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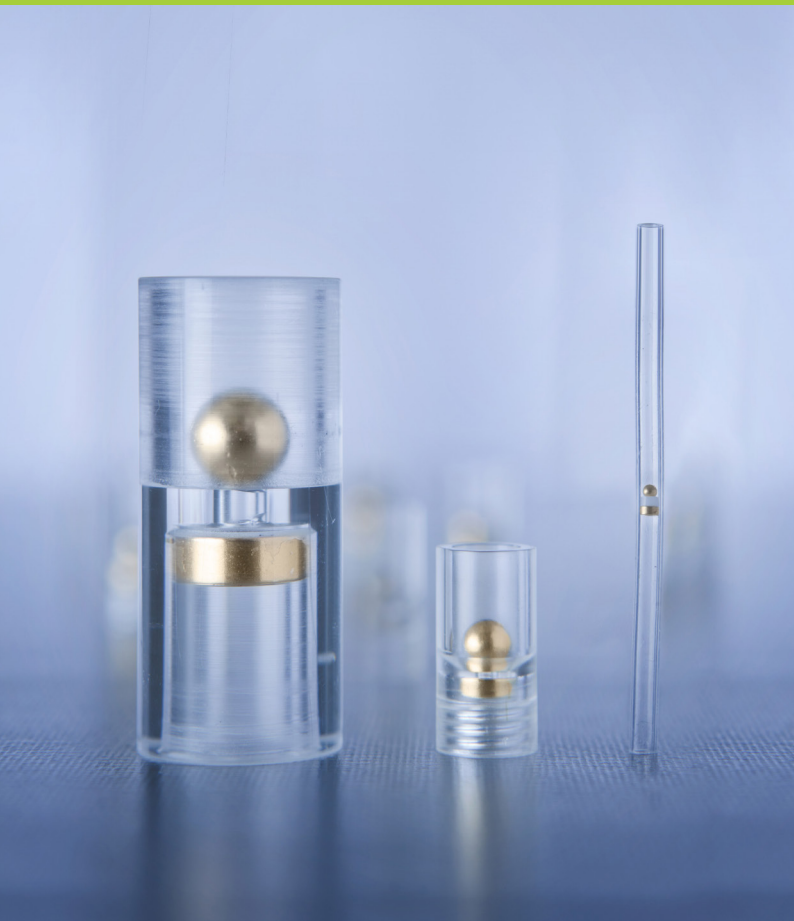
FRAUNHOFER INSTITUTE FOR
MANUFACTURING ENGINEERING AND AUTOMATION IPA

IPA.VALVE –
UNIVERSAL CLOSURE VALVE



Introduction

Liquids are dispensed in a number of situations: for example, washing with liquid soap, in bonding processes, dosing drugs or lubricating bearings. In most cases, a small but annoying amount of medium drips or run out on completion of the dispensing process. This tends to occur irrespective of the viscosity of the liquid, i. e. whether it is thin or thick, and is caused by a decrease in pressure taking place in the system and medium. If a closure valve is placed directly at the point of exit of the medium, it would close the aperture and prevent this from happening.

Solution

Fraunhofer IPA has developed and patented the IPA.VALVE. The valve can be implemented as an adaptable unit or be integrated into a product, for example, as a component to improve conventional systems such as widely-used time-pressure dispensers, or be built directly into a product, e. g. into the outlet of a container for liquids or the surface of a sliding bearing to be lubricated. It is also available as a disposable product.

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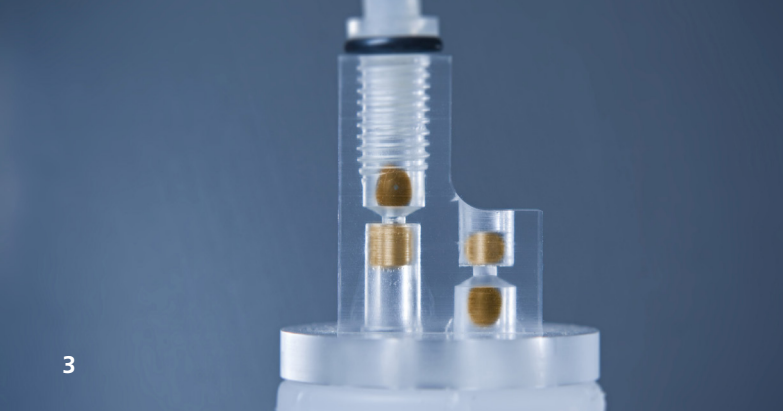
Design and functioning principle

The valve is composed of two opposing permanent magnets set in a valve housing. The magnet located at the inlet is fixed and ring-shaped to allow liquids to flow through it. In a normal state, the opposing ball-shaped magnet lies on the valve seat located between the two magnets but can be displaced radially to open the valve. The closing force can be adjusted to suit various applications by using different magnet pairs or by altering the distance between the two magnets.

There are two ways of opening the valve. The most suitable method depends upon the respective application. With the first method, the ball-shaped magnet can be radially displaced by increasing the feed pressure applied to the magnet by the pump. The pressure is raised to a level above the threshold value, the latter being determined by the magnetic force. The valve closes automatically as soon as feed pressure falls below the limiting pressure. This way reducing system pressure or evacuating medium from the nozzle become unnecessary. As the feed pressure does not need to be restored completely before each dispensing step, very short cycle times can be achieved.



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Instead of increasing pressure by way of the pump, the valve can also be activated in combination with a venting technique. Here, by specifically diverting part of the prevailing air pressure via a bypass, the feed pressure applied to the dispensing medium is kept below the threshold value. If, at a constant pump delivery rate, the volume of air emitted is decreased by closing the venting nozzle, the feed pressure rises to a level above the threshold value set on the pump and the valve opens. For example, this allows a dispensing system to be developed which self-actuates when the nozzle outlet nears the substrate surface with the valve closing in dependence upon the distance of the outlet from the surface. A system for dispensing processes on substrates moving relative to the nozzle can also be realized which enables them to start and stop without the need for a positioning sensor. Dispensing commences as soon as the foremost edge of the substrate passes the venting nozzle allocated to the dispensing nozzle, and continues as long as the substrate surface is in contact with the outlet. The process stops automatically as soon as the rearmost edge of the substrate passes the nozzle and the outlet is no longer obstructed.

1 *IPA.VALVE basic version.*
2 *Syringe with IPA.VALVE.*
3 *Wash bottle with dosing and vent valve.*

The other method of opening the valve is to use a supplementary external magnet. If it is arranged relative to the ball-shaped magnet in such a way that it counteracts the magnetic force created by the ring magnet, this results in a specific reduction in the threshold value. The valve is opened simply by applying a feed pressure set below the original threshold pressure. By arranging the magnet at the side, the ball can also be radially displaced so that the valve seat is no longer obstructed and the set feed pressure can be applied in full. This variation thus also permits position-dependent self-actuation of the valve on approaching the magnet in a defined way. For example, a roll cart used in a linear guide system and fitted with a trigger magnet passing a lubricating nozzle with an integrated closure valve at a specific point in the guide rail. In order to realize such a system, additional sensors are required to ascertain position and subsequently initiate the dispensing process via the controls.

TITEL *IPA.VALVE – from macro to micro.*

4 *IPA.VALVE multiple dispensing head.*

Applications and demonstrators

The possibility of miniaturizing, integrating and arranging several valves in an array makes the IPA.VALVE highly versatile and enables it to be used in a wide range of applications. The following applications mentioned below are all feasible and some have already been realized as demonstrators:

- Adaptable IPA.VALVE with inlet and outlet line attachment as disposable component
- Miniaturized IPA.VALVE as attachment for injection or dispensing needles
- IPA.VALVE multiple dispensing head
- IPA.VALVE fluid switch with separate external trigger magnets for each medium
- Self-actuating IPA.VALVE dispensing unit for system-integrated minimal quantity lubrication
- Air bearing with integrated IPA.VALVE nozzle array
- Packaging or container-integrated IPA.VALVE dispensing technology

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