Pressure-resistant switches for highly dynamic requirements

Pressure-resistant inductive proximity switches are used for a multitude of applications, especially in the field of hydraulics, as well as for various pressures (up to 500 bar). Pressure-resistance requires thick housing walls, particularly also at the sensing face. The main problem lays in providing an acceptable operating distance, despite the thick walls.


Picture 1: P20

Pressure resistance

The required pressure-resistance (up to 500 bar, and over) of Contrinex high-pressure-resistant proximity switches is obtained exclusively in the "direct way", i.e. by means of sufficient wall strength. At the sensing face, a ceramic disk of sufficient thickness to withstand pressure without further reinforcement measures inside the housing is used. Thus, no auxiliary constructions, such as for instance internal supports, are required. The entire electronic module, including the ferrite core and the coil, are placed in the pressure-free part of the housing. However, due to the thickness of the ceramic disk of 2.5 mm (P20), using a proximity switch module with a normal operating distance (in this case, 2 mm) would result in a usable operating distance of less than zero. The solution to this problem is described below.

Fixing and sealing of the sensing face

Pressure-resistance by necessity demands a seal which prevents harmful quantities of liquids and gases from entering the housing part under pressure, even at maximum operating pressures. Such a seal is particularly crucial between the ceramic sensing face and the metal housing.

In case of these Contrinex proximity switches, the housing is heat-shrunk unto the ceramic disk. Picture 2 shows the housing and the ceramic disk before and after assembly, and fig. 1 shows the parts in cross-section. Assembly is made by heating the housing in the joint area. This can, for instance, be achieved in a few seconds by means of induction heating. While the housing is still hot, the ceramic disk is inserted


Picture 2

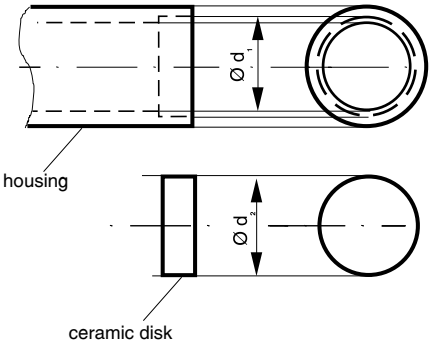

Fig. 1

without mechanical force. Then, the whole assembly is left to slowly cool down. Due to the higher temperature coefficient of metal, as compared to ceramic, the metal housing shrinks much more than the ceramic disk. With the appropriate choices of diameters d_1 and d_2, this results in a powerful force fit, which is, however, not yet sufficiently impervious. Gas-tight sealing is achieved by means of inserting a thin layer of copper between the housing and the ceramic disk (fig. 2). The entire housing is copper plated before the shrinking process, and stripped again after. At the joint, the copper remains. This, in conjunction with the shrinking process, which produces a pressure of up to

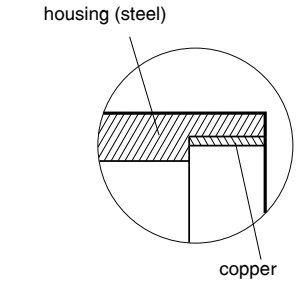

Fig. 2

200 N / mm^2 at the interface, results in an outstanding seal.

Operating distance

As mentioned above, an inadmissibly large part of the usable operating distance is lost, as a rule, due to the thickness of the ceramic disk. In order to nevertheless achieve a sufficiently long operating distance, an electronic module with long operating distance (approx. 3 times the norm, Condist® oscillator) is used, instead of the standard module. The for the type P20 resulting operating distance is with 3 mm still superior to that of a simple unit without a ceramic disk (2 mm).

Dynamic requirements

Conventional pressure-resistant proximity switches are only rarely suited for dynamic pressure requirements, since the usually used support systems and Teflon seals wear out after a limited number of pressure cycles. However, in practice, this kind of strain occurs frequently, especially in hydraulic systems. The Contrinex proximity switches are, in this respect, completely different. Due to their simple construction, in conjunction with the high pressure used to bond the housing onto the ceramic disk, they are completely insensitive to dynamic strain and pressure peaks.

Available models

For the present, the following models are available:

Picture 3

Picture 4

Advantages

- A virtually unlimited number of pressure cycles are permissible over the full pressure range.
- Long operating distances.
- Gas-tight at the sensing face.
- Easy mounting: For P20, just turn to stop. No setting required.

Applications

The Contrinex switches can replace other devices available on the market to advantage everywhere. Of particular importance are their easy installation and their long operating distances.

However, their application is particularly recommended where dynamic pressure strain is to be expected, such as for

- piston end-position monitoring in hydraulic cylinders;
- control and monitoring of hydraulic valve switching;
- rpm monitoring and measuring of hydraulic motors;
- control and monitoring of valve switching in gas distribution systems (the devices are gas tight);
- applications in high-vacuum.

Technical data:

(according to IEC 60947-5-2)

	P20	P12 / P18
Max. operating pressure	500 bar	500 bar
Max. peak pressure	800 bar	800 bar
Operating distance	3.0 mm	1.5 mm
Hysteresis	10 % typ.	10 % typ.
Supply voltage range U_B	10 ... 30 VDC	10 ... 30 VDC
Maximum ripple content	20 %	20 %
Output current	≤ 200 mA	≤ 200 mA
Output voltage drop	2.0 V max. at 200 mA	2.0 V max. at 200 mA
Switching frequency	500 Hz	600 Hz (P12) / 800 Hz (P18)
Operating temperature range	-25 ... + 80 °C	-25 ... + 80 °C
Degree of protection		
at sensing face:	IP 68	IP 68
connection side:	IP 67	IP 67
Housing material	Stainless steel V4A	Stainless steel V2A
Sensing face material	Ceramic ZrO_2	Ceramic ZrO_2
EMC protection:		
IEC 60255-5	1 kV	1 kV (P12) / 5 kV (P18)
IEC 61000-4-2	Level 2	Level 2
IEC 61000-4-3	Level 3	Level 3
IEC 61000-4-4	Level 2	Level 2

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Dipl. Ing. Peter Heimlicher studied electronics at the ETH in Zurich. In 1972, immediately after his studies, he founded Contrinex AG, of which he has been managing director ever since. His company is specialized in the manufacture of high-performance inductive and photoelectric proximity switches.