Linear actuators made of silicone

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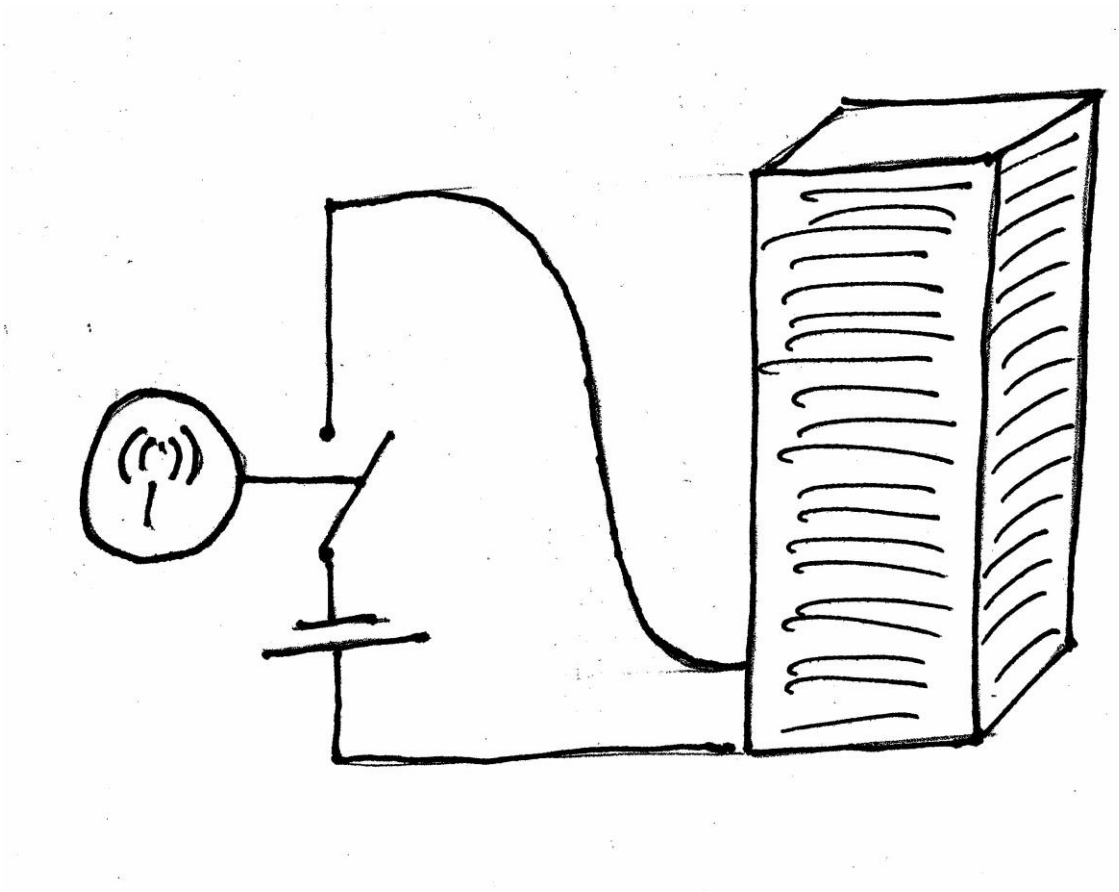
What comes to mind when you think of silicone? Joint sealant? Reusable baking tins? Implants? The material is very elastic, remains stable at low temperatures as well as at high temperatures and lasts a super long time. You probably know all this. But have you heard that silicones can also be used to make linear actuators? Structures like artificial muscles that contract when an electrical potential is applied and relax again just as quickly. Together with Momentive Performance Materials and Datwyler, we have set out to bring this Dielectric Elastomer Actuator (DEA) technology to market maturity. We can use it to replace small motor-gear units, very energy-efficient and maintenance-free. Or help you to build innovative products where the actuators become an integral part of the housing.

You probably remember the basic principle of physics from school: electrostatically charged surfaces attract or repel each other. Can you still remember how you charged a balloon on your hair or sweater and then not only did your hair stand on end, but the balloon stuck to the ceiling? If you now take two conductive plates, remove electrons from one and charge the other with electrons, these plates will attract each other. Stick a little silicone between the plates and the dielectric elastomer actuator is ready.

Of course, it's not quite that simple. In principle, however, you have just built a capacitor to which you can apply a high DC voltage in order to develop the attractive forces. Dielectric elastomer actuators from Datwyler are stacks of thousands of individual silicone layers with conductive coatings. There is a lot of know-how in the product and the manufacturing processes! The movement dynamics depend heavily on the base material used by Momentive Performance Materials and the dimensions of the stacks: the base area essentially determines the possible actuating force of the linear actuator; the length of the stack determines the distance traveled per applied voltage. The softer the silicone, the greater the travel and the lower the force. Datwyler's standard stacks, for example, have a maximum force of up to 20N and a compression of up to 8% of their length at rest. The typical operating voltages for these DEA stacks are around 800 volts.



Which brings us to the electrical properties and challenges. 800V sounds like a very high voltage at first, at least for domestic use. We know 230V from the socket, 12 V from the car battery and 5V from USB power supplies. Small standard batteries supply 3V or 1.5V. So is 800V unusually high, and perhaps even dangerous? For comparison: rubbing the balloon on the sweater from the example at the beginning can generate more than 10kV. Since we only have to charge a small capacitor with approx. 50nF and a relevant resistor, only a small current flows. The energy consumption of the DEA stack, especially for holding a position, is correspondingly low, as only parasitic losses need to be compensated.

To make the technology easy to use, we at BSC are developing a modular DEA control unit. In principle, this control unit does everything that is not done in conventional low-voltage electronic circuits: Generation and regulation of the high voltage; protection against overvoltage; charge, trickle charge and discharge management and much more. We also design the module so that it can be used with standard supply voltages in battery operation and is extremely energy-efficient. The movement of the DEA stack is controlled via a serial interface. We also ensure that DEA technology is easy to integrate into end products: the module and its interfaces meet the approval requirements in the voltage range used, and we also test EMC compatibility.

This means that all the building blocks for the use of DEA technology are available for use in products. We have compiled these in our BSCiDEA development kit so that you can easily evaluate the basic functions. However, we at BSC do not leave you to develop your product ideas alone: We are on hand with help and advice on how you can best integrate our Electronic Controls Unit and also the DEA stacks mechatronically into your end device. Or we can take over the contract development through to the production of customer-specific electronic and mechatronic solutions. We believe in sustainable motion through dielectric elastomer actuators!

Further information: www.bsc-idea.com

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