Encoders make mobile elevating work platforms flexible

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Introduction

Construction and maintenance work on buildings and houses used to be done with expensive scaffolds. In the 70s of the last century mobile elevating work platforms came on to the market reducing the effort and costs for the work at places difficult to access. The first platforms had a height of 10 m to 20 m. This range is now increased to 100 m. But not only the height was important. The total operation distance was also of interest. (See Figure 1)

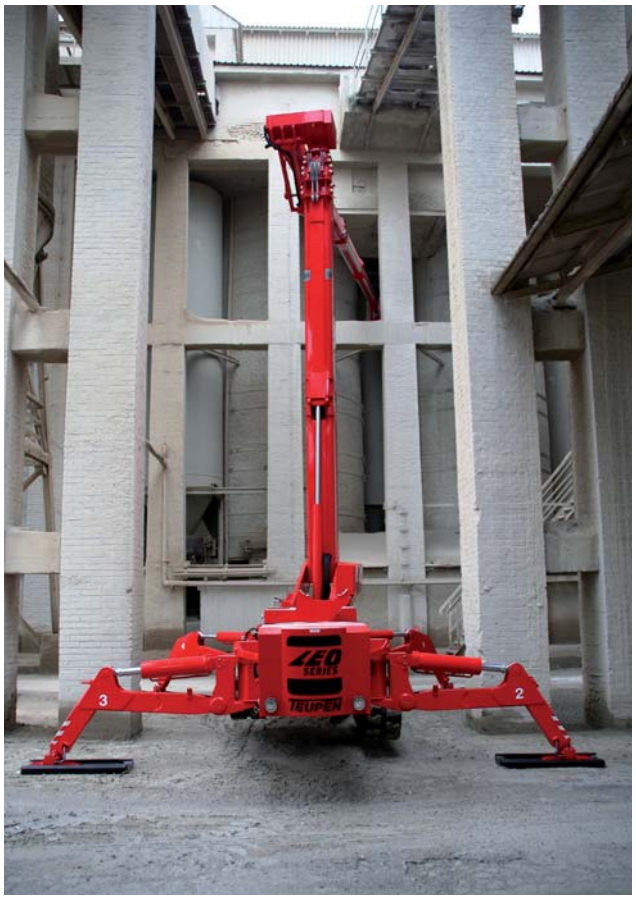

Figure 1: The LEO platform with stabilizer

To reach areas in buildings that are difficult to access, the elevating work platforms needed to become more flexible. Now encoders are required to give set-points and values for rotation and inclination. The control takes care of the stability and the balance to prevent falling of the platform. The speed of moving and the load of the platform are also considered.

The company Teupen developed a specific control for a large variety of their elevating platforms. This control is based on fuzzy control logic to react fast enough to dynamic movements and loads. Important test points are within the tracked chassis moving the complete platform. Further measurements are done in all joints and at the basket.

The inclinometers of the series NBX65 are based on MEMS technology (micro electro mechanical system). They detect the inclination within a range of 10° to 180° with an accuracy of 0,5°. The resolution is 0,01°. They measure one or two axis and generate a CANopen, analogue or SSI output signal.

The first approach to make elevating work platforms smarter was using standard electro-optical encoders with SSI interface. They were of singleturn type measuring 360 ° with 12 bit resolution. They allowed for continuous rotation and started from zero again after a complete round. As the slewing ring of the tracked chassis and the pinion of the measuring device form a gear the measuring device needed to be of multiturn type. The multiturn types have an internal gear box that can measure up to 4096 rotations.

The multiturn types were mounted to the tracked chassis of the platform measuring the angle of rotation. A similar application can be found in all mobile cranes, bucket excavators and motorized concrete pumps.

Standard optical encoders were doing well for the technical requirements but safety regulations required additional effort.

Figure 2: Elevating platform LEO for exceptional height and distances

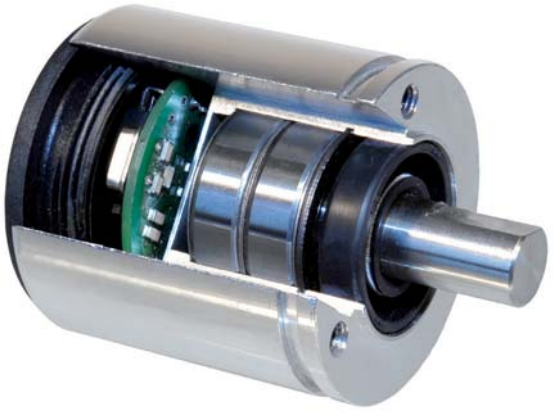

Figure 3: T-series encoder in two-chamber technique

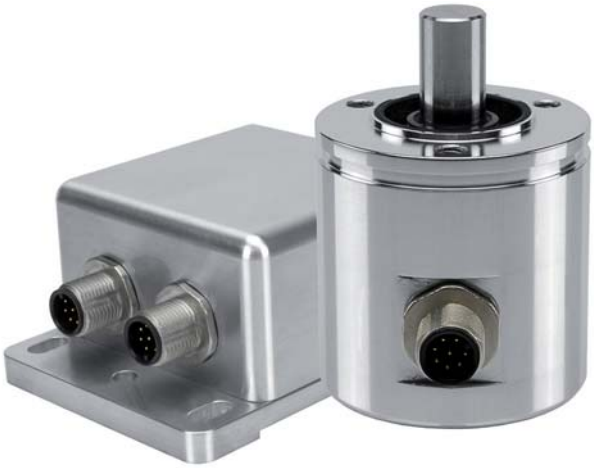

Figure 4: TRN64 encoder for slewing ring and gearwheel free from backlash (ZRS)

The measurements needed to be carried out redundantly to make sure that in case of failure of any component incl. sensors nobody gets injured. This is in accordance to SIL2 (safety integrated level 2). To avoid two encoders on a ll measuring points TWK developed encoders with duplicates of all components that are susceptible to failures. The electro-magnetic encoders of the T-series give the possibility to duplicate all relevant components inside the device. So the mean time to failure (MTBF) was increased.

The development of a special encoder for slewing ring applications was the consequent result of that requirement. The electromagnetic encoder TRN64 is equipped with redundant sensing and transmission components. It is to be mounted to a gearwheel free from backlash (ZRS). This gear wheel is also a development from TWK. The gearwheel is made of high-grade synthetic. It is solid and has a well-defined flexibility at the contact points. Standard gearwheels for backlash free operation consist of several components including a spring. Standard gearwheels are not applicable in safety relevant application as their components have a limited lifetime. Another feature of that special encoder is that it will never have an “overflow”. As the circumferences of slew ring and gearwheel are known the micro controller inside the encoder calculates the position correctly even when the internal number of 4096 rotations is exceeded. The TRN64 has a CANopen safety interface and is SIL2 certified.

The singleturn type TBE with SSI interface is also electro-magnetic. The sensing elements are based on hall effect. The encoders are built in two-chamber technique so the electronic chamber can be potted. The extended temperature range of -40 °C to +85 °C, which in former times used to be an expensive option on the electro-optical devices, is now the standard range. The redundant SSI output and the redundant supply voltage are connected with two separate plugs. Even if one connection fails, the application can continue working correctly. The control can detect the failure and take measures to drive the application into a safe position according to the safety regulations.

The housings of the encoders are made of aluminum or of stainless steel. The thickness of the wall is 5 mm to 10 mm. The shaft is made of 12 mm stainless steel and can take a load of 250 N axial and radial. A sealing ring around the shaft prevents water from entering the encoder at the mechanic chamber.

As the electronic chamber does not contain moving parts it can be potted. The protection class is IP69K. The encoders can be used in harsh environment.

TWK offers a range of encoders and inclinometers with CANopen safety and PROFIsafe interface in redundant technique certified by German TÜV. ◀

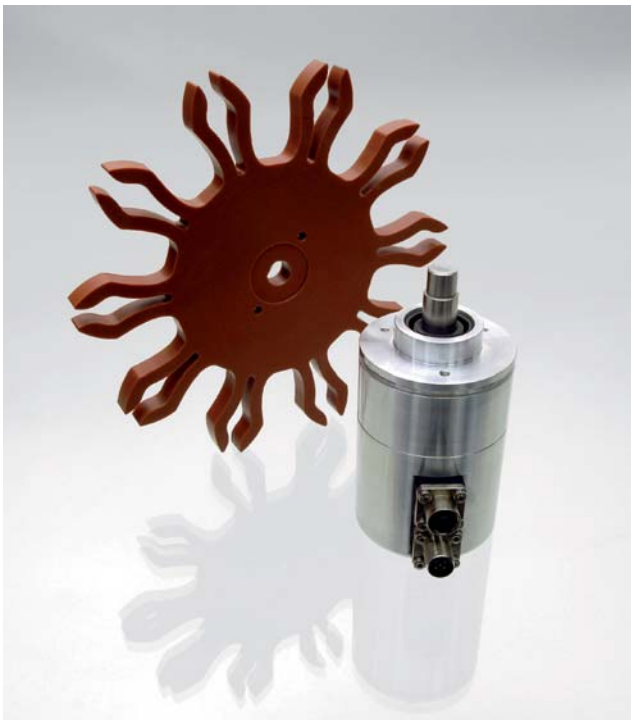

Figure 5: TRN64 encoder for slewing ring and gearwheel free from backlash (ZRS)