

DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:	PCT/US2015/030486
International filing date:	13 May 2015 (13.05.2015)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 61/992,610
	Filing date: 13 May 2014 (13.05.2014)
Date of receipt at the International Bureau:	25 May 2015 (25.05.2015)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

705780

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

May 24, 2015

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.

APPLICATION NUMBER: *61/992,610*

FILING DATE: *May 13, 2014*

RELATED PCT APPLICATION NUMBER: *PCT/US15/30486*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US61/992,610*



Certified by

Michelle M. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

Inventor 1

Remove

Given Name	Middle Name	Family Name	City	State	Country
Joshua	R.	Leonard	Noblesville	IN	US

All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

Title of Invention	ACTUATOR FLEXIBLE MEMBER WITH REACTION FEATURE
Attorney Docket Number (if applicable)	BAM0014.PROV

Correspondence Address

Direct all correspondence to (select one):

The address corresponding to Customer Number Firm or Individual Name

Customer Number: 48985

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

- No.
- Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:
- Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Entity Status**Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29**

- Applicant asserts small entity status under 37 CFR 1.27
- Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
- No

Warning

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Todd T. Taylor, Reg. No. 36945/			Date (YYYY-MM-DD)	2014-05-13
First Name	Todd T.	Last Name	Taylor	Registration Number (If appropriate)	36945

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that : (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to a n other federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ACTUATOR FLEXIBLE MEMBER WITH REACTION FEATURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to actuators, and, more particularly, to actuators with flexible members.

2. Description of the Related Art

[0002] Pneumatic actuators utilize pressurized gas, such as air, to push against workpieces. Pneumatic actuators are known that include a stiff base member and a flexible member connected to the base member, with an air chamber between the flexible member and stiff base member. When the air chamber fills with pressurized air, the pressure from the air forces the flexible member away from the stiff base member and allows the surface of the flexible member to produce work on a workpiece. The flexible member is structured so that it does not excessively expand in the radial direction due to pressurization.

[0003] What is needed in the art is an actuator with a flexible member.

SUMMARY OF THE INVENTION

[0004] The present invention provides an actuator with a flexible member that has a reaction feature which governs the flexible member's sidewall movement while maintaining appropriate levels of sidewall stiffness.

[0005] The invention in one form is directed to an actuator including a stiff base member defining a bottom of the actuator; a flexible member connected to the stiff base member and having a sidewall and a contact surface on top of the flexible member, the flexible member and the stiff base member defining a fluid chamber therebetween, the sidewall having a first end connected to the stiff base member and a second end, the second end and the contact surface

defining a transition area therebetween, the flexible member being configured to expand when the fluid chamber is filled with fluid pressure; and a reaction feature placed on the transition area that is configured to govern movement of the sidewall.

[0006] The invention in another form is directed to an actuator including a base; a flexible member connected to the base, the flexible member having a sidewall and a contact surface, an area between the sidewall and the contact surface defining a transition area; and a reaction feature placed on the transition area that is configured to govern movement of the sidewall.

[0007] The invention in yet another form is directed to a method of actuating a workpiece, including the steps of: providing an actuator including a base and a flexible member connected to the base that has a sidewall and a contact surface, an area between the sidewall and the contact surface defining a transition area; introducing a fluid between the base and the flexible member to put the actuator in an expanded state; removing at least some of the fluid; and pushing on the transition area to put the actuator in at least a partially collapsed state.

[0008] An advantage of the present invention is that it provides a reaction feature which can help return the flexible member to its collapsed position.

[0009] Another advantage is that the reaction feature can help the sidewall resist pivoting about the transition area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

[0011] Fig. 1 is a perspective view of an actuator known in the prior art in a collapsed position;

[0012] Fig. 2 is a perspective view of an actuator known in the prior art in an expanded position;

[0013] Fig. 3 is a perspective view of a flexible member of the present invention; and

[0014] Fig. 4 is a close-up sectional view of a flexible member of the present invention.

[0015] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the invention and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Referring now to the drawings, and more particularly to Figs. 1 and 2, there is shown an actuator 10 that is known in the prior art and which generally includes a stiff base 12 and a flexible member 14 connected to the stiff base 12. The flexible member 14 is connected to the stiff base 12 by a joint 16 formed on an edge 18 of the stiff base 12. A fluid chamber 20 is formed between the stiff base 12 and flexible member 14. An opening 22 formed in the stiff base 12 allows for fluid to enter and exit the fluid chamber 20. The fluid exerts a pressure, shown as arrow P in Fig. 2, that extends the flexible member 14 away from the stiff base 12.

[0017] The flexible member 14 is generally cylindrical in shape and has a contact surface 24 on its top that can produce work on a workpiece 26 when fluid pressure expands the flexible member 14 away from the stiff base 12. The flexible member 14 has a sidewall 28 that has convolutions 30 when the actuator 10 is in a collapsed state (as shown in Fig. 1). When the actuator 10 is in the expanded state (as shown in Fig. 2), which is caused by fluid pressure P, the convolutions 30 approach the profile of the sidewall 28 as it straightens to expand its length and push the contact surface 24 against the workpiece 26.

[0018] Referring now to Fig. 3, a flexible member 40 of the present invention is shown that can be used in place of the flexible member 14 shown in Figs. 1 and 2. The flexible member 40 of the present invention includes a sidewall 42 that has a first end 44 that connects to a stiff base member, which defines the actuator's bottom, and a second end 46 at the top of the sidewall 42. The flexible member 40 shown in Fig. 3 is in the contracted state and has convolutions 48 that arise in the sidewall 42 as a result of being contracted. These convolutions 48 can be absent in the sidewall 42 when the actuator is in an expanded state. The flexible member 40 has a contact surface 50, which will produce work against a workpiece when the actuator is in the expanded state. The contact surface 50, unlike the sidewall 42, will generally stay the same shape regardless of whether the actuator is in an expanded or contracted state. As can be seen, the contact surface 50 can be angled to produce a top surface 51 that will be the furthest part of the contact surface 50 from the bottom of the actuator 10 and be the primary surface of contact with an actuated workpiece. A transition area 52 is defined between the second end 46 of the sidewall 42 and the contact surface 50. The transition area 52 can be defined between a top edge 54 of the flexible member 40 and the contact surface 50. A reaction feature 56, shown in greater detail in Fig. 4, is placed on the transition area 52 and governs sidewall 42 movement and stiffness. As shown in Fig. 4, the reaction feature 56 is a protrusion of material of the sidewall 42 that is shaped as a wedge that follows the perimeter of the top edge 54. The reaction feature 56 can have a material distribution that changes across the transition area 52, such that the material distribution of the reaction feature 56 is greatest near the top edge 52 and decreases as it approaches the contact surface 50. When pressure is created in the fluid chamber, the flexible member 40 expands so that the contact surface 50 and reaction feature 56 press against an actuated workpiece, with the majority of the contact between the flexible member 14 and the actuated workpiece occurring at the top surface 51. At high enough pressure, the portion of the

sidewall 42 near the top edge 52 attempts to pivot about the transition area 54 as a result of pressure in the fluid chamber pushing on the flexible member 40, causing expansion, and the expansion being constrained about the top surface 51 by force from the actuated workpiece. As the material of the flexible member 40 expands and attempts to pivot about the transition area 54, the reaction feature 56 can come into contact with the actuated workpiece and force created by the actuated workpiece pushing on the reaction feature 56 impedes pivoting of the sidewall 42 near the top edge 52 and also helps to push the flexible member 40 back to its collapsed position when pressure in the fluid chamber is removed. A recess 58 can be formed on top of the flexible member 40 to reduce the chance of creating a heat sink during production of the flexible member 40. The flexible member 40 of the present invention can be formed of any material that can sufficiently expand and collapse to actuate a workpiece, such as flexible polymers.

[0019] While the reaction feature 56 is shown as being an integral part of the sidewall 42, it is also contemplated that the reaction feature 56 is included as a part of the actuated workpiece or as a separate piece that rests on the transition area 52. The reaction feature 56 can be continuous along its length and/or width or be segmented to alter the force distribution that is applied to the transition area 52. The reaction feature 56 does not need to be placed on the entire transition area 52 between the sidewall 42 and the contact surface 50, but can be placed on sections of the transition area 52 where pivoting about the transition area 52 is likely to occur and/or collapsing of the flexible member 40 is hindered. The reaction feature 56 can be made of the same material as the sidewall 42 or different materials that can sufficiently apply force to collapse the flexible member 40 and/or hinder pivoting about the transition area 52.

[0020] While this invention has been described with respect to at least one embodiment, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention

using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

WHAT IS CLAIMED IS:

1. An actuator, comprising:
 - a stiff base member defining a bottom of said actuator;
 - a flexible member connected to said stiff base member and having a sidewall and a contact surface on top of said flexible member, said flexible member and said stiff base member defining a fluid chamber therebetween, said sidewall having a first end connected to said stiff base member and a second end, said second end and said contact surface defining a transition area therebetween, said flexible member being configured to expand when said fluid chamber is filled with fluid; and
 - a reaction feature placed on said transition area that is configured to govern movement of said sidewall.
2. The actuator according to claim 1, wherein said reaction feature is a mass of material.
3. The actuator according to claim 2, wherein said mass of material is a protrusion of said sidewall.
4. The actuator according to claim 2, wherein said mass of material has a material distribution across said transition area, said material distribution being higher in an area adjacent to said second end than in an area adjacent to said contact surface.
5. The actuator according to claim 2, wherein said flexible member has a recess formed between said mass of material and said contact surface.

6. The actuator according to claim 2, further including an actuated workpiece, wherein said reaction feature is located on said actuated workpiece.

7. The actuator according to claim 2, wherein said reaction feature is segmented.

8. The actuator according to claim 1, wherein said sidewall includes at least one convolution between said first end and said second end.

9. The actuator according to claim 8, wherein said at least one convolution has an arced shape.

10. An actuator, comprising:

a base;

a flexible member connected to said base, said flexible member having a sidewall and a contact surface, an area between said sidewall and said contact surface defining a transition area;
and

a reaction feature placed on said transition area that is configured to govern movement of said sidewall.

11. A method of actuating a workpiece, comprising the steps of:

providing an actuator including a base and a flexible member connected to said base that has a sidewall and a contact surface, an area between said sidewall and said contact surface defining a transition area;

introducing a fluid between said base and said flexible member to put said actuator in an

expanded state;

removing at least some of the fluid; and

pushing on said transition area to put said actuator in at least a partially collapsed state.

ABSTRACT OF THE DISCLOSURE

The present invention provides an actuator including a stiff base member defining a bottom of the actuator; a flexible member connected to the stiff base member and having a sidewall and a contact surface on top of the flexible member, the flexible member and the stiff base member defining a fluid chamber therebetween, the sidewall having a first end connected to the stiff base member and a second end, the second end and the contact surface defining a transition area therebetween, the flexible member being configured to expand when the fluid chamber is filled with fluid; and a reaction feature placed on the transition area that is configured to govern movement of the sidewall.

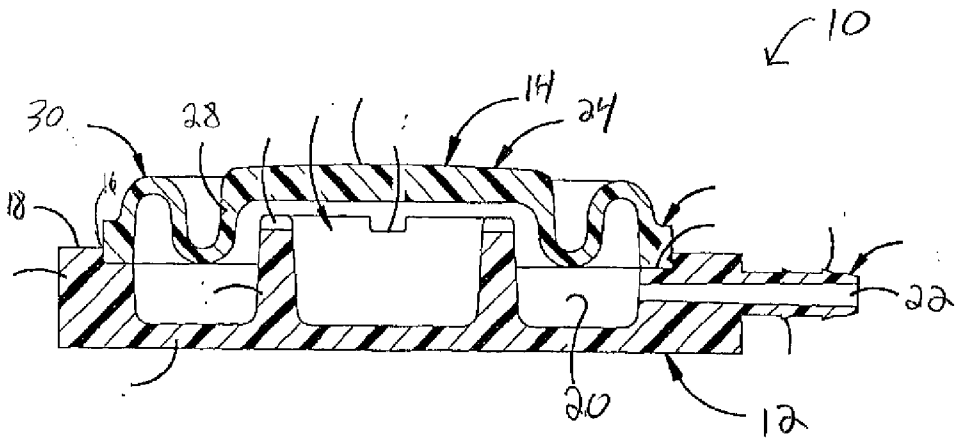


Fig. 1
Prior Art

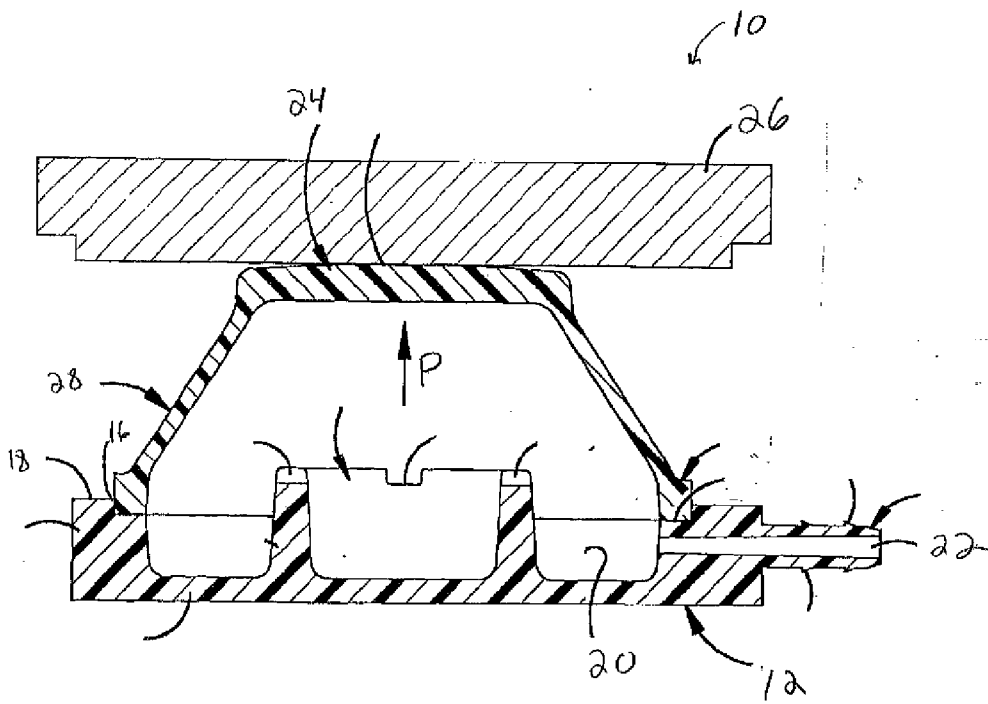
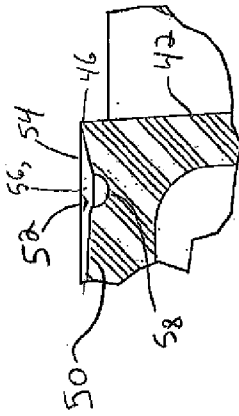
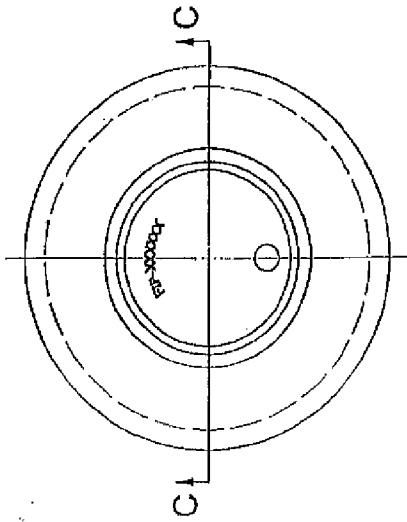


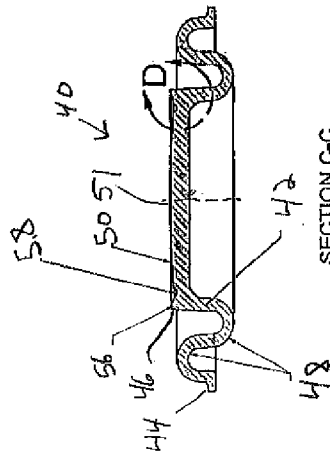
Fig. 2
Prior Art



TRANSITION AREA
DETAIL D
SCALE 4:1

Fig. 4

[Signature]
12/10/13



SECTION C-C
SCALE 1:1

Fig. 3

SHEET
2 OF 2

NO ANGLES PROHIBITED

DO NOT SCALE

NOTE AND TO

DATE

NO.

DESCRIPTION

REV

BY

DATE

TABLE OF REVISIONS

REV. DIMS.

SK00027 (BASE)

SK00023 (ASSY)

SK00021 (SC. R-10)

MATERIAL

UNLESS SPEC.

REMOVE BURRS

SHARP EDGES

THE DRAWING IS THE PROPERTY OF PRESTITEME INDUSTRIAL PRODUCTS CO., LLC
IT IS TO BE USED ONLY FOR THE PROJECT AND FOR THE QUANTITY SPECIFIED THEREIN.
IT IS TO BE RETURNED TO PRESTITEME INDUSTRIAL PRODUCTS CO., LLC UPON COMPLETION OF THE PROJECT.
THIS DRAWING IS THE PROPERTY OF PRESTITEME INDUSTRIAL PRODUCTS CO., LLC.
THE MANUFACTURER OF THIS DRAWING WILL BE HELD RESPONSIBLE FOR THE ACCURACY OF THE DRAWING.
PRESTITEME INDUSTRIAL PRODUCTS CO., LLC
INDIANAPOLIS, INDIANA

ACTUATOR FLEX MEMBER
REACTION FEATURE

PreStone
INDUSTRIAL PRODUCTS CO., LLC
INDIANAPOLIS, INDIANA

Drawn By: JBL
Date: 08/20/13
Checked: FULL
App'd By:

SK004169-

Electronic Acknowledgement Receipt

EFS ID:	19021793
Application Number:	61992610
International Application Number:	
Confirmation Number:	9670
Title of Invention:	ACTUATOR FLEXIBLE MEMBER WITH REACTION FEATURE
First Named Inventor/Applicant Name:	Joshua R. Leonard
Customer Number:	48985
Filer:	Todd T. Taylor
Filer Authorized By:	
Attorney Docket Number:	BAM0014.PROV
Receipt Date:	13-MAY-2014
Filing Date:	
Time Stamp:	16:55:01
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$260
RAM confirmation Number	3272
Deposit Account	060925
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Provisional Cover Sheet (SB16)	BAM0014PROVXMT.pdf	1477179 d53f8c0d9d9aa2a9b3583cb41cda7679cf6cf675f	no	3

Warnings:

Information:

2		BAM0014PROV.pdf	90036 f2e122dad183b26c7f5fd0f91d7c6d41e86950bb	yes	10
---	--	-----------------	---	-----	----

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	6
Claims	7	9
Abstract	10	10

Warnings:

Information:

3	Drawings-other than black and white line drawings	BAM0014PROVFIGS.pdf	40491 fb906a4a097b9ca3bc818ac1e95fd71c04206359	no	2
---	---	---------------------	---	----	---

Warnings:

Information:

4	Fee Worksheet (SB06)	fee-info.pdf	29415 de43b3afb4393c1e5ebb7c47ff713d63d1cb9a44	no	2
---	----------------------	--------------	---	----	---

Warnings:

Information:

Total Files Size (in bytes):			1637121		
-------------------------------------	--	--	---------	--	--

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

SCORE Placeholder Sheet for IFW Content

Application Number: 61992610

Document Date: 05/13/2014

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via eDAN using the Supplemental Content tab, or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.