Optimising the energy efficiency of modern drive concepts for closed-die forging presses

**SMS group is convinced that the future of main drives for forging presses will be torque drive technology. The MEERtorque® drive concept combines efficiency and dynamics of torque drives with the most effective way to store and accumulate the required forming energy – a rotating flywheel. The MEERtorque® drive concept significantly reduces energy demand, hence achieves more efficient production.**

*Fig 1 Eccentric Press MT 630 with MEERtorque® Servodrive concept*

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acceleration, ram deceleration and allocation of forming energy (see Figure 2). Unlike ordinary servo-drive systems the MEERtorque® concept uses a continuously rotating, but significantly smaller flywheel to accumulate the energy. This is then used in conjunction with a separate smaller servo-drive motor. The result is that the installed power rating of such a servo press can be significantly lower than of conventional servo-driven presses as their energy demand has far lower peaks during the forging press cycle.

This solution separates the ram movement from the allocation of forming energy and so allows a combination of the advantages of all servo-driven presses with those with conventional clutch/brake systems. For instance, Eumuco-Hasenclever Maxima (MP) presses are known for extremely short die contact times due to their very high ram speeds, coupled with the shortest deceleration and acceleration times between bottom dead centre (BDC) and top dead centre (TDC) and vice versa. This leads to the die contact times being significantly lower and the time available for die lubrication and transfer of forgings to be maximised. This helps to increase die life and uptime rates and drastically reduces emissions and energy consumption. The forming energy is accumulated and instantly available in the continuously rotating flywheel while being supplemented by the servo motor.

With MEERtorque® the press ram is driven directly by the acceleration servo motor located on the left-hand side of the eccentric shaft. The continuously rotating flywheel is driven and maintained at speed by a separate directly mounted flywheel motor arranged on the right-hand side of the eccentric shaft, so eliminating the need for any additional belt drive or back shaft.

The design of both motors is basically identical in terms of the electrical stator components. The eccentric shaft is accelerated by the servo motor and, when the speed matches the flywheel, the connection with the flywheel is established via the clutch without any significant wear or noise. The reduction in flywheel speed, caused by withdrawal of energy during the forming process, will be compensated by using the flywheel motor. The clutch is also used for the limitation of the press force to prevent overload (safety function). After the forming process the ram decelerates and the acceleration motor on the left-hand side is then switched to recovery mode and the generated deceleration energy is used to restore the flywheel energy.

In addition, the MEERtorque® Servodrive concept provides an acceleration angle of 120° that is about eight times larger than that of conventional clutch-brake drive systems (10-15°). This allows the required delivered torque to be around one-eighth of a conventional drive system.
This is why these drives are far smaller and more economic than those of a conventional clutch-brake drive system.

Comparable to modern hybrid drive concepts used in vehicle powertrains, the torque motor driving the eccentric shaft generates electrical current during the deceleration phase that is used to re-accelerate the flywheel.

In addition, the MT series has been developed and designed with both today’s and future requirements in mind regarding performance, precision and quality, and is based on a highly rigid and robust forming unit with generously dimensioned die area and precise and accurate ram guiding in mind.

The split frame tie rod design of the press is based on the well-proven, extremely reliable and highly durable design of Eumuco-Hasenclever eccentric presses, but has been further optimised by using the latest finite element design tools. The machine frame has very large press windows which are suitable for easy access for tool and bolster change, as well as all established methods of automation. The new innovative design offers optimum access for all kind of maintenance and inspection work without disassembly of cover parts.

All major frame parts are cast steel and free of the residual stresses typically caused by thermal distortion in welded constructions. The ram is mounted between adjustable, temperature-independent diagonally oriented and exceptionally long guideways. The bottom of the stroke position of the ram can be adjusted in 0.1 mm steps between strokes, even in fully automatic mode through use of an electric motor linked to a worm gear.

Customers using the MEERtorque® Servodrive concept will benefit from the following advantages:

- Increased die life due to reduced die contact time
- Reduced maintenance cost due to reduced wear on mechanical parts (eg, no brake needed during continuous operation) as well as a virtually wear-free clutch
- Increased production output due to outstanding reliability and improved performance
- Extremely smooth and silent operation due to the absence of brake, gearbox, etc.
- Use of an energy supply column means that all compressed air, electric power, hydraulic fluids etc., are supplied to the press via a single device which contains all necessary hoses, valves, cables, pipes and tubes connected to the take-over points of the user's facility. This facilitates maintenance as they are directly accessible without opening foundation covers and cable ducts and makes overhead cable trays obsolete.

SONA BLW Praezisionsschmiede GmbH was the first user to receive the all-new MT closed-die forging press with the MEERtorque® drive concept (see Figure 3) as the centerpiece of a fully automated forging line for warm forging of precision powertrain parts (see Figure 4). In its first year of production well over 5 million precision forged components were produced on this line.

CONCLUDING REMARKS

SMS group is convinced that the future of main drives for forging presses will be torque drive technology. The MEERtorque® drive concept ideally combines efficiency and dynamics of torque drives with the most effective way to store and accumulate the required forming energy – a rotating flywheel. Manufacturers of conventional servo-presses refrain from using a flywheel to store the energy, so to allocate sufficient working capacity (energy), they need high power consumption that requires enormous connected power. The MEERtorque® drive concept significantly reduces that demand, hence achieves more efficient production.

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