On the MMA 50/70 these are platen 1.3 and platen 2.2. Adjustment of the mechanical stop in pressing position can be carried out on the upper or lower part on 2 platens each. Adjustment by up to 5 mm each is possible.

All the other platens have very high supporting forces in pressing position, ranging from 70% to 100% of the maximum pressing force.

SUMMARY

The multi-platen die set is of modular structure and can be extended at any time by additional platens in the upper and in the lower part to its maximum configuration. The minimum configuration consists of 2 levels in the lower part plus the upper coupling plate. There are 3 tool levels in the upper part and 3 tool levels in the lower part plus two powder transport systems in the maximum configuration.

All platens are moved hydraulically. The overall length of the basic die set version is designed already for the maximum configuration. The user can therefore add platens at a later date at very reasonable costs and without much expenditure on mechanical components.

The advantages for partmakers using the new modular multi-platen die set MMA of DORST Technologies are:

Very convenient adjustment of the stops for pressing position and filling position by hand wheels. The fixed stops for all platens in pressing position are centrally arranged. The lower part of the multi-platen die set MMA is pre-stressed to achieve high rigidity and minimize the deformation under load. The die set provides very high hydraulic locking forces and mechanical holding pressures in pressing position. Powder transfer is possible for each platen. 4 guide rods in the upper part and in the lower part provide for guidance for the movements in the die set. Tool design can be prepared in simple manner, thus allowing short set-up times. All in all the die set is of very compact design. All hydraulic cylinders are arranged in the base plate.