

2011 Technical Publication Days

The Innovation: EnDra® Multiturn Technology

Background and description of the problem

An absolute encoder transmits a position value for a shaft, the single-turn position, for the purposes of positioning in industrial applications, such as production or packaging machines. If you want to determine the absolute value for more than one revolution, the number of revolutions is also given, in addition to the single-turn position. This kind of device is called a multiturn encoder. Typically, a protocol is used to send the position indications to a controller via an intelligent interface (e.g. CANBUS). Due to the rotary motion involved in the application, the encoder has mechanical energy at its disposal. If an adequate amount of this could be successfully converted into electrical energy, thus enabling the number of rotations to be written to an electrical counter, then it would not exactly mark the invention of a perpetual motion machine, but it would in fact mark the invention of an energy self-sufficient rotation counter. A dynamo would not work because minimal rotations could also occur at low speeds. Wachendorff's invention is called EnDra® (from the German "Energie Draht" = Energy Wire).

Operating principle of EnDra® Multiturn Technology (simplified description)

A Wiegand wire consists of a hard magnet coating over a soft magnet core. The absolute position for each rotation (single turn) is measured using a magnet in the rotating shaft and four hall sensors. If the magnet's field passes along the Wiegand wire during rotation, then the soft magnetic core will be attracted to it, but the hard magnetic sheath will oppose it. An ever increasing field difference will arise in the wire (analogous to drawing back on a bowstring). As soon as the external field reaches the coercive field strength of the sheath, the sheath demagnetises and the tension built up is suddenly released. This speed-independent pulse is generated twice per rotation and converted into an electrical pulse via a coil. These pulses produce enough energy to operate a low-energy FRAM memory unit and also communicate the number of rotations completed. This rotation counting function does not require any additional energy. If external tension arises again, then an intelligent microcontroller calculates the correct value from the position and the number of rotations and sends it to the controller.

The benefits this technology has to offer to users – machine construction firms and factory operators – are enormous.

This is clearly demonstrated in the following comparisons:

Feature	Benefits
No batteries	Environmentally-friendly, maintenance-free, no waste disposal, lower administrative costs
Gearless	No wear and tear, maintenance-free
Smaller design, light-weight	Space savings, new applications possible
Fewer components	Reduced risk of failure
Low consumption	Energy savings

Creative destruction

EnDra® Multiturn Technology has the potential to unleash creative destruction. It can – and “will” in Wachendorff’s opinion – fundamentally change the market.

Some of the considerations behind this conviction are:

- 1.) In Germany alone, this technology is expected to eliminate the need for over 250,000 batteries and gears a year. This also offers major benefits in terms of the environment.
- 2.) Within around 2 to 3 years – once the market is adequately aware of the new technology – the older designs with gears and batteries will have been phased out completely.
- 3.) Due to its low costs for materials and in production, all new areas of application can be developed.
- 4.) Further, thanks to the decline of the older technologies with gears or batteries (e.g. temperature sensitivity, space requirements, maintenance requirements, environmental impact and waste disposal requirements), new fields are constantly being developed, such as in the wind energy, medical technology, hoisting technology, mobile work machines and factory/machine construction sectors.
- 5.) Gear manufacturers in the multiturn encoder segment will certainly suffer a drop in sales.

Conclusion

EnDra® multiturn technology opens the door to all new areas of application for absolute encoders, such as in hoisting technology, mobile work machines, medical technology, alternative power generation and in the machine and apparatus production sectors. EnDra® marks a innovative milestone in miniaturisation, maintenance reduction and CSR for absolute multiturn encoders and unleashes “creative destruction”.

Excursus:

Creative Destruction (source: German version of wikipedia.org)

Creative destruction is a term taken from macroeconomics, based on the underlying idea that: every economic development (in the sense of developments that are not strictly quantitative) builds on the process of creative destruction. New successful combinations of production factors displace and eventually destroy older structures. Thus, destruction is necessary (and not some kind of flaw in the system) in order to enable reorganisation. (published by Joseph Alois Schumpeter)

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