SAMSON

SPECIAL PRINT

Rugged No-wear Travel Sensing

Special print of German article published online at
www.process.vogel.de/verschleissfreie-und-robuste-wegmessung-a-552394/
on 30 September 2016

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Rugged No-wear Travel Sensing

Modern positioners come with different travel sensing systems. Only very few of these systems fulfil the high expectations placed on them when it comes to wear-free operation, ruggedness and easy installation.

The primary task of positioners is to ensure that control valves control precisely. To do so, the positioners receive a set point signal from a control system, which they assign to a certain valve position (Fig. 1). They compare the target valve position to the actual valve position measured by the travel sensing system and issue a signal pressure, which moves the closure member and thus the valve to the required position. As a result, the sensing of the valve's travel or opening angle has a major influence on the positioner's control quality. The valve position also plays an important role in valve diagnostics to implement predictive maintenance, for example when detecting seat leakage and increased friction. The valve position is specified in percent and, in valves with direction of action 'increasing/increasing', it represents the distance to the valve's CLOSED position. It is a geometric quantity and corresponds to the distance that the closure member has travelled, starting at the valve's zero point. This geometric quantity must be converted into an electric signal to make it usable by modern electronic and digital positioners.

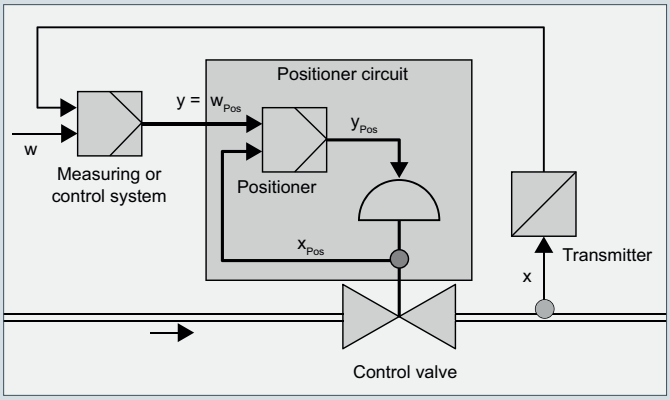

Fig 1: The positioner ensures a predetermined assignment of the valve position (controlled variable x_{Pos}) to the input signal (set point w_{Pos}).

Contact and non-contact travel sensing systems in use

A variety of sensors are used for travel measurement, which differ in the fundamental measuring principle they apply. The sensors measure the signals either using a contact or a non-contact system. When using contact sensors, the measuring system is linked directly with the object of measurement. With non-contact sensors, the measuring system and the object of measurement are arranged in mechanically separated systems.

Potentiometric (resistive) sensors are still widely used in positioners. These contact sensors operate based on a variable ohmic resistance. A mechanical pick-up system on the valve moves a slider inside the positioner across a resistive track. The distance between the point of contact and the slider is increased when the valve opens and reduced when the valve closes. The ohmic resistance processed by the positioner electronics changes proportional to the movement of the slider. The potentiometric sensors use direct current and their mechanical and electric implementation is easy. Positioners including potentiometric sensors feature easy installation and quick start-up on linear and rotary actuators using suitable mounting kits. On the downside, the sensor systems wear out if they are used in applications where frequent valve motions or alternating set points occur.

Almost immune to wear, however, are non-contact inductive, capacitive and magnetic sensors:

- Inductive sensors used for travel measurement in positioners work with an AC voltage that is applied to a coil. Inside the coil is a core, which moves along an axis and whose position causes the inductivity to change. The core is moved by the pick-up mechanics, which modifies the inductivity and AC resistance.
- The measuring principle of capacitive sensors is based on the capacity changes of a capacitor mounted in the positioner. In the simplest design, the capacitor consists of two opposing capacitor plates to which the AC voltage or voltage pulses are applied. When the valve moves, the capacitor plates are displaced in parallel to one another, which causes the capacitance and thus the AC resistance to change.
- Magnetic sensors measure variable magnetic fields. Different types of magnetic field sensors are used in positioners. They include Hall effect, GMR and AMR sensors.
- Hall effect sensors are simple in design. They use the Hall effect to sense changes in magnetic fields. The electrons of a current-carrying semiconductor are exposed to a permanent magnet's field, which causes an electrical voltage to appear (Hall voltage). The magnet's field strength varies, for example when a ferromagnetic part of the mechanical travel pick-up system enters the field due to the valve's motion. This causes the measurable electrical voltage in the semiconductor to change.

AMR and GMR sensors offer a better resolution than Hall effect sensors. They do not use the change in magnetic field strength but the change in direction of the magnetic field lines. When exposed to an external magnetic field, a measurable variable changes in these sensors, too: their electric resistance. The external magnetic field re-aligns the molecular magnets inside the AMR sensor element. In everyday use, the travel pick-up mechanics on the valve include a magnet whose effect on the sensor element's magnetic field lines varies depending on the valve position. The change in resistance caused by the external magnetic field is much greater in giant magnetoresistance (GMR) sensors than in anisotropic magnetoresistance (AMR) sensors. Nevertheless, it can have negative effects on the measuring accuracy when the measuring element moves in the opposite direction as this creates a high hysteresis.

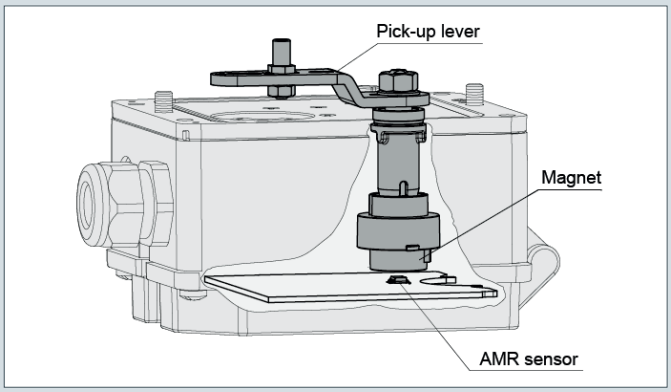

Fig. 2: Protected non-contact travel sensor for Type 3725 Positioners and the latest generation of SAMSON positioners

Non-contact sensors show benefits in terms of wear resistance; on the downside, they have clear disadvantages if they are installed outside the positioner without protection. The ruggedness of travel sensing systems is directly influenced by certain factors, such as electromagnetic disturbances as well as challenging ambient conditions due to extreme weather conditions or salty atmospheres. As valves are installed in many different locations, mounting the various parts of the travel sensing system to match the conditions on site is often complex and requires additional adjustments. Positioners fitted with contact sensors, however, mostly comprise only a few parts and are easy to mount. In many positioners made by different manufacturers, it suffices to run a mostly automatic initialization routine to adapt the positioners to the valve's specific mounting position.

Going one step further: protected non-contact travel sensing

As described, external non-contact sensors do not comply with all requirements placed on positioners. This is why the valve manufacturer SAMSON takes a different approach. An AMR sensor fitted into the positioner housing is used for travel sensing (Fig. 2). The AMR sensor works free of wear. It can be used at all temperatures and measures the travel with reliability and precision. Just like in positioners with potentiometric sensors, the valve position is transmitted using a lever. The pick-up lever is mounted on a shaft that ends inside the positioner housing. Consequently, the magnet and sensor are protected against external influences. This makes these systems more rugged and their measurements more reliable than those of unprotected systems. In terms of mounting parts, positioners with protected systems do not differ from the versions fitted with potentiometric sensors. As a result, the proven mounting kits for easy attachment can still be used. SAMSON implemented the described setup for the first time in its Type 3725 Positioner. Only a few simple steps are necessary to directly attach the positioner to SAMSON's Type 3277 Actuator or to mount it on any globe valve according to IEC 60534-6-1. Attachment to rotary actuators according to VDI/VDE 3845 is just as easy (Fig. 3). A control valve equipped with such automation features complies with the strictest requirements. It is unaffected by environmental effects and steam hammering. Based on the positive experience made with the Type 3725, the non-contact AMR sensors will also be used in future positioner series engineered by SAMSON. For example in the new positioner that the company presented at the 2016 Valve World Expo trade show. This new positioner comes with valve diagnostics as well as other useful, innovative features. Stay curious for more innovations.

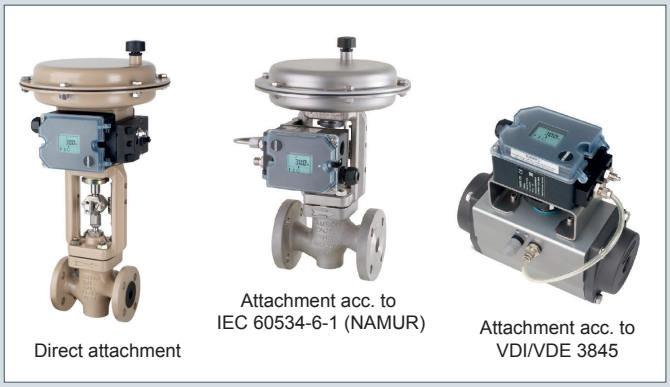

Fig. 3: Different types of attachment for Type 3725 Positioners with protected non-contact travel sensor

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2018-01 · WA 385 EN