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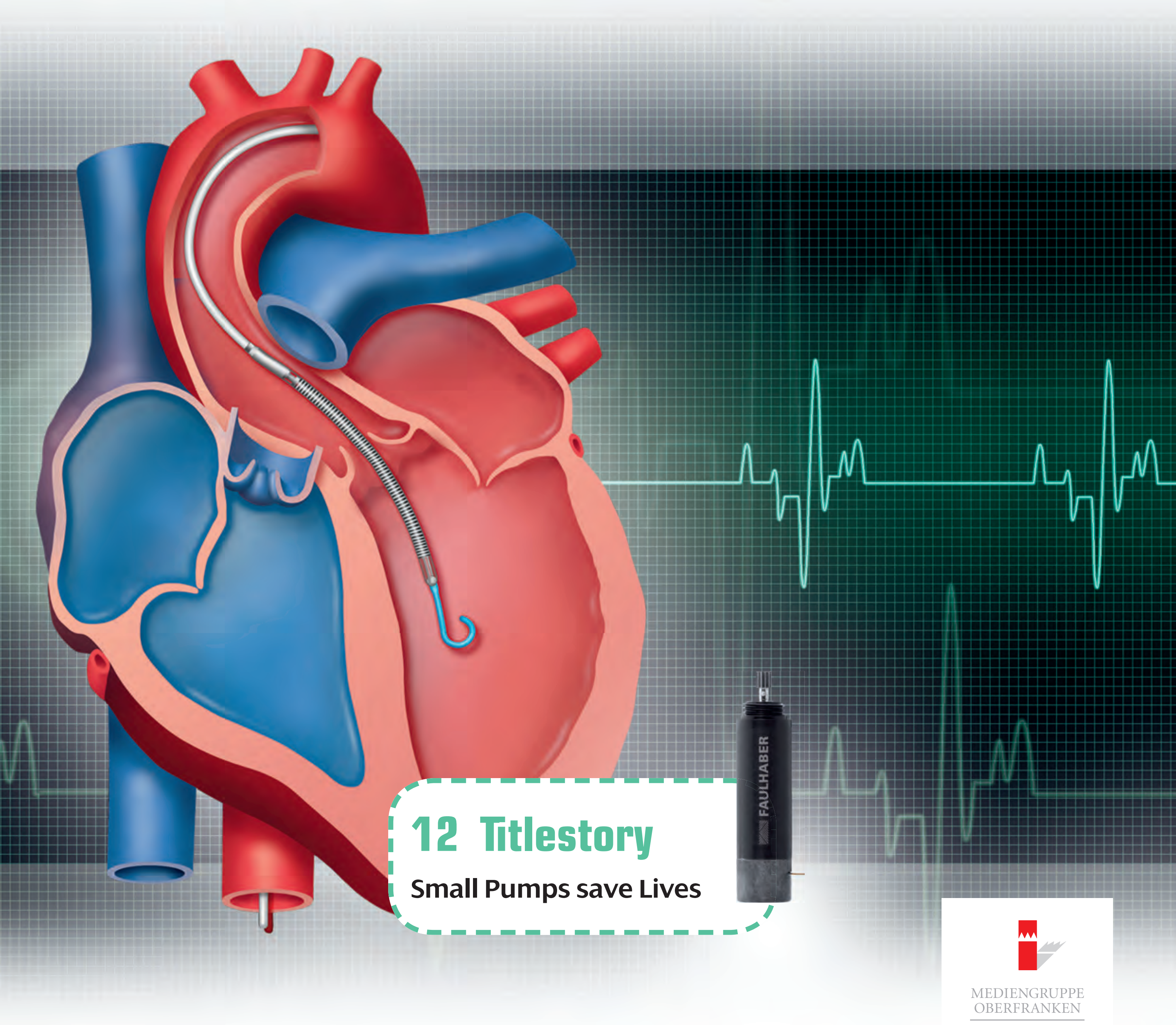

12 Titlestory

Small Pumps save Lives

MEDIENGRUPPE OBERFRANKEN
FACHVERLAGE

Motion technology is continuously improving to meet the myriad requirements of increasingly capable and reliable medical devices. Advances in planetary gearheads are helping modern diagnostic systems to become more powerful and precise.

How motion technology makes modern medical imaging possible

The earlier an illness is detected, the more effective and successful a treatment will be. Modern diagnostic procedures mean that risky surgical interventions, and the associated stress caused to patients, are no longer necessary. Computed Tomography (CT) scanners are at the forefront of „non-invasive' diagnostics and are used in practically every medical discipline.

Technical developments have seen several generations of devices emerge over the years, delivering ever better results and exposing patients to lower doses of radiation in the process. Whereas radiation exposure lasted up to an hour during the first images taken when Konrad Röntgen discovered X-Rays in the 19th century, today´s exposure times are just a few hundred milliseconds. The radiation dose for an examination is now just 2% of the dose needed during the pioneering age of X-ray technology.

CT rotation set high requirements for the motion components.

At the same time, scanning technology has continued to improve to the extent that imaging results produced by modern devices now have little in common with the first X-ray images, apart from the fact they use the same basic technique. For example, spiral computed tomography uses thousands of cross-sectional views, which are processed and put together in the computer, to create fully three-dimensional images of the parts of the body being examined. To achieve this, the radiation/detection unit, known as the gantry, rotates at high speed around the patient, who is moved smoothly through it horizontally. Whereas first generation devices needed hours for a single rotation, today's CT rotation times can be lower than 500 milliseconds.

Understandably, these highly developed precision devices set very high requirements for the motion components within them. In particular, the movement of the patient in relation to the scanning units must be both smooth and precise – the faster the rotation and, by implication, the scanning speed, the more precise this needs to be. These days, the gantry is rotated either by large slip ring motors or, more recently and increasingly, by inductive linear motors with a moving electromagnetic field. This field moves the tubular detection unit, which can weigh up to a tonne, like a magnetically levitated train.
The motion system technology responsible for moving the patient table through the gantry horizontally has to satisfy many requirements. In fact, selecting suitable components is very

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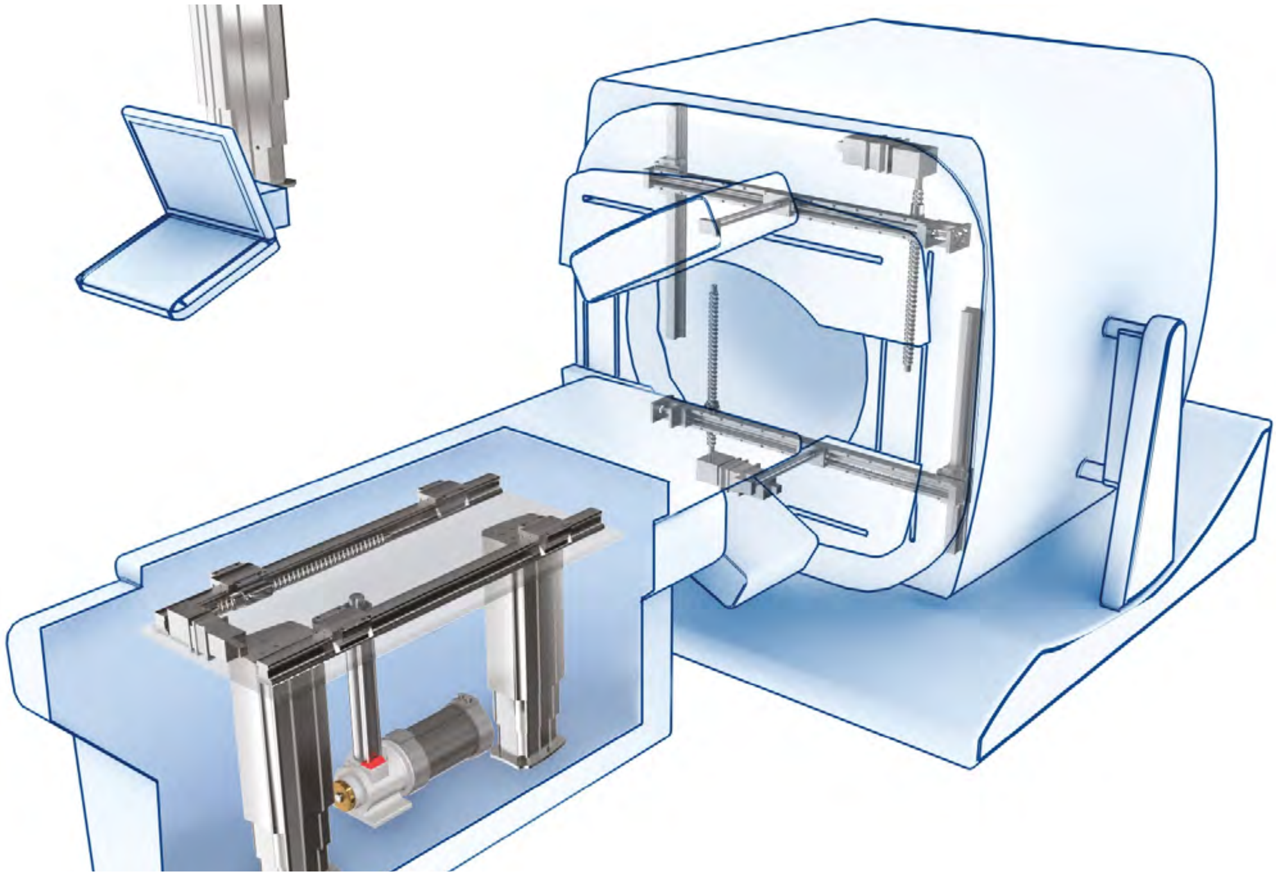


All Figures: Thomson

The motion system must be possible to make very fine adjustments.

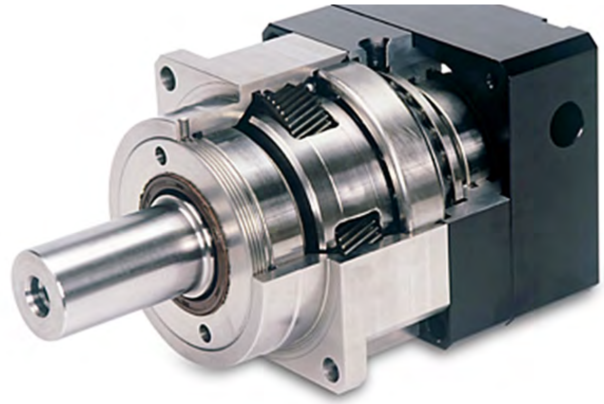
important in terms of the performance of the system as a whole. Only an optimal motion system, which satisfies all the various requirements will be able to support this kind of high-resolution CT scanning.

First of all, motion systems must ensure the patient table moves precisely and completely smoothly with no jerking whatsoever. It must also be possible to make very fine adjustments. Generally speaking, even the slightest unevenness in terms of this horizontal movement could disturb image quality and make the entire scan unusable. This would mean exposing the patient to a second dose of radiation with another scan.

The motion system needs to be extremely reliable so as to rule out as many faults or failures as possible. It is also true that many patients find examinations in computed tomography scanners an unpleasant experience given how narrow the inside of the tube is. Quite often, these confined conditions can trigger claustrophobic panic attacks. As such, repeating this procedure because of a fault would not only present a problem with the additional radiation load, but also in many cases cause unnecessary psychological stress. For these reasons too, only motion systems with a high level of functional reliability can be considered for use in CT scanners.

The demanding requirements expected of motion systems in terms of smooth running and low levels of noise generation also make the process more comfortable for patients. Every decibel reduced at this stage helps the patient to relax. This cuts the incidence of involuntary patient movements, which can also make scans unusable. Quiet motion system components also make it easier for medical personnel and patients to communicate. If the patient cannot clearly understand a given instruction, such as „now hold your breath“, this too can make a scan more likely to fail.

Fundamental requirements such as speed adjustment and load bearing capacity also place demands on motion systems. The currently applicable safety regulations stipulate a maximum permissible table load of 280 kg. This value is expected to increase to 340 kg in the near future. This means the motion system must be able to move this kind of weight in a reliable »



Smooth running and low levels of noise are the requirements.

High requirements for motion systems.

manner. The ever faster rotation speed of the tubular detection unit in the latest generation of devices - made possible by the use of inductive linear motors - means the patient table needs to be moved ever faster too. The required feed speeds range from 10 to 100 mm/s.

This requirement for increased speed and load bearing capacity must be balanced with the demand for motors to be as compact as possible. All components in medical devices must be fully enclosed and there is a limited amount of room in the gantry, which means there are also limits on the physical size of the motors. Fast, relatively small servomotors must be employed and for this reason, some type of gearing system must be used to both reduce motor speed and increase output torque.
For medical applications this step up in torque, along with smooth operation, can be achieved using planetary gearheads. Planetary gearheads use a sophisticated gear arrangement in which 3-5 spur gears, known as planet gears, rotate about a central pinion or „sun gear".

The main advantage of planetary gearheads is that the planet gears all share the load attached to the output shaft, giving the arrangement a higher load capacity than a spur gearhead for a given size of gearbox. This load-sharing also gives planetary gearheads a longer life than other types of gearhead and reduces maintenance requirements and downtime.

The design of planetary gearheads provides the highest possible torque output, doing so with high efficiency and precision. That way servomotor size can be reduced, keeping the overall size of medical equipment to a minimum. Planetary gearheads also offer low backlash, eliminating positioning errors and reducing vibration and noise.

Medical equipment is a fast–developing and competitive market, with OEMs seeking cost and technical advantage over their competitors. This, combined with changing regulations and new opportunities, is driving innovation and performance in motion control. This diverse market includes devices for handling patients, such as wheelchairs, operating tables, bath lifts, and dentist´s chairs, as well as complex diagnostic systems such as cardiac scanners and the computed tomography scanners already described. Of course, motion control requires more than just gearheads. Thomson has long specialized in the support of medical device manufacturers with a comprehensive product range offering solutions such as linear bearings, linear guides, ball screws and lead screws, clutches and brakes, rod-style electric linear actuators and complete pre-assembled motion systems. Also available are rod-style electrical linear actuators and precision linear actuators for installation in a variety of sizes and designs.
As global competition continues to grow, the need for technologically advanced motion systems can only increase. Thomson offers more than 70 years experience in designing and engineering solutions that enable its customers to stay ahead with more reliable and capable machines.

Thomson has six decades of experience in high precision gearing and has a comprehensive range of Micron True Planetary gearheads engineered for medical applications. Seven gearhead families offer helical crowned gearing which reduces vibration; ideal for the jerk-free, smooth and quiet operation required by CT scanners. Helical gearing is when the teeth of the gear are cut at an angle to the centerline of the drive shaft, providing an increased contact ratio. This results in 30-50% more torque capacity than spur type planetary gearing, further increased load sharing and therefore load bearing ability, and a smoother operation. The UltraTRUETM, for example, is the smoothest and quietest gearhead on the market today. The high torque performance capabilities of the UltraTRUE and ValueTRUE also offer superior reliability and higher safely factors, which are critical in many medical applications.

Resistance to water and disinfectants

Other families include the XTRUE, which is compliant with EU Directive 2002/95/EC (RoHS) and the corrosion resistant and watertight AquaTRUE planetary gearhead (IP66/IP67/IP69K rating), which provides resistance to water and disinfectants, essential in some medical applications.
Designers of medical devices not only have a large selection of components to choose from, but also benefit from the fact that components are perfectly tailored to each other, which can save planning time. Thomson´s innovative RediMount system provides error-free installation of gearheads to any motor and allows easy changing of motors.

Online tools can help to select the correct gearhead and other components for the application. Thomson has extensive experience designing and testing medical solutions to develop products in partnership with machine builders. For example the MicronMotioneering tool (www.micronmotioneering.com). It allows customers to select from a vast range of configuration options using real world application parameters and advanced motion profiles.

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