Pneumatic device for actuating organs

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Invention

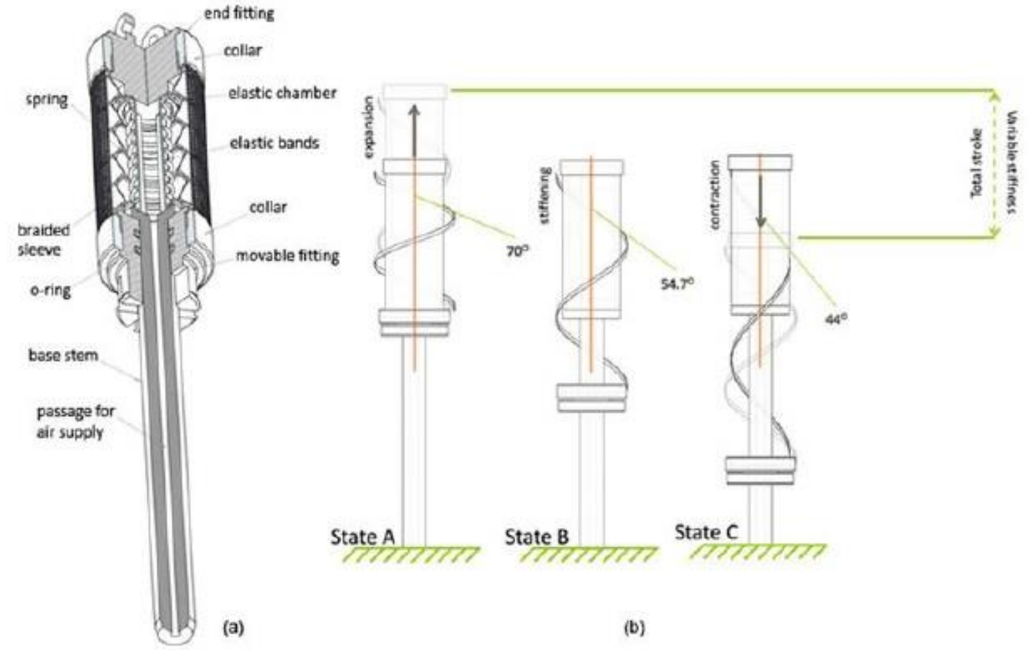
The device offered is a pneumatic braided muscle actuator, able to produce bi-directional force and motion, and variable stiffness. Pneumatic muscles are generally preferred thanks to their high power to weight ratio, light weight, ease of installation, hazard-free use and inherent compliance. The existing/traditional pneumatic muscle actuators has a fixed braid fiber angle and are usually able to produce a pulling uni-directional force when actuated. Conversely this actuator is able to achieve variable stiffness depending on the braid angle. Pneumatic artificial muscles usually consist of a hollow cylindrical elastomeric chamber covered by an outer braided sleeve, consisting of fibres made of un-stretchable material and arranged in an anti-symmetric helical configuration. The hollow internal chamber and the braided sleeve are tightly sealed and attached to rigid end fittings, a passage is provided through one of these end fittings for pressurizing the elastic chamber. The mechanical work done is transferred to an external system through these end fittings. The working principle of the Bi-directional actuator is based on the traditional pneumatic muscles but some fundamental changes enables the user to change the initial braid fiber angle independently. Depending on the braid angle, the actuator is able to produce extension and contraction upon pressurization, moreover the ability to change the initial braid fiber angle enables the actuator to achieve variable stiffness at each point along the total stroke of the actuator, whereas the traditional pneumatic muscles lack this ability.

The main advantages are:

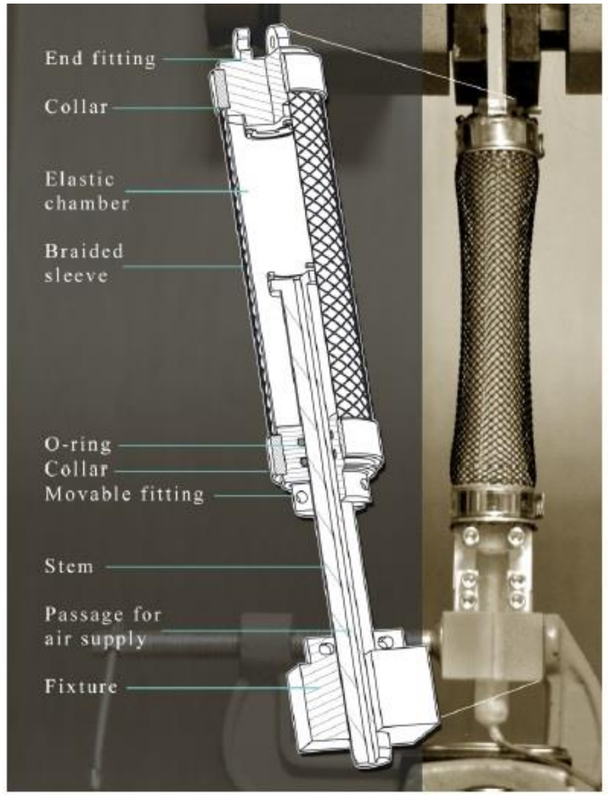
- Inherently compliant (good for human/ machine interaction from safety point of view);
- High power to weight ratio;
- Bi-directional force and motion;
- Able to achieve max and variable stiffness at each point along the total stroke of the actuator;
- No precise alignment required during installation due to the flexible body of the actuator.

IIT Istituto Italiano di Tecnologia is a co-owner of the patent.

Drawings & pictures



(a) CAD rendering showing the schematics of the design. (b) Actuator working concept. A single braid fiber is shown instead of the whole outer braided sleeve for clarity. State A



Industrial Applicability

The fields of application are:

- Rehabilitation robotics: robotic prosthesis or rehabilitation devices;
- Manipulation, locomotion, industrial automation;
- Automatic control of valves;
- Single revolute joint resulting in light weight designs, where the muscle can also be used to control the stiffness of the revolute joint.

Possible developments

The research group is interested in obtaining industrial collaborations aimed at increasing the technological maturity of the present invention or industrial partners interested in taking the license of the technology object of this patent.

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