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Unequalled tolerance to knocks: Condet® proximity switches

The problem: mechanical damage of the sensing face

As a general rule, approximately 80% of inductive proximity switch failures in practice are caused by mechanical damage. This damage occurs almost exclusively at the most critical weak point of the devices, i.e. at the sensing face. In standard devices, the face is protected by a thin-walled plastic cap. Thicker walls would inevitably lead to shorter usable operating distances. Normally, these plastic caps are not very robust, and, moreover, they are mostly to be found in extremely exposed positions, i.e. close to moving parts. To further aggravate the situation, the field-generating element, the ferrite core and coil, is located directly behind the plastic cap. With respect to mechanical susceptibility, this ferrite core behaves similarly to a relatively delicate, easily breakable ceramic. Core breakage results in either total failure, or at least a drastic reduction of the device's performance.

Picture 1: Condet® proximity switch: mechanically severely damaged, but fully functional

The solution: stainless-steel one-piece housings

Series 700 devices from Contrinex, which function according to Condet® technology, are based on the principle of direct transformer coupling. Consequently, they do not require high operating frequencies (only in the order of 10 kHz), and as a result permit considerable wall thicknesses at the sensing face (picture 2). With a sensing-face wall thickness of 0.2 mm (size M8) to 1 mm (size M30), these proximity switches are extremely resistant to mechanical damage. By eliminating the plastic cap, the problems arising as a result of different thermal expansions of the materials used are also eliminated. Additionally, as a consequence of the transformer principle, possible core breakages, which even in this case, despite the outstanding mechanical protection, can never be completely excluded, do not appreciably influence the device's properties.

Picture 2: One-piece housing

Further important advantages of the one-piece housings are their absolute impermeability to gases and liquids at the sensing face and very high resistance to external pressure influences. Even standard devices are designed for a maximum pressure of 80 bars (size M12), connection side excluded.

The above-mentioned advantages of Condet® technology in no way detract from the other properties, in fact, quite the opposite. The achievable operating distances on steel remain largely unmatched by competitors' devices. On non-ferrous metals in particular, the operating distances of Contrinex's series 700 proximity switches are several times greater than those of conventional devices. Thanks to the long operating distances, the devices can be mounted further away from moving parts, which reduces the risk of mechanical damage to a minimum and considerably increases the operating reliability of installations. In addition, there are no reductions with respect to switching frequency, permissible temperature range, EMC, etc.

High mechanical resistance

The number of applications under difficult environmental conditions is constantly increasing. As a rule, where there are controls, sensors are not far away. However, while control systems can frequently be placed in protected places, this is not generally the case with sensors. These are inevitably found where positions and process parameters are to be detected, even when environmental conditions at the measuring point are extremely unfavorable. Despite this, users demand devices that also perform in such places - often under extreme conditions - in a trouble-free and permanent manner.

Based on a few chosen application cases taken from practical experience, the special advantages of proximity switches using Condet® technology will be demonstrated.

At the same time, these examples should help to avoid the most frequent problems, and prevent failures.

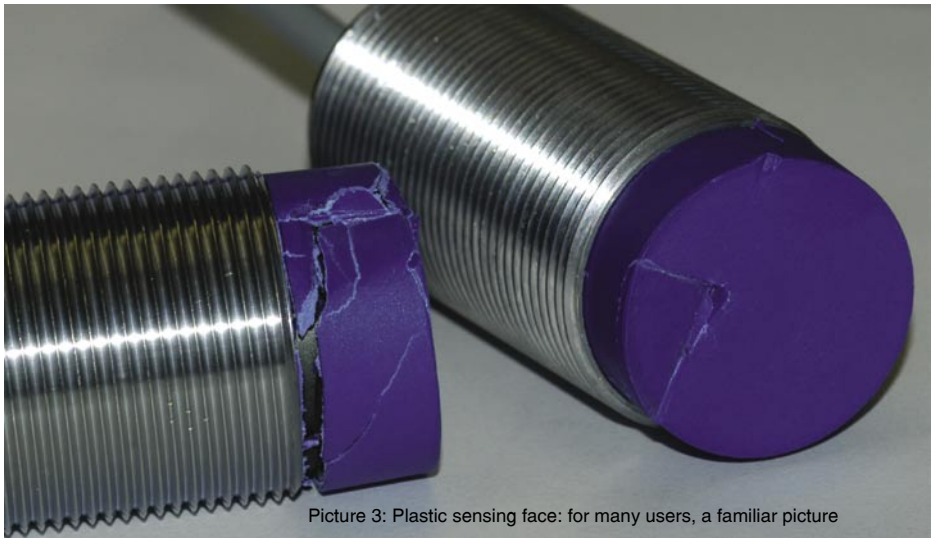
It would be desirable, when presenting these application examples, to show corresponding pictures and drawings. However, because they wish to protect their process know-how, users have proven to be extremely reticent in this respect. The author therefore assumes that readers will obtain sufficient information from purely textual examples.

Part recognition on a gripper

The transfer of parts to and from a large lathe center takes place by means of a gripper robot, the monitoring of whose arms is effected by conventional proximity switches. The operation is rough, and the devices had to be exchanged frequently, due to mechanical damage of the sensing face. Since series 700 proximity switches from Contrinex have been used, the situation has improved tremendously. On the one hand, these devices, with their one-piece stainless-steel housings, are mechanically very robust, and on the other, their long operating distances permit mounting at a considerably greater distance from moving parts, which in turn greatly reduces the risk of contact between the sensing face of the sensors and moving parts.

Part recognition in free fall

At a handling unit outlet, heavy steel disks fall close to a horizontally mounted conventional type of proximity switch which is used for counting. Some of these disks have a rim, and can moreover slightly rotate during their fall, frequently colliding with the face of the proximity switch. As a result of these contacts, the face cap especially of the detection device is already damaged after a short time, and the switch has to be replaced at great cost. Seeking better, and above all, less expensive solutions, the planning engineers and constructors came across Contrinex's series 700 proximity switches and, without further ado, replaced the previous switch by a device with a one-piece stainless-steel housing. Thanks to the long operating distance, the detection device could be mounted further back, which greatly reduced the contact frequency. Moreover, in the exceptional



Picture 3: Plastic sensing face: for many users, a familiar picture

case of contact, the mechanically robust sensing face of the Condet® proximity switch (of thick-walled stainless steel) resists much better than the previously employed proximity switch with a sensing face of easily damaged plastic. Since then, the failure rate has been negligible.

Detection of steel tubing

Hardened steel tubing is pressed by means of a hammer into an assembly jig and subsequently joined to other parts by electro-welding. In order to carry out the welding process, the tubing has to be detected by means of a proximity switch. In order to ensure safe detection, conventional proximity switches had to be mounted very close to the assembly jig, due to their short operating distances. However, since the tubing has very large tolerances, these detection devices frequently received mechanical knocks on the face and broke down every 1-2 weeks. After these devices had been replaced by Contrinex series 700 switches, the functioning period on the identical installation rose to around 7 weeks. Unfortunately, the user had overlooked the fact that, in addition to robust one-piece stainless-steel housings, the new devices had a much longer operating distance, which would have allowed him to mount them correspondingly further back. Since this discovery, the distance between the tubing and the sensing face of the sensor has been increased to such an extent that breakdowns should be a thing of the past.

Position enquiry for parts in a brewery

The position of stainless-steel components in a brewery has to be detected. The position of these elements is very inexact, so that sporadic mechanical contact with the proximity switch sensing face cannot be avoided. Consequently, the sensing faces of normal devices are mechanically destroyed. However, series 700 devices have resolved the problem to the complete satisfaction of the user. On the one hand, due to their longer operating distances, they can be mounted further away from the parts to be detected, so that the contact frequency is greatly reduced. On the other hand, thanks to the excellent resistance of series 700 devices to mechanical blows on the sensing face, reliability is further improved. Breakdowns have become a rarity.

Transport wagons

In an automated manufacturing installation, transport wagons have to be stopped at the end of the run. The end position used to be detected by means of a conventional M30 device, which in itself presents no problem. However, it occasionally happens that the goods transported get caught between the proximity switch and the wall and, as a result, the plastic sensing face of the proximity switch gets so badly damaged that the switch

has to be replaced. Since mechanically and electrically compatible series 700 devices have been used, there have been hardly any breakdowns.

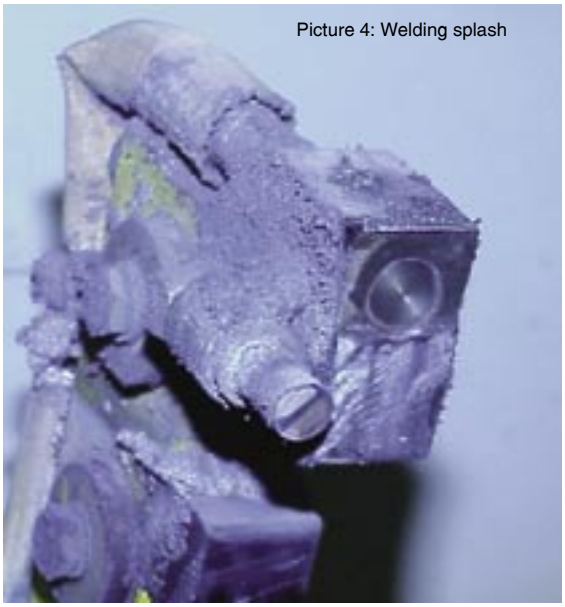
In another manufacturing installation, there were problems with the detection of transport wagons that are guided by means of embedded rails. The proximity switches (70 in all) are mounted flush with the floor, sensing face uppermost. Even when great attention is paid, it is unavoidable that, now and then, goods being transported fall off the wagons and onto the sensing faces of the proximity switches. As a result, standard devices frequently break down and have to be replaced at great cost. Some time ago, all 70 proximity switches were replaced by series 700 devices from Contrinex. Evaluation of the results after 12 months showed that many devices had suffered mechanical damage. However, not one single complete failure was recorded - even though, as before, transported goods had fallen on the Condet® proximity switches.

Garbage-collection trucks

For the detection of garbage bins, non-embeddable M30 standard proximity switches had previously been used. This was necessary in order to achieve a sufficient operating distance on the aluminum surface of the garbage bins. As a consequence, the rather fragile protruding plastic caps of these devices were frequently damaged. In addition, since the vehicles' charging zone is hosed down under high pressure and washed with aggressive cleaning agents daily, the breakdown frequency of the proximity switches was completely unacceptable. In the meantime, the switches have been replaced by series 700 devices from Contrinex. Thus, a sufficiently long operating distance (even on aluminum) has been achieved, even with embeddable executions. At the same time, installation of the proximity switches on the vehicles has also become considerably easier. Thanks to the extremely high resistance of the sensor heads to mechanical influences and aggressive cleaning agents, it has been possible to achieve unrivalled long-term stability of the detection devices.

Resistance to welding splashes

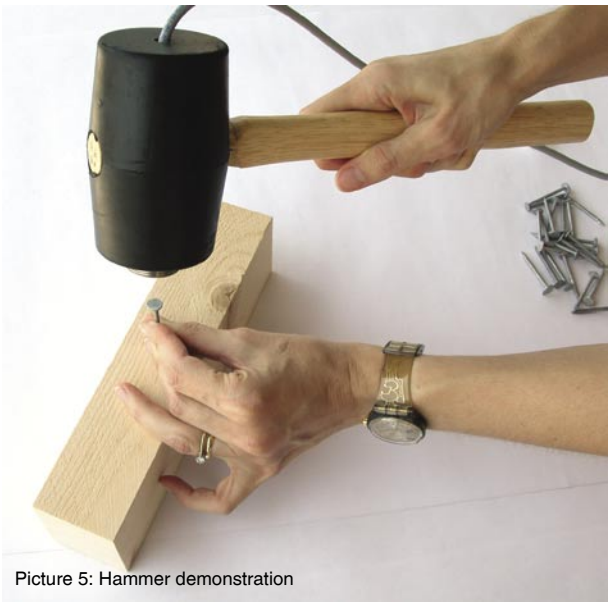
The proximity switches on the welding installation of a well-known car manufacturer are exposed to welding splashes that, after a certain time, form a compact coating on the proximity switches' sensing faces, thereby impairing their functioning. Even though PTFE-coated devices were used, the strongly adhering slag coating had to be regularly removed by hand. However, during the cleaning process, the protective PTFE coating was also partly removed, leading to the devices breaking down and having to be replaced every 2 to 4 weeks. After replacement of these previous proximity switches by series 700 ones from Contrinex, during a 30-month period, not a single breakdown occurred. The welding splashes adhere only moderately to the one-piece stainless-steel housings and, in addition, cannot eat into the stainless steel. When cleaning is nevertheless necessary from time to time, no special care has to be taken, thanks to the robustness of the housings.



Picture 4: Welding splash

A supplier to the automobile industry uses automatic welding machines to a great extent during the production of his accessories. The series 700 proximity switches used in the welding area are sometimes covered with so much slag that they can no longer be recognized. Despite these adverse conditions, functioning of the sensors is hardly affected, and the production process does not have to be interrupted (for instance, in order to clean the sensing faces). If cleaning nevertheless becomes necessary, even a very rough cleaning process cannot cause damage to the extremely resistant housings.

A manufacturer of household appliances also uses a number of automatic electrical-welding machines. The problem of welding splashes, and the slag coating on conventional proximity switches, could not be resolved satisfactorily either until a short time ago. The solution was brought about by the use of Contrinex's series 700 devices. Thanks to the long operating distances of these devices, they could be mounted further away. As a result, considerably fewer splashes reach their sensing faces, and the cleaning cost has been greatly reduced.



Picture 5: Hammer demonstration

Striking proof: the hammer demonstration

As a dramatic demonstration of the advantages described in the above examples, one of Contrinex's innovative sales engineers thought up a striking, in more than one sense of the word, way of providing proof: the hammer demonstration.

For this, a series 700 proximity switch (standard production sample) is built into the head of a conventional rubber hammer. For practical reasons, a size M30 device, connected to an equally standard proximity switch testing-device, is used. With this so-modified hammer, nails are hammered with force into a piece of wood, using the device's sensing face as the striking surface. The buzzer of the proximity switch testing-device confirms trouble-free functioning of the proximity switch before, during and after hammering.

The use of this hammer demonstration during exhibitions did not merely attract a lot of attention. It also demonstrated that such a hammer survives knocking in several thousand nails, even when they are sometimes hammered in crookedly by some less-than-skilful visitors. Then, it is often not even the sensor that has to be changed! Surprisingly, it usually outlasts the rubber hammer without problem, as the latter eventually disintegrates after being badly maltreated by some not particularly accurately-aiming visitors.

Neither does the proximity switch escape without traces of damage after such use. First of all, the sensing face becomes notched, then more and more dented (1 ...2 mm deep!). As the devices so mistreated show after subsequent dismantling, the ferrite cores are broken in many places, and in some cases, only a granular structure remains, held together to some extent exclusively by the device's potting compound. It is little short of a miracle that not only have the proximity switches survived, but also that their properties are scarcely altered.


Picture 6: Sensing face after 1,500 nails

Economic aspects

Series 700 devices are, admittedly, more expensive than standard devices - but in return, their operating reliability and lifespan is many times greater. In addition, if the overall cost situation, instead of the individual switch price, is taken into account, very significant economies can be made in many cases, and any thoughts concerning the additional price for the devices are quickly forgotten.

The author knows of cases where particularly exposed proximity switches had to be changed every couple of days, and this over many years. Despite intensive searching, it had not been possible to find any device equal to the task. The costs incurred as a result were many times greater than the cost of the actual devices. By using the extremely resistant series 700 devices from Contrinex, however, it has been possible to drastically reduce breakdowns, often eliminating them completely, within a short time. The economic benefit of using sensors optimized for specific environmental conditions is thus obvious.

Conclusion

Of course, even Condet® proximity switches are not completely indestructible. According to available, extensive application experience however, a drastic reduction in the number of replacements in all known difficult cases involving high failure rates can be expected. Therefore, wherever high demands on reliability and operating security have to be fulfilled, despite difficult environmental conditions, the use of Contrinex's series 700 proximity switches should be considered.

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.

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