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- (71) Applicant: **PARKER-HANNIFIN CORPORATION**  
[US/US]; 6035 Parkland Boulevard, Cleveland, OH 44124 (US).
- (72) Inventors: **YOO, Mikyong**; 1916 Louis Road, Palo Alto, CA 94303 (US). **LEONG, Weyland**; 355 Hamilton Street, San Francisco, CA 94134 (US). **QUAN, Xina**; 19100 Brook Lane, Saratoga, CA 95070 (US). **OBISPO, Anthony**; 580 Ahwanee Avenue SPC 69, Sunnyvale, CA 94085 (US).
- (74) Agents: **KUSS, William, E.** et al.; K&L Gates LLP, K&L Gates Center, 210 Sixth Avenue, Pittsburgh, PA 15222-2613 (US).
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**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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(54) Title: ELECTROACTIVE POLYMER ACTUATOR WITH IMPROVED PERFORMANCE

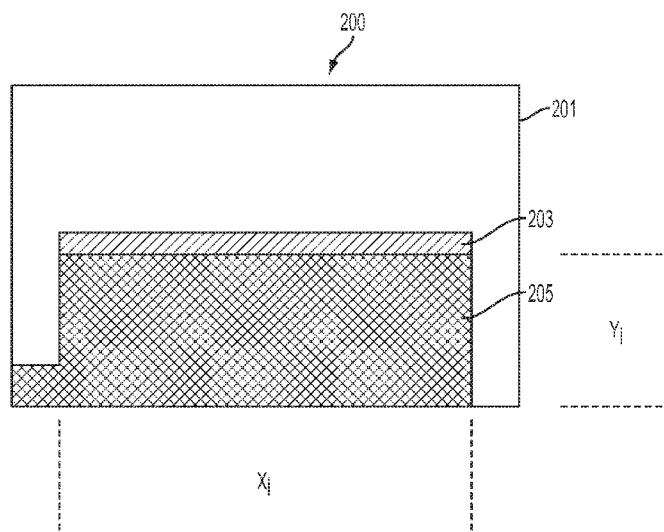


FIG. 2

(57) Abstract: An electroactive polymer transducer including a dielectric elastomer material having a first configuration with a first spring constant and a second configuration with a second spring constant and where the second spring constant is lower than the first spring constant.



## AMENDED CLAIMS

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**WHAT IS CLAIMED IS:**

1. An electroactive polymer transducer comprising:
  - a dielectric elastomer material having a first configuration with a first spring constant and a second configuration with a second spring constant;
  - wherein the second spring constant is lower than the first spring constant.
2. The electroactive polymer transducer of claim 1, further comprising an electrode, wherein the dielectric elastomer material comprises an active area and a passive area, wherein the electrode is coupled to the active area of the dielectric elastomer material and configured to couple to an energy source, and wherein the passive area comprises the second spring constant and the active area comprises the first spring constant.
3. The electroactive polymer transducer of any one of claims 1 and 2 further comprising:
  - the dielectric elastomer material having a first modulus of elasticity, a second modulus of elasticity, and a third modulus of elasticity; and
  - wherein the first modulus of elasticity is defined when the dielectric elastomer material is in a pre-strained state; and
  - wherein the second modulus of elasticity is defined when the dielectric elastomer material is under a first predetermined strain in addition to the pre-strained state; and
  - wherein the third modulus of elasticity is defined when the dielectric elastomer material is under a second predetermined strain in addition to the pre-strained state; and
  - wherein the second predetermined strain is greater than the first predetermined strain and the third modulus of elasticity is less than the second modulus of elasticity;
  - wherein the dielectric elastomer material is configured to operate in a modulus of elasticity range between the second modulus of elasticity and the third modulus of elasticity.
4. The electroactive polymer transducer of any one of claims 1 and 2, further comprising an output component coupled to the dielectric elastomer material.

5. The electroactive polymer transducer of claim 4, wherein the output component has a first configuration and a second configuration, wherein the first configuration of the output component comprises the output component coupled to the dielectric elastomer material when the dielectric elastomer material is in a first predetermined pre-strained state, and wherein the second configuration of the output component comprises the output component having an offset in a first direction such that the dielectric elastomer material is configured to operate in the modulus of elasticity range based on the offset of the output component.
6. The electroactive polymer transducer of claim 4, further comprising a spring device coupled to the output component.
7. The electroactive polymer transducer of claim 2, wherein a different spring constant between the passive area and the active area is achieved by adding an additive to at least one of the passive area and the active area.
8. The electroactive polymer transducer of claim 7, wherein the additive is chosen from a group comprising a plasticizer, a hardening agent, or ions.
9. The electroactive polymer transducer of claim 2, wherein the passive area and the active area are asymmetric in at least one material property.
10. The electroactive polymer transducer of claim 9, wherein the passive area has a first surface area and the active area comprises a second surface area, wherein the first surface area and the second surface area are different.
11. The electroactive polymer transducer of claim 3, wherein the pre-strained state comprises a pre-strain applied to the dielectric elastomer material and wherein the pre-strain is applied anisotropically.

12. The electroactive polymer transducer of claim 11, wherein the pre-strain applied to the dielectric elastomer material is applied in a first direction wherein the pre-strain applied in the first direction is greater than the pre-strain applied in a second direction, wherein the first direction is orthogonal to the second direction.

13. A method of manufacturing an electroactive polymer transducer comprising:

providing a dielectric elastomer material having a first modulus of elasticity, a second modulus of elasticity, and a third modulus of elasticity, the first modulus of elasticity being defined when the dielectric elastomer material is in a pre-strained state, the second modulus of elasticity is defined when the dielectric elastomer material is under a first predetermined strain in addition to the pre-strained state, the third modulus of elasticity is defined when the dielectric elastomer material is under a second predetermined strain in addition to the pre-strained state, wherein the second predetermined strain is greater than the first predetermined strain and the third modulus of elasticity is less than the second modulus of elasticity; and

pre-straining the dielectric elastomer material by a strain having a value between the second predetermined strain and the third predetermined strain;

attaching at least one electrode to the dielectric elastomer material, wherein the at least one electrode is configured to couple the dielectric elastomer material to an energy source.

14. The method of claim 13, further comprising adding a plasticizer to the dielectric elastomer material.

15. The method of any one of claims 13 and 14, further comprising adding ions to the dielectric elastomer material.

## STATEMENT UNDER ARTICLE 19 (1)

In Box No. VIII of the Written Opinion of the International Searching Authority (Written Opinion), claims 14 and 15 are alleged to refer to themselves, thereby rendering the definition of the subject matter of said claims unclear (PCT Article 6). It was also noted that the Written Opinion had been established on the assumption that claim 14 refers to claim 13, and claim 15 refers to claim 14. By these amendments, Applicant clarifies the subject matter of claims 14 and 15 by amending the dependencies thereof.