Functional Element Technology
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A functional element is punching through sheet metal and by a cold joining process a tight connection is formed.
More Function in Sheet Metal

In many industries components are equipped with elements such as nuts, bolts and screws for special functions. Most of these so-called functional elements can be integrated into workpieces by means of pressing, punching, riveting or clinching processes.

The predominantly automated connections that can be made by means of cold joining technologies are significantly more cost-effective than conventional connections like welding, as no rework caused by contaminations or component distortions is required.

The connections provide good retention, particularly with regard to torques and press-out forces, and the consistent quality can be easily monitored through simple measurement procedures. The continuous documentation of the connection parameters is valued by users worldwide across a wide range of different industries.

The use of functional elements has already been proven in a wide range of applications. For each element there is a safe, fast and cost-effective procedure.

**Insertion Procedure**

All forms of insertion have a similar procedure:

1. Elements are stored in a hopper
2. Workpiece is moved to the machine
3. Element is singulated
4. Element is moved to the setting head
5. Element is placed on position
6. Element is inserted
7. Workpiece is moved out of the machine

The steps are monitored and analyzed to achieve continuous quality.
Advantages of the Functional Element Technology

Versatile and full of options

Functional elements are available from various manufacturers. They differ in function, type of fastening and dimensions. Most elements can be pressed into common materials such as steel, stainless steel, high strength steel (boron), aluminium and fiber composite materials of 0.6 - 10 mm thickness.

The insertion of functional elements by cold joining process offers numerous technical advantages:

**Vorteile:**
- Fast work processes
- High precision positioning
- Energy-saving technology
- Joining without heat: No heat development on the workpiece and element
- Automatic and precise monitoring and documentation of the process
- Very good dynamic joining properties
- Flexible positioning on components due to high accessibility of the systems
- Wide range of applications

### Clinching Studs

The Clinching Stud is particularly suitable for workpieces that have to be gas- or liquid-tight, because the sheet metal is not severed. For the processing of these elements we were patent holders for many years and are the technology experts now.

**Versions:**
- Ball head
- Coarse thread
- Regular thread

**Application materials:**
- Steel sheet metal thickness 0.8 mm up to 1.2 mm
- Aluminium sheet metal thickness 1.2 mm up to 2.0 mm

**Retention forces:**
- Maximum pulling force: up to 2,200 N
- Maximum Torque: up to 20 Nm
White goods and consumer electronics

Medical equipment

Heating elements and door frames

Trunk lid / Trunk deck

Hood / Front opening

Back shelf

Fender

Door sill / Door seal carrier

Spoiler / Spoilerattachment
Process competence

The best technical solution for every application

We provide you with the best technological solutions and complete turnkey systems from one source. In addition to the most widely used processes, our employees are also working on individual solutions.

**Process without pre-punching**

**Self-Clinching**

The element meets an unpunched component and is pressed in with high pressure. The component deforms and creates a solid clinch connection.

**Self-Piercing**

The functional element punches through the unpunched component. A solid connection that is resistant to twisting and pressing out is created by the flow of material into the element.

**Process with pre-punching**

**Press Fitting**

The functional element is pressed into a pre-punched and formed component. The material flows behind the element and ensures a force-locking connection.

**Riveting**

The element is inserted into a pre-punched component. It gets deformed and a solid connection is created.
Proven Process Quality

Continuous Quality Monitoring
A significant advantage of inserting functional elements with our technology is the simple quality control even in series production. By continuously measuring e.g. the force-travel-curve each connection can be checked. An additional analysis can be carried out by cross sections (cut through the element). The shear and pull strength can be determined in tensile tests.

Preliminary tests in the TOX®-Technical Center
Prior to collaboration, we will already work on the most effective solution for you in our laboratory. Here we will perform preliminary joining tests on your samples, which we test and analyze afterwards. We will also determine all parameters for your application, e.g. the required press force and suitable tools, and we will establish which system can be used for your joining application.

Final Check of the Machine Parameters
Before we deliver a system, we check the real processing results. We will create a cross section and analyze the joining process and the retention forces of the rivet. Everything will be documented in a detailed test report. The delivery condition of the system is based on these determined values and parameters.

Advantages
- Demonstrable joining quality in pre-tests and during series production
- Measurement and documentation of the shear and tensile strengths
- Documentation of the joining quality
- Production of pre-series workpieces

With a cross section (cut through the element), the exact formation can be examined under the microscope for analysis. If necessary, optimizations can be made.
TOX® PRESSOTECHNIK with its decades of experience, provides you with competent know-how of systems. Regardless of the manufacturer of your functional elements, we are able to custom fit to your application using a wide range of components and modules. Your customer-specific requirements are met down to the last detail, utilizing standard system components thanks to our modular design.

1 Setting equipment and tools
   We determine the correct setting tools for every functional element. Centerpiece is the setting head and the dies.

2 Hopper system, feeder, singulation and escapement
   Fully automatic systems for receiving and storing the elements. With blow and slide units, hoses and pick & place solutions the functional elements reach the right place at the right time.

3 Frame
   The high forces occurring during inserting are received by a torsion-free frame.

4 TOX®-Drives
   The forces required are generated by electromechanical servodrives or pneumohydraulic, hydraulic or pneumatic cylinders.

Safety Devices
   Safety door, light curtain, safety controls etc.

Sensors
   Sensors for automatic control of process parameters (pressure, force-travel measurement) and additionally to examine the properties of piece parts or the elements.

Accessories
   We provide numerous accessories for example the spraying systems for spraying the tools and materials, turn tables, piece part holders or ejection systems and slug removal equipment to realize a custom designed production system.
Different basic designs are possible for systems that process functional elements. Crucial factors for choosing the system over another are the potential integration into production lines, optimum feed-in, the desired working speed and the size of the components etc..

**Tongs – stationary or mobile**
For integration in machine lines and equipment stationary machine tongs are suitable. Another option is a mobile tong which is moved and controlled by a robot. The elements are either supplied by means of docking via a station or through a feed hose.

**Machines**
Machines can be designed as fully automatic, semi-automatic or purely manual workstations.
Components

TOX®-Setting heads

The requirements of the setting technique, particularly of the setting head, are crucial for the different types of functional elements. Based on our years of experience and laboratory tests for each application TOX® PRES-SOTECHNIK can select and develop the suitable setting head.

The structural design of the setting heads differs depending on:

- Shape of the functional element
- Type of feeding
- Required press forces
- Drive versions
- Direction of setting (free, vertical from top, vertical from bottom, etc.)
- The type of insertion

Advantages

- Die and setting head as an integrated solution
- Process-reliable separation of elements
- Slim tool design for tight spaces
- Maintenance-friendly design
- High guide accuracy
- Components with low wear

Setting head designs

TOX®®-Setting Head for nuts

Designed for special nuts that are punched into thick sheet metal. An additional stroke removes the slug.

TOX®®-Setting Head for elongated bolts

Processes individually blown in elements with its own stroke, holding the elements safely in the punch and ensuring transmission of the required press force.

TOX®®-Setting Head for clinch rivet elements

For elements that are blown individually, cross-pushed and clinched into the component in a downward movement.

TOX®®-Dies

The die is the crucial counterpart of the setting head and ensures the correct formation of the joint. We offer our own dies but dies from other manufacturers can also be integrated into our systems.
Hopper systems and feeder

Prerequisite for a smooth process flow is the safe and reliable feeding of the element. A hopper is used for stocking larger quantities of functional elements to be pressed in. From here bolts, nuts and screws move to the feeder bowl and then to the sorting equipment. Feeder and escapement are adjusted to the desired manufacturing process depending on the type, shape and size of the element.
Components

Singulation and escapement system

Singulation is required for the processing of some functional elements. The type of the functional element defines the feed method into the setting head. In most cases, this occurs by means of blown air and molded hoses. Sensor modules that check the elements for dimensions or quality can be integrated here.

Feeding hoses

After sorting and singulation, feeding hoses transport the functional elements to the setting head. Depending on the element shape, they are round, rectangular or profiled.
Flexible control-software for integrated production

Flexible Multi-Technology Control
One system - many possibilities! Our multi-technology control operates and monitors all functions. It is drive-independent and can be used for any technology. When a robot changes its tong, the system recognizes the parameters and can continue working immediately. This means the highest degree of flexibility. Additionally, the intuitive TOX®-HMI software allows easy installation and operation of the system. It is clearly structured and internationally understandable.

Integrated Production
Due to numerous interfaces it is easy to connect the TOX®-Equipment to a company network. The system components communicate with each other via fieldbus. The data collected there enables continuous monitoring and improvement of the processes. Feedback from the production process can be used to optimize the technology parameters (e.g. residual bottom thickness). Unnecessary maintenance work and downtimes can be avoided thanks to predictive maintenance.

Advantages
- One control for different application technologies and machines
- Import of process parameters from customer network
- Autoconfiguration of system components
- Condition Monitoring: Storage of operating hours, maintenance counter, tool information etc.
- Preventive Maintenance avoids downtime
- Dynamic process monitoring
- Numerous interfaces for connecting periphery units (e.g. robots, measurement sensors, feeding systems etc.)
- Network communication via e.g. OPC UA / MQTT
- Simplified cabling
Components

Process Monitoring Devices

Special process monitoring devices are available for the insertion of functional elements. They allow the complete monitoring and documentation of the essential quality parameters of the process. Force sensors measure the press force and a travel measuring system monitors the force-travel progress.

Advantages

- Easy force-travel monitoring
- End values presented
- Storage of the data
- Recording of OK parts and NOK parts

Sensors

Fill levels, process progress and quality features of the elements to be processed are monitored and displayed with optional sensor systems. For example thread detection for the functional element (figure on right). Here it is ensured that the singulated element meets the quality requirements. If it does not meet these, it is discharged. This technology ensures a consistently high production quality.

The production quality can also be guaranteed with a barcode scanner. In order to avoid the use of incorrect elements, the packaging of the functional elements must be scanned before it is filled into the hopper. If the elements are not correct, the hopper will not open.
Frames

The forces that occur during insertion of functional elements are absorbed by a frame or the columns of a column press. The designs take into account interfering contours, total weight, piece part accessibility, working conditions and occupational safety.

Frames
Torsion-resistant frames are used for tongs and presses. We respond to the specific requirements with standard frames or individual designs.

Column presses
Column presses are particularly useful for multi-point clinching tools. They can be manufactured in various sizes, but all have the same precision and good handling.

TOX®-Drives

The insertion of elements requires high forces on the setting head. This force is generated by electromechanical servo drives or pneumohydraulic cylinders.

TOX®-ElectricDrive
The modular electromechanical servo drive systems generate press forces up to 1000 kN.

TOX®-Powerpackage
The strong pneumohydraulic drive, which is already used worldwide in thousands of machines. Available with press forces of 2 – 2000 kN.

Additional Components

Information about additional components like controls, piece part holders, safety devices and accessories can be found on our website tox-pressotechnik.com.
TOX® PRESSOTECHNIK designs process chains more economically – with special systems, intelligent assembly systems and fully automatic feeds with integrated additional functions. We possess long-standing experience and comprehensive know-how in the development and design of these systems.

We are keeping an eye on the high efficiency of the later process chain at all times and place our customer’s requirements at the center of our work. We are committed to finding the best solution for optimising the manufacturing processes according to our customer’s requirements.

For this reason, our machines are the product of close cooperation between customers and our project managers. Our service team will also be on hand quickly and reliably at all times following completion.

Identify demand
An extensive consultation forms the basis of each concept for us – for special machines as well as production systems. We use much experience and a high level of expertise to identify the framework conditions, determine the required components, and sketch out a first system layout. In our lab we can perform sampling runs with original materials, components and elements in parallel.

Development process
The specific system concept is forwarded to our construction department, which creates the machine layout and generates detailed drawings for production. The components are manufactured or procured according to plan and the system is mounted. Then, the electrics are installed and the control components are configured.

Commissioning
On completion, the machine is test driven. Once everything corresponds to the requirements and planning, acceptance occurs in-house – if desired, together with the customer. Following delivery, set-up and connection of the system, commissioning is supported by our qualified personnel.

After-sales service
The operating personnel receives extensive training. Either at our premises or on site at the original machine. Often, we also support initial production and provide advice and assistance. When everything is running smoothly, all that is required are regular maintenance tasks.
Application examples

Stationary Tong
for pressing in self piercing nuts.

4-Column-Press
with multi-point tool for car body parts.

Machine with 4 C-frames
as a manual workstation for pressing in nuts.
Stationary Tong for pressing in pierced nuts in an axle support.

Stationary Tong that presses in self piercing nuts.

C-Frame Press as a manual workplace. It presses in rivet bolt in a part of a car hood.

4-Column-Manual Press, which presses in ground bolts into the unpunched wheel arch of a car.