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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

29270 7590 01/30/2024

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

EXAMINER	
DELISLE, ROBERTA S	

ART UNIT	PAPER NUMBER
3677	

NOTIFICATION DATE	DELIVERY MODE
01/30/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspatentmail@klgates.com

Meishan v. Howmet
IPR2026-00268
Ex. 1003-001

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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/423,980	30-Jan-2024	11885358

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
Pittsburgh, PA 15222-2613

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	01/30/2024	11885358	118508/US01/PCTNS/180639P	4184

29270 7590 01/10/2024

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 361 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Robert B. Wilcox, McGregor, TX;
James Thomas Smith, Crawford, TX;
Troy Don Pierce, Hewitt, TX;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

HOWMET AEROSPACE INC., Pittsburgh, PA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

29270 7590 11/09/2023
K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

TITLE OF INVENTION: BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/09/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
DELISLE, ROBERTA S	3677	411-043000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 K&L Gates LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: HOWMET AEROSPACE INC.
(B) RESIDENCE: (CITY and STATE OR COUNTRY): PITTSBURGH, PENNSYLVANIA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (*Please first reapply any previously paid fee shown above*)

☒ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 02-1818

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Robert J. Sovesky/ Date November 30, 2023

Typed or printed name Robert J. Sovesky Registration No. 73,798

Petitioner's Ex. 1003-005

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/423,980	**11/30/2023 03:08:04 PM Z ET**	**118508/US01/PCTNS/180639P**

Title of Invention

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Application Information

APPLICATION TYPE	Utility - U.S. National Stage under 35 USC 371	PATENT #	-
CONFIRMATION #	4184	FILED BY	Amanda Kernan
PATENT CENTER #	63440193	FILING DATE	07/19/2021
CUSTOMER #	29270	FIRST NAMED INVENTOR	Robert B. Wilcox
INTL. APPLICATION #	-	INTL. FILING DATE	-
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Robert Sovesky

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
11-30-2023-Issue fee transmittal.pdf	1	Issue Fee Payment (PTO-85B)	1640 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
11-30-2023-Issue fee transmittal.pdf	21DB9B89EAFCD874BD59544A97AE725F13E371C61AA2FBD87E1996DC63F47B8055E916E2445F93AC0816DD4F000E5B58BE57E6011432811DB948C65F4E9A58FF

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 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.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/423,980	11/30/2023 03:08:04 PM Z ET	118508/US01/PCTNS/180639P

Title of Invention

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Application Information

APPLICATION TYPE	Utility - U.S. National Stage under 35 USC 371	PATENT #	-
CONFIRMATION #	4184	FILED BY	Amanda Kernan
PATENT CENTER #	63440193	AUTHORIZED BY	Robert Sovesky
CUSTOMER #	29270	FILING DATE	07/19/2021
INTL. APPLICATION #	-	INTL. FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Robert B. Wilcox

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 021818	E2023ATF09297448	Amanda Kernan

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
021818	37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges); 37 CFR 1.492 (National application filing, search, and examination fees)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	$1,200.00

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.

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United States Patent and Trademark Office
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

29270 7590 11/09/2023

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

EXAMINER
DELISLE, ROBERTA S

ART UNIT	PAPER NUMBER
3677	

DATE MAILED: 11/09/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

TITLE OF INVENTION: BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/09/2024

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

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Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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29270 7590 11/09/2023
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K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

TITLE OF INVENTION: BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/09/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
DELISLE, ROBERTA S	3677	411-043000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Petitioner's Ex. 1003-011

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

29270 7590 11/09/2023

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

EXAMINER	
DELISLE, ROBERTA S	
ART UNIT	PAPER NUMBER
3677	

DATE MAILED: 11/09/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 1.14. This collection is estimated to take 30 minutes 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

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 another 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.

Notice of Allowability	Application No. 17/423,980	Applicant(s) Wilcox et al.	
	Examiner ROBERTA S DELISLE	Art Unit 3677	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Remarks filed 10/31/2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ROBERTA S DELISLE/
Primary Examiner, Art Unit 3677

Petitioner's Ex. 1003-014

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	**Art Unit**
	ROBERTA S DELISLE	3677

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/29/2023	11/06/2023							
	1	✓	=							
	2	✓	=							
	3	✓	=							
	4	✓	=							
	5	✓	=							
	6	✓	=							
	7	✓	=							
	8	✓	=							
	9	✓	=							
	10	✓	=							
	11	✓	=							
	12	✓	=							
	13	✓	=							
	14	✓	=							
	15	✓	=							
	16	✓	=							
	17	✓	=							
	18	✓	=							
	19	✓	=							
	20	✓	=							

Petitioner's Ex. 1003-015

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	**Art Unit**
	ROBERTA S DELISLE	3677

CPC							
Symbol						**Type**	**Version**
F16B	/	19	/	1054		F	2013-01-01
F16B	/	19	/	10		A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/ROBERTA S DELISLE/ Primary Examiner, Art Unit 3677	06 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20231106

Petitioner's Ex. 1003-016

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	**Art Unit**
	ROBERTA S DELISLE	3677

INTERNATIONAL CLASSIFICATION				
CLAIMED				
F16B	/	19	/	10

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
411	43

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/ROBERTA S DELISLE/ Primary Examiner, Art Unit 3677	06 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20231106

Petitioner's Ex. 1003-017

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	**Art Unit**
	ROBERTA S DELISLE	3677

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/ROBERTA S DELISLE/ Primary Examiner, Art Unit 3677 (Primary Examiner)	06 November 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No.: 20231106

Petitioner's Ex. 1003-018

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	Art Unit
	ROBERTA S DELISLE	3677

CPC - Searched*		
Symbol	Date	Examiner
F16B 5/04; 7/14; 19/10, 1054; 37/00, 04	08/29/2023	rsd
F16B 19/10, 1054	11/06/2023	rsd

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
411	43, 44-45, 54, 60.1	08/29/2023	rsd
411	43	11/06/2023	rsd

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventors name search	08/29/2023	rsd
Forward / backward citation searching	08/29/2023	rsd
Text searching	08/29/2023	rsd
Reviewed cited prior art of record	11/06/2023	rsd
Forward / backward citation searching	11/06/2023	rsd
Text searching	11/06/2023	rsd

Petitioner's Ex. 1003-019

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	Art Unit
	ROBERTA S DELISLE	3677

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
F16B	19/10, 1054	11/06/2023	rsd
411	43	11/06/2023	rsd

Petitioner's Ex. 1003-020

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	420	411/43.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:24 PM
L2	294	F16B19/10.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:27 PM
L3	766	F16B19/1054.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:29 PM
L4	5	("20130177365"|"20140271024"|"20170268556"|"20180207711"|"4376604").PN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:42 PM
L5	50	("1695303" | "2341598" | "3129630" | "4033222" | "4142439").pn. OR ("2018/0207711" | "2017/0268556" | "2014/0271024" | "2013/0177365" | "4376604").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:42 PM
L6	1	("2014/0271024").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:43 PM
L7	16	("3215026" | "3404596" | "3667340" | "3750525" | "3837208" | "4044591" | "4696610" | "5025128" | "6494652" | "20140271024").pn. OR ("9388843").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:43 PM
L8	15	"411".clas. AND (blind SAME (fastener OR rivet) SAME (without SAME breakneck))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:45 PM
L9	21	(blind SAME (fastener OR rivet) SAME (without SAME breakneck))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/11/06 01:46 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	239	F16B19/10.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/06 01:34 PM
N2	661	F16B19/1054.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/06 01:35 PM

Petitioner's Ex. 1003-021

N3	375	411/43.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/06 01:38 PM

Petitioner's Ex. 1003-022

Bibliographic Data

Application No: 17/423,980

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ROBERTA S DELISLE/ Examiner's Signature | Initials

Title: BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/19/2021	411	3677	118508/US01/PCTNS/180639 P
RULE			

APPLICANTS

HOWMET AEROSPACE INC., Pittsburgh, PA, UNITED STATES

INVENTORS

Robert B. Wilcox, McGregor, TX, UNITED STATES

James Thomas Smith, Crawford, TX, UNITED STATES

Troy Don Pierce, Hewitt, TX, UNITED STATES

CONTINUING DATA

This application is a 371 of PCT/US2019/016973 02/07/2019

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/11/2022

STATE OR COUNTRY

UNITED STATES

ADDRESS

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613
UNITED STATES

FILING FEE RECEIVED

$1,660

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Wilcox, *et al.*	:	
U.S. App. No.: 17/423,980	:	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
371(c) Date: July 19, 2021	:	
Art Unit: 3677	:	
Examiner: Roberta S. Delisle	:	Attorney Docket No. 118508/US01/ PCTNS/180639PCTUS
Confirmation No.: 4184	:	

RESPONSE TO OFFICE ACTION

VIA EFS-Web

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Response in reply to the Office Action issued on September 15, 2023 ("*Office Action*") for the above-identified patent application ("*Subject Application*"). In this Response:

Remarks begin on page 2.

Petitioner's Ex. 1003-024

REMARKS

I. Application Status

Claims 1-20 are pending and were subject to examination in the *Office Action*.

In the *Office Action*, the Office rejects claims 1-20 under 35 U.S.C. § 103 as allegedly unpatentable over U.S. Patent Application Publication No. 2014/0271024 to Jones ("*Jones*").

Applicant respectfully traverses the rejection. Applicant respectfully requests reconsideration, withdrawal of the rejection, and allowance of the *Subject Application*. References herein to numbered paragraphs in the "Specification" refer to the paragraph numbering in U.S. Patent App. Pub. No. 2022/0120306.

II. Rejections Under 35 U.S.C. § 103

The Office bears the burden to establish a *prima facie* case of obviousness in view of the *Graham v. John Deere Co.* factual inquiries.[1] In particular, the Office must (1) determine the scope and content of the prior art, (2) ascertain the differences between the prior art and the claims in issue, and (3) resolve the level of ordinary skill in the pertinent art.[2] "Once the *Graham* factual inquiries are resolved, [the Office] must determine the claimed invention would have been obvious to one of ordinary skill in the art."[3]

Independent Claim 1 and 16

Independent claim 1 recites, in part, "the pull region comprises an axial length no greater than 4 times a diameter of the shank region." FIG. 1 of the *Subject Application*, shown

[1] *See* MPEP 2143; MPEP 2144 (citing *Graham v. John Deere*, 383 U.S. 1, 17-18 (1966)); *see also KSR International v. Teleflex Inc.*, 127 S.Ct. 1727, 82 USPQ2d 1385 (2007).

[2] *See id.*

[3] MPEP 2141(III).

Petitioner's Ex. 1003-025

below, illustrates one non-limiting embodiment of a blind fastener including a pull region configured as recited in claim 1:

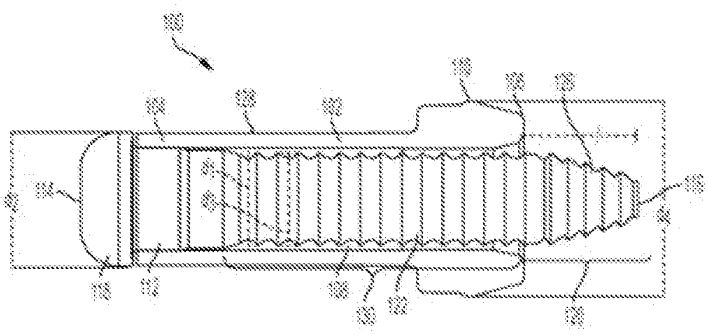


FIG. 1

The pull region comprising an axial length no greater than 4 times a diameter of the shank region can enable the pull region to remain intact after installation, which, in turn, reduces the shock force occurring during installation. As explained in Paragraph [0018] of the *Subject Application*, "[r]educing the installation force requirement and installing without a shock force occurring during fracture of the mandrel can enable lighter weight installation tools, longer life of installation tool components, limit damage to the structural components, and enhance ergonomics for operators using the installation tools."

The Office concedes on page 3 of the *Office Action* that *Jones* does not teach a pull region comprising an axial length no greater than 4 times a diameter of the shank region. However, the Office asserts on page 3 of the *Office Action* that "it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region." Applicant respectfully disagrees and asserts that the Office's reasoning is conclusory and therefore cannot support a *prima facie* case of obviousness.

Applicant asserts that the Office has not provided "an explanation of why it would have been routine optimization to arrive at the claimed invention and why a person of ordinary skill in the art would have had a reasonable expectation of success to formulate the claimed range", as would be required by MPEP § 2144.05(II)(B). The Office merely states that such a configuration

would have been obvious because "discovering the optimum or workable ranges involves only routine skill in the art," and that "discovering an optimum value of a result effective variable involves only routine skill in the art." *Office Action* at page 3. However, these statements are nothing more than conclusory.

Applicant notes that the Office has not provided any evidence or explanation as to why it would have been routine optimization to configure a blind fastener such that the pull region comprises an axial length no greater than 4 times a diameter of the shank region. The Office has not provided any teaching or suggestion of why or how one of ordinary skill in the art would arrive at an axial length no greater than 4 times a diameter of the shank region. Similarly, the Office provides no evidence that the axial length of the pull region is a result-effective variable, such that one of ordinary skill in the art would have been motivated to change the axial length of the pull region of the fastener in *Jones* to achieve the fastener recited in independent claim 1. Accordingly, the Office has not established a *prima facie* case of obviousness.

Applicant also asserts that *Jones* does not teach or suggest every element as recited in claim 1. For example, *Jones* does not teach a fastener that comprises a pull region comprising an axial length no greater than 4 times a diameter of the shank region, as recited in claim 1. For example, FIG. 3 of *Jones* is reproduced below.

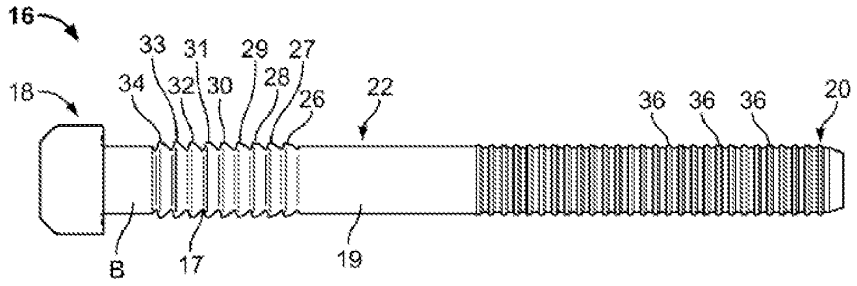


FIG. 3

As illustrated, *Jones*' pin 16 comprises a shank 22 and pull groves 36. *Jones* is silent with respect to the length of the section comprising the pull grooves 36. However, one of ordinary skill in the art reviewing *Jones* would believe that the section comprising the pull grooves is a standard length,

which has an axial length significantly greater than 4 times a diameter of the shank region.

However, even if the Office concludes that a *prima facie* case of obviousness has been established, Applicant asserts that the invention recited in independent claim 1 achieves unexpected results. As stated above, the pull region of the fastener recited in claim 1 can remain intact after installation and reduce the shock force occurring during installation. *Jones* does not teach this advantage and does not teach or suggest a fastener comprising a pull region comprising an axial length no greater than 4 times a diameter of the shank region. In fact, *Jones* explicitly teaches that "the installation force will break the pin." *Jones* at paragraph [0025]. Thus, the pull region comprising an axial length significantly greater than 4 times a diameter of the shank region as recited in claim 1 achieves results that would not have been achieved by or expected from *Jones*. Accordingly, any *prima facie* case of obviousness that may have been established is rebutted by the unexpected results achieved by the claimed invention.

The arguments herein for the patentability of claim 1 apply with similar or equal force to independent claim 16. Additionally, claims 2-15 and 17-20 are allowable at least because each directly or indirectly depends from independent claim 1 or 16, as the case may be. Accordingly, Applicant respectfully submits that the present Response fully addresses the § 103 rejection directed to claims 1-20, and Applicant respectfully requests that the office withdraw the rejection.

Dependent Claims 4 and 18 are Separately Patentable

Applicant further notes that dependent claim 4 recites that "the pull region comprises a taper extending from the shank region." As explained in paragraph [0035] of the *Subject Application*, such a taper can reduce the potential stripping of the grooves of the pull region due to crest-to-crest engagement, which can be particularly important when the size of the pull region is reduced because there are fewer threads/grooves that will be engaged by an installation tool. The pull region in *Jones* does not comprise a taper as recited by dependent claim 4. Accordingly, *Jones* does not teach or suggest every element of dependent claim 4.

The arguments herein for the patentability of claim 4 apply with similar or equal force to dependent claim 18. Accordingly, Applicant requests withdrawal of those rejections.

Petitioner's Ex. 1003-028

VI. Conclusion

Applicant submits that the claims of the *Subject Application* as presented herein are in condition for allowance. Applicant respectfully requests reconsideration and allowance of the *Subject Application*.

Applicant is not conceding that the claims of the *Subject Application* in their prior forms are not patentable. Applicant submits the present amended claims only to facilitate expeditious prosecution of the *Subject Application*. Applicant reserves the right to present the prior claims and other claims in continuing applications, subsequent responses, and/or appeal or pre-appeal proceedings. This Response should not be taken as acquiescence to any of the specific rejections, assertions, statements, and the like, presented in the *Office Action* that Applicant has not explicitly addressed herein. Applicant reserves the right to specifically address all such rejections, assertions, and statements in continuing applications, subsequent responses, and/or appeal or pre-appeal proceedings, if necessary.

If the undersigned can be of assistance to the Office in addressing any additional issues to advance the application to a condition of allowance, please contact the undersigned at the number set forth below. The Office is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No. 02-1818.

Respectfully submitted,

Date: October 31, 2023

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Petitioner's Ex. 1003-029

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Wilcox, *et al.*	
U.S. App. No.: 17/423,980	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
371(c) Date: July 19, 2021	
Art Unit: 3677	
Examiner: Roberta S. Delisle	Attorney Docket No. 118508/US01/PCTNS/180639PCTUS
Confirmation No.: 4184	

VIA ELECTRONIC FILING

October 31, 2023

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT TRANSMITTAL

1. Transmitted herewith is an amendment for this application.

STATUS

2. Applicant is

☐ A statement that this filing is by a small entity is hereby asserted in accordance with the rule change effective September 8, 2000, 65 Fed. Reg. 54603.

☒ other than a small entity.

Petitioner's Ex. 1003-030

EXTENSION OF TERM

NOTE: "Extension of Time in Patent Cases (Supplement Amendments) - If a timely and complete response has been filed after a Non-Final Office Action, an extension of time is not required to permit filing and/or entry of an additional amendment after expiration of the shortened statutory period.

If a timely response has been filed after a Final Office Action, an extension of time is required to permit filing and/or entry of a Notice of Appeal or filing and/or entry of an additional amendment after expiration of the shortened statutory period unless the timely-filed response placed the application in condition for allowance. Of course, if a Notice of Appeal has been filed within the shortened statutory period, the period has ceased to run." Notice of December 10, 1985 (1061 O.G. 34-35).

NOTE: See 37 CFR 1.645 for extensions of time in interference proceedings, and 37 CFR 1.550(c) for extensions of time in reexamination proceedings.

3. The proceedings herein are for a patent application and the provisions of 37 CFR 1.136 apply.

(complete (a) or (b), as applicable)

(a) ☐ Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

Extension (months)	Fee for other than small entity	Fee for small entity
☐ one month	$ 220.00	$ 88.00
☐ two months	$ 640.00	$ 256.00
☐ three months	$1,480.00	$ 592.00
☐ four months	$2,320.00	$ 928.00

Fee: $_____

If an additional **extension** of time is required, please consider this a petition therefor.

(check and complete the next item, if applicable)

☐ An extension for _____ months has already been secured and the fee paid therefor of $_____ is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request **$**

OR

(b) ☒ Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition for extension of time.

Petitioner's Ex. 1003-031

FEE FOR CLAIMS

4. The fee for claims (37 CFR 1.16(b)-(d) has been calculated as shown below:

(Col. 1)	(Col. 2)	(Col. 3)	SMALL ENTITY			OTHER THAN A SMALL ENTITY	
CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NO PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDIT. FEE	OR	RATE	ADDIT. FEE
TOTAL 20•	MINUS 20••	=0	X40=	$0		X100=	$0
INDEP. 2•	MINUS 3•••	=0	X192=	$0		X480=	$0
☐ FIRST PRESENTATION OF MULTIPLE DEP. CLAIM			+344=	$0		+860=	$0
			TOTAL ADDIT. FEE	$0	OR	TOTAL ADDIT. FEE	$0

- • If the entry in Col. 1 is less than entry in Col. 2, write ")" in Col. 3.
- •• If the "Highest No. Previously Paid for" IN THIS SPACE is less than 20, enter "20."
- ••• If the "Highest No. Previously Paid for" IN THIS SPACE is less than 3, enter "3."
  The "Highest No. Previously Paid for" (Total or indep.) is the highest number found in the appropriate box in Col. 1 of a prior amendment or the number of claims originally filed.

WARNING "After final rejection or action (§ 1.113) amendments may be made cancelling claims or complying with any requirement of form which has been made." 37 CFR § 1.116(a) (emphasis added).

Complete (c) or (d), as applicable)

(c) ☒ No additional fee for claims is required.

OR

(d) ☐ Total additional fee for claims required $_____

FEE PAYMENT

5. ☐ Attached is a check in the sum of $ _____

☐ Charge Account No._____ the sum of $_____

316943876.1

Petitioner's Ex. 1003-032

FEE DEFICIENCY

NOTE: If there is a fee deficiency and there is no authorization to charge an account, additional fees are necessary to cover the additional time consumed in making up the original deficiency. If the maximum, six-month period has expired before the deficiency is noted and corrected, the application is held abandoned. In those instances where authorization to charge is included, processing delays are encountered in returning the papers to the PTO Finance Branch in order to apply these charges prior to action on the cases. Authorization to charge the deposit account for any fee deficiency should be checked. See the Notice of April 7, 1986, (1065 O.G. 31-33).

6. ☒ If any additional extension and/or fee is required, charge Account No.

02-1818.

AND/OR

7. ☒ If any additional fee for claims is required, charge Account No.

02-1818.

/Robert J. Sovesky/
SIGNATURE OF ATTORNEY

Reg. No.: 73,798

Robert J. Sovesky
(type or print name of attorney)

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Customer No. 29270

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316943876.1

Petitioner's Ex. 1003-033

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/423,980	**10/31/2023 03:18:25 PM ET**	**118508/US01/PCTNS/180639P**

Title of Invention

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Application Information

APPLICATION TYPE	Utility - U.S. National Stage under 35 USC 371	PATENT #	-
CONFIRMATION #	4184	FILED BY	Amanda Kernan
PATENT CENTER #	63124200	FILING DATE	07/19/2021
CUSTOMER #	29270	FIRST NAMED INVENTOR	Robert B. Wilcox
INTL. APPLICATION #	-	INTL. FILING DATE	-
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Robert Sovesky

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
10-31-2023-Amendment Transmittal.pdf		4	Miscellaneous Incoming Letter	118 KB
10-31-2023-Response to NFOA.pdf		6	-	178 KB
10-31-2023-Response to NFOA-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	107 KB
10-31-2023-Response to NFOA-REM.pdf	(2-6)	5	Applicant Arguments/Remarks Made in an Amendment	170 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
10-31-2023-Amendment Transmittal.pdf	A206C8BC1F0D3B597A37D7F8740745BF9A302A807B5BE0A455ED8E4A2F380CEF41A8751B48082229F4537F70D3998E90B60A65ECA2B78EEED0C6E8975A450913
10-31-2023-Response to NFOA.pdf	10B0EAD356A243FB645C1961D33B10EBE67ACF5F0B6219D00A16E146D9C771B101022C7F1DBE6D53BFE5E777DD86976C483A0B190C398A599E54F3110E5DBA0F
10-31-2023-Response to NFOA-A....pdf	CCEDB01B0AD3B1D2C0D5A99AB35F92AF37D6F3586830DA6B524ADA2261E3025D0C64C646A269F8B9087BC1E57AA23C24D26CBE2A394BDC3B0F2499E6237EEFD0
10-31-2023-Response to NFOA-REM.pdf	C96638151AA32AD0A304F75FECFE6E906B40F238D57791CB5F995F21C9BBDC78C24306C235CC19014727B845585A918E74E0885B53D8D34050D2F176390B2E6D

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 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.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/423,980	Filing Date 07/19/2021	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	10/31/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JACQUELYN L WILLIAMS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 1.14. This collection is estimated to take 12 minutes 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/ PCTNS/180639P	4184

29270 7590 09/15/2023

K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

EXAMINER	
DELISLE, ROBERTA S	

ART UNIT	PAPER NUMBER
3677	

NOTIFICATION DATE	DELIVERY MODE
09/15/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspatentmail@klgates.com

Office Action Summary	Application No. 17/423,980	Applicant(s) Wilcox et al.	
	Examiner ROBERTA S DELISLE	Art Unit 3677	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 7/19/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 7/19/2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Petitioner's Ex. 1003-038

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

2. Claim Status:

   a. Claims 1-20 Pending

3. Prior Art Reference:

   b. Jones USPAP 2014/0271024 A1

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. **Claims 1-20 are rejected under 35 U.S.C. 103 as being unpatentable over Jones (USPAP 2014/0271024 A1).**

Regarding claim 1, Jones discloses a blind fastener (abstract) comprising:

a sleeve (12) comprising a first sleeve end (40; fig. 8),

a second sleeve end (38; fig. 8),

a cavity (14) extending from the first sleeve end (40) to the second sleeve end (38); and

a mandrel (16; figs. 3-4) configured to be at least partially received by the cavity (14) of the sleeve (12), the mandrel (16) comprising

a first mandrel end (18) disposed adjacent to the first sleeve end (40) and comprising an enlarged portion (figs. 3-4) having a diameter greater (fig. 2) than a diameter of the cavity (14),

a second mandrel end (20) comprising a pull region (36), and

a shank region (22) extending intermediate the first mandrel end (18) and the second mandrel end (20),

except for [wherein the pull region (36) comprises an axial length no greater than 4 times a diameter of the shank region (22)**]** and is configured to be engaged by an installation tool (¶ [0024]).

Examiner notes that Jones does not explicitly disclose wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region. However, it would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region limitation disclosed by Applicant, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller, 105 USPQ 233*. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)*. Refer to MPEP § 2144.05.

Regarding claim 2, Jones discloses the blind fastener of claim 1, **except for** wherein the pull region (36) comprises an axial length no greater than 3.8 times the diameter of the shank region (22).

However, it would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 3.8 times the diameter of the shank region limitation disclosed by Applicant, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller, 105 USPQ 233*. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)*. Refer to MPEP § 2144.05.

Regarding claim 3, Jones discloses the blind fastener of claim 1, **except for** wherein the pull region (36) comprises an axial length no greater than 2 times the diameter of the shank region (22).

However, it would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 2 times the diameter of the shank region limitation disclosed by Applicant, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller, 105 USPQ 233*. Further, it has been held that discovering an optimum value of a result

effective variable involves only routine skill in the art. *In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).* Refer to MPEP § 2144.05.

Regarding claim 4, Jones discloses the blind fastener of claim 1, wherein the pull region (36) comprises a taper (figs. 3-4) extending from the shank region (22).

Regarding claim 5, Jones discloses the blind fastener of claim 1, wherein the mandrel (16) does not comprise a breakneck groove (figs. 3-4).

Regarding claim 6, Jones discloses the blind fastener of claim 1, **except for** wherein the mandrel (16) comprises a Rockwell hardness of at least HRC 25.

However, it would have been an obvious matter of design choice wherein the mandrel comprises a Rockwell hardness of at least HRC 25, as Applicant has not disclosed that it solves any stated problem of the prior art or is for any particular purpose. It appears that the invention would perform equally well as the invention disclosed by Jones.

Regarding claim 7, Jones discloses the blind fastener of claim 1, **except for** wherein the mandrel (16) comprises a Rockwell hardness of at least HRC 43.

However, it would have been an obvious matter of design choice wherein the mandrel comprises a Rockwell hardness of at least HRC 43, as Applicant has not disclosed that it solves any stated problem of the prior art or is for any particular

purpose. It appears that the invention would perform equally well as the invention disclosed by Jones.

Regarding claim 8, Jones discloses the blind fastener of claim 1, wherein the shank region (22) comprises at least one of, a threaded region, an annular shoulder, and a groove (26-34 and 36).

Regarding claim 9, Jones discloses the blind fastener of claim 1, wherein the pull region (36) comprises at least one of a threaded region, an annular shoulder, and a groove (36).

Regarding claim 10, Jones discloses the blind fastener of claim 1, wherein the sleeve (12) is generally cylindrical (fig. 8) and the mandrel (16) is generally cylindrical (figs. 3-4).

Regarding claim 11, Jones discloses the blind fastener of claim 1, wherein the blind fastener (10) comprises at least one (¶ [0019]) of a metal, metal alloy, and a composite material.

Regarding claim 12, Jones discloses the blind fastener of claim 1, wherein the blind fastener (10) is adapted to be installed in a bore (fig. 9) in a structure (W1, W2), the bore (fig. 9) having a diameter greater (fig. 9) than the diameter of the enlarged portion (figs. 3-4).

Regarding claim 13, Jones discloses the blind fastener of claim 12, wherein the sleeve (12) further comprises a collar (38), the sleeve (12) is configured to deform on a first side of the structure (W1, W2), and the collar (38) is configured to swage onto the shank region (22) on an oppositely disposed second side of the structure (W1, W2).

Regarding claim 14, Jones discloses the blind fastener of claim 12, wherein the structure (W1, W2) comprises at least one (¶ [0024]) of a metal, a metal alloy, and a composite material.

Regarding claim 15, Jones discloses the blind fastener of claim 12, wherein the structure is configured as at least one of an aerospace component, an automotive component, a transportation component, and a building and construction component (¶ [0024]; "workpieces").

Regarding claim 16, Jones discloses a method for fastening, the method comprising:

inserting a first mandrel end (18) of a blind fastener (10) into a bore (fig. 9) in a structure (W1, W2), the blind fastener (10) comprising

a sleeve (12) comprising a first sleeve end (40; fig. 8),

a second sleeve end (38; fig. 8), and

a cavity (14) extending from the first sleeve end (40) to the second sleeve end (38), and

a mandrel (16; figs. 3-4) configured to be at least partially received by the cavity (14) of the sleeve (12), the mandrel (16) comprising

a first mandrel end (18) disposed adjacent to the first sleeve end (40) and comprising an enlarged portion (figs. 3-4) having a diameter greater (fig. 2) than a diameter of the cavity (14),

a second mandrel end (20) comprising a pull region (36), and

a shank region (22) extending intermediate the first mandrel end (18) and the second mandrel end (20),

except for [wherein the pull region (36) comprises an axial length no greater than 4 times a diameter of the shank region (22)**]** and is configured to be engaged by an installation tool (¶ [0024]);

engaging a collet of the installation tool ((¶ [0024]) with the pull region (36) of the blind fastener (10);

after the inserting, forcibly contacting the second sleeve end (38) of the blind fastener (10) with an anvil of the installation tool ((¶ [0024]) and moving the pull region (36) distal from the second sleeve end (38) utilizing the collet of the installation tool ((¶ [0024]); and

deforming (fig. 9) the sleeve (12) on a first side of the structure (W1, W2), and swaging (figs. 9-11) the second sleeve end (38) onto the shank region (22) on an oppositely disposed second side of the structure (W1, W2), thereby securing at least a portion of the blind fastener (10) in the structure (W1, W2).

Examiner notes that Jones does not explicitly disclose wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region.

However, it would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region limitation disclosed by Applicant, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller, 105 USPQ 233*. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)*. Refer to MPEP § 2144.05.

Regarding claim 17, Jones discloses the method of claim 16, **except for** wherein the pull region (36) comprises an axial length no greater than 3.8 times the diameter of the shank region (22).

However, it would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention, to contrive any number of desirable ranges wherein the pull region comprises an axial length no greater than 3.8 times the diameter of the shank region limitation disclosed by Applicant, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller, 105 USPQ 233*. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)*. Refer to MPEP § 2144.05.

Regarding claim 18, Jones discloses the method of claim 16, wherein the pull region (36) comprises a taper (figs. 3-4) or reverse taper extending from the shank region.

Regarding claim 19, Jones discloses the method of claim 16, wherein the mandrel (16) does not comprise a breakneck groove (figs. 3-4).

Regarding claim 20, Jones discloses the method of claim 16, wherein the blind fastener (10) comprises at least one (¶ [0019]) of a metal, a metal alloy, and a composite material.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERTA S DELISLE ("Bobbi") whose telephone number is (571)270-3746. The examiner can normally be reached M-F: 7 am - 3 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Victor D Batson can be reached on 571-272-6987. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ROBERTA S DELISLE/
Primary Examiner, Art Unit 3677

rsd

Notice of References Cited	Application/Control No. 17/423,980	Applicant(s)/Patent Under Reexamination Wilcox et al.	
	Examiner ROBERTA S DELISLE	Art Unit 3677	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20140271024-A1	09-2014	Jones; John W.	F16B19/1054	411/43
*	B	US-20130177365-A1	07-2013	Schneider; Stephan	F16B19/1054	411/43
*	C	US-4376604-A	03-1983	Pratt; John D.	F16B19/1063	411/54
*	D	US-20180207711-A1	07-2018	Wang; Pei-Chung	F16B19/086	1/1
*	E	US-20170268556-A1	09-2017	Koontz; Elaine	F16B19/1054	1/1
	F					
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	I					
	J					
	K					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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Petitioner's Ex. 1003-049

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	Art Unit
	ROBERTA S DELISLE	3677

CPC - Searched*		
Symbol	Date	Examiner
F16B 5/04; 7/14; 19/10, 1054; 37/00, 04	08/29/2023	rsd

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
411	43, 44-45, 54, 60.1	08/29/2023	rsd

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventors name search	08/29/2023	rsd
Forward / backward citation searching	08/29/2023	rsd
Text searching	08/29/2023	rsd

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Petitioner's Ex. 1003-050

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/423,980	Wilcox et al.
	Examiner	**Art Unit**
	ROBERTA S DELISLE	3677

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/29/2023								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
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	9	✓								
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	11	✓								
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	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

Petitioner's Ex. 1003-051

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Robert B. WILCOX
Art Unit	
Examiner Name	
Attorney Docket Number	118508/US01/PCTNS/180639P

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	51-101469	JP	U	1976-08-14	Huck Manufacturing Company		
	2	03-060608	JP	U	1991-06-14	Tokin Corp.		
	3	61-035214	JP	U	1986-03-04	Wakai & Co., Ltd.		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.S.D/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert B. WILCOX
	Art Unit	
	Examiner Name	
	Attorney Docket Number	118508/US01/PCTNS/180639P

	4	2014-029210	JP	A	2014-02-13	Newfrey LLC		
	5	10-2005-0037765	KR	A	2005-04-25	Hyundai Motor Company		X

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	International Search Report and Written Opinion for International Application No. PCT/US2019/016973 mailed November 7, 2019 10 pages.	

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EXAMINER SIGNATURE

Examiner Signature	/ROBERTA S DELISLE/	Date Considered	08/29/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	First Named Inventor	Robert B. WILCOX
	Art Unit	
	Examiner Name	
	Attorney Docket Number	118508/US01/PCTNS/180639P

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2021-07-19
Name/Print	Robert J. Sovesky	Registration Number	73798

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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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.

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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 the Freedom of Information Act requires disclosure of these record s.

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.

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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 another 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 inspections or an issued patent.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17423980
Filing Date	2021-07-19
First Named Inventor	Robert B. WILCOX
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	118508/US01/PCTNS/180639P

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	1	2015/033330	WO	A1	2015-03-12	INFASTECH IP PTE LTD	Corresponding to JP2016-535221	

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Petitioner's Ex. 1003-056

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

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Examiner Signature	/ROBERTA S DELISLE/	Date Considered	08/29/2023

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

CERTIFICATION STATEMENT

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☒ A certification statement is not submitted herewith.

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Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2022-09-07
Name/Print	Robert J. Sovesky	Registration Number	73,798

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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	1	2004/102016	WO	A1	2004-11-25	TEXTRON FASTENING SYSTEMS LIMITED		☐

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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Petitioner's Ex. 1003-060

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
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	Examiner Name	TBD
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	1		☐

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Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2022-07-14
Name/Print	Robert J. Sovesky	Registration Number	73,798

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Doc description: Information Disclosure Statement (IDS) Filed

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(Not for submission under 37 CFR 1.99)

Application Number	17423980
Filing Date	2021-07-19
First Named Inventor	Robert B. WILCOX
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	118508/US01/PCTNS/180639P

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4203346		1980-05-20	Hall et al.	
	2	4907922		1990-03-13	Jeal et al.	

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	1	2016/028489	WO	A1	2016-02-25	PRECISION TOWER PRODUCTS, LLC		☐

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	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

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Name/Print	Robert J. Sovesky	Registration Number	73,798

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	420	411/43.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 12:49 PM
L2	618	411/44-45.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 01:02 PM
L3	185	411/54.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 02:22 PM
L4	166	411/60.1.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 02:25 PM
L5	6379	((("WILCOX") near3 ("Robert")) OR (("SMITH") near3 ("James")) OR (("PIERCE") near3 ("Troy"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/08/29 02:28 PM
L6	2	("4203346" OR "4907922").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/08/29 03:15 PM
L7	762	f16b19/1054.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:20 PM
L8	293	f16b19/10.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:32 PM
L9	1082	f16b5/04.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:35 PM
L10	339	f16b7/14.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:41 PM
L11	956	f16b37/00.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:50 PM
L12	421	f16b37/04.cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/29 03:55 PM
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L14	50	("1695303" | "2341598" | "3129630" | "4033222" | "4142439").pn. OR ("2018/0207711" | "2017/0268556" | "2014/0271024" | "2013/0177365" | "4376604").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/30 11:21 AM
L15	1	("2014/0271024").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/30 11:21 AM
L16	1	("2013/0177365").urpn.	(US-PGPUB; USPAT;	OR	ON	ON	2023/08/30

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		AND (PGPB | USPT | USOC).dbnm.	USOCR)				11:21 AM
L17	1831	"411".clas. AND (blind SAME (fastener OR rivet))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/30 11:22 AM
L18	16430	(blind SAME (fastener OR rivet))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/30 01:54 PM
L19	48	L18 AND (without SAME breakneck)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/30 01:55 PM

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There are no Interference searches to show.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

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	1	2015/033330	WO	A1	2015-03-12	INFASTECH IP PTE LTD	Corresponding to JP2016-535221	

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	Art Unit	TBD
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Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2022-09-07
Name/Print	Robert J. Sovesky	Registration Number	73,798

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(72) **Inventors**: **BREWER, Jonathan**; 1 Kirby Road, Dunstable Bedfordshire LU6 3JH (GB). **HESANT, Carl**; 13 Crouchfield, Bengeo, Hertford Hertfordshire SG14 3LP (GB).

(74) **Agent**: **SCOTT & YORK INTELLECTUAL PROPERTY**; 45 Grosvenor Road, St. Albans, Hertfordshire AL1 3AW (GB).

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[Continued on next page]

(54) **Title**: LOCKBOLT

(57) **Abstract**: A lockbolt for installation into apertured workpiece members, comprising a pin having a head and a tail end provided with locking grooves and a single pull groove (20), wherein an installation tool having a collet with a corresponding shape to the pull groove is used to apply an increasing pulling force to the pin tail, thereby to push the collet towards the workpiece, and as the force applied by the hydraulic piston further increases, causing the collar (10) to be swaged into the lock grooves, and halting the force applied by the tool either at a predetermined maximum value or when the pin tail breaks at a breaker groove formed by the single pull groove.

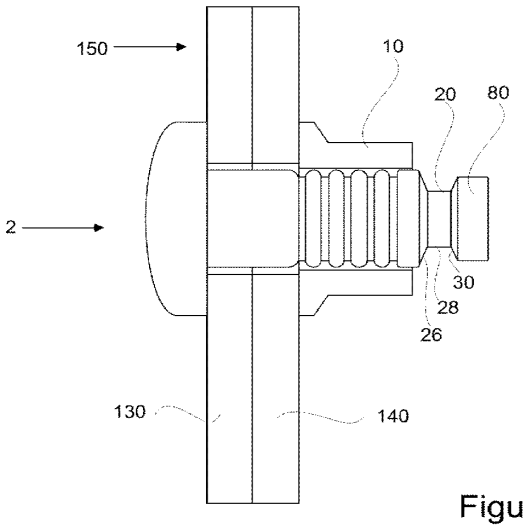


Figure 8

WO 2015/033330 A1

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Lockbolt

This invention relates to a lockbolt fastener for securing apertured workpiece members together.

A known lockbolt fastener, as disclosed in UK patent GB2444420 (Huck International Inc.), comprises a pin having a short, small diameter pin tail which does not break on installation of the fastener into a workpiece. The lockbolt of GB'420 comprises a plurality of pull grooves provided on the pin portion, which are engaged by a plurality of collet teeth provided on the installation tool.

A problem with the non-breakstem lockbolt fastener as disclosed in GB2444420 is that the crests of the teeth of the installation tool may not engage sufficiently with the shallow grooves provided on the pin, e.g. the crests of the teeth may be caused to close directly onto the crests of the pull grooves, which can cause increased loads and slippage, thereby causing damage to the tool and/or fastener.

It is also possible for the tool teeth not to engage all fastener pulling grooves in an axial direction, which can lead to overstressing and stripping of the loaded pulling grooves on the fastener.

The multiple pull grooves and tool teeth of the prior art embodiments are also sensitive to angled entry into the collet, therefore the operator is required to check that the fastener is correctly aligned within the collet before actuating the tool.

A further disadvantage of the current non-breakstem lockbolt fasteners such comprising a plurality of pull grooves is that the narrow, shallow pull grooves, and also the shallow pulling teeth on the tool, can easily become clogged with debris, particularly in dirty working environments. Fine pitch multiple groove collet teeth are also much more vulnerable to damage by sand and small stones common to the outdoor environments in which these

heavy duty lockbolt fasteners are often used (e.g. building of solar power plant structures in desert locations).

Manufacturing of multiple pull grooves lockbolts requires complex and therefore expensive thread rolling tooling, and the multiple pull groove forms generated on the pin are difficult and time consuming to inspect in production, therefore increasing time and cost of production.

Multiple collet teeth on an installation tool require small radii around the teeth, which increases stresses and leads to premature cracking. These teeth are also more complex to manufacture and inspect, and so are more costly.

Furthermore, any misalignment of the collet teeth and the pulling grooves, or pitch error between the teeth and the pulling grooves due to normal manufacturing tolerances, may result in an uneven distribution of pulling load and therefore generate higher localised stresses that lead to premature failure.

Some currently known non-breakstem lockbolt fasteners also include helical locking grooves into which the collars are swaged, which can be disadvantageous in that tampering or working loose could lead to the collar becoming unscrewed from the locking grooves.

Furthermore, the protruding end of the installed lockbolt could include sharp pull groove crests, therefore presenting a risk of injury to the operator or other personnel.

Known lockbolt fasteners can also include relatively wide locking grooves having a relatively high groove depth, i.e. a relatively broad pitch, thereby limiting the number of grooves, provided over the length of the locking portion. As the number of surfaces for interlocking with the collar when swaged is also therefore reduced, the overall strength of the installed lockbolt is accordingly limited. Furthermore, on swaging of the collar onto deep

locking grooves, incomplete filling of the grooves by the collar material can occur, thereby further reducing the overall strength of the installed lockbolt.

It is an aim of the present invention to provide a lockbolt which overcomes the above disadvantages.

Accordingly the present invention comprises, in a first aspect, a lockbolt in accordance with claim 1 of the appended claims.

As the present invention has only a single relatively large pull groove, rather than a plurality of relatively small pull grooves, this enables easier operator engagement of the tool with the pin, as angular alignment and axial positioning are less critical than with prior art embodiments comprising multiple pull grooves. On engagement of the tool with the lockbolt, the deep pull groove allows the lockbolt to be maintained in an initial position relative to the tool; even if the lockbolt is at an angle relative to the longitudinal axis of the tool, the angular positioning of the lockbolt will be corrected on actuation of the tool. Because alignment and positioning are less critical than with prior art embodiments, it is quicker and simpler for the operator to enter the pin into the tool nose, thereby leading to improved installation productivity.

The single pull groove of the present invention is less likely to become clogged with debris than the shallower multiple grooves of prior art embodiments.

The lockbolt of the present invention can be manufactured more simply and cheaply than prior art multiple pull groove lockbolts. It is also much less susceptible to manufacturing tolerances, as the groove is much larger/deeper than previous embodiments, and therefore the effect of tolerances is much reduced. Furthermore, no pitch error is possible with the single pull groove.

The locking portion is preferably parallel in form, i.e. having a constant major diameter along its length.

The locking grooves of the present invention are entirely, or substantially, annular in form, and so ensure that separation of the collar from the pin by an unscrewing action cannot occur after installation of the lockbolt, e.g. the collar cannot become separated from the pin via rotation.

Preferably, the pitch of the locking grooves is in the range 0.40mm to 2.13mm, and the ratio of the major diameter of the locking portion to the pitch of the locking grooves is in the range 11.15 to 12.01. The relatively fine pitch of the locking grooves provides a greater number of interlocked surfaces with the collar over the length of the swaged area. This provides an increased nominal strength of fastening compared to that of prior art embodiments having broader pitch locking grooves. Furthermore, the relatively shallow form of the locking grooves ensures each of the grooves are almost completely filled with collar material when the collar is swaged onto the pin tail, thereby further increasing the strength of the installed lockbolt in tension. A shallower locking groove also means that the root diameter of the locking grooves 18 is larger and hence the cross sectional area of the pin is increased for improved strength in both shear and tension.

Preferably, the contact surface of the single pull groove is provided by a tapered portion.

Preferably, the end section of the pin tail of the lockbolt is shorter than the locking portion, and has a maximum diameter which is smaller than a maximum diameter of the locking portion.

Preferably, the ratio of the minimum diameter of the single pull groove to the maximum diameter of the locking portion is within the range 0.50 to 0.78.

Preferably, the ratio of the maximum diameter of the end portion to the maximum diameter of the locking portion, is within the range 0.7 to 1.0.

Preferably the ratio of the total length of the pin tail over which the pull groove and the end portion extends, to the maximum diameter of the locking portion, is within the range 0.7 to 1.2.

Preferably, the ratio of the length of the pin tail over which the pull groove extends, to the maximum diameter of the locking portion, is within the range 0.3 to 0.7.

Preferably, the ratio of the length of the pin tail over which the end portion extends, to the maximum diameter of the locking portion, is within the range 0.26 to 0.5.

Preferably, the pull groove includes a first tapered section and a second tapered section and a plain portion between the first and second tapered section, the groove root having a constant cross-sectional area throughout its length. Alternative embodiments could feature alternative profiles of pull groove.

Preferably, the lockbolt includes a retaining feature, which retains the collar in an initial assembly position on the pin after the operator has placed the pin and collar in the workpiece and before the installation tool is actuated to install the lockbolt by swaging of the collar. The retaining feature ensures that the collar will not fall from the pin tail before installation can be effected, which is particularly advantageous in difficult working conditions, such as when the pin axis is vertical with the tail end pointed down. In addition the retention prevents accidental pushing of the pin back out of the collar as the tool nose is being engaged onto the pin tail by the Operator. Furthermore engaging the retaining feature ensures the pull groove protrudes sufficiently from the collar to allow engagement of the tool nose and collet.

The retaining feature may comprise a shallow axial slot or flat provided on the pin tail, which allows a tab provided on the throughbore of the collar to pass down to a first locking groove into which the collar tab can be rotated to engage, i.e. in a 'push-and-twist' motion.

The retaining feature may alternatively comprise a short helical screw thread provided on a section of the locking portion adjacent the pull groove, and a corresponding short screw thread, helix or tab provided in the throughbore of the collar which engage. In this embodiment, on installation of the lockbolt, the collar swages predominantly or entirely into the annular locking grooves beyond, therefore there is no risk of unscrewing of the collar and pin.

A further alternative retaining feature may comprise an elastomeric bead or ring, provided either on the throughbore of the collar or on the locking grooves of the pin tail.

The collar and pin are pushed together thereby compressing the resilient bead or ring and generating a frictional force to resist separation.

Each of the retaining features described above provides a sufficient degree of retention force to maintain the collar on the pin until the installation tool is used for the next stage of installation. When the installation tool is actuated, the retention force is overcome by the swaging stroke of the installation tool, and is weak enough not to adversely influence the sheet take-up and swaging action of the collar during installation into the workpiece.

The pin tail of the lockbolt may further include a stepped portion adjacent the pull groove and between the pull groove and the end face of the pin tail remote from the pin head, wherein the stepped portion has a greater cross-sectional area than that of the end portion. The stepped portion provides a pin tail geometry which spreads loads and stresses effectively, whilst avoiding excessive pin tail weight.

Furthermore, the stepped end aids insertion of the pin tail into the tool collet prior to actuation of the tool.

The lockbolt may further comprise full swage indications means, to provide a visual indication that, during installation of the lockbolt, the collar has been fully swaged onto the pin locking grooves. The full swage indication means may comprise one or more projections or protrusions provided on an outer surface of a flange of the collar which are partially or fully deformed by the anvil of the installation tool.

Alternatively, the full swage indication means could comprise one or more projections or protrusions provided on an end face of the anvil of the installation tool, which are caused to indent the outer surface of the collar flange on installation of the lockbolt.

The portion of the pin tail that remains protruding from the swaged collar of the installed lockbolt is free of sharp features and therefore presents a lower risk of personal injury than do the pintails of prior art embodiments having multiple grooves with sharp crests to each groove.

In an alternative embodiment, the pin tail is configured to be broken off during installation of the lockbolt in a workpiece. This embodiment is advantageous in situations wherein the added weight or length of a pin tail cannot be accommodated. Furthermore, this embodiment is advantageous when the material of the pin does not present a corrosion risk at the fracture surface, e.g. stainless steel or aluminium alloy pins.

In further aspects, the present invention also provides apparatus for, and a method of, installing a lockbolt in accordance with the present invention, and a method of manufacturing a pin in accordance with the present invention, including a step of rolling the pin thereby displacing material and forming a stepped portion adjacent the pull groove, towards the tail end. The flow of metal during the roll-forming provides superior strength of pin tail compared to, for example, a machine-cut groove.

The collet of the installation tool used in the present invention does not protrude beyond the front of the nosepiece, and therefore presents a much lower risk of operator injury than prior art embodiments as the collet pulls in and closes together. There is also less chance of collet damage if the tool is dropped heavily.

The relatively large internal lip of the collet of the present invention is also less likely to become clogged with debris, or damaged by sand and small stones in dirty/outdoor working environments than the multiple fine pitch collet teeth of prior art tools.

As the collet internal lip of the present invention does not require the small radii at the root of pull jaw teeth that are required with prior art multiple pulling jaw tools, stresses on the internal lip will be lower than in the jaws of prior art tools, and premature cracking is much less likely.

The installation tool may further comprise a depressible plunger, wherein the tool is disabled whilst the plunger is not depressed. This provides a safety feature as the tool cannot be actuated accidentally.

The plunger may have a rounded tip, and a dimple may be provided in the end face of the lockbolt pin tail, whereby the rounded tip of the plunger is engageable with the dimple. The engagement of the rounded plunger tip ensures that the pin tail is in the correct position within the installation tool, i.e. that it is inserted fully in the axial direction within the tool nose, before actuation of the tool, thereby preventing damage to the tool or harm to the operator.

Preferably, part of the collet of the installation tool has a shape complementary to at least part of the shape of the pull groove.

When installing a lockbolt wherein the pin tail includes a stepped portion as described above, the stepped portion effectively provides an additional surface (in addition to

the contact surface of the pull groove), for contact with the internal lip of the collet, thereby providing localised reinforcement of the pin tail on installation due to the greater cross-sectional area of the surface on which the installation tool contacts.

The lockbolt may further include a first plain portion between the pin head and the locking portion, and the ratio of the length of the first plain portion to the length of the locking portion is preferably within the range 0.62 to 1.27 for lockbolts having a grip capability of three times the nominal pin diameter. Ratios within this range ensure an increased shear strength of the lockbolt compared to one having a shorter plain section relative to the length of the locking portion due to the absence of locking grooves within the shear plane.

The invention will now be described by way of example only and with reference to the accompanying figures in which:

Figure 1 is a cross-sectional side view of a lockbolt according to the present invention inserted into a hydraulically powered installation tool ready for installation of the lockbolt into a workpiece (the workpiece is shown in later figures);

Figure 2 is a detailed cross-sectional view of the lockbolt and installation of tool of Figure 1 indicated as area II on Figure 1, with the retaining feature in an engaged condition;

Figures 2a and 2b are partial side views of the pin tail of alternative lockbolts in accordance with the present invention;

Figure 3a is a front view of the installation tool of Figure 1 (with the lockbolt removed for clarity), and illustrates at line I where a cross-sectional view is taken;

Figure 3b is a detailed view of part of the installation tool as indicated at area IIIb on Figure 3a;

Figure 4 is a cross-sectional view of the tool of Figure 3b along the line IV-IV, ready to install a lockbolt in accordance with the present invention;

Figures 5a and 5b are simplified side views of a lockbolt pin in accordance with the present invention, with collar retaining features removed for clarity;

Figure 5c is a simplified side view of a lockbolt collar in accordance with the present invention;

Figure 5d is a longitudinal cross-sectional view of an alternative lockbolt collar in accordance with the present invention including full swage indication means;

Figure 5e is an end view of the alternative lockbolt collar of Figure 5d;

Figure 5f is an isometric view of the alternative lockbolt collar of Figure 5d;

Figures 6 to 15 show stages of installation of a lockbolt in accordance with the present invention, the tool, workpiece and lockbolt being in cross-section or partial cross section;

Figure 16 shows an installation stage of an alternative embodiment of lockbolt in accordance with the present invention;

Figure 17 shows an installation stage of an further alternative embodiment of lockbolt in accordance with the present invention;

Figure 18a is an end view of the alternative collar of Figures 5d to 5f after installation (lockbolt pin and workpiece removed for clarity);

Figure 18b is a side view of the alternative collar of Figure 18a;

Figure 18c is an isometric view of the alternative collar of Figure 18a;

Figure 19a is an end view of an anvil of an alternative installation tool anvil portion in accordance with the present invention;

Figure 19b is an isometric view of the anvil of Figure 19a;

and

Figure 19c is a side view of the anvil of Figure 19a.

Referring to the figures, a lockbolt 2 in accordance with a first aspect of the present invention comprises a pin 4 comprising a pin tail 6 and a pin head 8, and a collar 10 having a throughbore 12 (Figure 7) and a flange 11 having an outer surface 13. The pin tail 6 includes a locking portion 36 comprising annular locking grooves 18, a first plain portion 14 between the locking portion 36 and the pin head 8, and a single pull groove 20 between the locking portion 36 and end face 22 of the pin tail 6 remote from the pin head 8. The locking portion 36 has a major diameter D, as shown in Figure 5b, and is parallel in form, i.e. it has a constant major diameter along its length. An end portion 80 is provided between the locking grooves 18 and the end face 22 of the pin tail 6. The end portion 80 is plain, and has parallel sides, i.e. a constant cross-sectional area throughout its length. Furthermore the end portion 80 is short, relative to the length of the locking portion 36, and is of a smaller maximum diameter than the maximum diameter of the locking portion 36. In an exemplary embodiment, where D is the maximum diameter of the locking portion 36, G is the minimum diameter of the pull groove 20 (in the embodiment shown in the figures, the minimum diameter of the pull groove 20 is at a groove root 28), and T is the maximum diameter of the end portion 80, the following applies:

G = 0.675 D (and more generally is within the range 0.50D to 0.78D);
T = 0.836 D (and more generally is within the range 0.7D to 1.0D).

Furthermore, wherein L is the total length of the pin tail 6 over which the pull groove 20 and end portion 80 extend, N is the length over which the end portion 80 extends, and M is the length over which the pull groove 20 extends, the following applies:

L = 0.936D (and more generally is within the range 0.7D to 1.2D);

M = 0.581D (and more generally is within the range 0.3D to 0.7D);

N = 0.355D (and more generally is within the range 0.26D to 0.5D).

Examples of length of the plain portion 14, the length of the locking portion 36, and the resulting ratio of first plain portion length to locking portion length, for a range of pins of nominal diameter ranging from 4.8mm (3/16") to 25.4mm (1") are provided in Table 1 below; in each case the pin length selected is one capable of fastening a total joint thickness of at least three times the nominal pin diameter. The ratio of the length of the first plain portion 14 on the pin tail, to the length of the locking portion 36, is typically in the range 0.62 to 1.27.

Nominal pin diameter (mm)	First plain portion length (mm)	Locking portion length (mm)	Ratio
4.8	8.81	14.13	0.62
6.4	14.67	17.71	0.83
7.9	17.56	20.52	0.86
9.5	20.60	23.10	0.89
12.7	29.98	31.58	0.95
15.8	36.33	36.63	0.99
19.0	49.03	43.13	1.14
22.2	61.73	48.39	1.28
25.4	68.08	53.59	1.27

Table 1

Examples of the major diameter D of the locking portion 36, the pitch of the locking grooves 18, and the resulting ratio of locking portion major diameter to locking groove pitch,

are provided in table 2 below, for a range of pins of nominal diameter ranging from 4.8mm (3/16") to 25.4mm (1"). The pitch of the locking grooves 18, is typically in the range 0.40mm to 2.13mm, and the ratio of the major diameter D of the locking portion 36 to the pitch of the locking grooves 18 is typically in the range 11.15 to 12.01.

Nominal pin diameter (mm)	**Locking portion major diameter (mm)**	**Lock groove pitch (mm)**	**Ratio**
4.8	4.65	0.40	11.62
6.4	6.06	0.53	11.36
7.9	7.61	0.67	11.41
9.5	9.26	0.80	11.57
12.7	12.45	1.07	11.67
15.8	15.57	1.40	11.15
19.0	18.67	1.57	11.85
22.2	21.97	1.83	12.01
25.4	25.10	2.13	11.76

Table 2

The single pull groove 20 includes a first tapered section 26, a second tapered section 30 (the second tapered section 30 being closer to the tail end 22 of the pin 6 than the first tapered section 26), and the groove root 28, having a constant cross-sectional area along its length between the first tapered portion 26 and the second tapered portion 30, i.e. the groove root 28 is parallel to the axis of the pin tail 6.

Figures 6 to 15 show successive stages of installation of a lockbolt 2 into apertures 120, 122 of a workpiece comprising workpiece members 130 and 140, including using an installation tool 100, thereby to secure the workpiece members 130 and 140 together.

Initially, the pin 4 is inserted by an operator by hand into the apertures 120, 122 of the workpiece members 130, 140, from the rear side 150 of the workpiece, as shown in Figure 6, until the underside 34 of the head contacts the rear surface 152 of the workpiece.

At this stage, part of the pin tail 6 protrudes from the front side 160 of the workpiece. The collar 10 is then fitted by hand onto the protruding end of the pin tail 9, from the front side 160 of the workpiece, as shown in Figure 7.

After the collar 10 has been fitted onto the pin 4, the collar 10 is positively retained in an initial assembly condition (or an engaged position) on the pin 4. This positive engagement is achieved by a retaining feature 24. In the embodiment as shown in Figures 1 and 2, the retaining feature 24 is a 'push-and-twist' type feature, comprising a shallow axial slot 56 provided on the pin tail 6, and a tab 52 provided on the throughbore 12 of the collar 10. The axial slot 56 allows the tab 52 to pass down to the first locking groove 18 of the locking portion 36; the collar is then rotated by 180° thereby causing the tab 52 to engage the first locking groove 18. In Figure 2, the retaining feature 24 is shown in an engaged position. For clarity, a retaining feature 24 is not shown in the installation sequence figures.

The retaining feature 24 provides a sufficient degree of retention force to maintain the collar on the pin until the installation tool is used for the next stage of installation. When the installation tool is actuated, the retention force is overcome by the swaging stroke of the installation tool, and is weak enough not to adversely influence the sheet take-up and swaging action of the collar 10 during installation into the workpiece.

The lockbolt 2 is then installed into the workpiece by use of the installation tool 100. The installation tool 100 includes a split collet 102 (Figures 10 to 14), surrounded by a nosepiece 108.

A sprung plunger 104 (Figure 11 to 14) having a rounded tip 114 (shown most clearly in Figures 11b and 11c) is provided within the installation tool 100, which engages with a dimpled recess 32 provided in the end face 22 of the lockbolt pin. The plunger is depressed by the end face 22 of the lockbolt pin 6 when the pin tail 6 is entered into the open collet 102. The engagement of the plunger 104 in the dimpled recess 32 ensures that the pin tail is in the correct position within the installation tool 100, i.e. that it is not tilted at an

unacceptable angle relative to the tool axis. Depression of the plunger 104 allows the operator to commence installation of the lockbolt 2. Unsafe operation of the tool with a pin tail incorrectly positioned inside the tool collet, or with no pin and thus a greater risk of entrapment to the operator, is thereby avoided.

Upon actuation of the installation tool 100, a hydraulic piston 106 (shown in Figure 1) exerts an increasing pulling force on the collet 102, thereby pulling the collet 102 into the tool 100, and thereby exerting a pulling force on the pin tail 6 via the pull groove 20. As the collet 102 is pulled into the tool 100, the tapered anvil portion 112 of the nosepiece 108 causes the collet 102 to close around the end of the pin tail 6, and an internal lip 110 of the collet 102 engages with the single pull groove 20, at the contact surface provided by second tapered section 30. In the embodiment illustrated herein, the internal lip 110 of the collet 102 has a shape complementary to at least part of that of the pull groove 20, i.e. complementary to the groove root 28 and the second tapered section 30 of the pull groove 20, therefore the collet 102 engages the plain groove root 28 and the second tapered section 30.

The pulling force which is applied to the collet 102 by the hydraulic piston 106 is transferred to the pin tail 6 via the contact surface provided by the tapered portion 30 of the pull groove 20. Therefore as the collet 102 is pulled into the tool 100, the pin tail 6 is also pulled in towards the tool 100.

Subsequently, as the collet 102 is pulled further into the tool 100 by the hydraulic piston 106, the anvil portion 112 of the nosepiece 108 comes into contact with the collar 10, and the collar 10 is progressively pushed by the anvil 112, in the direction of the pin head 8. The workpiece members 130, 140 are thereby pushed together, closing any gap between them, and a clamp load is applied to the workpiece. As the force applied by the tool 100 increases, the anvil portion 112 gradually swages the collar 10 down into the locking grooves 18 of the pin tail 6, i.e. the material of the collar 10 is forced into locking grooves 18.

The force applied by the tool, and thereby also the swaging of the collar 10 onto the locking grooves 18, is halted when the force reaches a pre-set maximum value. The hydraulic piston 106 then returns to its pre-actuation position and the anvil portion 112 retracts from the fully swaged collar 10. When the collar 10 has been fully swaged onto the pin tail 6, the collar is securely fixed to the pin 4 and the two components cannot become accidentally separated.

In the embodiment discussed above, the end of the pin tail 6 does not break off during installation of the lockbolt 2 into a workpiece. However, in the alternative embodiment of lockbolt 2' shown in Figure 16, the end portion 80' of the pin tail 6' is caused to break off during installation, as a result of the single pull groove 20' being deeper than the pull groove 20 of the first embodiment, i.e. the first tapered section 26' and the second section 30' are steeper than those of the first portion (and as a result the groove root 28' has a smaller diameter). The pull groove therefore acts as a breaker groove. In this embodiment, the installation tool applies a pulling force to the pin tail 6' until the pin tail fractures at the breaker groove / pull groove 20. The broken-off pin portion 80' is ejected from the installation tool 100 after the installation cycle. In this embodiment, the form of the internal lip 110 of the collet 102 (not shown in Figure 16) may not correspond to that of the pull groove 20', however the force of the tool will still be transferred to the pin tail 6' via the contact surface provided by the tapered section 30'.

In a further embodiment (not shown), the contact surface may be formed of an alternative feature of the pull groove, for example a shoulder, providing a contact surface 90º to the axis of the pin tail 6.

The retaining feature 24 may alternatively comprise a short helical screw thread 54 (shown in Figure 2a) provided on a section of the pin tail 6'' adjacent the pull groove 20, and a corresponding short screw thread, helix or tab provided in the throughbore 12 of the collar 10 into which the locking portion screw thread engages. As the collar 10 will be swaged

predominantly or entirely into the annular locking grooves 18 beyond, there is no risk of unscrewing of the collar and pin tail 6.

In a further alternative embodiment, the retaining feature 24 could comprise an elastomeric bead or ring, provided either on the throughbore 12 of the collar 10 or on the locking grooves 18 of the pin tail 6.

In alternative embodiments, a pull groove having a different profile, for example only being comprised of the two tapered sections 26 and 30 and not having a parallel groove root 28, i.e. a groove root having a constant cross-sectional area along its length, may be provided. An example of a pull groove 20'' having an alternative form is shown in Figure 2a. Similarly, the form, profile and shape of the installation tool collet 102 may also differ. More specifically the form of the internal lip 110 of the collet 102 may not correspond partially to that of the pull groove 20. However, contact will still be made between the internal lip 110 of the collet 102 and a tapered portion of the pull groove.

The end portion 80 of the pin tail 6 as discussed above is plain, with a constant cross-section area along its length. However the end portion 80 may have a different profile, such as alternative end portion 80'' shown in Figure 2a, including two tapered portions 82 and 84 and a shorter plain portion 86 between the tapered portions 82 and 84.

As shown in the alternative end portion of Figure 2b, the pin tail 6 may include a stepped portion 88 adjacent the pull groove 20''', towards the end portion 80'''. The stepped portion 88 has a greater cross-sectional area than the plain end portion 80'''. It is produced by material displaced during rolling of the pin tail 6 during manufacturing; the flow of metal during the roll-forming provides superior strength of pin tail 6 compared to, for example, a machine-cut groove. The stepped portion 88 provides a pin tail geometry which spreads loads and stresses effectively, whilst avoiding excessive pin tail weight.

The stepped portion 88 effectively provides an additional surface 90 (in addition to the contact surface of the pull groove 20''') for contact with the internal lip 110 of the collet 102, thereby providing localised reinforcement of the pin tail on installation due to the greater cross-sectional area of the surface on which the installation tool contacts.

Although the embodiment described above has a dimple provided in the end face of the lockbolt pin tail which is engaged by a plunger provided on the installation tool, in the alternative embodiment shown in Figure 17, the dimple and plunger are not present. Figure 17 illustrates a tool engaging a lockbolt wherein the longitudinal axis of the lockbolt is misaligned with that of the tool. Due to the depth of the single pull groove 20, the tool and lockbolt are maintained in engagement despite the angular misplacement. The angular alignment of the lockbolt 2 relative to the tool is corrected on actuation of the tool 100.

An alternative embodiment of lockbolt according to the present invention includes full swage indication means. In the example of Figures 5d to 5f, the full swage indication means comprises projections 58 provided on an outer surface 13' of a flange 11' of the collar 10'. On installation of a lockbolt, once the anvil portion 112 of the installation tool 100 has reached the projections 58, the projections 58 are caused to be at least partially deformed.

The projections 58 will not depress until the anvil portion 112 has reached a point such that the collar 10' has been fully swaged onto the pin tail 6. Accordingly, when the installation tool 100 is withdrawn from the lockbolt, the operator can check that the projections 58 have at least partially depressed, thereby confirming full swaging of the collar 10' onto the pin tail 6. Figures 18a to 18c show the collar of Figure 5d to 5f after installation (the lockbolt pin and workpiece into which the lockbolt is installed have been removed for clarity). Projections 58 have been partially deformed by the anvil portion 112. As three projections 58 are provided at equal distances around the collar 10', the operator can confirm that the collar 10' has been fully swaged onto the pin tail 6 around the entire circumference of the collar 10'.

In an alternative embodiment, as shown in Figures 19a to 19c, the full swage indication means comprises one or more projections 60 provided on an end face 59 of the anvil portion 112' of the tool, wherein the projections 60 are situated such that when the collar 10 has been fully swaged onto the pin tail 6, the projections 60 are caused to depress into the outer surface 13 of the flange 11 of the collar 10, thereby to indicate, on removal of the installation tool 100 from the lockbolt, that the collar 10 has been fully swaged onto the pin tail 6. Again, as three equally spaced protrusions 60 are provided, the operator can confirm that the collar 10 has been fully swaged onto the pin tail 6 around the entire circumference of the collar 10.

Claims

1. A lockbolt fastener comprising a collar and a pin;
the pin comprising a pin head and a pin tail adapted to be inserted though aligned apertures in workpiece members;
the pin tail comprising a locking portion comprising locking grooves, and only a single pull groove, the single pull groove including a first tapered section, a second tapered section and a plain portion between the first tapered section and the second tapered section, the single pull groove being provided between the locking portion and an end face of the pin tail remote from the pin head, and an end portion provided between the pull groove and the end face;
the collar being adapted to be fitted over the locking grooves and swaged onto the locking grooves, one of the tapered sections of the single pull groove providing a contact surface.

2. A lockbolt as claimed in claim 1, wherein the combined length of the pull groove and end portion is shorter than the locking portion, and has a maximum diameter which is smaller than a maximum diameter of the locking portion.

3. A lockbolt as claimed in claim 1, wherein the locking portion has a constant major diameter along its length.

4. A lockbolt as claimed in claim 1, wherein the locking grooves are annular in form.

5. A lockbolt as claimed in claim 1 wherein the ratio of the minimum diameter of the single pull groove to the maximum diameter of the locking portion is within the range 0.50 to 0.78.

6. A lockbolt as claimed in claim 1 wherein the ratio of the maximum diameter of the end portion to the maximum diameter of the locking portion is within the range 0.7 to 1.0.

7. A lockbolt as claimed in claim 1 wherein the ratio of the total length of the pin tail over which the locking groove and the end portion extends, to the maximum diameter of the locking portion, is within the range 0.7 to 1.2.

8. A lockbolt as claimed in claim 1 wherein the ratio of the length of the pin tail over which the pull groove extends, to the maximum diameter of the locking portion, is within the range 0.3 to 0.7.

9. A lockbolt as claimed in claim 1 wherein the ratio of the length of the pin tail over which the end portion extends, to the maximum diameter of the locking portion, is within the range 0.26 to 0.5.

10. A lockbolt as claimed in claim 1 wherein the plain portion of the pull groove has a constant cross-sectional area throughout its length.

11. A lockbolt as claimed in claim 1 further comprising a retaining feature to retain the collar in an initial assembly position on the pin.

12. A lockbolt as claimed in claim 11 wherein the retaining feature comprises a helical screw thread provided on a section of the locking portion adjacent the pull groove, and at least one corresponding screw thread, helix or tab provided in the throughbore of the collar into which the helical screw thread provided on the locking portion engages.

13. A lockbolt as claimed in claim 11 wherein the retaining feature comprises a shallow axial slot or flat provided on the pin tail, which allows a tab provided on the

throughbore of the collar to pass down to a first locking groove of the locking portion, into which the collar tab can be rotated to engage, in a 'push-and-twist' motion.

14. A lockbolt as claimed in claim 11 wherein the retaining feature comprises an elastomeric bead or ring, provided either on the throughbore of the collar or on the locking grooves of the pin tail.

15. A lockbolt as claimed in claim 1 wherein the pin tail further includes a stepped portion adjacent the pull groove and between the pull groove and the end face of the pin tail remote from the pin head, wherein the stepped portion has a greater cross-sectional area than that of the end portion.

16. A lockbolt as claimed in any one of the preceding claims further comprising a plain portion between the pin head and the locking portion, wherein the ratio of the length of the plain portion to the length of the locking portion is in the range 0.62 to 1.27 for pins of a length capable of fastening a total joint thickness of at least three times the nominal pin diameter.

17. A lockbolt as claimed in claim 1 further including full swage indication means.

18. A lockbolt as claimed in claim 17 wherein the full swage indication means comprises one or more projections provided on the outer surface of a collar flange, and wherein the projections are configured to at least partly deform or break off under the force of an anvil portion of an installation tool.

19. Apparatus for installing a lockbolt comprising a lockbolt according to claim 1, and an installation tool comprising a collet surrounded by a nosepiece, the nosepiece being provided with a tapered anvil section.

20. Apparatus as claimed in claim 19 wherein the installation tool further comprises a depressible plunger, wherein the tool is disabled whilst the plunger is not depressed.

21. Apparatus as claimed in claim 20 wherein the plunger has a rounded tip which is engageable with a dimple provided in the end face of the lockbolt pin tail.

22. Apparatus as claimed in claim 19 wherein part of the collet has a shape complementary to at least part of the shape of the pull groove.

23. Apparatus claimed in claim 19, wherein the tool further comprises at least one projection provided on the anvil portion, wherein the at least one projection is configured to deform an outer surface of a flange of the collar on installation of the lockbolt.

24. A method of installing a lockbolt according to claim 1 into a workpiece comprising apertured workpiece members thereby to secure the workpiece members together, using an installation tool comprising a hydraulic piston, a collet surrounded by a nosepiece provided with an tapered anvil section,

the method comprising steps of:

inserting the pin into the apertures of the workpieces from a rear side of the workpiece until the underside of the pin head contacts a rear side of the workpiece and the pin tail partially protrudes from a front side of the workpiece;

fitting the collar onto the protruding end of the pin tail from the front side of the workpiece;

actuating the tool thereby applying a pulling force to the collet, such that the anvil section of the nosepiece causes the collet to close and therefore engage the contact surface of the pull groove, thereby applying a pulling force to the pin tail via the pull groove,

and subsequently causing the collar to be pushed towards the workpiece members thereby to bring the workpiece members together,

and subsequently causing the tool anvil section of the nosepiece to apply a force to the collar, thereby to gradually swage the collar into the locking grooves of the pin tail.

25. A method as claimed in claim 24 wherein the force applied by the tool is halted when the force reaches a pre-set maximum value, wherein the anvil portion retracts from the collar.

26. A method as claimed in claim 24 wherein the force applied by the tool is halted when a part of the pin tail is caused to break off at the breaker groove formed by the pull groove.

27. A method as claimed in claim 24 wherein the lockbolt further comprises retaining means such that after the collar has been fitted onto the pin, and before the installation tool is used to install the lockbolt in the workpiece, the collar is maintained on the pin in an initial assembly condition.

28. A method as claimed in claim 24 wherein an outer surface of a flange of the collar is provided with one or more projections, and wherein after the collar has been fully swaged onto the pin tail during installation of the lockbolt, the anvil portion of the tool causes at least a part of the one or more projections to deform or break off.

29. A method as claimed in claim 24 wherein the tool anvil is provided with one or more projections, wherein after the collar has been fully swaged onto the pin tail during installation of the lockbolt, the one or more projections are caused to deform a portion of an outer surface of a flange of the collar.

30. A method as claimed in claim 24 further including a step of rolling the pin, whereby material of the pin tail is displaced to form a stepped portion, the stepped portion having a greater cross-sectional area than that of the end portion.

31. A tool for use in installing a lockbolt according to claim 1 into a workpiece comprising apertured workpiece members, the tool comprising a hydraulic piston and a collet, wherein on actuation of the tool, the collet moves from an open position to a closed position and is pulled into the tool by the hydraulic piston, and wherein the collet is configured to be closed around a lockbolt such that an internal lip engages the pull groove of the lockbolt and thereby causes the lockbolt to be pulled into the tool.

32. A tool as claimed in claim 31 wherein the internal lip additionally engages a surface of a stepped portion provided adjacent the pull groove and between the pull groove and the end face of the pin tail remote from the pin head, wherein the stepped portion has a greater cross-sectional area than that of the end portion.

33. A lockbolt substantially as hereinbefore described and with reference to the accompanying figures.

34. Apparatus substantially as hereinbefore described and with reference to the accompanying figures.

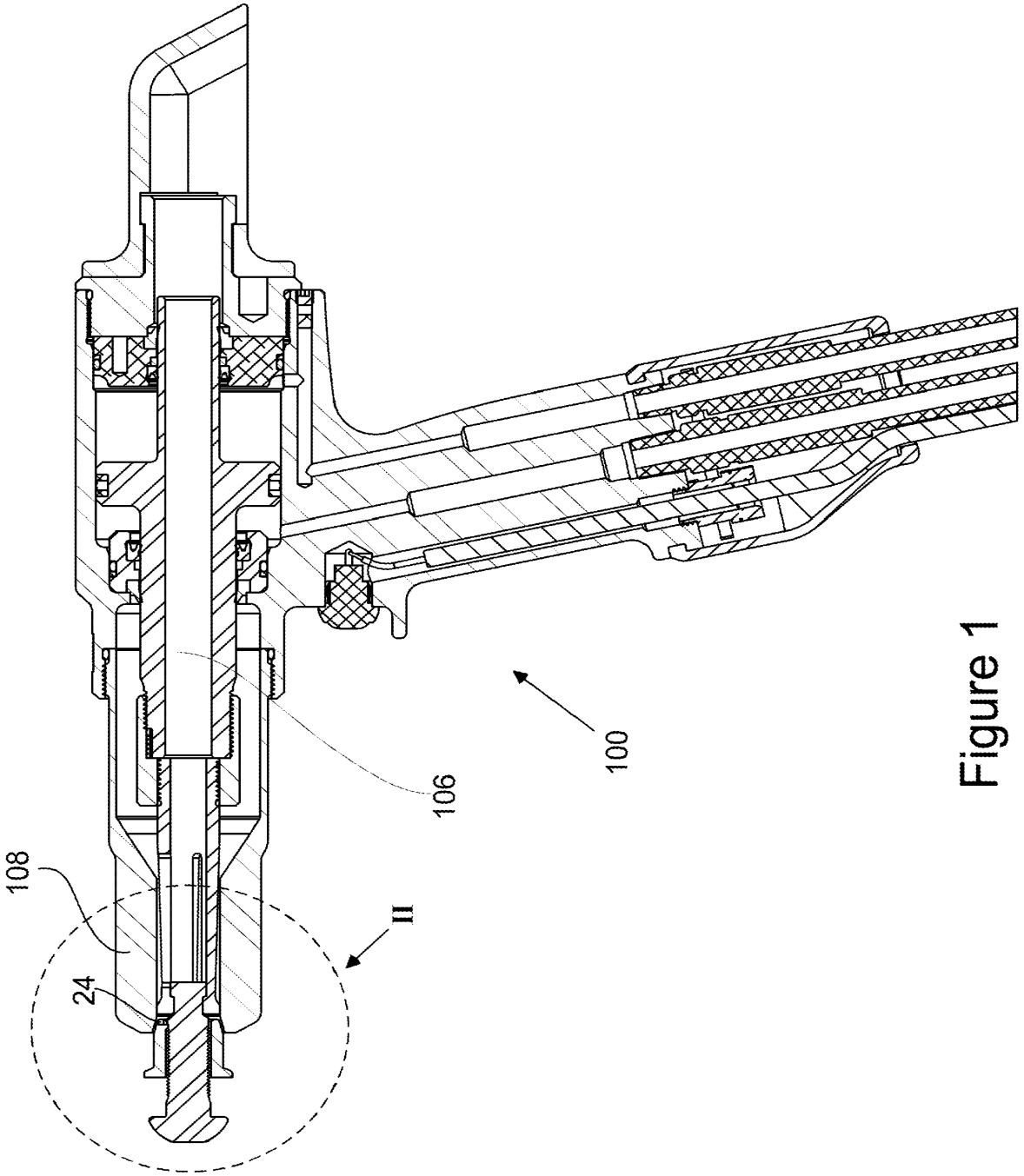


Figure 1

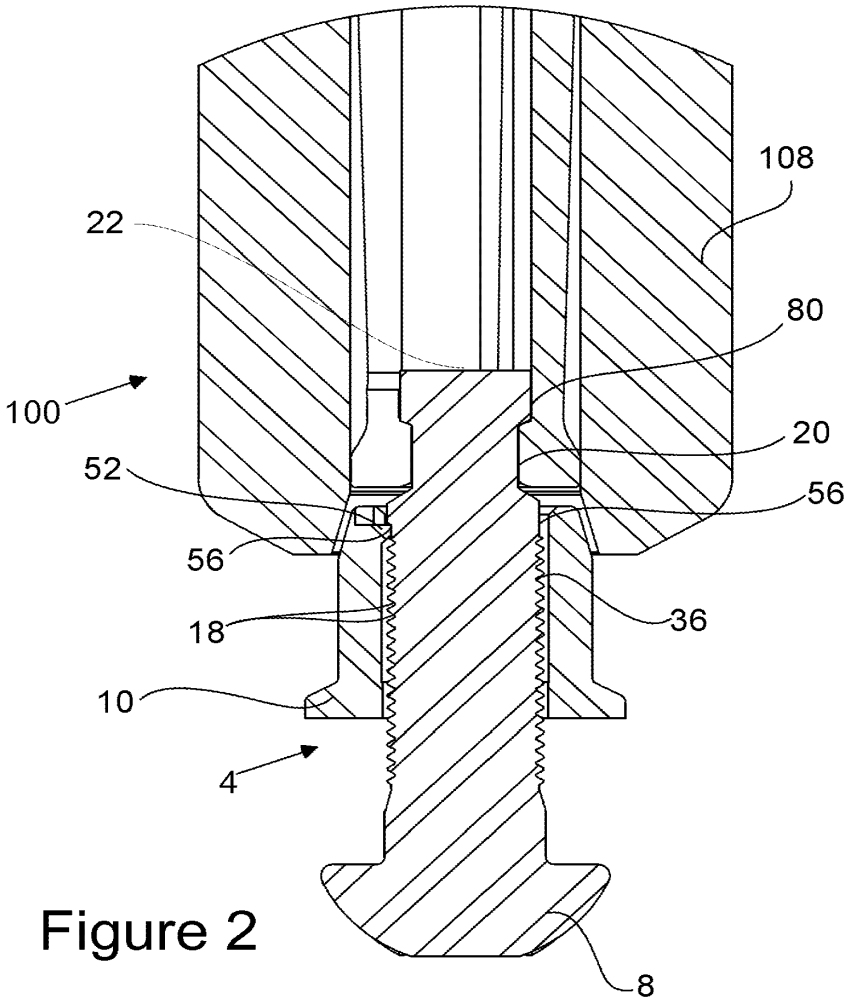


Figure 2

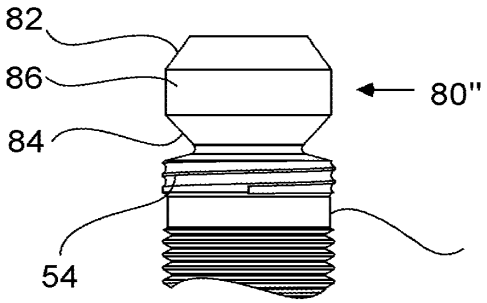


Figure 2a

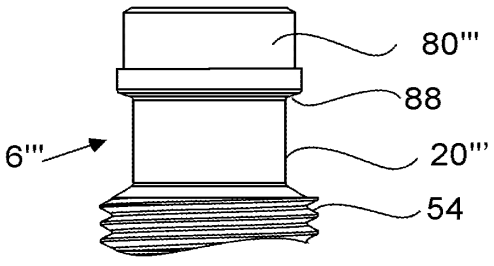


Figure 2b

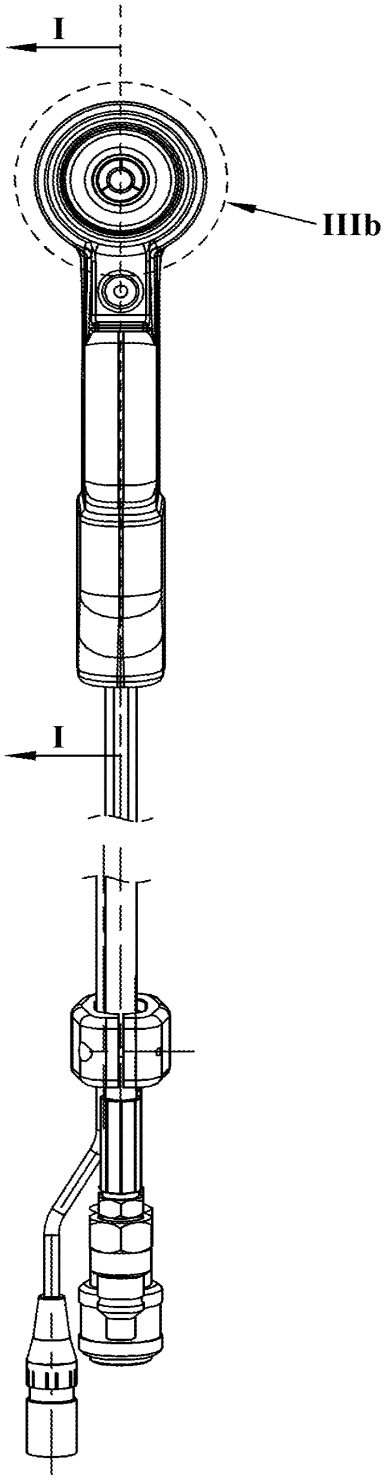


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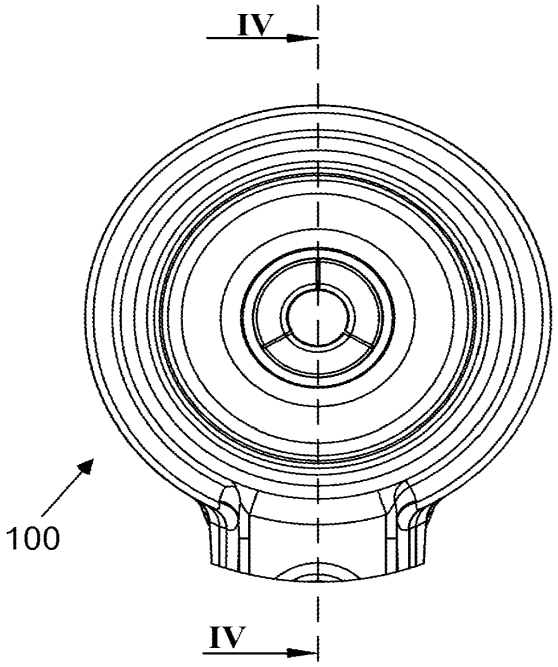


Figure 3b

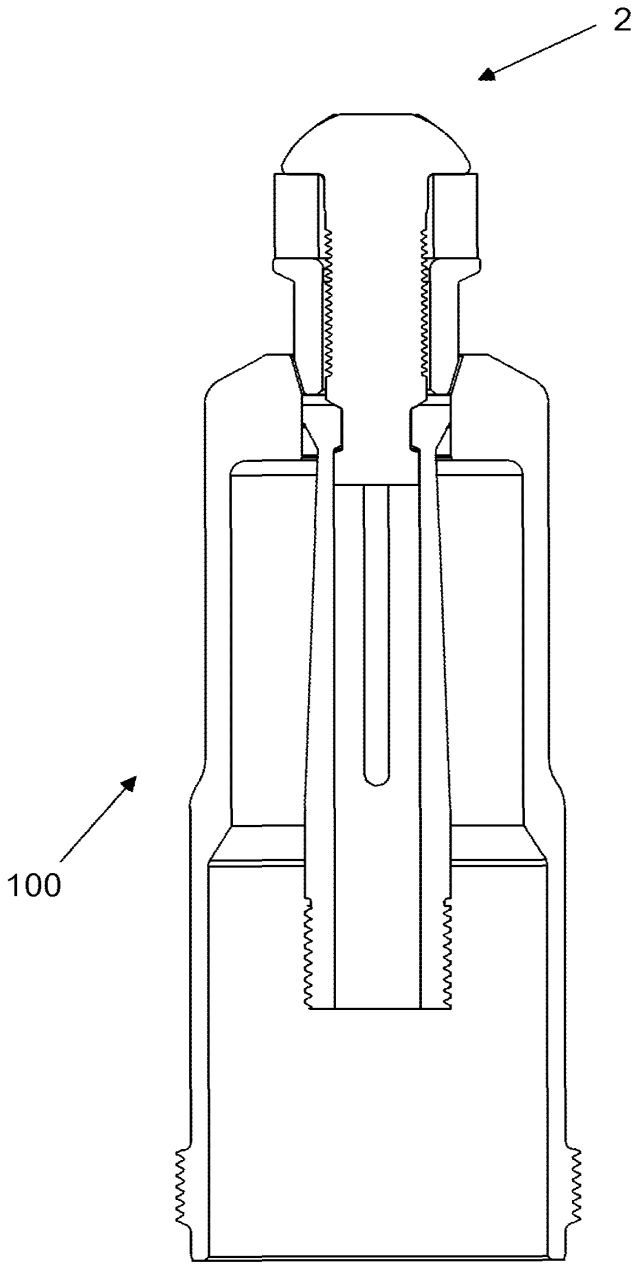


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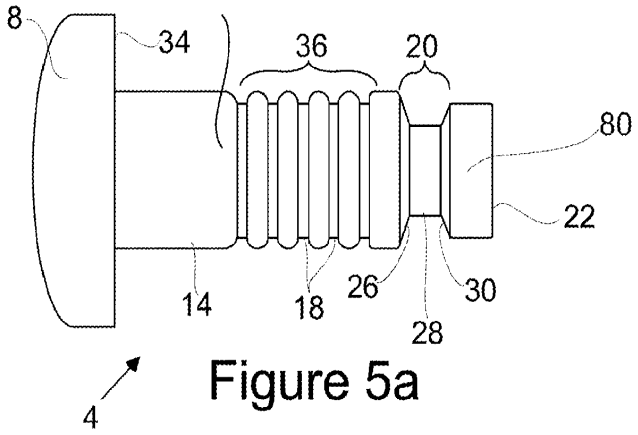


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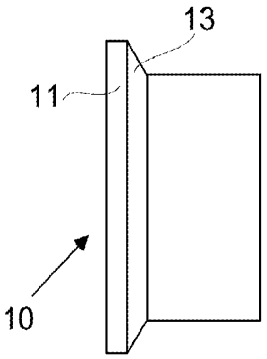


Figure 5c

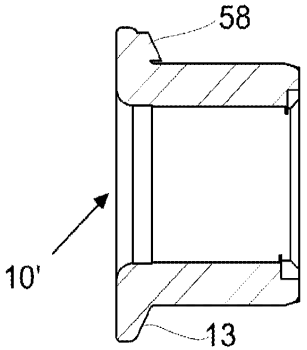


Figure 5d

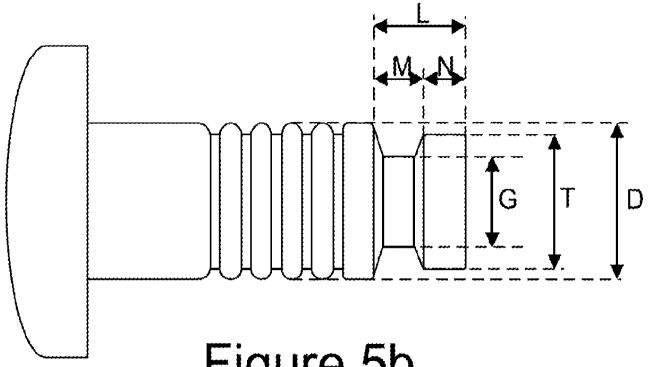


Figure 5b

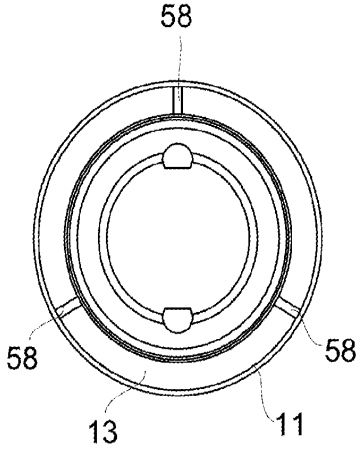


Figure 5e

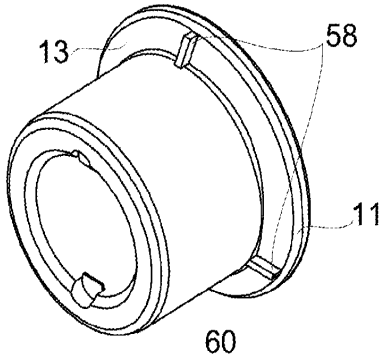


Figure 5f

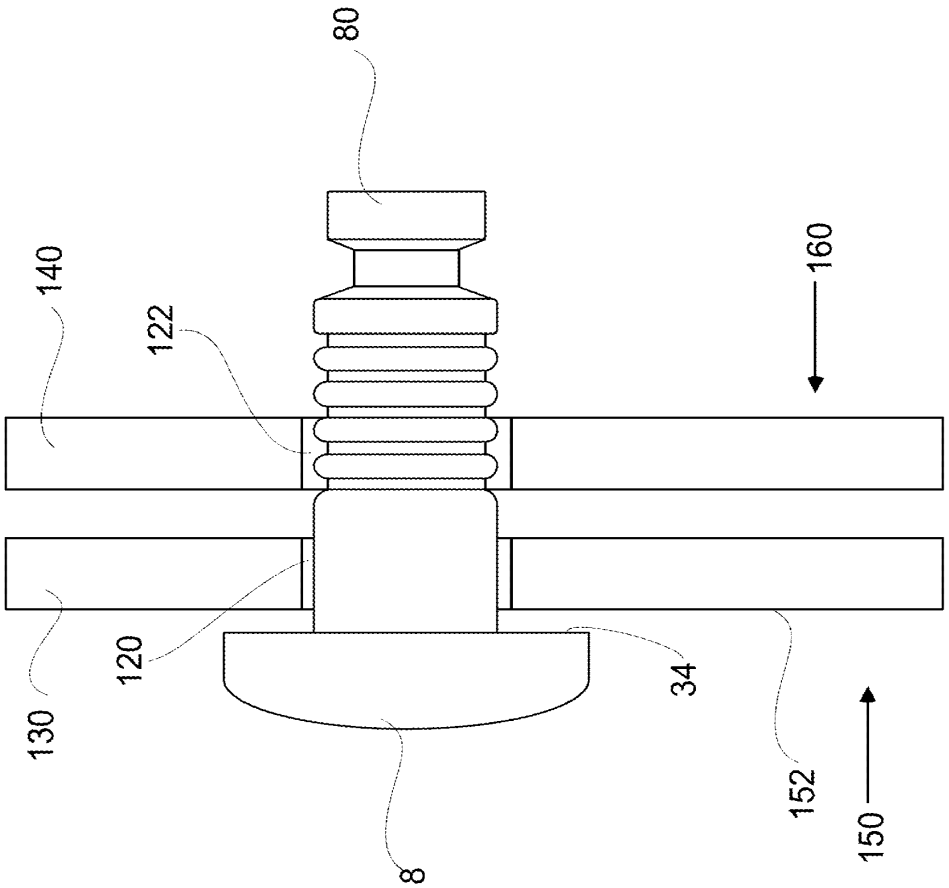


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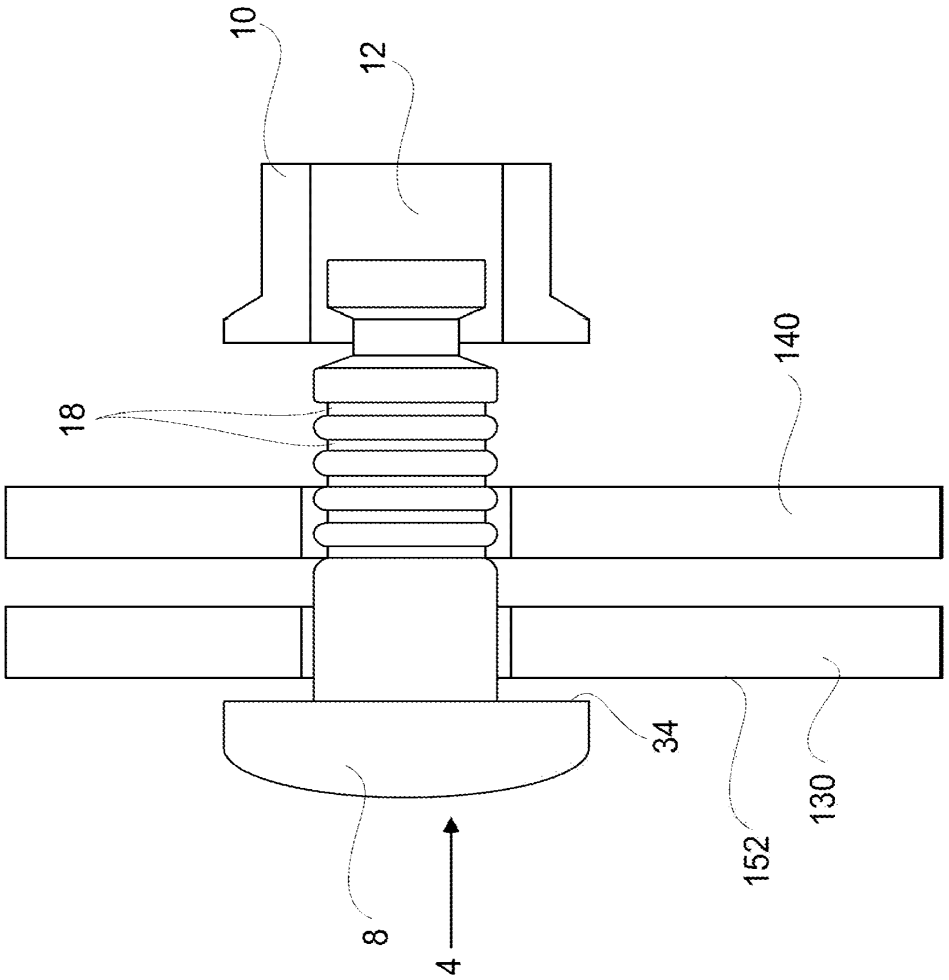


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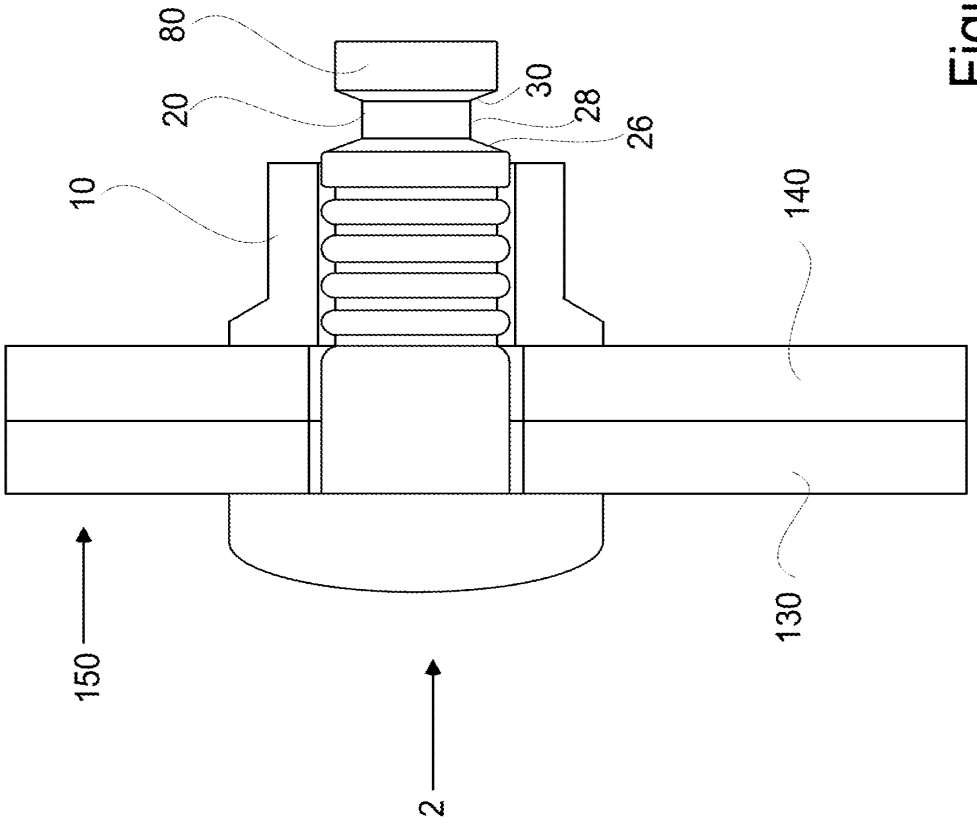


Figure 8

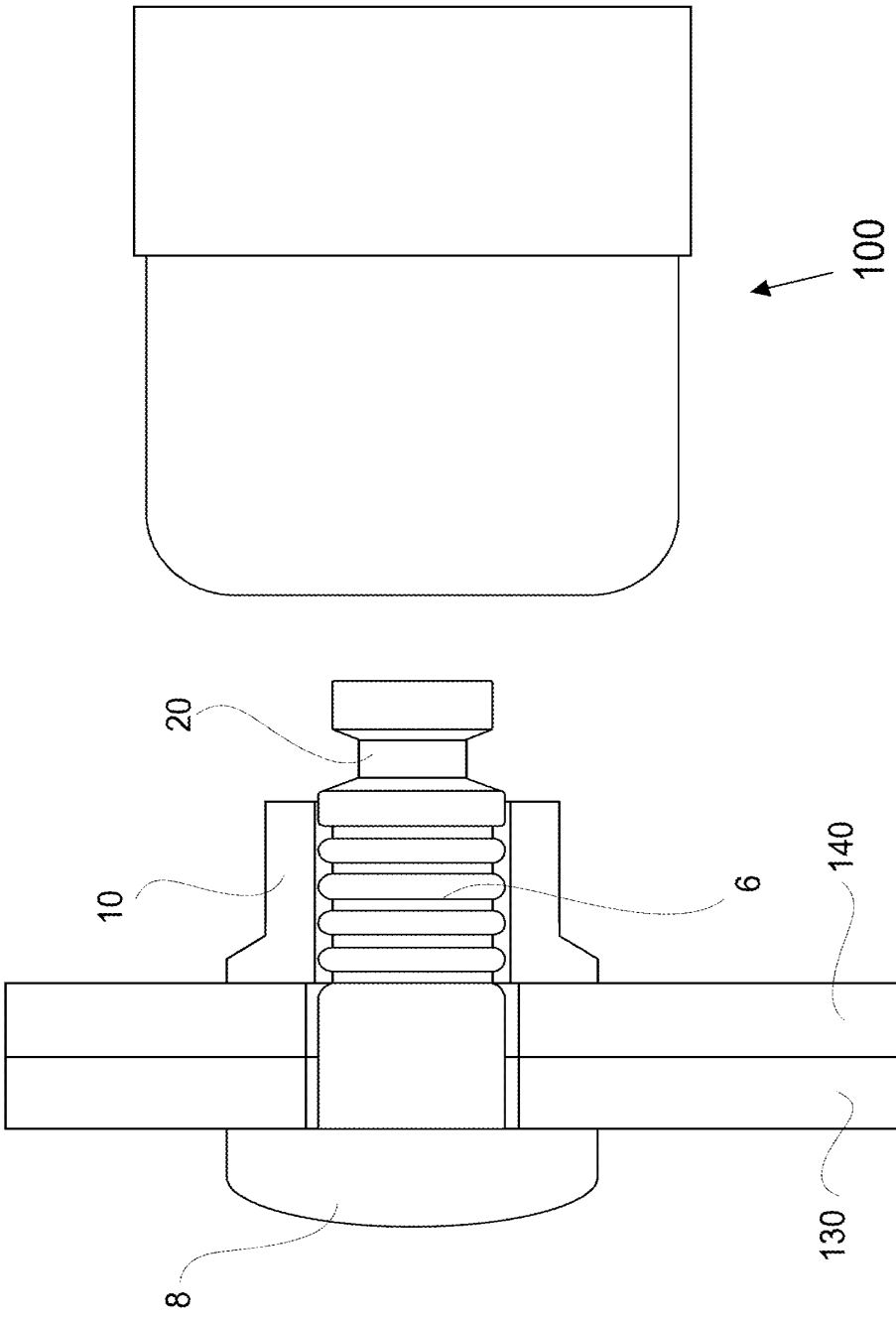


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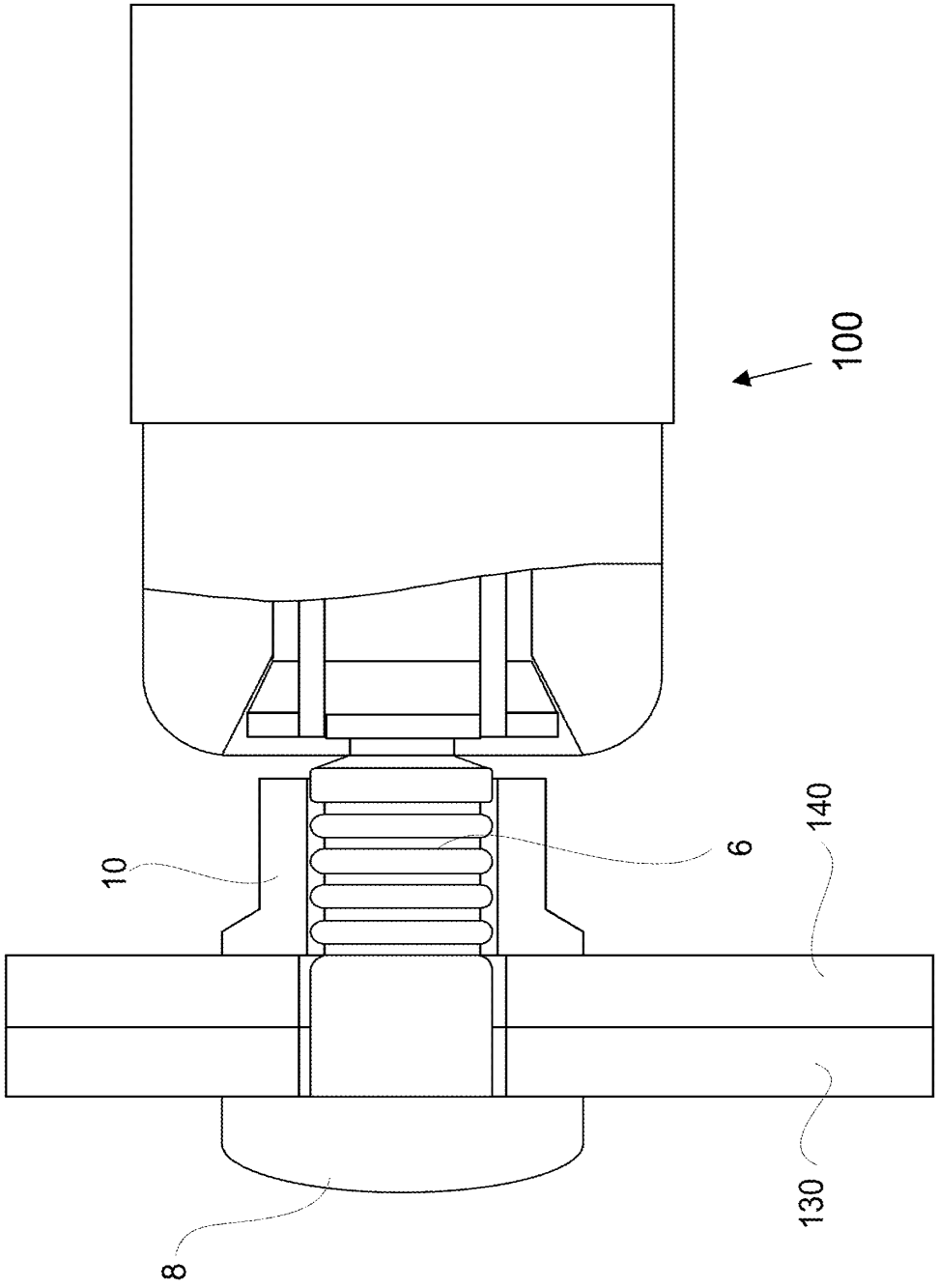


Figure 10

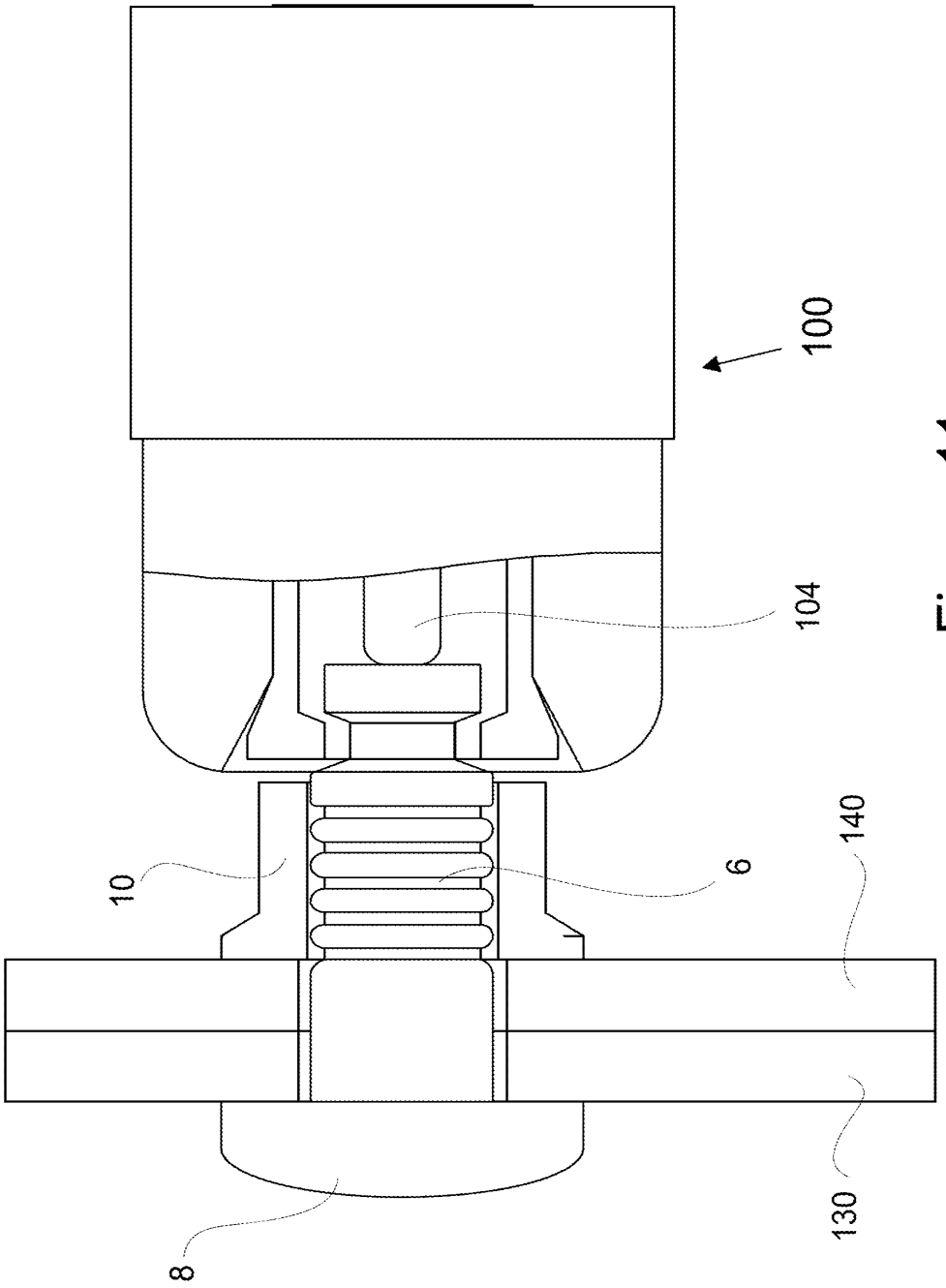


Figure 11a

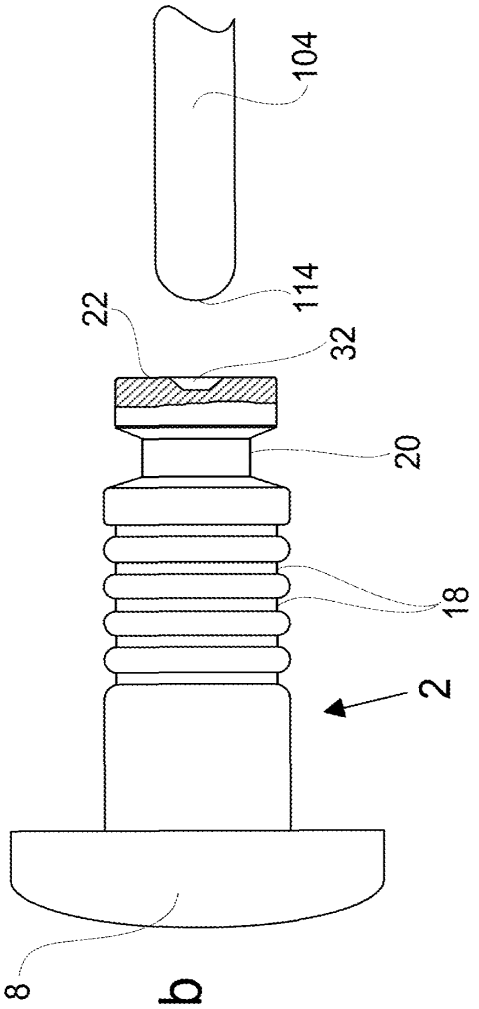


Figure 11b

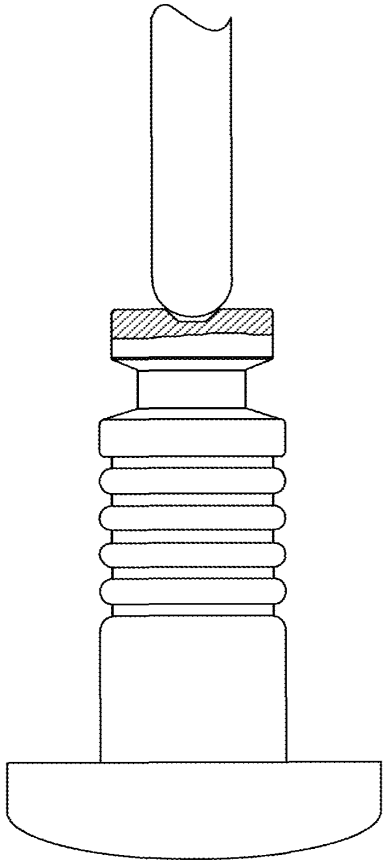


Figure 11c

Petitioner's Ex. 1003-111

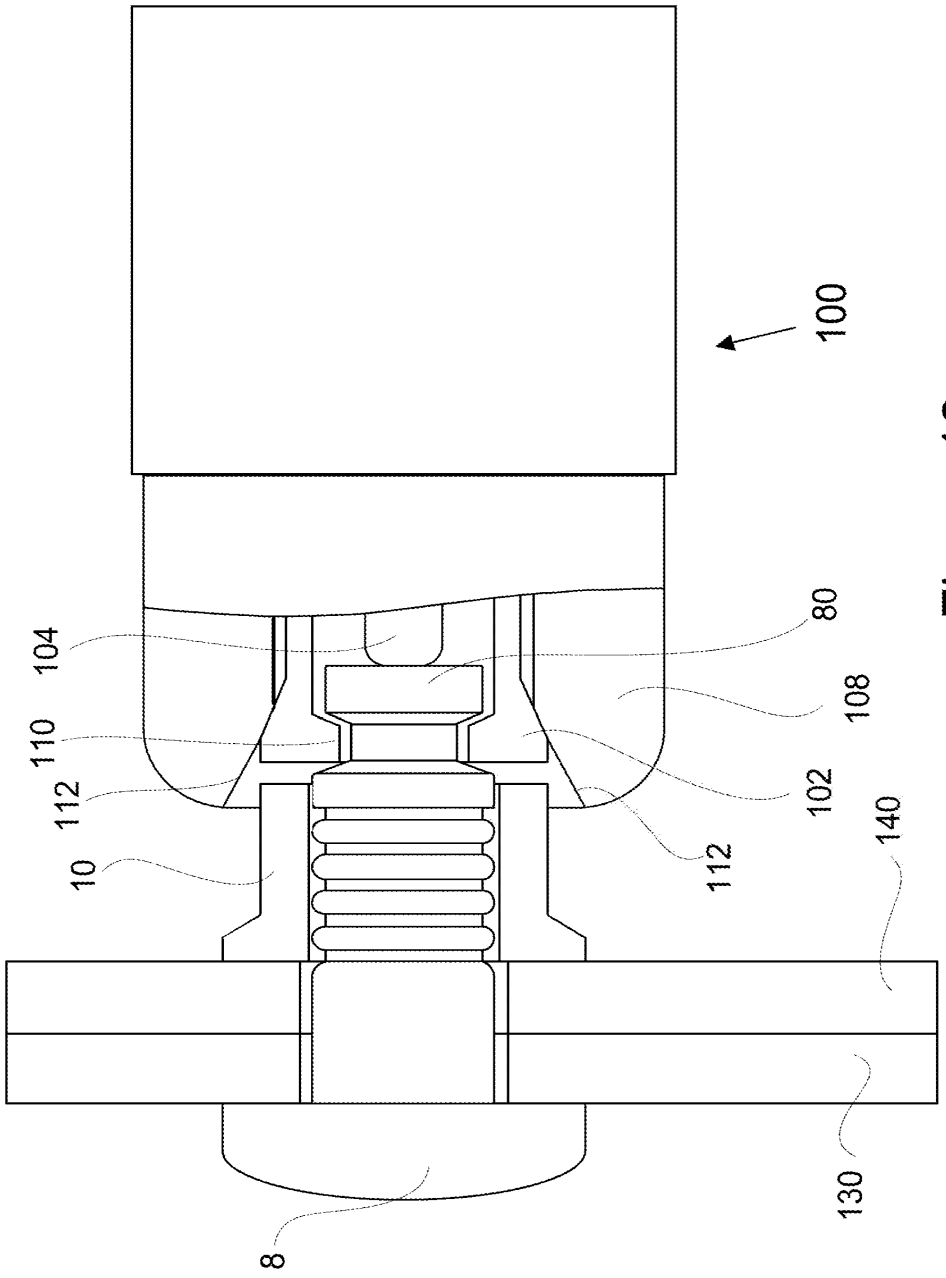


Figure 12

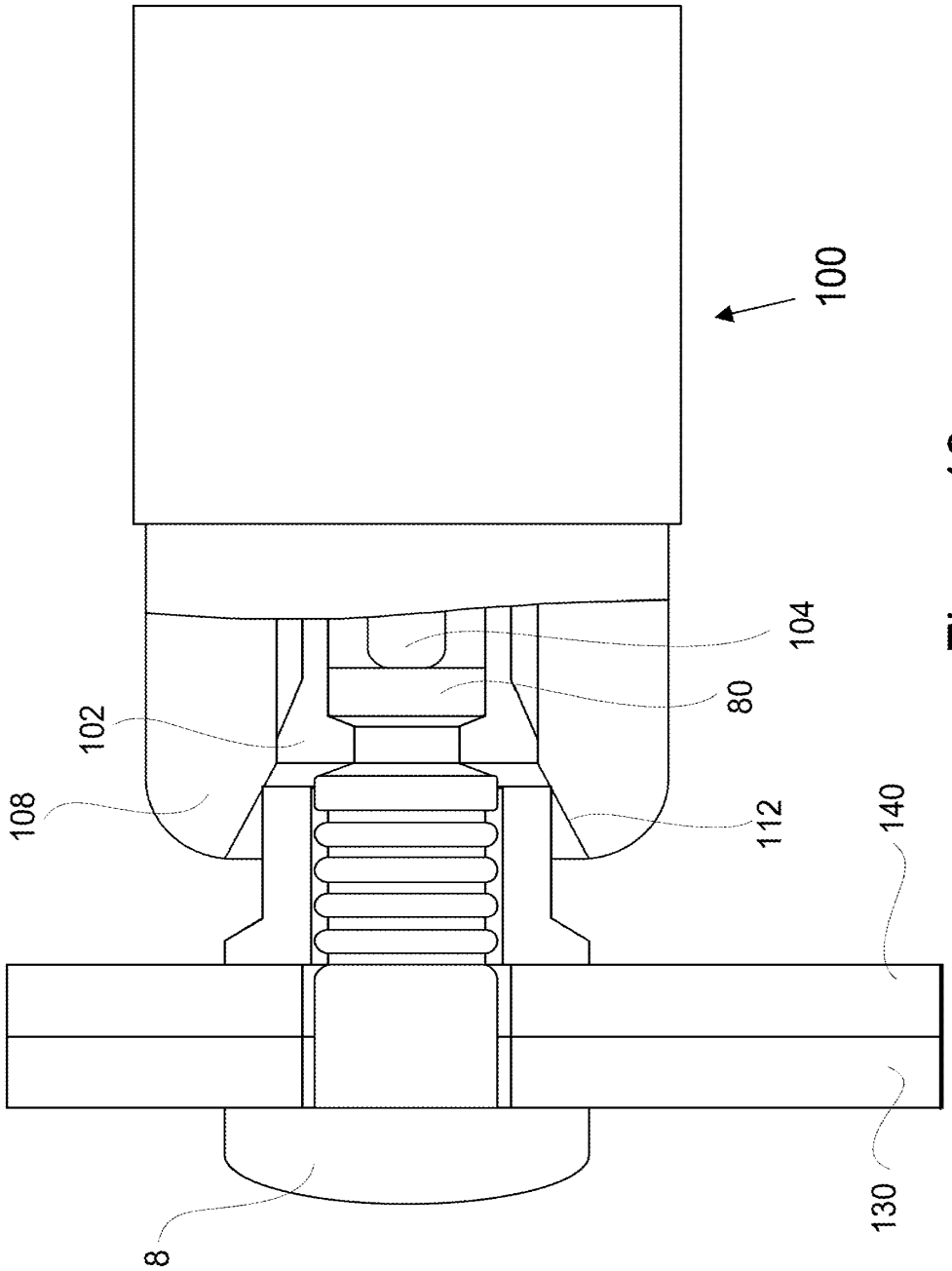


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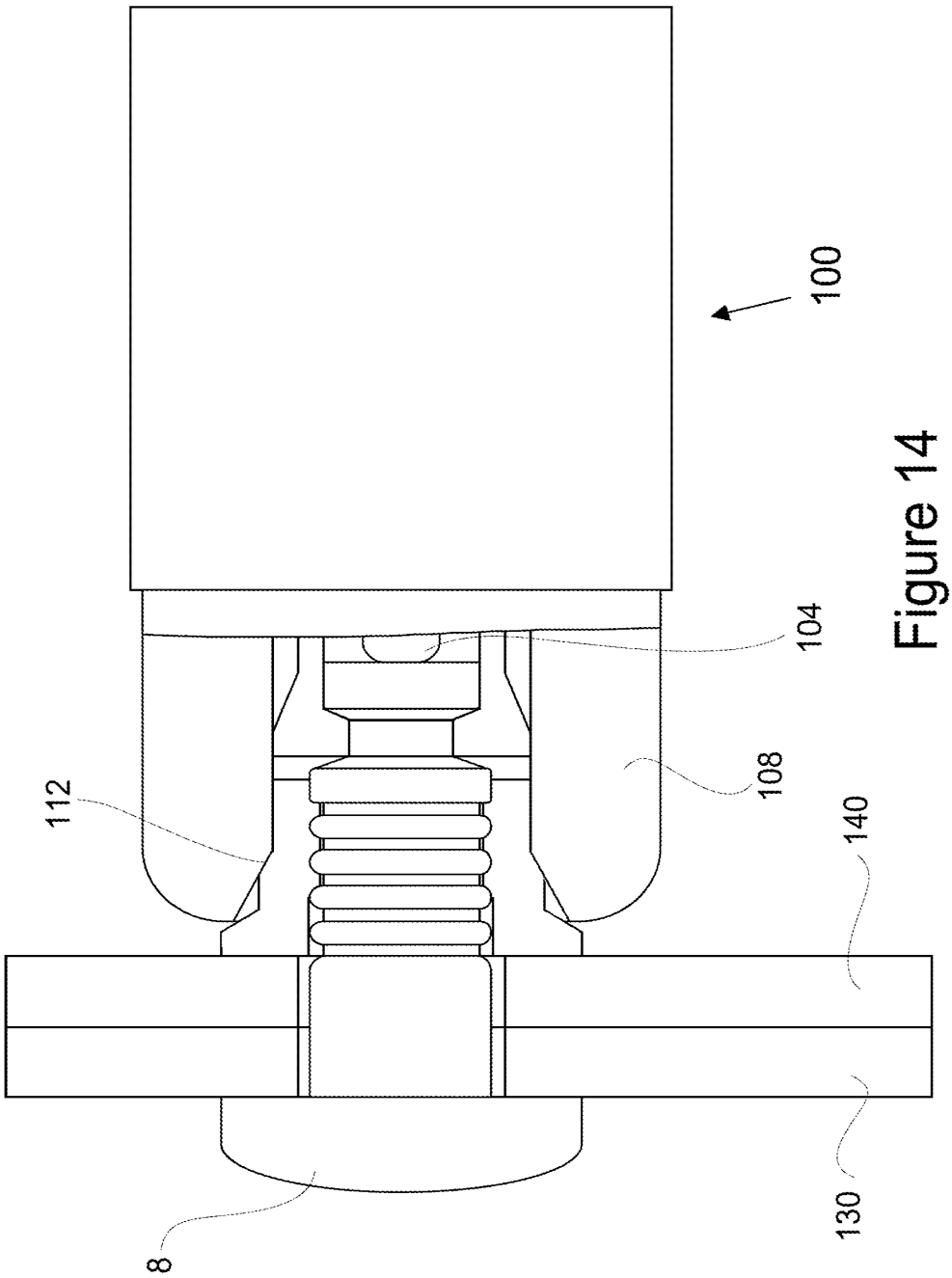


Figure 14

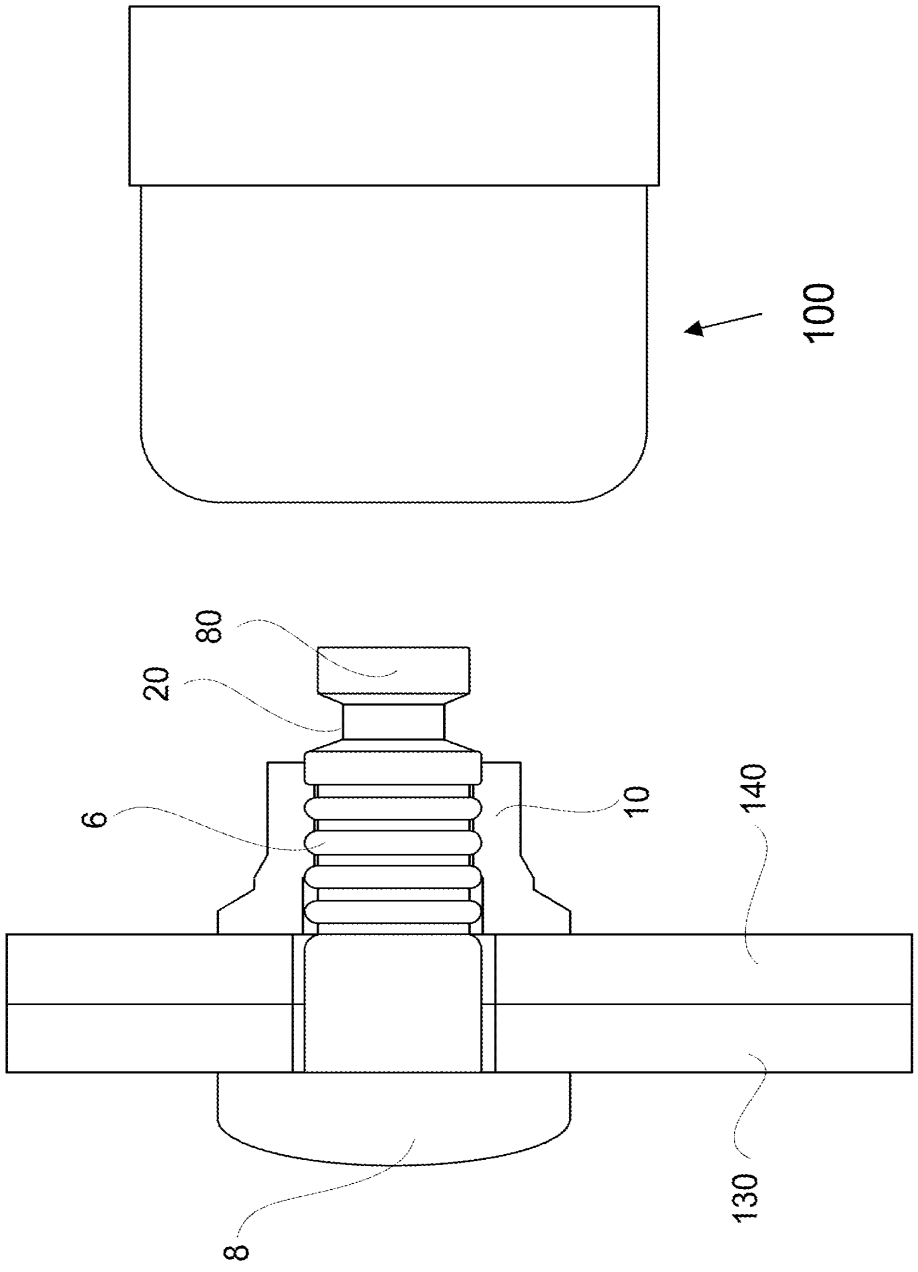


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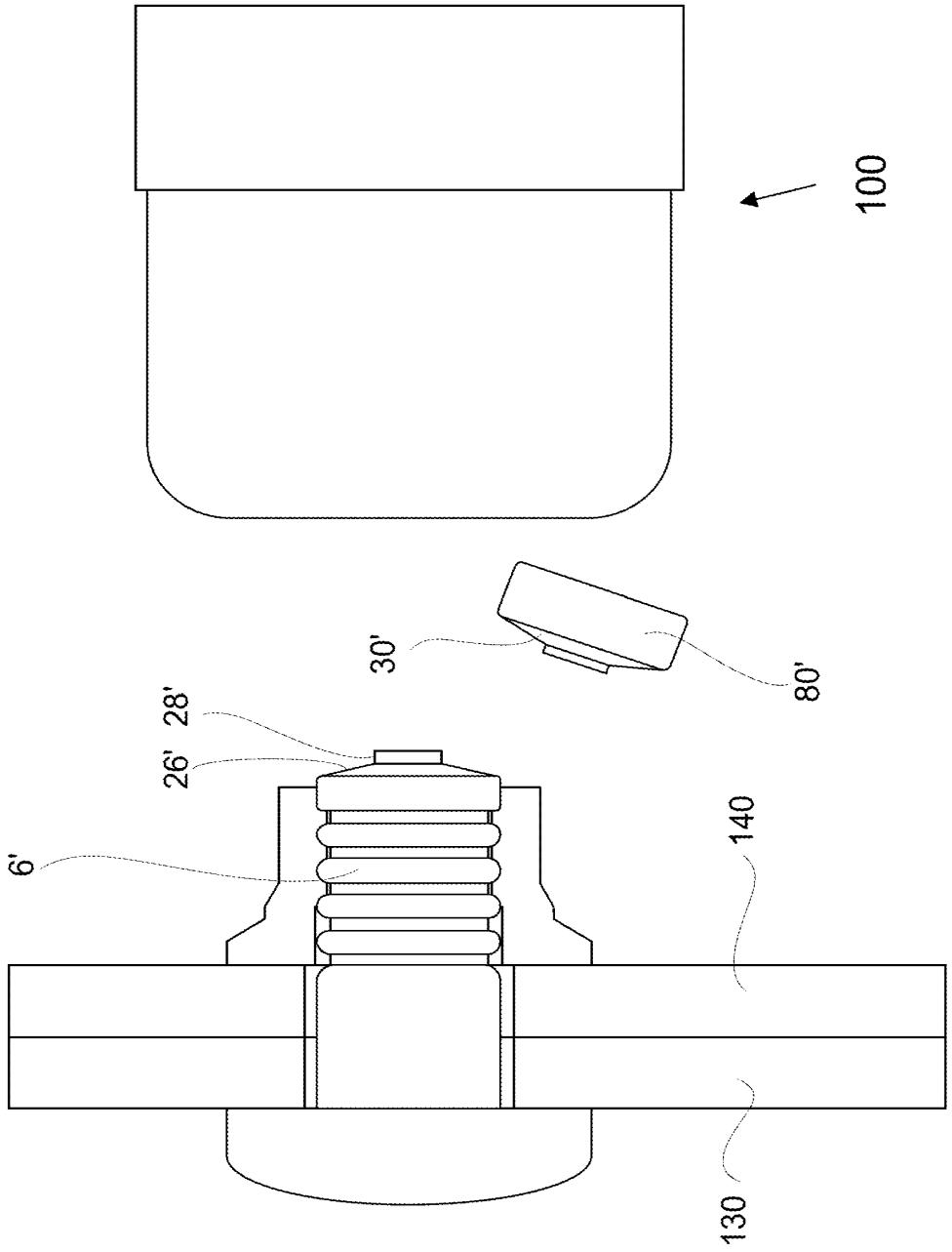


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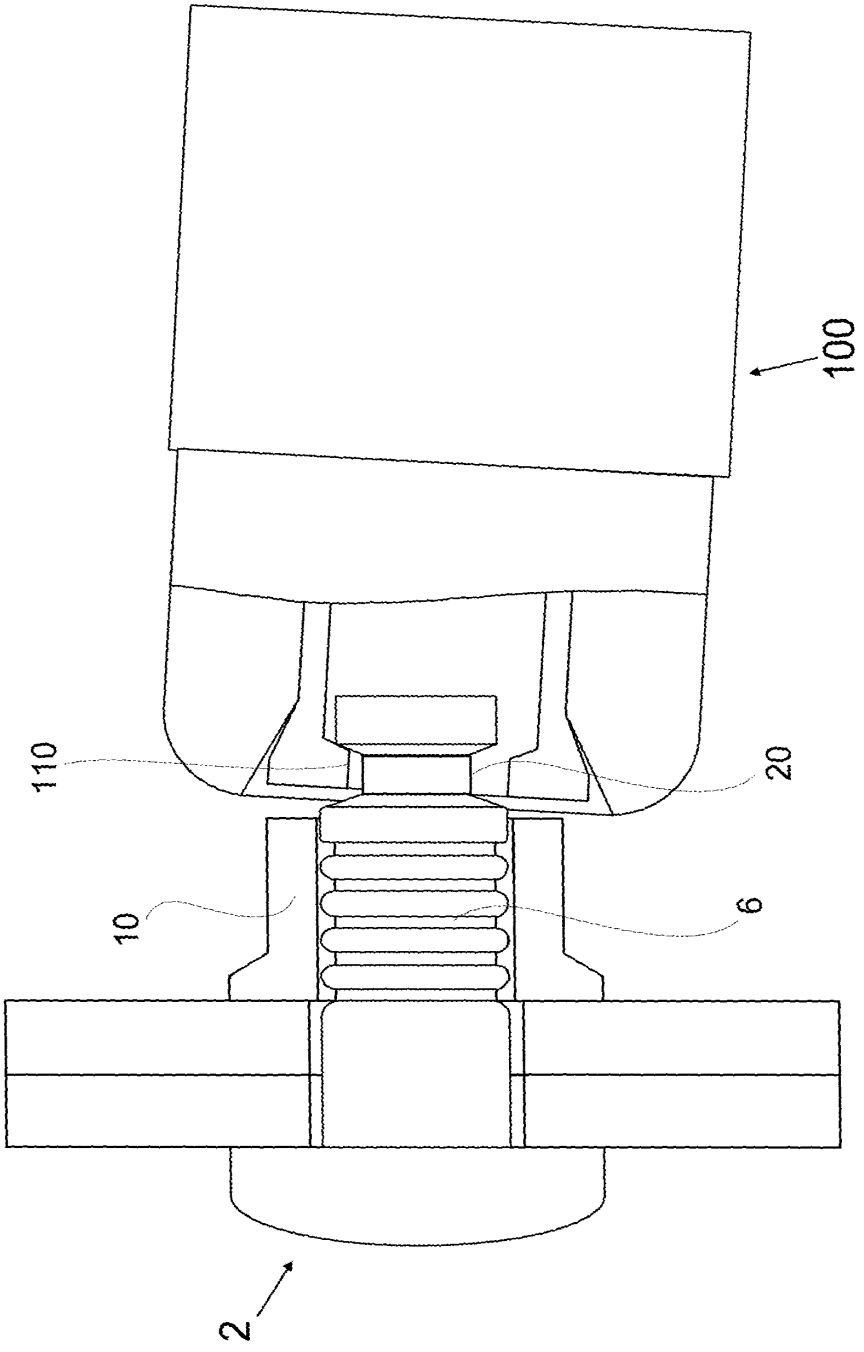


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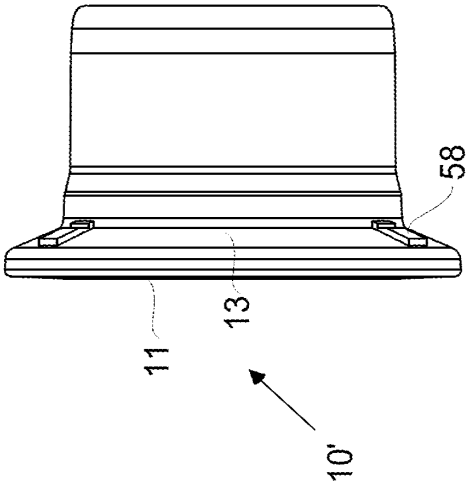


Figure 18b

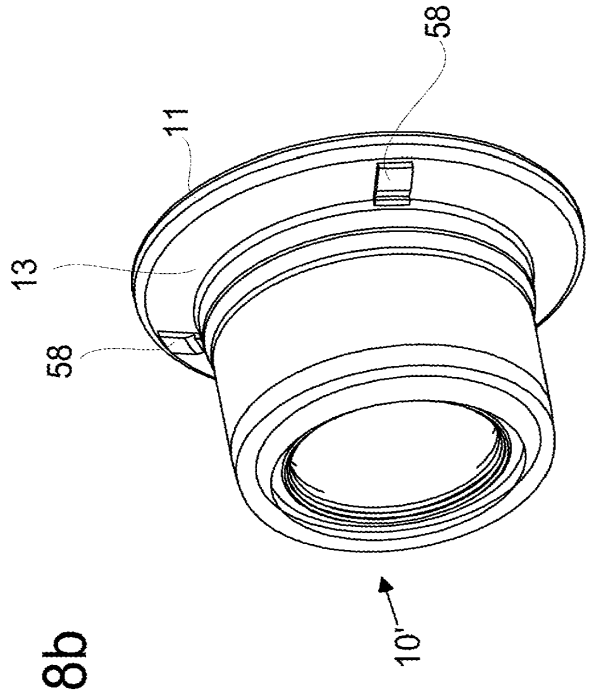


Figure 18c

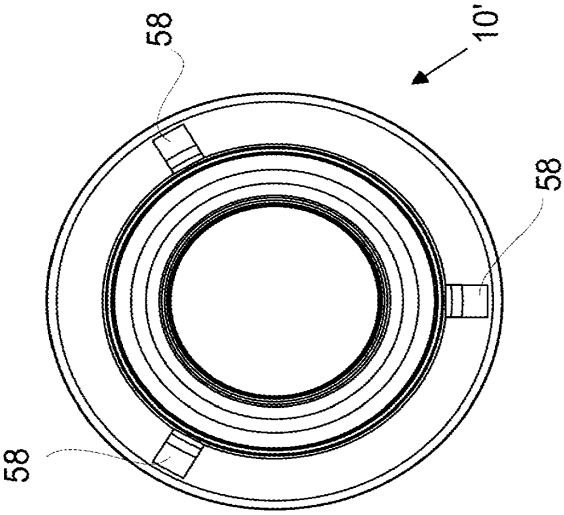


Figure 18a

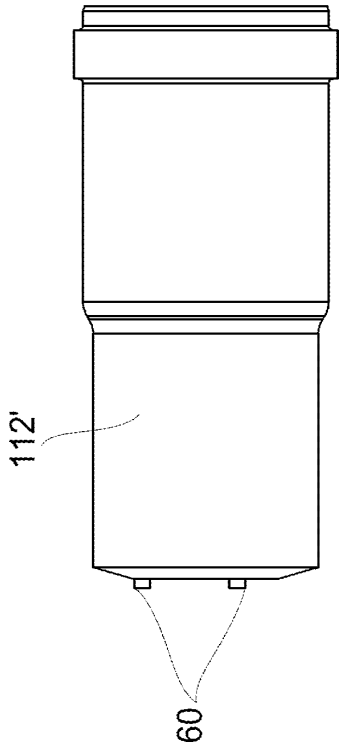


Figure 19b

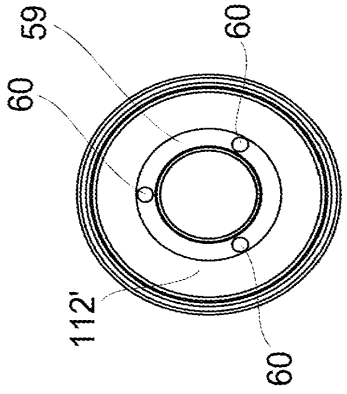


Figure 19a

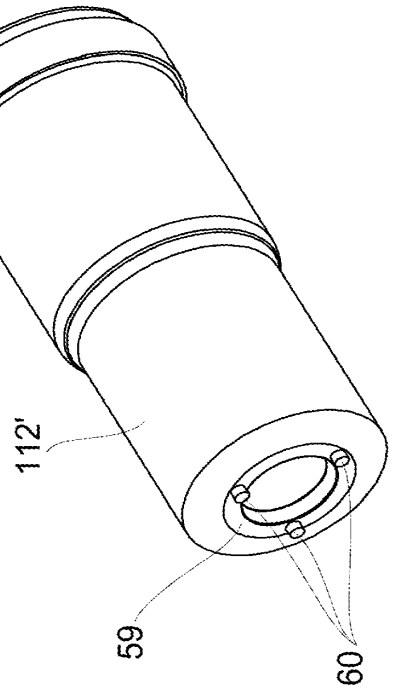


Figure 19c

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/065857

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B19/05 B21J15/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16B B21J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 091 982 A (GEORGE SIEBOL) 4 June 1963 (1963-06-04)	1-10,15, 16, 19-23, 33,34
Y	column 2, line 17 - line 20; figures 1-3	11-14, 17,18

X	GB 858 882 A (HUCK MFG CO) 18 January 1961 (1961-01-18)	1-16, 24-26, 30-32
Y	page 2, lines 35-68; figures 1-4	27-29

X	US 4 254 809 A (SCHUSTER MICHAEL M) 10 March 1981 (1981-03-10) column 2, line 66 - column 3, line 4; figures 7,8	1-16

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 January 2015	28/01/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fritzen, Claas

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/065857

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1 629 925 A (CUSHING MOORE FRED) 24 May 1927 (1927-05-24) page 2, lines 9-14; figures 1-4	1
Y	US 5 315 755 A (FULBRIGHT DAVID J [US] ET AL) 31 May 1994 (1994-05-31) figure 7	11-13,27
Y	WO 87/00891 A1 (HUCK MFG CO [US]) 12 February 1987 (1987-02-12) abstract; figures 1-8	14
Y	US 2013/202382 A1 (CORBETT ROBERT J [US]) 8 August 2013 (2013-08-08) abstract; figures 1-5	17,18, 28,29
X	US 4 299 519 A (CORBETT ROBERT J) 10 November 1981 (1981-11-10) figures 1-6	19-23
X,P	WO 2014/041328 A1 (INFASTECH IP PTE LTD; BREWER JONATHAN [GB]; HERSANT CARL [GB]) 20 March 2014 (2014-03-20) the whole document	1-16, 19-27, 30-34

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/065857

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		TW 201418589 A	16-05-2014
		WO 2014041328 A1	20-03-2014

Electronic Acknowledgement Receipt

EFS ID:	46567706
Application Number:	17423980
International Application Number:	
Confirmation Number:	4184
Title of Invention:	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
First Named Inventor/Applicant Name:	Robert B. Wilcox
Customer Number:	29270
Filer:	Robert John Sovesky/Jessica Brandenburg
Filer Authorized By:	Robert John Sovesky
Attorney Docket Number:	118508/US01/PCTNS/180639P
Receipt Date:	07-SEP-2022
Filing Date:	19-JUL-2021
Time Stamp:	15:19:52
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	Supplemental_IDS_9-7-22.pdf	1034301 53df8d1439fe8c032b23432c0550475baa3dfb37	no	4
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(Not for submission under 37 CFR 1.99)

Application Number	17423980
Filing Date	2021-07-19
First Named Inventor	Robert B. WILCOX
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	118508/US01/PCTNS/180639P

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4203346		1980-05-20	Hall et al.	
	2	4907922		1990-03-13	Jeal et al.	

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	1	2016/028489	WO	A1	2016-02-25	PRECISION TOWER PRODUCTS, LLC		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
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	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

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	1		☐

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2022-08-26
Name/Print	Robert J. Sovesky	Registration Number	73,798

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Declarations under Rule 4.17:

---- *as to the identity of the inventor (Rule 4.17(i))*

—— *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: BLIND FASTENER

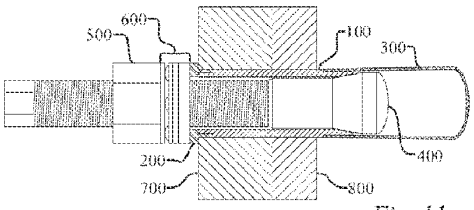


Fig. 11

(57) Abstract: A blind fastener device for fastening workpieces, including a sleeve and an expander having a locking section and an expansion section. A portion of the expander passes through the sleeve and rotation of various components draws the expander's distal end toward the sleeve's proximal end thereby drawing a portion of the expansion section of the expander into a structural region located on the sleeve and expanding at least a portion of the sleeve's structural region, and drawing a portion of the locking section past the sleeve's distal end toward the sleeve's proximal end and deforming at least a portion of the sleeve's distal end to a locked state. The sleeve may be configured as a multi-section sleeve having a sleeve retainer to locate the sections in a predetermined relationship.

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BLIND FASTENER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Patent Application No. 14/817,248, filed on August 04, 2015, which is a continuation of U.S. Patent Application No. 14/622,023, filed on February 13, 2015, which claims the benefit of U.S. provisional patent application Serial No. 62/039,939, filed on Aug 21, 2014, all of which are incorporated by reference as if completely written herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to blind fasteners which are capable of fastening structures which produce shear loading across the blind fastener; particularly structures comprised of structural plates, tubes, and other shapes that are commonly used in towers, poles, storage tanks, and other structures.

BACKGROUND OF THE INVENTION

Blind fasteners have generally incorporated a sleeve that expands and bends during installation often exposing sharp edges of the sleeve, as seen in USPN 6,234,734. Exposing such sharp edges in an empty hollow structure may be acceptable, however exposed sharp edges in a structure filled with wires and/or cables can be disastrous, particularly when more wires and/or cables are pulled through the structure after the sharp edges have been exposed.

In addition to sharp edges found on the expanding sleeves of prior art blind fasteners, the blind fasteners in the prior art often requires preassembly and special tools to install them on various workstructures. Take for instance a technician that is assembling a tower structure suspended high above the ground. In this scenario, the technician must assemble the blind

fastener in a certain order and use multiple tools to put the blind fastener into an engaged state. In this scenario the technician must be careful not to drop any of the blind fasteners components, or tools, out of inconvenience of recovering the dropped components and the safety risk to those that may below him. Additionally, the mere fact that the technician needs multiple specialized tools means that they have to carry additional weight while performing their work. Additionally, the extra tools required also increases the inconvenience and hazards of dropped tools.

SUMMARY OF THE INVENTION

A blind fastener to secure at least two workpieces enables a significant advance in the state of the art and greatly improves wire and cable protection, job site safety and simplifies blind fastener installation. A blind fastener device for fastening at least two workpieces, including a sleeve, an expander having a tensioning section, a locking section, and an expansion section, and a nut. A portion of the expander passes through the sleeve to cooperate with the nut so that relative rotation of the expander and nut draws the expander's distal end toward the sleeve's proximal end thereby drawing a portion of the expansion section of the expander into a structural region located on the sleeve and expanding at least a portion of the sleeve's structural region, and drawing a portion of the locking section past the sleeve's distal end toward the sleeve's proximal end and deforming at least a portion of the sleeve's distal end to a locked state. The sleeve may be configured as a multi-section sleeve having a sleeve retainer to locate the sections in a predetermined relationship.

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BRIEF DESCRIPTION OF THE DRAWINGS

Without limiting the scope of the present invention as claimed below and referring now to the drawings and figures:

FIG. 1 is an embodiment of an exploded view of a blind fastener according to the present invention;

FIG. 2 is a cross-sectional exploded view of an embodiment of a blind fastener embodiment;

FIG. 3 is a plan view of an embodiment of a pre-insertion pre-actuation blind fastener with the shroud and workpieces shown in section for clarity;

FIG. 4 is a plan view of an embodiment of a post-insertion pre-actuation blind fastener with the shroud and workpieces shown in section for clarity;

FIG. 5 is a plan view of an embodiment of a post-insertion pre-actuation blind fastener with the shroud and workpieces shown in section for clarity;

FIG. 6 is a cross-sectional view of an embodiment of a post-insertion pre-actuation blind fastener;

FIG. 7 is a partial cross-sectional view of an embodiment of a post-insertion pre-actuated blind fastener;

FIG. 8 is a cross-sectional view of an embodiment of a post-insertion pre-actuated blind fastener;

FIG. 9 is a plan view of an embodiment of a post-insertion partial-actuated blind fastener with the shroud and workpieces shown in section for clarity;

FIG. 10 is a cross-sectional view of an embodiment of a post-insertion partial-actuated blind fastener;

FIG. 11 is a partial cross-sectional view of an embodiment of a post-insertion partial-actuated blind fastener;

FIG. 12 is a cross-sectional view of an embodiment of a post-insertion partial-actuated blind fastener;

FIG. 13 is a plan view of an embodiment of a post-insertion fully-actuated blind fastener with the shroud and workpieces shown in section for clarity;

FIG. 14 is a cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

FIG. 15 is a partial cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

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FIG. 16 is a cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

FIG. 17 is a plan view of an expander embodiment;

FIG. 18 is a plan view of another expander embodiment;

FIG. 19 is an exploded plan view of a sleeve, retainer and shroud assembly embodiment;

FIG. 20 is a cross-sectional exploded plan view of a sleeve, retainer and shroud assembly embodiment;

FIG. 21 is another embodiment of an exploded plan view of a sleeve, retainer and shroud assembly;

FIG. 22 is another embodiment of a cross-sectional exploded plan view of a sleeve, retainer and shroud assembly;

FIG. 23 is another embodiment of an exploded view of a blind fastener;

FIG. 24 is another embodiment of a cross-sectional exploded view of a blind fastener;

FIG. 25 is a plan view of another expander embodiment;

FIG. 26 is another embodiment of a plan view of an expander;

FIG. 27 is another embodiment of a plan view of a sleeve;

FIG. 28 is another embodiment of a cross-sectional plan view of a sleeve;

FIG. 29 is another embodiment of a cross-sectional view of a blind fastener;

FIG. 30 is another embodiment of a cross-sectional view of a post-insertion pre-actuation blind fastener;

FIG. 31 is another embodiment of a cross-sectional view of a post-insertion fully-actuated blind fastener;

FIG. 32 is another embodiment of a cross-sectional view of a post-insertion pre-actuation blind fastener;

FIG. 33 is another embodiment of a cross-sectional view of a post-insertion fully-actuated blind fastener;

FIG. 34 is another embodiment of a cross-sectional view of a post-insertion pre-actuation blind fastener;

FIG. 35 is another embodiment of a cross-sectional view of a post-insertion fully-actuated blind fastener;

Fig. 36 is a plan view of another embodiment of a sleeve retainer and pre-inserted sleeve;

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Fig. 37 is a plan view of another embodiment of a sleeve retainer and a partially inserted sleeve;

Fig. 38 is a plan view of another embodiment of a sleeve retainer and a fully inserted sleeve;

Fig. 39 is a plan view of another embodiment of a sleeve retainer undergoing contraction and a fully inserted sleeve;

Fig. 40 is a plan view of another embodiment of a fully contracted sleeve retainer and a fully inserted sleeve;

Fig. 41 is a cross-sectional and magnified view of another embodiment of a fully contracted sleeve retainer and a fully inserted sleeve;

Fig. 42 is another cross-sectional view of another embodiment of a fully contracted sleeve retainer and a fully inserted sleeve;

Fig. 43 is a plan view of another sleeve embodiment having a channel;

Fig. 44 is a cross-sectional and magnified view of another embodiment of a sleeve having channels;

Fig. 45 is a plan view of another sleeve embodiment having channels;

Fig. 46 is a plan view of another sleeve embodiment having channels;

Fig. 47 is a partial cross-sectional view of another sleeve embodiment;

Fig. 48 is a partial cross-sectional view of another embodiment of a sleeve having a sleeve retainer;

Fig. 49 is a plan view of another sleeve embodiment with bonded sleeve sections;

Fig. 50 is a cross-sectional view of another embodiment of a sleeve with bonded sleeve sections;

Fig. 51 is a partial cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

Fig. 52 is a partial cross-sectional view of an embodiment of a post-insertion un-actuated blind fastener;

Fig. 53 is a partial cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

Fig. 54 is a partial cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener;

Fig. 55 is a cross-sectional and magnified view of another embodiment of a sleeve having a single channel;

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Fig. 56 is a cross-sectional view of another embodiment of a sleeve;

FIG. 57 is a cross-sectional view of an embodiment of a post-insertion pre-actuated blind fastener;

FIG. 58 is a cross-sectional view of an embodiment of a post-insertion partial-actuated blind fastener; and

FIG. 59 is a cross-sectional view of an embodiment of a post-insertion fully-actuated blind fastener.

These illustrations are provided to assist in the understanding of the exemplary embodiments of a blind fastener as described in more detail below and should not be construed as unduly limiting the specification. In particular, the relative spacing, positioning, sizing and dimensions of the various elements illustrated in the drawings may not be drawn to scale and may have been exaggerated, reduced or otherwise modified for the purpose of improved clarity. Those of ordinary skill in the art will also appreciate that a range of alternative configurations have been omitted simply to improve the clarity and reduce the number of drawings.

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DETAILED DESCRIPTION OF THE INVENTION

With reference now to FIGS. 1 and 2, show an exploded view of an embodiment of a blind fastener. In this particular embodiment the main components of the blind fastener may include a sleeve (100), a sleeve retainer (200), an expander (400), a nut (500), and optionally a shroud (300) and/or a washer system (600).

The sleeve (100) will first be disclosed in detail. The sleeve (100) serves the role of expanding radially in order to fill openings located in workpieces being fastened together. The expanding sleeve (100) serves to eliminate any movement in the workpieces in relation to one another due to loose fitting fasteners; the sleeve (100) reduces the likelihood of fasteners failing due to shear loading on the fastener; and sleeve (100) facilitates the blind fastener locking in place. Now with reference to FIGS. 19 and 20, the sleeve (100) has a sleeve proximal end (120), and a sleeve distal end (130). The sleeve (100) has a sleeve length (155) which is defined as the distance from the sleeve proximal end (120) to the sleeve distal end (130). Furthermore, the sleeve (100) has a sleeve outer diameter (140) that is adjacent the walls of a first workpiece opening (720), located in a first workpiece (700) having a first workpiece opening diameter (722) and a first workpiece thickness (710), and the walls of a second workpiece opening (820), located in a second workpiece (800) having a second workpiece opening diameter (822) and a second workpiece thickness (810), when the blind fastener is installed, as seen in FIGS. 3, 13 and 15. In some embodiments, the sleeve (100) may be composed of two or more distinct segments, or two or more segments that are formed when the sleeve (100) splits apart, as will be disclosed later in great detail. For instance, the embodiments of in FIGS. 6, 8, 10, 12, 14, 16, 34 and 35 have a first sleeve section (101), a second sleeve section (102), a third sleeve section (103), and a forth sleeve section (104), however the embodiment of FIG. 56 illustrates a single sleeve section embodiment, while FIG. 30 illustrates a two sleeve section embodiment, and FIG. 32 illustrates a three sleeve section embodiment.

As seen in FIGS. 43-46, embodiments of the sleeve (100) may incorporate one or more frangible sections that break apart during use to create distinct sleeve sections. The sleeve (100) may have at least one longitudinal sleeve channel (110) that provides a fracturable area on the sleeve (100). Each longitudinal sleeve channel (110) has a sleeve channel width (111) and sleeve channel length (112), as seen in FIGS. 43-44, that may be created by, but not limited to, milling, stamping, casting, and press forming during the creation of the sleeve (100). FIG. 43 illustrates an embodiment of sleeve (100) having at least

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one longitudinal sleeve channel (110) with the sleeve channel length (112) equal to 100% of the sleeve length (155), thereby allowing the sleeve (100) to fracture into full sleeve (100) sections. FIG. 44 is a cross sectional view of a sleeve (100) designed to fracture into four sections, having a sleeve first channel (115), a sleeve second channel (116), a sleeve third channel (117), and a sleeve forth channel (118). Depending on the application, variations in the first workpiece thickness (710) and the second workpiece thickness (810) may induce a need for other embodiments of fracturable sleeves (100). FIG. 55 is a cross sectional view of a sleeve (100) designed to fracture having a single sleeve first channel (115), however it may be formed with two channels, three channels, four channels, five channels, or even six, or more, channels.

One embodiment of sleeve (100), as shown in FIG. 45, incorporates one or more sleeve channels (110) that do not extend the entire length of the sleeve (100). One benefit of such an embodiment is that the additional load must be applied to the blind fastener to split the sleeve (100) into separate sections ensuring a tighter joint. One, or more, partial sleeve channels (110) may be located on the sleeve proximal end (120), having a sleeve proximal end channel length (113), and/or one, or more, partial sleeve channels (110) may be located on the sleeve distal end (130), having a sleeve distal end channel length (114). The partial sleeve channels (110) may align as seen in FIG. 45, or they be offset as seen in FIG. 46. In one embodiment at least two partial sleeve channels (110) extend from the sleeve proximal end (120) toward the sleeve distal end (130). This embodiment ensures that the sleeve (100) splits into at least two distinct pieces. In another embodiment at least two partial sleeve channels (110) extend from the sleeve distal end (130) toward the sleeve proximal end (120). In yet a further embodiment at least two distally extending partial channels align with at least two proximally extending partial channels, as seen in FIG. 45. In an even further embodiment at least three partial sleeve channels (110) extend from the sleeve proximal end (120) toward the sleeve distal end (130). This embodiment ensures that the sleeve (100) splits into at least three distinct pieces; and in another embodiment at least three partial sleeve channels (110) extend from the sleeve distal end (130) toward the sleeve proximal end (120). In yet a further embodiment at least three distally extending partial channels align with at least three proximally extending partial channels. In yet an even further embodiment at least four partial sleeve channels (110) extend from the sleeve proximal end (120) toward the sleeve distal end (130), similar to the section of FIG. 44. This embodiment ensures that the sleeve (100) splits into at least four distinct pieces; and in another embodiment at least four partial sleeve

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channels (110) extend from the sleeve distal end (130) toward the sleeve proximal end (120). In yet a further embodiment at least four distally extending partial channels align with at least four proximally extending partial channels.

In one embodiment the sleeve proximal end channel length (113) is less than 95% of the sleeve length (155), while in a further embodiment, the sleeve proximal end channel length (113) is 15-80% of the sleeve length (155), and in an even further embodiment, the sleeve proximal end channel length (113) is 30-60% of the sleeve length (155), while in an even further embodiment the sleeve proximal end channel length (113) is less than 50% of the sleeve length (155). Likewise, in another embodiment the sleeve distal end channel length (114) is less than 95% of the sleeve length (155), while in a further embodiment, the sleeve distal end channel length (114) is 15-80% of the sleeve length (155), and in an even further embodiment, the sleeve distal end channel length (114) is 30-60% of the sleeve length (155), while in an even further embodiment the sleeve distal end channel length (114) is less than 50% of the sleeve length (155). In some applications it may be desirable for the sleeve (100) to include partial sleeve channels (110) located on both the sleeve proximal end (120) and sleeve distal end (130), having a sleeve proximal end channel length (113) and a sleeve distal end channel length (114). In one such embodiment preferential loading is achieved when there is a separation distance between the ends of the channels that is 1-20% of the sleeve length (155), while in a further embodiment the separation distance is 5-10% of the sleeve length (155), which is enough to require additional fastener loading to split the sleeve (100) into sections.

The depth of any of the disclosed sleeve channels (110), full length or partial length, may also be used to control the fastener loading needed to split the sleeve (100) into sections. The depth, seen in FIG. 44, is preferably at least 50% of the maximum structural region wall thickness (172), seen in FIG. 20 and later described in detail. In a further embodiment the depth is 60-95% of the maximum structural region wall thickness (172), while in an even further embodiment the depth is 75-95% of the maximum structural region wall thickness (172).

In another embodiment, the sleeve (100) may have separate sections that are bonded together by a sleeve bonding agent (105), as seen in FIGS. 49 and 50. The sleeve bonding agent (105) bonds the individual sleeve sections into a fracturable sleeve (100) unit which breaks apart into individual sleeve (100) sections when exposed to a predetermined load. The sleeve bonding agent (105) may include, but is not limited to, a directly applied adhesive or

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polymer applied between the sections as seen in FIGS. 49-50, an adhesive or polymer in which the sleeve (100) is dipped thereby covering a portion, or all, of the sleeve (100), and an injection cast polymer inner sleeve (100) surface, outer sleeve (100) surface or a completely embedded sleeve (100). Further, the sleeve bonding agent (105) may be soldering or brazing alloy, or even a weld material produced during a continuous, or a spot, welding process. Thus, in some embodiments the sleeve bonding agent (105) does not extend the full length of the individual sleeve sections.

In another embodiment, the sleeve (100) may have pre-separated distinct sections that are held in place by one or more sleeve retainers (200), as seen in FIGS. 1-15, 19-20, 23-24, and 48, and in some embodiments a shroud (300). In one embodiment the sleeve (100) includes at least two distinct sections (101, 102), as seen in FIGS. 30-31, while in another embodiment the sleeve (100) includes at least three distinct sections (101, 102, 103), as seen in FIGS. 32-33, and in an even further embodiment includes at least four distinct sections (101, 102, 103, 104), as seen in FIGS. 34-35. The segmentation of the sleeve (100) allows the sleeve outer diameter (140) to expand when the blind fastener is actuated, as seen in FIGS. 31, 33, and 35, and provides edges of the distinct sections that bite into the workpieces (700, 800). The sleeve (100) has a sleeve inner diameter (150), seen in FIG. 6, forming a bore in which the expander (400) passes through.

As seen in FIGS. 19 and 20, in one embodiment the sleeve (100) has a retainer engagement region (160) having a retainer engagement region wall thickness (162), a retainer engagement length (164) and a retainer engagement region diameter (168). While the embodiment of FIG. 20 illustrates the sleeve retainer (200) located at the sleeve proximal end (120), it may be located anywhere along the length of the sleeve (100, as seen near the middle of the sleeve (100) in FIG. 21 and at the sleeve distal end (130) in FIG. 48.

In some embodiments the sleeve (100) includes at least one retainer engagement region ledge (166), as illustrated in FIGS. 20 and 47. The engagement region ledge (166) provides a surface for the sleeve retainer (200) to abut and helps provide a smooth transition from the sleeve retainer (200) and sleeve (100). In such ledge embodiments the retainer engagement region wall thickness (162) is preferably at least 20% of a maximum structural region wall thickness (172), while in a further embodiment the retainer engagement region wall thickness (162) is 30-95% of the maximum structural region wall thickness (172), and in an even further embodiment the retainer engagement region wall thickness (162) is at least 50% of the maximum structural region wall thickness (172). A still further embodiment has a

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retainer engagement region wall thickness (162) of at least 65% of the maximum structural region wall thickness (172). The minimum retainer engagement region wall thickness (162) ensures that the retainer engagement region (160) will not crush longitudinally when subjected to severe loading. Additionally the retainer engagement region (160) may have a retainer engagement region wall thickness (162) such that when the retainer (200) is attached to the retainer engagement region (160), the sum of the retainer engagement region wall thickness (162) and the retainer thickness, which is half the distance between the sleeve engagement section outer diameter (216) and the sleeve engagement section inner diameter (214) seen in FIG. 20, is not more than the structural region wall thickness (172), thereby ensuring passage through a tight opening (720, 820) in the workpieces (700, 800).

Furthermore, in one embodiment the sleeve (100) has a retainer engagement region (160) located on the sleeve proximal end (120) allowing the sleeve retainer (200) to be affixed to the sleeve (100), as seen in FIG. 19. In a further embodiment, the retainer engagement region (160) is located in an area located between the sleeve proximal end (120) and the sleeve distal end (130), as seen in FIGS. 21 and 22. In another embodiment, the retainer engagement region (160) is located on the sleeve distal end (130) as seen in FIG. 47, which also serves to cover the sleeve distal end (130) as it flairs outward thereby providing many of the benefits discussed later herein with respect to the shroud (300) embodiment. In yet another embodiment, the retainer engagement region (160) includes the entire sleeve length (155), as seen in FIG. 36 and described later in more detail

Additionally, the sleeve (100) has a structural region (170) with a structural region length (174) and a structural region wall thickness defined by the sleeve outer diameter (140) and the sleeve inner diameter (150), as illustrated by FIGS. 19 and 20. The structural region (170) has a structural region length (174) sufficiently long enough to engage the first workpiece (700) and second workpiece (800) when the blind fastener is placed through the overlapping first workpiece opening (720) and second workpiece opening (820) as illustrated in FIGS. 3 and 4. In order to accommodate a wide variety of workpiece thicknesses and configurations, the structural region length (174) is preferably at least 35% greater than an expansion section length (448), seen in FIG. 17 and discussed later in detail. While in another embodiment the structural region length (174) is preferably at least 50% greater than an expansion section length (448), and in yet a further embodiment the structural region length (174) is 50-95% greater than an expansion section length (448). Furthermore, when the blind fastener is in a fully actuated locked state, the sleeve structural region (170) and the expander

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(400) substantially fill the opening in the workpieces and impart a radial load on the workpiece openings, while resisting shear forces at a workpiece interface (900) located where the first workpiece opening (720) and second workpiece opening (820) abut, as seen in FIGS. 3, 4, 13 and 15. The structural region (170) of the sleeve (100) is that portion intended to carry the load at the shear plane of the workpiece interface (900), and includes the adjacent portions of the sleeve (100) having a sleeve outer diameter (140) within 5% of the maximum sleeve outer diameter (140), but this does not require the structural region (170) to have a perfectly smooth outer surface. For instance, the outer surface of the structural region (170) may have surface texturing or stippling to increase the grip as the outer surface comes in contact with the workpieces (700, 800); further, the outer surface of the structural region (170) may have channels in the outer surface, which may produce limited regions in which the sleeve outer diameter (140) is not within 5% of the maximum sleeve outer diameter (140) provided (a) the total volume of such channels is less than 25% of the volume of the structural region (170), and (b) in a series of five equally spaced transverse cross-sections through the structural region (170) at least three of the five transverse cross-sections have at least 50% of the cross-sectional perimeter is within 5% of the maximum sleeve outer diameter (140), thereby allowing limited longitudinal channels, as well as limited transverse channels, within the structural region (170).

In one embodiment the structural region (170) has a structural region wall thickness (172), as seen in FIGS. 20 and 22. Further, the retainer engagement region wall thickness (162) of the retainer engagement region (160), as seen in FIGS. 19 and 20, has a minimum retainer engagement region wall thickness (162) that is at least 25% of the maximum structural region wall thickness (172) to ensure the retainer engagement region (160) does not compress longitudinally as the expander (400) is drawn into the structural region (170) of the sleeve (100).

In another embodiment the sleeve (100) may also have a shroud engagement region (190) on which the shroud (300) may attach, as shown in FIGS. 19 and 20. The shroud engagement region (190) has a shroud engagement region length (192) that is sufficiently long enough to allow the shroud (300) to remain attached during the actuation and locking of the blind fastener. In reference to the shroud (300), the shroud has a proximal end (310), a shroud distal end (320) and a shroud thickness (330), as shown in FIGS. 1 and 20. The shroud (300) may be composed of an elastic material, or may have a hard protective cap with an elastic skirt on the shroud proximal end (310) that attaches to the shroud engagement region (190).

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Furthermore, the shroud (300) cooperates with sleeve shroud engagement region (190) and encloses at least a portion of the expander (400) and a portion of the sleeve (100), as seen in FIG. 5; while in a further embodiment the shroud (300) encloses the sleeve distal end (130) and the expander distal end (420) in the initial state, the expanded state, and the locked state; and in an even further embodiment the shroud (300) has a shroud proximal end (310), a shroud distal end (320), and a shroud thickness (330), whereby the shroud proximal end (310) is attached to the sleeve (100) and the shroud distal end (320) totally encloses and seals the sleeve distal end (130). In many embodiments at least a portion of the shroud (300) is elastic and applies a compressive force on to the sleeve (10).

The shroud (300) serves an important function of protecting cables from being damaged from the exposed surfaces of a blind fastener, however as previously disclosed this protective function may also be achieved via the sleeve retainer (200) when positioned at the sleeve distal end (130) as shown in FIG. 48. The shroud engagement region (190) may have a shroud engagement region ledge (194) against which the shroud proximal end (310) abuts as seen in FIGS. 19 and 20. Additionally the shroud engagement region (190) may have a shroud engagement region wall thickness (196) such that when the shroud (300) is attached to the shroud engagement region (190), the sum of the shroud engagement region wall thickness (196) and the shroud thickness (330) is not more than the structural region wall thickness (172). Furthermore, in another embodiment the shroud engagement region wall thickness (196) is at least 25% of the maximum structural region wall thickness (172) to ensure that the shroud engagement region (190) does not compress longitudinally as the expander (400) is drawn into the structural region (170) of the sleeve (100). In a further embodiment the shroud engagement region wall thickness (196) is 30-95% of the maximum structural region wall thickness (172), and in an even further embodiment the shroud engagement region wall thickness (196) is at least 50% of the maximum structural region wall thickness (172). One particular embodiment has a minimum shroud engagement region wall thickness (196) that is 25-50% of the maximum structural region wall thickness (172). A still further embodiment has a shroud engagement region wall thickness (196) of at least 65% of the maximum structural region wall thickness (172). In some embodiments the sleeve (100) includes a shroud engagement region (190) having a shroud engagement region length (192) that is at least 10% of the structural region length (174), and the shroud (300) cooperates with the shroud engagement region (190). In a further embodiment the shroud engagement region length (192) is 10-50% of the structural region length (174). The shroud engagement region

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(190) may be a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one shroud engagement region ledge (194) to shield at least one edge of the shroud (300).

The sleeve (100) may include a sleeve throat (180) having a throat length (182), a throat angle (184), and a throat wall thickness (186), as illustrated in FIG. 20. The throat wall thickness (186) tapers as it approaches the sleeve distal end (130), as illustrated in FIG. 20. In one embodiment, the mid-point of the sleeve throat (180) has a throat wall thickness (186) of not less than 25% of the maximum structural region wall thickness (172). In another embodiment, the mid-point of the sleeve throat (180) has throat wall thickness (186) of not more than 75% of the maximum structural region wall thickness (172), while in yet a further embodiment, the mid-point of the sleeve throat (180) has throat wall thickness (186) that is 25-75% of the maximum structural region wall thickness (172). The throat wall thickness (186) ensure that the shroud engagement region (190) can easily enter the sleeve throat (180) and begin the deformation of the sleeve (100), which is completed by the locking section (430), while not compressing longitudinally as the expander (400) is drawn into the sleeve (100).

In one embodiment the sleeve throat length (182) is at least 25% of the length of the shroud engagement region (190), or the retainer engagement region length (164) when the sleeve retainer (200) when positioned at the sleeve distal end (130) as shown in FIG. 48. In another embodiment, the sleeve throat length (182) does not exceed 75% of the length of the shroud engagement region (190) or the retainer engagement region length (164). The sleeve throat length (182) and tapering throat wall thickness (186) forms a throat angle (184) which acts as a ramp within the sleeve throat (180) that helps ensure proper alignment and ingress of the expander (400) as it is drawn into the sleeve (100), as seen in FIG. 7. Furthermore, in one embodiment the throat angle (184) is 5-50 degrees, while in a further embodiment the throat angle (184) is 10-45 degrees, and in an even further embodiment the throat angle (184) is 15-30 degrees. The throat length (182) and throat angle (184) ensure that the shroud engagement region (190) can easily enter the sleeve throat (180) and begin the radial expansion and deformation of the sleeve (100) via the locking section (430), while not compressing longitudinally as the expander (400) is drawn into the sleeve (100).

The sleeve retainer (200) may be elastic in nature, contractible in nature, or non-elastic in nature, but applied with a preload, and has a sleeve engagement section (210) that cooperates with the retainer engagement region (160) to maintain the sleeve (100) in an initial

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state. As seen in FIGS. 19, 20 and 42, the sleeve engagement section (210) of the sleeve retainer (200) has a sleeve engagement section length (212), a sleeve engagement section inner diameter (214), a sleeve engagement section outer diameter (216), and a retainer thickness, which is one-half of the difference between the sleeve engagement section outer diameter (216) and the sleeve engagement section inner diameter (214). In one embodiment, the sleeve engagement section outer diameter (216) is not more than the sleeve outer diameter (140) when the sleeve retainer (200) is attached to the retainer engagement region (160). In another embodiment, the sleeve engagement section outer diameter (216) is 1-15% larger than the sleeve outer diameter (140) when the sleeve retainer (200) is attached to the retainer engagement region (160), thereby providing a consistent outer surface of the blind fastener that can easily enter workpiece openings that are extremely tight without snagging. In yet another embodiment, the sleeve engagement section outer diameter (216) is less than the sleeve outer diameter (140) when the sleeve retainer (200) is attached to the retainer engagement region (160). Additionally, in one embodiment the sleeve engagement section length (212) is approximately the same as the retainer engagement region length (164) in order to prevent overlapping of the sleeve engagement section (210) when the sleeve retainer (200) is affixed to the retainer engagement region (160) of the sleeve (100), while in a further embodiment the sleeve engagement section length (212) is less than the retainer engagement region length (164) in order to prevent overlapping of the sleeve engagement section (210) when the sleeve retainer (200) is affixed to the retainer engagement region (160) of the sleeve (100). The sleeve engagement section length (212) may be at least 10% of the structural region length (174), while in a further embodiment the sleeve engagement section length (212) is 10-50% of the structural region length (174), while in an even further embodiment the sleeve engagement section length (212) is a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one retainer engagement region ledge (166) to shield at least one edge of the sleeve retainer (200). The retainer engagement region (160) has a retainer engagement region wall thickness (162), and the structural region (170) has a structural region wall thickness (172), whereby in one embodiment the minimum retainer engagement region wall thickness (162) is at least 25% of the maximum structural region wall thickness (172) to ensure the retainer engagement region (160) does not compress longitudinally as the expander (400) is drawn into the sleeve (100). Even further, the minimum retainer engagement region wall thickness (162) is 25-50% of the maximum structural region wall thickness (172) provides the necessary strength. These relationships

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provide a sleeve retainer (200) to sleeve (100) connection that is strong enough to withstand the forces encountered as the sleeve (100) is installed and radially expanded.

In another embodiment seen in FIG. 48, the sleeve retainer (200) may be located on, and overlap, the sleeve distal end (130) thereby forming a sleeve retainer protrusion (230). As previously mentioned, in this embodiment the sleeve retainer (200) provides the benefits previously described as being associated with the shroud (300) embodiment. The sleeve retainer protrusion has a sleeve retainer protrusion length (232) and a sleeve retainer protrusion width (234), as seen in FIG. 48. The retainer protrusion width (234) may have the same thickness as the fully contracted sleeve retainer (200). However, in one embodiment the retainer protrusion width (234) is greater than the height of the retainer engagement region ledge (166) and wraps around a portion of the sleeve distal end (130) further ensuring that the sleeve retainer (200) remains in place as the sleeve distal end (130) flares outward as the expander (400) is drawn into the sleeve (100) as seen in FIG. 15. Taking this even further, in the embodiment of FIG. 48 the retainer protrusion width (234) is equal to the height of the retainer engagement region ledge (166) and the throat wall thickness (186) at the sleeve distal end (130). Further, in another embodiment the sleeve retainer (200) has a sleeve engagement section length (212) that is at least as great as the sleeve throat length (182), thereby further reducing the likelihood that the sleeve retainer (200) moves out of position as the sleeve distal end (130) flares outward as the expander (400) is drawn into the sleeve (100). In an even further embodiment the sleeve engagement section length (212) is at least 50% greater than the sleeve throat length (182), and is at least 75% greater than the sleeve throat length (182) in another embodiment, while in a further embodiment the sleeve retainer protrusion length (232) is at least 5% of the retainer engagement region length (164). The retainer protrusion width (234) may have a thickness that is at least 15-30 % greater than the sleeve retainer (200) sleeve engagement section outer diameter (216) minus the sleeve engagement section inner diameter (214). The sleeve retainer protrusion (230) provides the benefit of aiding in the alignment and installation of the blind protective fastener, and also helps shield wires, cables and other important infrastructure from sharp edges that may form on the expanding sleeve distal end (130) during installation.

As seen in FIGS. 19-20, in another embodiment the sleeve retainer (200) may have a retainer flange (220) having a retainer flange overhang (222) and a retainer flange thickness (224), which while illustrated at the sleeve proximal end (120) in FIGS. 19-20 could also be located at the sleeve distal end (130) as seen in FIG. 48. When positioned at the sleeve

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proximal end (120), the retainer flange overhang (222) helps seal both the internal structure of the workpieces and the blind fastener from the natural elements. Additionally, the retainer flange thickness (224) is sufficient to form a water tight gasket when the blind fastener is actuated to a locked state.

As seen in FIGS. 21-22, one embodiment may incorporate a single sleeve retainer (200). Alternatively, the embodiment of FIGS. 21-22 may also incorporate a sleeve distal end (130) sleeve retainer (200), such as that seen in FIG. 48, or the sleeve distal end (130) shroud (300) as illustrated in FIGS. 21-22. Further, the embodiment of FIGS. 19-20 may incorporate a sleeve proximal end (120) sleeve retainer (200), either with or without a retainer flange (200), in unison with a sleeve distal end (130) sleeve retainer (200), such as that seen in FIG. 48, or the sleeve distal end (130) shroud (300) as illustrated in FIGS. 19-20. Even further, in the embodiments of FIGS. 36-41, a single sleeve retainer (200) may encircle majority, or all, of the sleeve (100), as will be explained in greater detail later, which may be used alone or in combination with any of the disclosed sleeve retainer (200) and/or shroud (300) embodiments.

In some embodiments, seen in FIGS. 36-41, a sleeve retainer (200) may be made of a contractible material, which may be incorporated individually into the blind fastener or may be applied in addition to at least one other sleeve retainer (200). In this embodiment the sleeve retainer (200) has a sleeve engagement section (210), as seen in FIGS. 36 and 38, which cooperates with the retainer engagement region (160) after contraction to maintain the sleeve (100) in an initial state. The retainer engagement region (160) may be recessed as illustrated in FIGS. 19, 20, 21 and 48. Alternatively, the retainer engagement region (160) may be on a non-recessed sleeve (100) retainer engagement region (160), as illustrated in FIGS. 40, 41 and 42, which may simply be the exterior surface of the sleeve (100). In one contractible material sleeve retainer (200) embodiment the sleeve retainer (200) has a sleeve engagement section length (212) prior to contraction that is at least 25% of the retainer engagement region length (164), which means that in one embodiment the sleeve engagement section length (212) prior to contraction is at least 25% of the overall sleeve length (155). In a further contractible material sleeve retainer (200) embodiment the sleeve retainer (200) has a sleeve engagement section length (212) prior to contraction that is at least 50% of the retainer engagement region length (164), which means that in one embodiment the sleeve engagement section length (212) prior to contraction is at least 50% of the overall sleeve length (155). In yet another contractible material sleeve retainer (200) embodiment the sleeve retainer (200)

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has a sleeve engagement section length (212) prior to contraction that is at least 75% of the retainer engagement region length (164), which means that in one embodiment the sleeve engagement section length (212) prior to contraction is at least 75% of the overall sleeve length (155). While an even further contractible material sleeve retainer (200) embodiment has a sleeve engagement section length (212) prior to contraction that is at least 100% of the retainer engagement region length (164), which means that in one embodiment the sleeve engagement section length (212) prior to contraction is at least 100% of the overall sleeve length (155). Another embodiment is designed to encircle the entire sleeve length (155) post-contraction of the sleeve retainer (200), and therefore has a sleeve engagement section length (212) prior to contraction that is at least 110% of the retainer engagement region length (164), which means that in one embodiment the sleeve engagement section length (212) prior to contraction is at least 110% of the overall sleeve length (155), and thus at least partially wraps either the sleeve proximal end (120), the sleeve distal end (130), or both, upon contraction.

Such contractible material sleeve retainer (200) embodiments have a pre-contraction inner and outer sleeve engagement section diameter (214, 216), as seen in FIG. 42. Furthermore, the pre-contraction sleeve engagement section inner diameter (214) is at least 5% larger than the sleeve retainer engagement region diameter (168). During assembly the sleeve (100) is positioned inside the sleeve retainer (200), as seen in FIGS. 37 and 38, which may include the use of a temporary mandrel to position the sleeve (100), or the sleeve (100) may already be positioned on a tensioning section (450) of the expander (400). Then a sleeve retainer (200) contraction activation means (H) is applied to the sleeve retainer (200). The contraction activation means (H) may include, but is not limited to, heat activation and/or dehydration activation. For instance, in one embodiment, a heat activated sleeve retainer (200) may be a shrink wrap sleeve that may be made of, but is not limited to, PETG, PVC, OPS, PE, or PLA shrink films. In another embodiment, that uses dehydration activation, the sleeve retainer (200) may be a shrink wrap sleeve made of, but not limited to, gelatin and collagen materials.

In other embodiments that have shrink wrap covering 100% of the sleeve (100) outer surface, the shrink wrap sleeve retainer (200) presents a seamless outer surface thereby further reducing the likelihood of snagging any of the components of the blind fastener as it is installed. Additionally, the shrink wrap sleeve, or any portion of the sleeve retainer (200), may be printed with installation instructions and warnings for the end user, and may be color

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coded to easily inform the user of an attribute of the blind fastener. For instance in one embodiment the color of the contractible material sleeve retainer (200) is indicative of the length of the blind fastener, or the thickness of the workpiece joint that may be joined via the blind fastener; whereas in another embodiment the color is indicative of the diameter of the blind fastener, or the size of the opening in the workpieces that may be joined via the blind fastener.

Furthermore, in some embodiments the sleeve retainer (200) ensures the components of the sleeve (100) and expander (400) remain together during shipping and installation, which improves worksite safety, particularly when the blind fastener is in the process of being installed high above the ground. After the sleeve retainer (200) has been fully contracted the sleeve engagement section inner diameter (214) is approximately the same as the retainer engagement region diameter (168) wherein the sleeve retainer engagement section (210) is in physical contact with the retainer engagement region (160) and imparts a radially compressive load on the sleeve (100). In yet another embodiment the contractible sleeve retainer (200) covers a portion of the sleeve (100), a portion of the expander (400), and a portion of the nut (500); while in a further embodiment it also covers a washer system (600) located between the nut (500) and the sleeve (100) thereby holding all of the components of the blind fastener together in a predetermined relationship.

With reference to FIGS. 36-41, in one embodiment the fully contracted sleeve retainer (200) is provided on the retainer engagement region (160) located on the sleeve proximal end (120) and extends from the sleeve proximal end (120) towards the sleeve distal end (130). In another embodiment, the contracted sleeve engagement section length (212) is at least 25% of the sleeve length (155). In another embodiment, the contracted sleeve engagement section length (212) is at least 50% of the sleeve length (155). In yet another embodiment, the contracted sleeve engagement section length (212) is at least 75% of the sleeve length (155). In one embodiment, the fully contracted sleeve retainer (200) is provided on the retainer engagement region (160) located on the sleeve distal end (130) and extends from the sleeve distal end (130) towards the sleeve proximal end (120). In another embodiment, the contracted sleeve engagement section length (212) is at least 25% of the sleeve length (155). In yet another embodiment, the contracted sleeve engagement section length (212) is at least 50% of the sleeve length (155). In still another embodiment, the contracted sleeve engagement section length (212) is at least 75% of the sleeve length (155). In other embodiments the sleeve retainer (200) and retainer engagement region (160) maybe offset

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from the sleeve proximal end (120) or the sleeve distal end (130). In another embodiment, the sleeve retainer and retainer engagement region (160) maybe located at the sleeve length (155) midpoint, as seen in FIGS. 21 and 22. In yet another embodiment, the sleeve (100) may have at least two sleeve retainers (200). In one embodiment the sleeve (100) may be provided with two retainer engagement regions (160) and two sleeve retainers (200), having one retainer engagement region (160) and one sleeve retainer (200) located on the sleeve proximal end (120) and the other retainer engagement region (160) and sleeve retainer (200) located on the sleeve distal end (130). Alternatively, in another embodiment, the sleeve (100) may be provided with two retainer engagement regions (160) and sleeve retainers (200), having one retainer engagement region (160) and one sleeve retainer (200) located on the sleeve proximal end (120) or sleeve distal end (130) and the other retainer engagement region (160) and sleeve retainer (200) located on the sleeve length (155) midpoint. In yet another embodiment, the fully contracted sleeve retainer (200) fully encompasses and engages the retainer engagement region (160) wherein the retainer engagement region length (164) is substantially equal to the sleeve length (155).

The use of sleeve retainer (200) made of a contractible material installed, or shrunk, around at least a portion of the sleeve (100) after the sleeve (100) is positioned on the expander (400) offers several advantages. The compressive radial force exerted by the contractible sleeve retainer (200) forces the sleeve (100) against the expander (400) and keeps it in place. For example in FIG. 29 the contractible sleeve retainer (200) is applied after the sleeve (100) is positioned on the tensioning section (450) of the expander (400), which effectively locks the sleeve (100) on the tensioning section (450) because the sleeve inner diameter (150) is less than the expansion section diameter (442).

Referring again to FIGS. 36-41, the contractible sleeve retainer (200) may be sized to extend beyond an end, or both ends, of the sleeve (100), and thereby also engage a portion of the expander (400). In one embodiment the contractible sleeve retainer (200) is specifically sized to extend beyond one or both ends of the sleeve (100) and engage the expander (400) at each end of the sleeve (100). This is particularly beneficial in a further embodiment in which the blind fastener includes factory installed thread lubricant, often referred to as anti-seize or bolt lubricant. Thread lubricant is often essential to achieve the necessary tension in blind fasteners used in structural connections. For example, looking at the embodiment of FIGS. 26-28, a thread lubricant may be applied to a portion of the tensioning section (450), the sleeve (100) may be positioned over the thread lubricant, and then the contractible sleeve

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retainer (200) may be applied to cover the assembly. The thread lubricant may include compositions of oil, grease, wax, graphite, and/or molybdenum disulfide. In one embodiment the thread lubricant includes a solid lubricant in a paste formulation to provide a consistent coefficient of friction and a paste that does not evaporate and is resistant to washout. Such solid lubricants include, but are not limited to, MoS_2, white solids, graphite, copper, zirconium dioxide, and PTFE. In one paste embodiment the base oil is a glycol, and in an even further embodiment the paste includes a polyalkylene glycol base oil. The contractible sleeve retainer (200) retains the thread lubricant and is constructed of an oil resistant material that does not break-down when it is in contact with the thread lubricant, and thereby prevents the thread lubricant from coming in contact with the installer's hands, which is very beneficial considering that these blind fasteners are often installed several hundred feet above the ground. Additionally, in another embodiment the expander (400) incorporates an anti-friction coating to provide a dry lubrication that does not attract dirt and dust such as a dry film lubricant spray. In a further embodiment at least a portion of the nut (500) includes an anti-friction coating, which in one embodiment is applied to the side of the nut (500) in contact with the washer system (600). In another embodiment at least a portion of the washer system (600) includes an anti-friction coating, which in one embodiment is applied to the portion of the washer system (600) that is in contact with the nut (500).

Alternatively, at least a portion of the sleeve retainer (200) may be elastic, which may include a sleeve retainer (200) having quasi-rubber band qualities and characteristics. In fact, the sleeve retainer (200) may be made of natural rubber, synthetic rubbers including, but not limited to, nitrile and butyl rubbers, and polymers. An elastic sleeve retainer (200) allows the sleeve engagement section (210) to stretch over the retainer engagement region (160), and also allows the sleeve (100) to expand when the expander (400) is drawn into the sleeve (100). Further, an elastic sleeve retainer (200) may be sized to remain in tension when cooperating with the retainer engagement region (160) to securely hold the two or more sleeve sections firmly in an aligned initial state, as seen in FIGS. 6 and 8.

Regardless of the type of sleeve retainer (200), the initial state of the sleeve (100), and the associated properties, are defined when the sleeve (100) is on the tensioning section (450) of the expander (400), as seen in FIG. 29, and in cross-section in FIG. 6. In some embodiments a multi-section sleeve (100) is assembled and then slid onto the tensioning section (450), while in other embodiments the multi-section sleeve (100) may be assembled on the tensioning section (450) and in effect using the expander (400) to aid in the assembly

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of the multi-section sleeve (100) until the sleeve retainer (200), or sleeve retainers (200), and/or shroud (300) are in position and keep the sleeve (100) in an assembled state. Regardless, at least one point along the sleeve length (155) has the sleeve inner diameter (150) in the initial state less than the maximum expansion section diameter (442), thereby preventing the majority of the sleeve (100) from coming in contact with the expansion section (440) until the blind fastener is in use, although as seen in FIG. 29 a portion of the sleeve throat (180), seen in FIG. 20, may extend beyond the expansion section transition (444) without resulting in an increase in the sleeve outer diameter (140).

In the multi-section sleeve (100) embodiment of FIGS. 6 & 8, the edges of each sleeve section (101, 102, 103, 104) are in contact with the edges of the adjacent sleeve sections in the initial state, and a small gap is illustrated between the sleeve inner diameter (150) and the expansion section diameter (442). Thus, in this embodiment the sleeve retainer (200) and/or shroud (300) is applying a radial compressive force on the sleeve sections (101, 102, 103, 104) and maintaining their edges in contact, however in this position there is no radial compressive force transferred from the sleeve (100) to the expander (400) because the edges of the sleeve sections (101, 102, 103, 104) contact each other. However, one skilled in the art will appreciate that the sleeve sections (101, 102, 103, 104) may be sized so that the edges do not contact one another when positioned about the expansion section (440), and therefore the radial compressive force may be transferred from the sleeve (100) to the expander (400). In fact, in one embodiment the radial compressive force is large enough to overcome gravity and keep the sleeve (100) from sliding off the expander (400), even in the orientation of FIG. 29, rotated 180 degrees; and in one embodiment the radial compressive force is at least 1 lbf, while in a further embodiment it is at least 2.5 lbf, and in yet another embodiment it is at least 5 lbf. The sleeve (100) also has an expanded state which defines the characteristics of the sleeve (100) when a portion of the expansion section (440) of the expander (400) has been drawn into the structural region (170) of the sleeve (100) and expanding at least a portion of the structural region (170) of the sleeve (100) from the initial state to this expanded state. Further, as a portion of the locking section (430) is drawn past the sleeve distal end (130) toward the sleeve proximal end (120), it expands, or deforms, at least a portion of the sleeve distal end (130) to a locked state, as seen in FIGS. 13 and 15.

In the embodiments in which at least one point along the sleeve length (155) has the sleeve inner diameter (150) in the initial state less than the maximum expansion section diameter (442), thereby preventing the majority of the sleeve (100) from coming in contact

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with the expansion section (440) until the blind fastener is in use, one benefit is the to ease of installation of the blind fastener into the first and second workpiece openings (722, 822). Furthermore, the sleeve retainer (200) may be located on and overlap the sleeve distal end (130) thereby forming a sleeve retainer protrusion (230). The sleeve retainer protrusion has a sleeve retainer protrusion length (232) and a sleeve retainer protrusion width (234), as seen in FIG. 48. The retainer protrusion width (234) may have the same thickness as the fully contracted sleeve retainer (200). Alternatively, in one embodiment, the retainer protrusion width (234) may have a thickness that is at least 10-50 % greater than the sleeve retainer (200) sleeve engagement section outer diameter (216) minus the sleeve engagement section inner diameter (214). In another embodiment, the retainer protrusion width (234) may have a thickness that is at least 15% to 30% greater than the sleeve retainer (200) sleeve engagement section outer diameter (216) minus the sleeve engagement section inner diameter (214). The sleeve retainer protrusion (230) provides the benefit of aiding in the alignment and installation of the blind protective fastener and also helps shield wires, cables and other important infrastructure from sharp edges that may form on the expanding sleeve distal end (130) during installation. The sleeve retainer (200) may cooperate with the sleeve proximal end (120), as seen in FIG. 19 and 20, or may be located at other locations throughout the length of sleeve (100). One advantage of the sleeve retainer (200) located on the sleeve proximal end (120) is that it allows for a greater surface area of the structural region (170) to be in contact with the walls of the first and second workpiece openings (722, 822) and does not run the risk of aligning with the workpiece interface (900) which would create an elastic void in the shear plane. Further, in another embodiment the shroud (300), located at the opposite end of the blind fastener, may also be elastic and stretch over the shroud engagement region (190), and also allows the sleeve (100) to expand when the expander (400) is drawn into the sleeve (100). Further, the shroud (300) may be sized to remain in tension when cooperating with the shroud engagement region (190) to securely hold the two or more sleeve sections firmly in an aligned initial state, as seen in FIGS. 6 and 8. Thus, the sleeve retainer (200) may exert a retainer force on the sleeve (100), and if present, the shroud (300) may exert a shroud force on the sleeve (100). In one embodiment a first retainer force is applied to the sleeve proximal end (120) and a second retainer force is applied to the sleeve distal end (130); and the second retainer force is $\pm$ 20% of the first retainer force to present a relatively balanced load on the sleeve (100). In yet a further embodiment these elements and their associated forces are located at opposite ends of the sleeve (100) and they are designed so

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that retainer force is ± 50% of the shroud force, while in another embodiment the retainer force is ± 25% of the shroud force, and in an even further embodiment the retainer force is ± 10% of the shroud force. Such balanced compressive loading of the sleeve (100) ensures the individual sections of the sleeve (100) remain in the desired position in the initial state and simplify the assembly process.

In yet another embodiment, the sleeve retainer (200) may be made of a non-elastic non-contractible material such as, but not limited to, a non-elastic plastic or metal band, having a sleeve engagement section (210), which slips around, or is wrapped around, the retainer engagement area (160); wherein the retainer engagement region diameter (168) is approximately the same as the sleeve retainers (200) sleeve engagement section inner diameter (214). Furthermore, the sleeve retainer (200) may be further secured to the sleeve (100) by a layer of adhesive located between the retainer engagement area (160) and the sleeve engagement section (210).

Now turning to the expander (400), as seen in FIGS. 17, 18, 25, and 26, it has an expander proximal end (410), an expander distal end (420), a tensioning section (450), a locking section (430), and an expansion section (440) between the tensioning section (450) and the locking section (430). The tensioning section (450) has a tensioning section diameter (452) and a tensioning section length (454). Additionally, the locking section (430) has a locking section diameter (432), and the expansion section (440) has an expansion section diameter (442) and an expansion section transition (444), as illustrated in FIG. 17. In some embodiments the tensioning section (450) may include a tensioning section gripping region (456), which may be an external surface as seen in FIG. 17, or an internal socket as seen in FIG. 18.

All of the disclosed relationships herein, including the lengths, angles, diameters, thicknesses, strength, elongation, and hardness, among the various portions of the expander (400) and the various portions of the sleeve (100), play an important role in the ease of installation and performance of the blind bolt, particularly when the blind fastener must be installed with a preload of at least 70,000 lbf. As previously touched upon one application of the blind fastener is in tower construction, and specifically in wind turbine tower construction. In such applications the tower is structural steel, and therefore the bolting in the tower splices must come under the Research Council on Structural Connections. This is the North American body that writes the design and installation specifications which govern all bolted structural steel connections. The only way to ensure that the bolts are going to survive

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in service is to get them uniformly tightened, read tensioned or loaded, to a very high percentage of their strength, which is the best insurance against loosening because the correctly tensioned bolts will not see very much change in tension as the external service loads vary. Correctly tensioned fasteners only experience a small percentage change in tension as external loads vary and therefore have an extremely long, practically infinite, fatigue life. However, if the fasteners are not tensioned correctly they will experience a large percentage change in tension, cyclically, and their residual clamping force will gradually diminish. Once the clamping force has dropped significantly, every cycle of external load will change the force in the fastener by a very high percentage, and the fatigue life of the fastener will limit its serviceability. Unlike many fasteners, the present blind fastener is specifically designed to encourage proper tensioning of the expander (400) and radial expansion of the sleeve (100) to engage the workpieces (700, 800), while still improving upon the ease of installation and incorporating protective features. In one particularly effective embodiment the expansion section diameter (442) is at least 7.5% greater than the tensioning section diameter (452), and the locking section diameter (432) is at least 15% greater than the expansion section diameter (442), while the structural region (170) has a structural region wall thickness (172) that is less than a difference between the locking section diameter (432) and the tensioning section diameter (452). While the previous embodiment includes a minimum relationship between the expansion section diameter (442) and the tensioning section diameter (452), as well as the locking section diameter (432) and the expansion section diameter (442), another embodiment recognizes preferred performance in a range with an upper boundary. In this embodiment the expansion section diameter (442) is no more than 15% greater than the tensioning section diameter (452); while in an even further embodiment the locking section diameter (432) is no more than 30% greater than the expansion section diameter (442), thereby providing a blind fastener that does not require drastically oversized workpiece openings (720, 820) and improves shear load distribution to the blind fastener at the workpiece interface (900).

With reference to FIGS. 17, 18, and 20, the locking section (430) has a locking section transition length (436) and a locking section transition angle (435), the expansion section (440) has an expansion section transition length (446) and an expansion section transition angle (445), and the structural region (170) of the sleeve (100) has a structural region length (174). The relationships of these lengths and angles promotes preferred loading of the expander (400) to achieve the necessary preload, as well as expansion of sleeve (100)

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to engage the workpieces (700, 800). In one such embodiment the locking section transition length (436) is at least twice the expansion section transition length (446), and the expansion section length (448) is at least 25% of the structural region length (174).

In a further embodiment the expansion section length (448) is 25-75% of the structural region length (174), further providing great flexibility for the blind fastener and assuring a solid plane of the sleeve (100) and the expansion section (440) at the workpiece interface (900). As seen in FIG. 20, the sleeve distal end (130) has a sleeve throat (180) having a throat length (182) and a throat angle (184). In one embodiment the throat angle (184) is 5-50 degrees, and the throat angle (184) is less than the expansion section transition angle (445), seen in FIG. 18, thereby providing a rather distinct point of expansion of the sleeve (100), which allows for gradual loading of the expander (400) as the expansion section transition (444) wedges the sleeve (100) radially against the workpieces (700, 800) as the expander (400) is drawn into the sleeve (100). Additionally, this virtually immediate engagement of the interior of the sleeve (100) with the expansion section (440), within five rotations of the nut (500) around the tensioning section (450), and the associated engagement of the exterior of the sleeve (100) with the workpieces (700, 800) allows the blind fastener to be installed with a single tool rotating the nut (500), without the need for a second specialized tool to hold the sleeve (100) and/or expander (400) and prevent them from rotating. While the sleeve (100) and/or expander (400) may rotate initially for five seconds or less, by the time the nut (500) has rotated around the tensioning section (450) five times the sleeve (100) will have engaged the workpieces (700, 800) and the expansion section (440) will have engaged the sleeve (100) such that sleeve (100) and the fastener (400) no longer rotate.

In another embodiment the relationships of these lengths and angles achieve engagement within three rotations of the nut (500) around the tensioning section (450) in a time period of less than two seconds. In a further embodiment embracing the initial rapid radial expansion of the sleeve (100) over the expansion section transition (444) and later gradual deformation of the sleeve distal end (130) by the locking section transition (434) and final loading of the expander (400), the locking section transition angle (435) is less than 50% of the expansion section transition angle (445). In an even further embodiment the throat angle (184) is greater than locking section transition angle (435); while in another embodiment the throat angle (184) is at least 5 degrees less than the expansion section transition angle (445), and the throat angle (184) is no more than 15 degrees greater than locking section transition angle (435). This preferential loading is exhibited in another

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embodiment in which the throat length (182) is greater than the expansion section transition length (446), and the locking section transition length (436) is greater than the expansion section transition length (446). In one particular embodiment the length of the expander (400) from the expander proximal end (410) to the expander distal end (420) is at least 100 mm, while in another embodiment it is at least 150 mm, and is at least 200 mm in a further embodiment. Additionally, in one embodiment of the blind fastener the tensioning section diameter (452) is at least 0.75", while in another embodiment it is at least 1.25", and is at least 2.0" in a further embodiment. Such long lengths and large diameters require unique relationships to ensure ease of installation, engagement of the sleeve (100), and the ability to achieve the necessary tension in the expander (400); relationships that are largely irrelevant to conventional length and diameter blind bolt assemblies. The surface of the locking section transition (434) may include a friction enhancing surface pattern to reduce the likelihood of the sleeve (100) and expander (400) rotating with respect to one another once the locking section transition (434) has engaged the sleeve (100). In one such embodiment the surface pattern is a friction promoting stippling pattern, whereas in another embodiment it includes a series of longitudinal channels.

Further, in one embodiment the tensioning section diameter (452) is 75 to 95% the diameter of the expansion section (440). The tensioning section (450) may utilize a threaded system, shown in FIGS. 17, 18, 23 and 25, to actuate the expander (400) while putting the blind fastener in a locked state by rotational forces applied to either the nut (500), or in some embodiments the tensioning section gripping region (456). Testing has shown that an advantage of the present invention is that a tensioning section gripping region (456) is not actually required to prevent the expander (400) from rotating as the nut (500) is turned to draw the expander (400) into the sleeve (100). The tight fit of the expander (400) and the edges of the sleeve (100) cooperate to prevent the expander (400) from rotating as the nut (500) rotates and draws the expander (400) into the sleeve (100). In one particular embodiment at least a portion of the expander (400) is composed of material having a Rockwell B-Scale hardness that is at least 10 units higher than the Rockwell B-Scale hardness of the sleeve (100), while in a further embodiment the Rockwell B-Scale hardness differential is at least 15 units, and in an even further embodiment the Rockwell B-Scale hardness differential is at least 20 units. In even further embodiments the tensioning section gripping region (456) may be in the form of bolt head, as seen in FIGS. 23 and 24, or recessed in the expander proximal end (410), as seen in FIG. 18.

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The expansion section (440) serves the purpose of expanding the sleeve (100) so that the sleeve outside diameter (140) is approximately the same as the first workpiece opening diameter (722) and second workpiece opening diameter (822), as illustrated in FIGS. 9-11, while exerting a substantial radial load on the openings (720, 820). In one embodiment, the pre-installed sleeve inner diameter (150) is 3 to 20% smaller than the expansion section diameter (442). In another embodiment, the pre-installed sleeve inner diameter (150) is 5 to 15% smaller than the expansion section diameter (442). In yet another embodiment, the expansion section diameter (442) is 5 to 20 % smaller than the locking section diameter (432). In another embodiment the expansion section diameter (442) is 7.5 to 15 % smaller than the locking section diameter (432). However, in an alternative set of embodiments the pre-installed sleeve inner diameter (150) is approximately equal to, or larger than, the expansion section diameter (442); thus in a further embodiment the pre-installed sleeve inner diameter (150) is 0.1 to 10% larger than the expansion section diameter (442), while in another embodiment it is 1 to 5% larger than the expansion section diameter (442), and in an even further embodiment it is 2.5 to 5% larger than the expansion section diameter (442).

In order to ensure proper alignment and ingress of the expander (400), the expansion section (440) has an expansion section transition (444), as seen in FIG. 18, having an expansion section transition angle (445) and expansion section transition length (446). In combination, the section transition angle (445) and expansion section transition length (446) form a ramp that engages the sleeve throat (180), thereby feeding the expansion section (440) into the sleeve (100) when the protective blind faster is actuated. Furthermore, in one embodiment the expansion section transition angle (445) is 5-50 degrees, while in a further embodiment the expansion section transition angle (445) is 10-45 degrees, and in an even further embodiment the expansion section transition angle (445) is 15-30 degrees. In one embodiment the expansion section transition angle (445) is equal to the throat angle (184). A further variation incorporates an expansion section transition angle (445) that is at least 1 degree greater than the throat angle (184), but preferably less than 5 degrees greater than the throat angle (184).

The locking section diameter (432) may be 5-25% larger than expansion section diameter (442), but the locking section diameter (432) may be equal to, or less than the sleeve outer diameter (140). In another embodiment, the locking section diameter (432) is 1-10% smaller than the sleeve outer diameter (140). These unique relationships of the diameters ensure that the components of the blind fastener are compactly configured for installation, yet

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the expansion section (440) serves to expand the sleeve (100) so that the sleeve (100) and the expansion section (440) completely fill the first workpiece opening (720) and second workpiece opening (820) to create a solid metal shear plane at the workpiece interface (900).

Furthermore, the locking section (430) has an overall locking section length (438) that includes a locking section transition (434) that has a locking section transition angle (435) and a locking section transition length (436), as illustrated in FIGS. 17 and 18. In combination, the locking section transition angle (435) and a locking section transition length (436) form a ramp that engages the sleeve proximal end (120) and deforms the sleeve (100), thereby locking the blind fastener into place. In another embodiment, the locking section (430) includes a plurality of individual ramps, each having their own the locking section transition angle (435) and a locking section transition length (436), as seen in FIG. 25. In one embodiment the locking section transition angle (435) is 5-50 degrees, while in a further embodiment the locking section transition angle (435) is 10-45 degrees, and in an even further embodiment the locking section transition angle (435) is 15-30 degrees. In one embodiment the locking section transition angle (435) is equal to the throat angle (184). A further variation incorporates a locking section transition angle (435) that is at least 1 degree greater than the throat angle (184), but preferably less than 5 degrees greater than the throat angle (184).

Furthermore, in one embodiment, the locking section diameter (432), seen in FIG. 17, is 0-5% smaller than the sleeve (100) retainer engagement region diameter (168), seen in FIG. 20. In another embodiment, the locking section diameter (432) is 1-20% larger than the sleeve (100) retainer engagement region diameter (168). In yet another embodiment, the locking section diameter (432) is 5-15% larger than the sleeve (100) retainer engagement region diameter (168).

In an alternative embodiment of the blind fastener, the expander (400) is composed of a tensioning section (450) that is separate and distinct from an expansion section (440), as seen in FIGS. 23 and 24. In this embodiment, tensioning section (450) engages threads in a bore located in the part composed of the expansion section (440) and locking section (430). As the tensioning section (450) is actuated, the part composed of the expansion section (440) and locking section (430) is drawn into the sleeve (100), thereby locking the blind protective fastener into place.

Referring back to FIG. 17, one particular embodiment has an expansion section diameter (442) that is 7.5-15% greater than the tensioning section diameter (452), and a

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locking section diameter (432) that is 15-30% greater than the expansion section diameter (442). In a further embodiment the locking section transition length (436) is at least twice the expansion section transition length (446), and the expansion section length (448) is at least 25% of the structural region length (174). In yet a further embodiment the expansion section length (448) is 25-75% of the structural region length (174). Another embodiment incorporates a locking section transition length (436) that is greater than the shroud engagement region length (192). These relationships provide preferred radial and longitudinal loading of the sleeve (100), while facilitating smooth ingress of the expander (400) into the sleeve (100) and preferred deflection of the sleeve distal end (130) for secure locking of the workpieces.

In one embodiment, seen in FIG. 26, the expander (400) includes a region of expander indicia (460) that is discernable by a person, such as an inspector or foreman, analyzing the installed blind fastener using binoculars from a distance of at least 100 yards. The expander indicia (460) easily informs a user of an attribute of the blind fastener. For instance in one embodiment the expander indicia (460) is a color coded region on the expander (400). In one embodiment the color of the expander (400) is indicative of the length of the blind fastener, or the thickness of the workpiece joint that may be joined via the blind fastener; whereas in another embodiment the color is indicative of the diameter of the blind fastener, or the size of the opening in the workpieces that may be joined via the blind fastener. For example, in one embodiment the expander indicia (460) is indicative of the allowable joint thickness to be joined via a specific blind fastener, and the indicia (460) is visible from long distances. Thus, an inspector would be able to remain on the ground consulting the blueprints of a new tower and then look up at the constructed tower and identify whether the blind fastener identified on the plans was indeed the one used in construction. In one embodiment the expander indicia (460) covers at least 25% of the exposed surface area of the tensioning section (450), located external to the workpieces (700, 800) and nut (500); while in a further embodiment the expander indicia (460) covers at least 50% of the exposed surface area; and in yet a further embodiment the expander indicia (460) covers at 1.0 square inch of the tensioning section (450). In one embodiment the color coded expander indicia (460) also corresponds with the color coding of the sleeve retainer (200), thereby creating a system in which the installer can easily identify the proper blind fastener for a particular locations and install it, and then the inspector can easily verify from a distance that the proper blind fastener was indeed installed.

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Additionally, as seen in FIG. 51, the externally exposed portion of the expander (400) may serve many important functions. For instance, the tensioning section (450), which is generally threaded, may provide an extra inch or more of available real estate along the exposed portion of the tensioning section (450) to attach any number of accessories, including, but not limited to, an anchor (1000), or an attachment device (1100), such as the illustrated step. Such anchors (1000) are particularly important during the construction of a tower and provide workers with virtually limitless locations to tie-off their safety lines. Additionally the anchors (1000) may be used with suspension equipment such as a suspended hoist work platform, lift, or bosun's chair. Further, this blind fastener design's extra inch or more of available real estate along the exposed portion of the tensioning section (450) provides great flexibility for later reinforcing of the tower, for instance as the technology of wind generators advances and necessitate the tower to support greater loads.

In one particular embodiment the blind fastener has a sleeve (100) having a sleeve proximal end (120), a sleeve distal end (130), a sleeve outer diameter (140), a sleeve inner diameter (150) , a retainer engagement region (160), and a structural region (170), as seen in FIGS. 19 and 20. Additionally, the blind fastener has a sleeve retainer (200) having a sleeve engagement section (210) that cooperates with the retainer engagement region (160) to maintain the sleeve (100) in an initial state. In addition to the sleeve retainer (200), the blind fastener has an expander (400) having an expander proximal end (410), an expander distal end (420), a tensioning section (450), a locking section (430), and an expansion section (440) between the tensioning section (450) and the locking section (430), wherein the expansion section (440) has an expansion section diameter (442) and an expansion section transition (444), as seen in FIG. 17, and at least one point along the length of the sleeve (100) has the sleeve inner diameter (150) in the initial state less than the maximum expansion section diameter (442). Furthermore, the blind fastener may have a shroud (300) that cooperates with a portion of the sleeve (100) and encloses at least a portion of the expander (400) and a portion of the sleeve (100), as seen in FIGS. 5, 7, 9, 11, 13 and 15. The blind fastener has a nut (500) wherein a portion of the expander (400) passes through the sleeve (100) to cooperate with the nut (500) so that relative rotation of the expander (400) and nut (500) draws the expander distal end (420) toward the sleeve proximal end (120), thereby drawing a portion of the expansion section (440) of the expander (400) into the structural region (170) of the sleeve (100), as seen in FIG. 11, and expanding at least a portion of the structural region (170) of the sleeve (100) from the initial state to an expanded state, as seen in FIG. 12.

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This also draws a portion of the locking section (430) past the sleeve distal end (130) toward the sleeve proximal end (120) and expands at least a portion of the sleeve distal end (130) to a locked state whereby the sleeve distal end (130) has been deformed to the point that it is larger than the opening in the workpieces and therefore cannot be withdrawn, as seen best in FIG. 15. In some embodiments a shroud (300), or a portion of a sleeve distal end (120) sleeve retainer (200) as seen in FIG. 48, encloses a portion of the sleeve (100) in the locked state as seen in FIGS. 13 and 15. Thus, the shroud (300), or sleeve distal end (120) sleeve retainer (200), must accommodate both the radial expansion from the initial state to the expanded state as the expansion section (440) forces the sleeve (100) outward and into contact with the workpieces, as well as accommodate the change in shape of the sleeve distal end (130) as the locking section (430) bends the sleeve distal end (130) outward.

In one embodiment the blind fastener's minimum sleeve inner diameter (150) increases at least 2.5% from the initial state to the expanded state to fill both the first and second workpiece openings (722, 822). The expanding sleeve serves to eliminate any movement in the workpieces in relation to one another due to loose fitting fasteners; reduces the likelihood of fasteners failings due to shear loading on the fastener; and allows the blind fastener to lock into place. As seen in FIGS. 9, 10, and 11, the blind fastener has expanded so that the shear plane, located at the workpiece interface (900), is effectively completely filled with the structural material of the sleeve (100) and expansion section (440). Further, the blind fastener has forced the first workpiece (700) and the second workpiece (800) together to reduce the likelihood of any voids in this high stress area. The ability to have radial expansion of the sleeve (100) from the initial state to the expanded state ensures that workers will not oversize the openings in the workpieces, as is often the case, which leads to loose joints, misalignment, and shear plane problems. Another embodiment provides even further flexibility by having the blind fastener's minimum sleeve inner diameter (150) increase at least 3.5% from the initial state to the expanded state to fill both the first and second workpiece openings (722, 822); while an even further embodiment has found a preferential range of expansion of minimum sleeve inner diameter (150) to be 2.5-5% from the initial state to the expanded state.

In the embodiment of FIG. 5, the blind fastener has been inserted into the workpieces but has not yet been actuated, meaning the expansion section (440) of the expander (400) has not yet been drawn into the sleeve (100), as shown in FIG. 7. Therefore, in one embodiment, as seen in FIG. 8, at least a portion of the edges of each sleeve section (101, 102, 103, 104)

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are in contact with the edges of the adjacent sleeve sections in the initial state, and a portion of any, or all, of the sleeve sections (101, 102, 103, 104) may be in contact with a portion of the tensioning section (450) of the expander (400). In fact, in one embodiment at least 50% of the surface area of the edges of each sleeve section (101, 102, 103, 104) are in contact with the adjacent sleeve section's edge, and at least a portion of abutting edges are substantially parallel. In a further embodiment, in the unactuated state, the interior surface of each sleeve section is in contact with the exterior surface of the threads of the tensioning section (450) throughout at least 50% of the sleeve length (155). In yet another embodiment illustrated in FIGS. 6 and 8, 100% of the surface area of the edges of each sleeve section (101, 102, 103, 104) are in contact with the adjacent sleeve section's edge, and at least a portion of abutting edges are substantially parallel in the unactuated state, and the interior surface of each sleeve section is in contact with the exterior surface of the threads of the tensioning section (450) throughout at least 75% of the sleeve length (155). FIGS. 9-12 illustrate the changes to FIGS. 5-8 when the blind fastener is partially-actuated, meaning that the expansion section (440) has entered the sleeve (100) and resulted in radial expansion of the sleeve (100). Further, FIGS. 13-16 illustrate the changes to FIGS. 5-12 when the blind fastener is fully-actuated, meaning that at least a portion of the locking section (430) has entered the sleeve (100) and resulted in further radial expansion of at least a portion of the sleeve throat (180). In series of figures of just one possible embodiment since the radius of curvature of the interior surface of the sleeve sections (101, 102, 103, 104) is within 5% of the radius of curvature of the exterior surface of the tensioning section (450), a small gap between the inner surface of the sleeve sections (101, 102, 103, 104) and the exterior surface of the expansion section (440) appears in the partially-actuated state seen in FIG. 12 until the sleeve sections (101, 102, 103, 104) are slightly bent as the tensile load is further applied to the blind fastener and the fully-actuated state is reached, as seen in FIG. 16, and there is complete surface contact between the inner surface of the sleeve sections (101, 102, 103, 104) and the exterior surface of the expansion section (440), as well as the exterior surface of the sleeve sections (101, 102, 103, 104) and the interior surface of the workpieces (700, 800). This deformation of the sleeve (100) allows the blind fastener system to compensate for any irregularities in the workpiece openings (720, 820).

However, such deformation changes the loading profile of the blind fastener and may be undesirable in embodiments having greater sleeve thicknesses and material strength. Thus, in another embodiment, shown in the series of FIGS. 57-59, which is analogous to FIGS. 8,

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12, and 16 of the previously discussed embodiment, wherein FIG. 57 is the cross-section in which the blind fastener has been inserted into the workpieces but has not yet been actuated, meaning the expansion section (440) of the expander (400) has not yet been drawn into the sleeve (100), as shown in FIG. 7; while FIG. 58 is the cross-section in which the blind fastener is partially-actuated, meaning that the expansion section (440) has entered the sleeve (100) and resulted in radial expansion of the sleeve (100); and FIG. 59 is the cross-section in which the blind fastener is fully-actuated, meaning that at least a portion of the locking section (430) has entered the sleeve (100) and resulted in further radial expansion of at least a portion of the sleeve throat (180). In this embodiment the sleeve (100) is designed to have a predetermined desired curvature when full-actuated without any bending or deformation of the sleeve (100), or individual sleeve sections (101, 102, 103, 104). Thus, as seen in FIG. 59, in one embodiment the interior surface of the sleeve (100), or one or more of the sleeve sections (101, 102, 103, 104), has a sleeve radius of curvature (Rs), and the exterior surface of the expansion section (440) has an expansion section radius of curvature (Res). In one particular embodiment each of the one or more sleeve sections has a sleeve radius of curvature (Rs) that is ± 5% of the expansion section radius of curvature (Res) throughout at least 25% of the structural region length (174); while in a further embodiment majority of the sleeve sections have a sleeve radius of curvature (Rs) that is ± 5% of the expansion section radius of curvature (Res) throughout at least 50% of the structural region length (174); while in an even further embodiment all of the sleeve sections have a sleeve radius of curvature (Rs) that is ± 5% of the expansion section radius of curvature (Res) throughout at least 75% of the structural region length (174).

In a further embodiment each of the one or more sleeve sections has a sleeve radius of curvature (Rs) that is ± 2.5% of the expansion section radius of curvature (Res) throughout at least 25% of the structural region length (174); while in a further embodiment majority of the sleeve sections have a sleeve radius of curvature (Rs) that is ± 2.5% of the expansion section radius of curvature (Res) throughout at least 50% of the structural region length (174); while in an even further embodiment all of the sleeve sections have a sleeve radius of curvature (Rs) that is ± 2.5% of the expansion section radius of curvature (Res) throughout at least 75% of the structural region length (174). In an even further embodiment each of the one or more sleeve sections has a sleeve radius of curvature (Rs) that is equal to the expansion section radius of curvature (Res) throughout at least 25% of the structural region length (174); while in a further embodiment majority of the sleeve sections have a sleeve radius of curvature (Rs)

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that is equal to the expansion section radius of curvature (Res) throughout at least 50% of the structural region length (174); while in an even further embodiment all of the sleeve sections have a sleeve radius of curvature (Rs) that is equal to the expansion section radius of curvature (Res) throughout at least 75% of the structural region length (174). Additionally, in the fully-actuated state of FIG. 59, with each sleeve section in contact with the expansion section (440), there is a section gap (106) between the adjacent sidewalls of the individual sleeve sections. Specifically, in the four sleeve section embodiment of FIG. 59, the first sleeve section (101) has two first sleeve section sidewalls (101a), likewise the second sleeve section (102) has two second sleeve section sidewalls (102a), the third sleeve section (103) has two third sleeve section sidewalls (103a), and the fourth sleeve section (104) has two fourth sleeve section sidewalls (104a). The section gap (106) is the minimum distance between the adjacent section sidewalls. In one particular embodiment effective loading and shear resistance is achieved when each section gap (106) is less than the maximum structural region wall thickness (172); while in a further embodiment each section gap (106) is less than 50% of the maximum structural region wall thickness (172); while in an even further embodiment each section gap (106) is 10-50% of the maximum structural region wall thickness (172); and in a still further embodiment each section gap (106) is 20-40% of the maximum structural region wall thickness (172). In one embodiment the maximum structural region wall thickness (172) is 2-10 mm, and each section gap (106) is less than 6 mm; while in a further embodiment the maximum structural region wall thickness (172) is 2-6 mm, and each section gap (106) is no more than 4 mm; while in a further embodiment the maximum structural region wall thickness (172) is 3-5 mm, and each section gap (106) is no more than 3 mm, and no more than 2 mm in an even further embodiment. The curvature and size of each sleeve section are designed to provide a compact size when in the un-actuated state, as seen in FIG. 57, to achieve the disclosed relationships that allows for reduced size opening in the workpieces while ensuring easy installation of the blind fastener. In another embodiment the sleeve length (155) is 30-120 mm, the structural region length (174) is 20-100 mm, the tensioning section length (454) is 60-145 mm, the expansion section length (448) is 25-75 mm, the tensioning section diameter (452) 12-30 mm, the expansion section diameter (442) is 15-35 mm, the locking section diameter (432) is 20-40 mm; while in a further embodiment the structural region length (174) is 25-60 mm, the tensioning section length (454) is 80-120 mm, the expansion section length (448) is 35-65 mm, the tensioning section diameter (452)

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15-25 mm, the expansion section diameter (442) is 20-30 mm, the locking section diameter (432) is 25-35 mm.

In the multi-section sleeve (100) embodiment of FIGS. 6 & 8, the edges of each sleeve section (101, 102, 103, 104) are in contact with the edges of the adjacent sleeve sections in the initial state, and a small gap is illustrated between the sleeve inner diameter (150) and the expansion section diameter (442). Thus, in this embodiment the sleeve retainer (200) and/or shroud (300) is applying a radial compressive force on the sleeve sections (101, 102, 103, 104) and maintaining their edges in contact, however in this position there is no radial compressive force transferred from the sleeve (100) to the expander (400) because the edges of the sleeve sections (101, 102, 103, 104) contact each other. However, one skilled in the art will appreciate that the sleeve sections (101, 102, 103, 104) may be sized so that the edges do not contact one another when positioned about the expansion section (440), and therefore the radial compressive force may be transferred from the sleeve (100) to the expander (400).

In another embodiment the sleeve retainer (200) and/or the shroud (300) are adhesively attached to the sleeve (100) to further ensure the desired positioning, and in the case of the shroud (300), so that the expander (400) cannot simply slide out of the sleeve (100), even when oriented vertically without the nut (500) in place, thereby offering great safety advantages during installations in which the workpiece openings are high above the ground. Thus, in one embodiment the shroud (300) will retain and confine the expander (400) even when the shroud (300) is subjected to a force of at least 2 lbf along the longitudinal axis of the expander (400), which ensures that the shroud (300) will support the weight of the expander (400) when oriented vertically without the nut (500) in place. In an even further embodiment the shroud (300) will retain and confine the expander (400) even when the shroud (300) is subjected to a force of at least 5 lbf along the longitudinal axis of the expander (400), which ensures that the shroud (300) will retain the expander (400) without the nut (500) in place even if force is applied to the expander (400) during installation.

In a further embodiment of the blind fastener, the sleeve retainer (200) cooperates with the sleeve proximal end (120) and further includes a retainer flange (220) extending radially beyond the maximum sleeve outer diameter (140) in the initial state by a retainer flange overhang (222), as seen in FIG. 19 and 20, and is at least 10% of the maximum sleeve outer diameter (140) in the initial state, and at least 25% of sleeve engagement section length (212). The retainer flange overhang (222) creates a weather-tight seal and provides stability

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to the sleeve (100). In another embodiment the retainer flange (220) has a longitudinal retainer flange thickness (224), as seen in FIG. 20, that is at least 25% of sleeve engagement section length (212) ensuring adequate material is present to create a good seal when exposed to the loads common with such blind fasteners. Additionally, the inner diameter of the retainer flange (220), through which the expander (400) passes, may be sized so that it is less than the sleeve inner diameter (150) in the initial state, as can be imagined in FIG. 19 and 20, so that a portion of the retainer flange (220) engages the tensioning section (450). One benefit of this embodiment is that the retainer flange (220) effectively grips the tensioning section (450) and keeps the sleeve (100) in place during transport and initial installation.

In another embodiment the retainer engagement region (160) has a retainer engagement region wall thickness (162), and the structural region (170) has a structural region wall thickness (172), as seen in FIG. 20. In this embodiment, the minimum retainer engagement region wall thickness (162) is at least 25% of the maximum structural region wall thickness (172) to ensure the retainer engagement region (160) does not compress longitudinally as the expansion section (440) of the expander (400) is drawn into the structural region (170) of the sleeve (100). In a further embodiment the minimum the retainer engagement region wall thickness (162) is 25-50% of the maximum structural region wall thickness (172). In yet another embodiment the retainer engagement region (160) is a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one retainer engagement region ledge (166) to shield at least one edge of the sleeve retainer (200). In yet another embodiment, the retainer engagement region ledge (166) has a ledge width that is 25-50% of the maximum structural region wall thickness (172).

In one embodiment the shroud (300), and/or the sleeve retainer (200), is waterproof. In an even further embodiment, either, or both, the shroud (300) and sleeve retainer (200) have at least a portion composed of thermoplastic polyurethane, natural rubber, urethane, neoprene, nitrile, butyl, EPDM, styrene butadiene, silicone, hypalon, or viton. In another embodiment at least a portion of the shroud (300), and/or the sleeve retainer (200), is composed of material having a tensile strength of at least 1000 psi, an elongation % of at least 150%, a tear-strength of at least 500-1000 pounds per linear inch, and a service temperature rating of at least 150 degrees Fahrenheit. In an even further embodiment at least a portion of the shroud (300), and/or the sleeve retainer (200), is composed of material having a tensile strength of at least 4000 psi and an elongation % of at least 300%. In an even further embodiment the sleeve retainer (200) and the shroud (300) may create a substantially sealed

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environment and retain a lubricant within the blind fastener, and therefore they may be composed of elastomeric materials that are resistant to breaking down in the presence of lubricants, such as thermoplastic polyurethane, nitrile rubber, silicone, fluoro-elastomers, EPDM, and perfluoro-elastomers.

The sleeve (100) may include a shroud engagement region (190) having a shroud engagement region length (192) that is at least 10% of the structural region length (174), and the shroud (300) cooperates with the shroud engagement region (190). In a further embodiment the shroud engagement region length (192) is 10-50% of the structural region length (174), while in an even further embodiment the shroud engagement region (190) is a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one shroud engagement region ledge (194) to shield at least one edge of the shroud (300). The shroud engagement region (190) has a shroud engagement region wall thickness (196), and the structural region (170) has a structural region wall thickness (172), whereby in one embodiment the minimum shroud engagement region wall thickness (196) is at least 25% of the maximum structural region wall thickness (172) to ensure the shroud engagement region (190) does not compress longitudinally as the expander (400) is drawn into the sleeve (100). Even further, the minimum shroud engagement region wall thickness (196) is 25-50% of the maximum structural region wall thickness (172) provides the necessary strength while also facilitating bending of the sleeve (100) for locking. These relationships provide a shroud (300) to sleeve (100) connection that is strong enough to withstand the forces encountered as the sleeve (100) deforms to a locked state.

In the embodiments illustrated in FIGS. 3-5, 7, 9, 11, 13 and 15 the shroud (300) encloses the sleeve distal end (130) and the expander distal end (420) in the initial state, the expanded state, and the locked state. Therefore in these embodiments the shroud (300) must be constructed to accommodate the change in shape of the sleeve (100) associated with the different states. In some embodiments the shroud (300) is elastic and it stretches to continue to cover the edges of the sleeve (100) even as the edges are flared outward to the locked state, thereby ensuring any apparatus on the blind side of the workpieces is not exposed to sharp metallic edges of the sleeve (100). In one particular embodiment the shroud proximal end (310) is attached to the sleeve (100) and the shroud distal end (320) totally encloses and seals the sleeve distal end (130). Alternatively, the shroud (300) does not have to incorporate elastic elements. Rather the shroud (300) may be configured so that there is space between the shroud distal end (320) and the expander distal end (420). The space accommodates the

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changes in shape of the sleeve (100). One embodiment ensures that the extra space in the shroud (300) does not result in a baggy shroud (300) that may be a hindrance as the blind fastener is fed into a blind hole. In fact, in one such embodiment the extra shroud (300) length may be folded and adhered internal to the shroud (300) so that it is not presented until the sleeve (100) deforms into the locked state.

The blind fastener is designed for ease of installation in a hole that is not much larger than the blind fastener. Therefore, in one embodiment the initial state the exterior surface of the shroud (300) does not extend radially beyond the maximum sleeve outer diameter (140).

Regardless of whether the shroud (300) is elastic or not, in one embodiment the shroud thickness (330) is no greater than the thickness of the sleeve engagement section (210), thereby ensuring the shroud (300) does not extend radially outward beyond the maximum sleeve outer diameter (140) and reducing the likelihood of snagging the shroud (300) as the blind fastener is fed through the first and second workpiece openings (722, 822).

In yet another embodiment the nut (500) cannot be removed from the expander (400). This may be accomplished in a number of methods including, but not limited to, striking the expander proximal end (410) after the nut (500) is in place to slightly enlarge the proximal end so that the nut (500) cannot pass over the enlarged end, placing a spot weld adjacent the expander proximal end (410) after the nut (500) is in place so that the nut (500) cannot pass over the weld material, and/or attaching a blocking member to the expander proximal end (410) after the nut (500) is in place so that the nut (500) cannot pass over the blocking member.

Some embodiments incorporate a washer system (600), which may consist of one or more washers. One such embodiment is a hardened washer and a self-indicating direct tension indicator. The illustrated embodiments show a three washer system (600) having a self-indicating direct tension indicator between two hardened washers.

In one embodiment the sleeve (100) has an ultimate tensile strength that is within ± 50% of the ultimate tensile strength of the expander (400), while in a further embodiment the sleeve (100) has an ultimate tensile strength that is within ± 25% of the ultimate tensile strength of the expander (400). Still further, in another embodiment the ultimate tensile strength of at least one of the expander (400) or sleeve (100) is at least 800 MPa, while in a further embodiment the ultimate tensile strength at least one of the expander (400) and the sleeve (100) is at least 100 MPa less than the other component. In a further embodiment the expander (400) has an ultimate tensile strength that is at least 25% greater than the ultimate

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tensile strength of the sleeve (100); while in a further embodiment it is at least 35% greater. In one embodiment the ultimate tensile strength of the expander (400) is at least 800 MPa, while the ultimate tensile strength of the sleeve (100) is less than 650 MPa; while in yet another embodiment the ultimate tensile strength of the expander (400) is at least 1000 MPa and the ultimate tensile strength of the sleeve (100) is less than 550 MPa. Still further, in another embodiment the Brinell Hardness (Tungsten Carbide Ball 3000 KG) of the expander (400) is greater than that of the sleeve (100); in fact, in a further embodiment the Brinell Hardness (Tungsten Carbide Ball 3000 KG) of the expander (400) is at least 10% greater than that of the sleeve (100), and, in another embodiment, is at least 25% greater than that of the sleeve (100). In yet another embodiment the percent elongation to break of the expander (400) is at least 30% less than that of the sleeve (100); and in an even further embodiment the percent elongation to break of the expander (400) is at least 50% less than that of the sleeve (100) while still having a elongation to break of the expander (400) that is at least 8 percent. These unique relationships between the properties of the sleeve (100) and the expander (400) facilitate the preferred deformation and loading of the components to achieve the required tensioning of the expander (400) in structural tower installations where an inspector must verify that the expander (400) has been tensioned to at least 70 kips.

As seen in FIGS. 52-54, the expander (400) may have a removable expander portion (470). In one embodiment the removable expander portion (470) is a portion of the tensioning section (450). In one particular embodiment a length of the removable expander portion (470) is at least 25% of the tensioning section length (454), while in a further embodiment the length of the removable expander portion (470) is at least 40% of the tensioning section length (454), and in a further embodiment the length of the removable expander portion (470) is at least 50% of the tensioning section length (454). The removable expander portion (470) may be joined to the expander (400) in any number of ways, however the illustrated embodiment incorporates cooperating male and female sections having threads opposite of those on the exterior surface of the tensioning section (450), which when joined cooperates with the bolt (500). The removable expander portion (470) may be removed after installation to reduce the amount of the expander (400) that extends beyond the bolt (500). In one embodiment the removable expander portion (470) is composed of a different material than the rest of the expander (400). In fact in one embodiment the removable expander portion (470) has an ultimate tensile strength that is at least 100 MPa less than that of the expansion section (440); and in a further embodiment the removable expander portion (470) has an

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ultimate tensile strength that is at least 200 MPa less than that of the expansion section (440). The removable expander portion (470) may be composed of a material having a density that is at least 25% less than the density of the expansion section (440); while in a further embodiment the density of the removable expander portion (470) is at least 50% less that the density of the expansion section (440). In yet a further embodiment the removable expander portion (470) is composed of non-metallic material, which in one embodiment is a polymeric material. For example, the removable expander portion (470) may be composed of magnesium alloys, aluminum/aluminum alloys, titanium alloys, carbon steels, stainless steels, PH (precipitation-hardenable) alloys, copper alloys, and nickel alloys, just to name a few. Non-metallic embodiments may be composed of materials such as a polycaprolactam, a polyhexamethylene adipinamide, or a copolymer of hexamethylene diamine adipic acid and caprolactam, however other embodiments may include polypropylene (PP), nylon 6 (polyamide 6), polybutylene terephthalates (PBT), thermoplastic polyurethane (TPU), PC/ABS alloy, PPS, PEEK, and semi-crystalline engineering resin systems, some of which may be fiber reinforced.

Numerous alterations, modifications, and variations of the embodiments disclosed herein will be apparent to those skilled in the art and they are all anticipated and contemplated to be within the spirit and scope of the instant invention. For example, although specific embodiments have been described in detail, those with skill in the art will understand that the preceding embodiments and variations can be modified to incorporate various types of substitute and or additional or alternative materials, relative arrangement of elements, and dimensional configurations. Accordingly, even though only few variations of the present invention are described herein, it is to be understood that the practice of such additional modifications and variations and the equivalents thereof, are within the spirit and scope of the invention as defined in the following claims.

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WE CLAIM:

1. A blind fastener, comprising:

a sleeve (100) having a sleeve proximal end (120), a sleeve distal end (130), a sleeve length (155), a sleeve outer diameter (140), a sleeve inner diameter (150) and a structural region (170);

an expander (400) having an expander proximal end (410), an expander distal end (420), a tensioning section (450), a locking section (430), and an expansion section (440) between the tensioning section (450) and the locking section (430), wherein the expansion section (440) has an expansion section diameter (442) and an expansion section transition (444), and a portion of the sleeve (100) has the sleeve inner diameter (150), in an initial state, less than the maximum expansion section diameter (442); and

a nut (500);

wherein a portion of the expander (400) passes through the sleeve (100) to cooperate with the nut (500) so that relative rotation of the expander (400) and nut (500):

(i) draws the expander distal end (420) toward the sleeve proximal end (120);

(ii) thereby drawing a portion of the expansion section (440) of the expander (400) into the structural region (170) of the sleeve (100) and expanding at least a portion of the structural region (170) of the sleeve (100) from the initial state to an expanded state; and

(iii) thereby drawing a portion of the locking section (430) past the sleeve distal end (130) toward the sleeve proximal end (120) and deforming at least a portion of the sleeve distal end (130) to a locked state.

2. The blind fastener of claim 1, wherein the locking section (430) has a locking section diameter (432), and the tensioning section (450) has a tensioning section diameter (452), wherein the expansion section diameter (442) is at least 7.5% greater than the tensioning section diameter (452), and the locking section diameter (432) is at least 15% greater than the expansion section diameter (442), and wherein the structural region (170) has a structural region wall thickness (172) that is less than a difference between the locking section diameter (432) and the tensioning section diameter (452).

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3. The blind fastener of claim 2, wherein the expansion section diameter (442) is no more than 15% greater than the tensioning section diameter (452).

4. The blind fastener of claim 3, wherein the locking section diameter (432) is no more than 30% greater than the expansion section diameter (442).

5. The blind fastener of claim 1, wherein the locking section (430) has a locking section transition length (436) and a locking section transition angle (435), the expansion section (440) has an expansion section transition length (446) and an expansion section transition angle (445), and the structural region (170) of the sleeve (100) has a structural region length (174), wherein the locking section transition length (436) is at least twice the expansion section transition length (446), and the expansion section length (448) is at least 25% of the structural region length (174).

6. The blind fastener of claim 5, wherein the expansion section length (448) is 25-75% of the structural region length (174).

7. The blind fastener of claim 6, wherein the sleeve distal end (130) has a sleeve throat (180) having a throat length (182) and a throat angle (184), wherein the throat angle (184) is 5-50 degrees, and the throat angle (184) is less than the expansion section transition angle (445).

8. The blind fastener of claim 7, wherein the locking section transition angle (435) is less than 50% of the expansion section transition angle (445).

9. The blind fastener of claim 7, wherein the throat angle (184) is greater than locking section transition angle (435).

10. The blind fastener of claim 9, wherein the throat angle (184) is at least 5 degrees less than the expansion section transition angle (445), and the throat angle (184) is no more than 15 degrees greater than locking section transition angle (435).

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11. The blind fastener of claim 7, wherein the throat length (182) is greater than the expansion section transition length (446), and the locking section transition length (436) is greater than the expansion section transition length (446).

12. The blind fastener of claim 1, wherein the sleeve (100) includes at least two distinct sections (101, 102).

13. The blind fastener of claim 12, further including a sleeve retainer (200) having a sleeve engagement section (210) that cooperates with a retainer engagement region (160) in the sleeve (100) to maintain the at least two distinct sections (101, 102) in a predetermined relationship.

14. The blind fastener of claim 13, wherein at least a portion of the sleeve retainer (200) is elastic and the sleeve retainer (200) exerts a compressive force on the sleeve (100).

15. The blind fastener of claim 13, wherein the sleeve retainer (200) is contractible when activated.

16. The blind fastener of claim 14, wherein a portion of the sleeve retainer (200) is in tension when cooperating with the retainer engagement region (160) and the sleeve (100) is located around the tensioning section (450).

17. The blind fastener of claim 13, wherein the sleeve engagement section (210) has a sleeve engagement section length (212), a sleeve engagement section inner diameter (214), and a sleeve engagement section outer diameter (216), the sleeve engagement section (210) wraps circumferentially around the sleeve (100), the structural region (170) of the sleeve (100) has a structural region length (174), the retainer engagement region (160) has a retainer engagement region length (164), and both the retainer engagement region length (164) and the sleeve engagement section length (212) are at least 10% of the structural region length (174).

18. The blind fastener of claim 17, wherein the sleeve retainer (200) extends beyond the sleeve distal end (130) forming a sleeve retainer protrusion (230) having a sleeve retainer

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protrusion length (232) and a sleeve retainer protrusion width (234), wherein the sleeve retainer protrusion length (232) is at least 5% of the retainer engagement region length (164).

19. The blind fastener of claim 13, wherein the retainer engagement region (160) has a retainer engagement region wall thickness (162), and the structural region (170) has a structural region wall thickness (172), whereby the minimum retainer engagement region wall thickness (162) is at least 25% of the maximum structural region wall thickness (172) to ensure the retainer engagement region (160) does not compress longitudinally as the expansion section (440) of the expander (400) is drawn into the structural region (170) of the sleeve (100).

20. The blind fastener of claim 19, wherein the retainer engagement region (160) is a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one retainer engagement region ledge (166) to shield at least one edge of the sleeve retainer (200).

21. A blind fastener, comprising:

a sleeve (100) having a sleeve proximal end (120), a sleeve distal end (130), a sleeve length (155), a sleeve outer diameter (140), a sleeve inner diameter (150), and a structural region (170);

an expander (400) having a locking section (430), an expansion section (440), an expander distal end (420), and a bore, wherein the expansion section (440) has an expansion section diameter (442) and an expansion section transition (444), and a portion of the sleeve (100) has the sleeve inner diameter (150), in an initial state, less than the maximum expansion section diameter (442);

a tensioning section (450) separate and distinct from the expander (400) and configured to mechanically cooperate with the expander (400), wherein an end of the tensioning section (450) is configured as a tensioning section gripping region (456); and

wherein a portion of the tensioning section (450) passes through the sleeve (100) to cooperate with the expander (400) so that relative rotation of the tensioning section (450) and the expander (400):

(i) draws the expander distal end (420) toward the sleeve proximal end (120);

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(ii) thereby drawing a portion of the expansion section (440) of the expander (400) into the structural region (170) of the sleeve (100) and expanding at least a portion of the structural region (170) of the sleeve (100) from the initial state to an expanded state; and

(iii) thereby drawing a portion of the locking section (430) past the sleeve distal end (130) toward the sleeve proximal end (120) and deforming at least a portion of the sleeve distal end (130) to a locked state.

22. The blind fastener of claim 21, wherein the tensioning section gripping region (456) is configured as a bolt head.

23. The blind fastener of claim 22, wherein the bore passes through the entire length of the expansion section (440).

24. The blind fastener of claim 23, wherein the bore passes through the entire length of the locking section (430).

25. The blind fastener of claim 21, wherein the locking section (430) has a locking section diameter (432), and the tensioning section (450) has a tensioning section diameter (452), wherein the expansion section diameter (442) is at least 7.5% greater than the tensioning section diameter (452), and the locking section diameter (432) is at least 15% greater than the expansion section diameter (442), and wherein the structural region (170) has a structural region wall thickness (172) that is less than a difference between the locking section diameter (432) and the tensioning section diameter (452).

26. The blind fastener of claim 25, wherein the expansion section diameter (442) is no more than 15% greater than the tensioning section diameter (452).

27. The blind fastener of claim 26, wherein the locking section diameter (432) is no more than 30% greater than the expansion section diameter (442).

28. The blind fastener of claim 21, wherein the locking section (430) has a locking section transition length (436) and a locking section transition angle (435), the expansion

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section (440) has an expansion section transition length (446) and an expansion section transition angle (445), and the structural region (170) of the sleeve (100) has a structural region length (174), wherein the locking section transition length (436) is at least twice the expansion section transition length (446), and the expansion section length (448) is at least 25% of the structural region length (174).

29. The blind fastener of claim 28, wherein the expansion section length (448) is 25-75% of the structural region length (174).

30. The blind fastener of claim 29, wherein the sleeve distal end (130) has a sleeve throat (180) having a throat length (182) and a throat angle (184), wherein the throat angle (184) is 5-50 degrees, and the throat angle (184) is less than the expansion section transition angle (445).

31. The blind fastener of claim 30, wherein the locking section transition angle (435) is less than 50% of the expansion section transition angle (445).

32. The blind fastener of claim 30, wherein the throat angle (184) is greater than locking section transition angle (435).

33. The blind fastener of claim 32, wherein the throat angle (184) is at least 5 degrees less than the expansion section transition angle (445), and the throat angle (184) is no more than 15 degrees greater than locking section transition angle (435).

34. The blind fastener of claim 30, wherein the throat length (182) is greater than the expansion section transition length (446), and the locking section transition length (436) is greater than the expansion section transition length (446).

35. The blind fastener of claim 21, wherein the sleeve (100) includes at least two distinct sections (101, 102).

36. The blind fastener of claim 35, further including a sleeve retainer (200) having a sleeve engagement section (210) that cooperates with a retainer engagement region (160) in

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the sleeve (100) to maintain the at least two distinct sections (101, 102) in a predetermined relationship.

37. The blind fastener of claim 36, wherein at least a portion of the sleeve retainer (200) is elastic and the sleeve retainer (200) exerts a compressive force on the sleeve (100).

38. The blind fastener of claim 36, wherein the sleeve retainer (200) is contractible when activated.

39. The blind fastener of claim 37, wherein a portion of the sleeve retainer (200) is in tension when cooperating with the retainer engagement region (160) and the sleeve (100) is located around the tensioning section (450).

40. The blind fastener of claim 36, wherein the sleeve engagement section (210) has a sleeve engagement section length (212), a sleeve engagement section inner diameter (214), and a sleeve engagement section outer diameter (216), the sleeve engagement section (210) wraps circumferentially around the sleeve (100), the structural region (170) of the sleeve (100) has a structural region length (174), the retainer engagement region (160) has a retainer engagement region length (164), and both the retainer engagement region length (164) and the sleeve engagement section length (212) are at least 10% of the structural region length (174).

41. The blind fastener of claim 40, wherein the sleeve retainer (200) extends beyond the sleeve distal end (130) forming a sleeve retainer protrusion (230) having a sleeve retainer protrusion length (232) and a sleeve retainer protrusion width (234), wherein the sleeve retainer protrusion length (232) is at least 5% of the retainer engagement region length (164).

42. The blind fastener of claim 36, wherein the retainer engagement region (160) has a retainer engagement region wall thickness (162), and the structural region (170) has a structural region wall thickness (172), whereby the minimum retainer engagement region wall thickness (162) is at least 25% of the maximum structural region wall thickness (172) to ensure the retainer engagement region (160) does not compress longitudinally as the

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expansion section (440) of the expander (400) is drawn into the structural region (170) of the sleeve (100).

43. The blind fastener of claim 42, wherein the retainer engagement region (160) is a circumferential recess in the exterior surface of the sleeve (100) thereby creating at least one retainer engagement region ledge (166) to shield at least one edge of the sleeve retainer (200).

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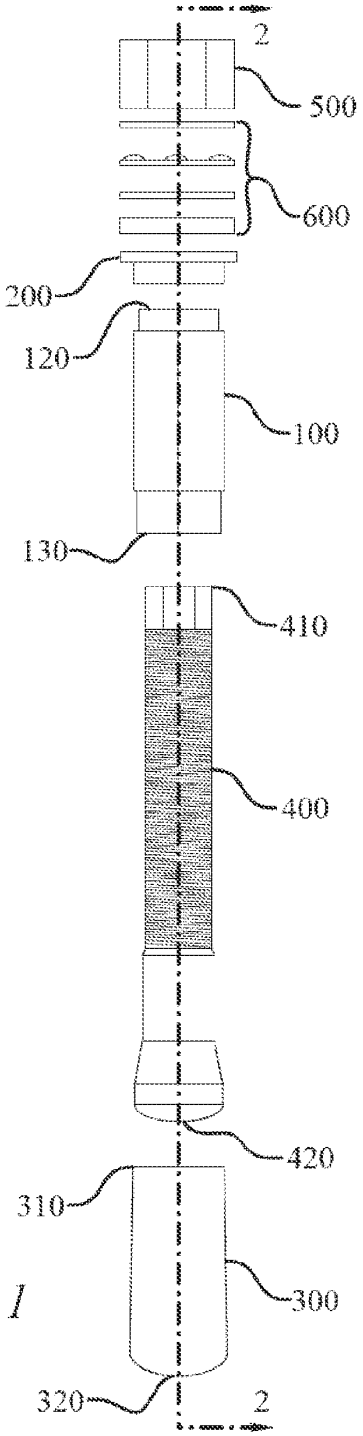


Fig. 1

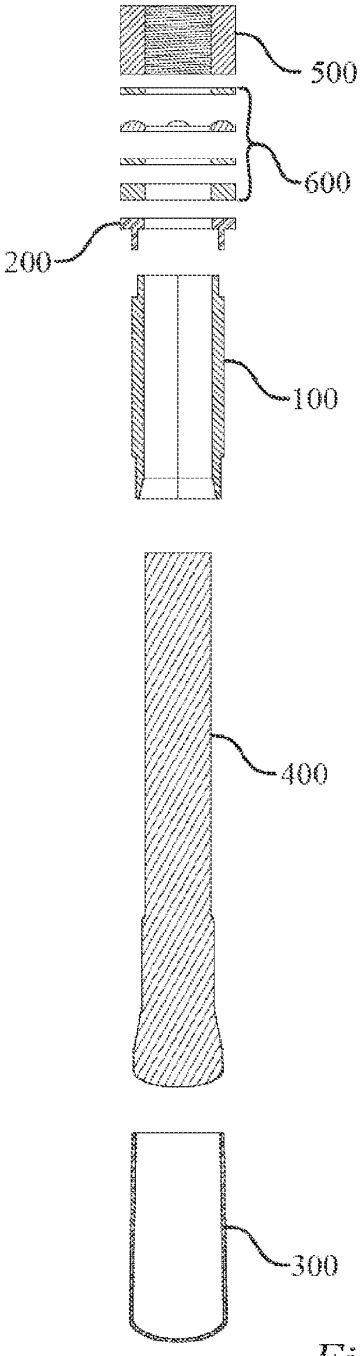


Fig. 2

Petitioner's Ex. 1003-177

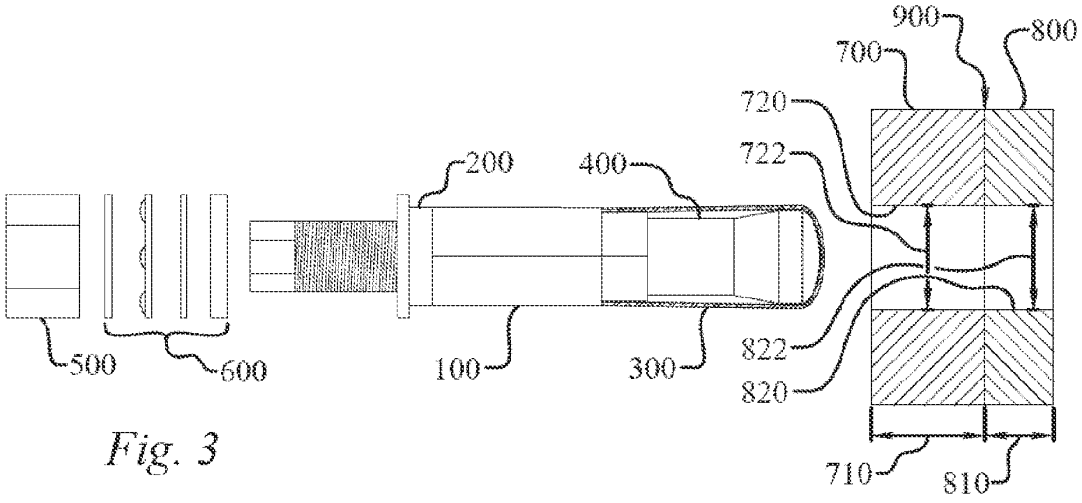


Fig. 3

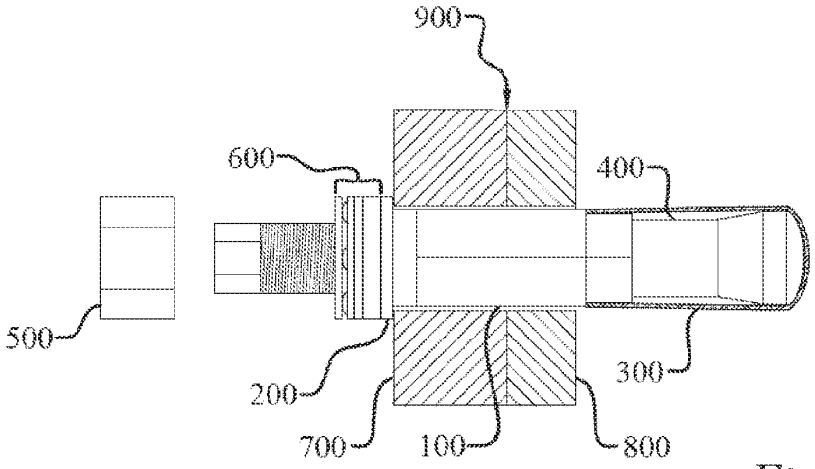


Fig. 4

Petitioner's Ex. 1003-178

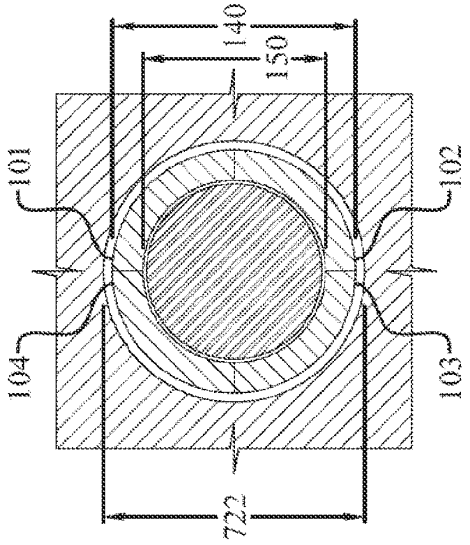


Fig. 6

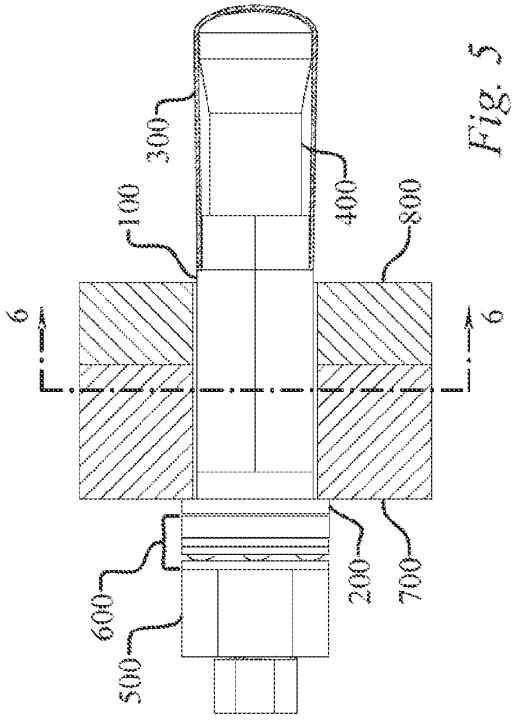


Fig. 5

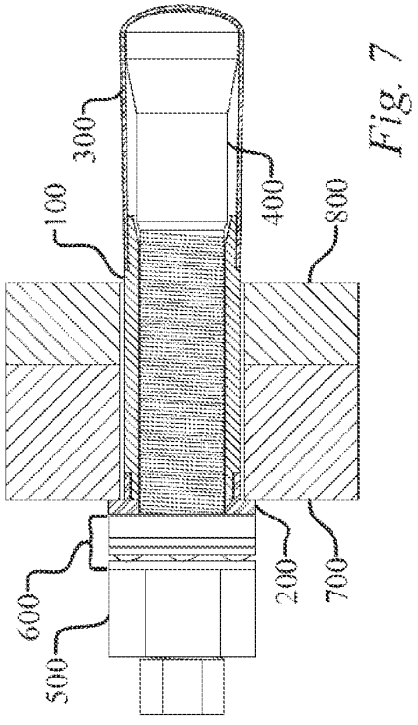


Fig. 7

Petitioner's Ex. 1003-179

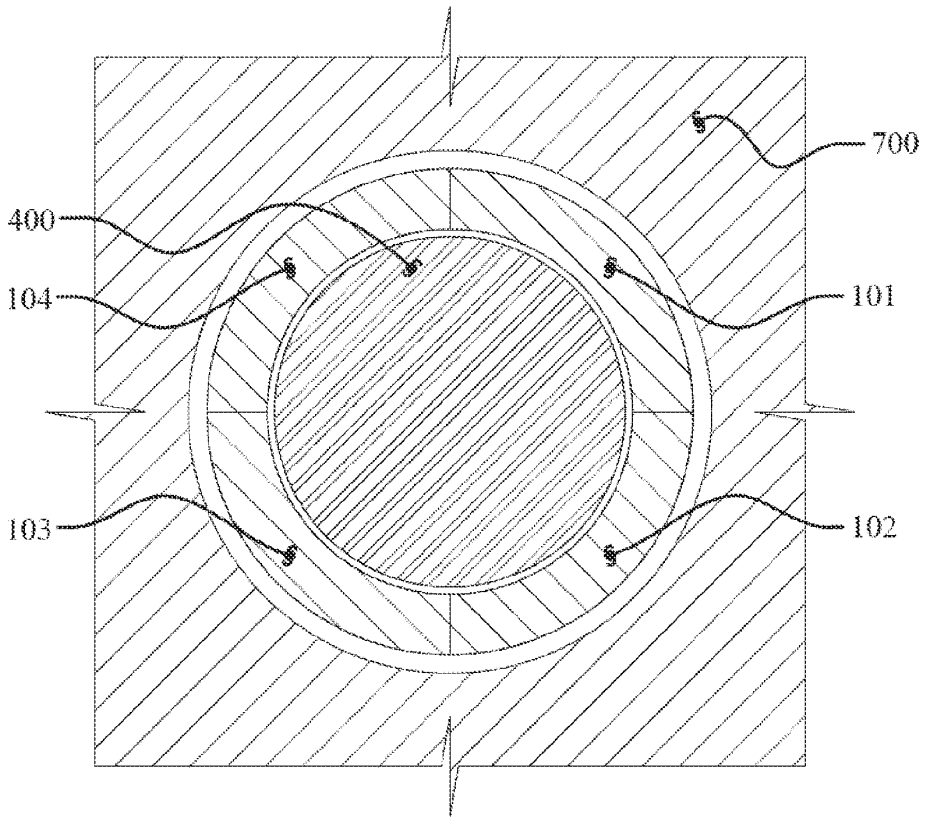


Fig. 8

Petitioner's Ex. 1003-180

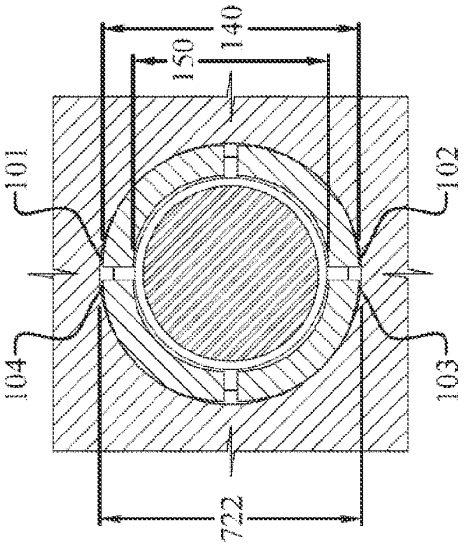


Fig. 10

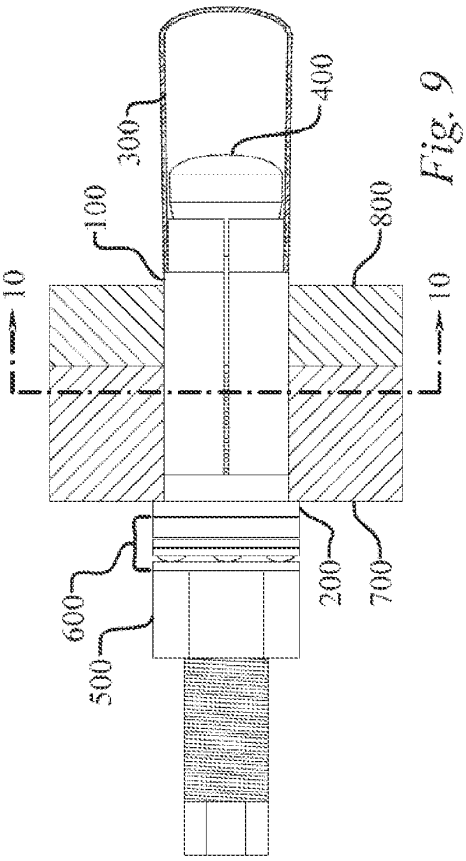


Fig. 9

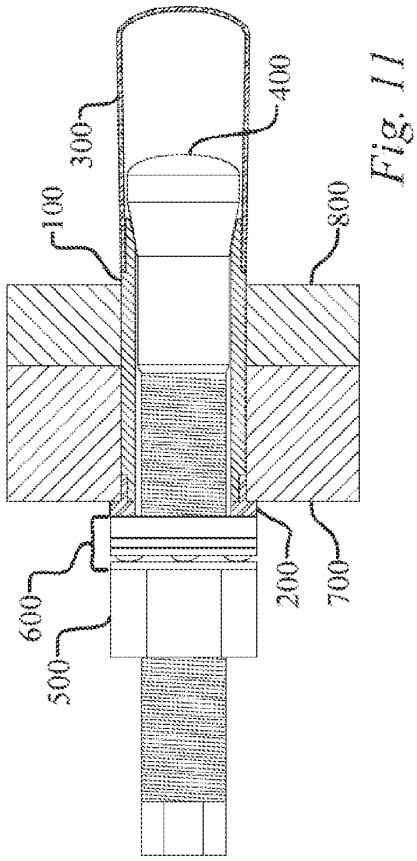


Fig. 11

Petitioner's Ex. 1003-181

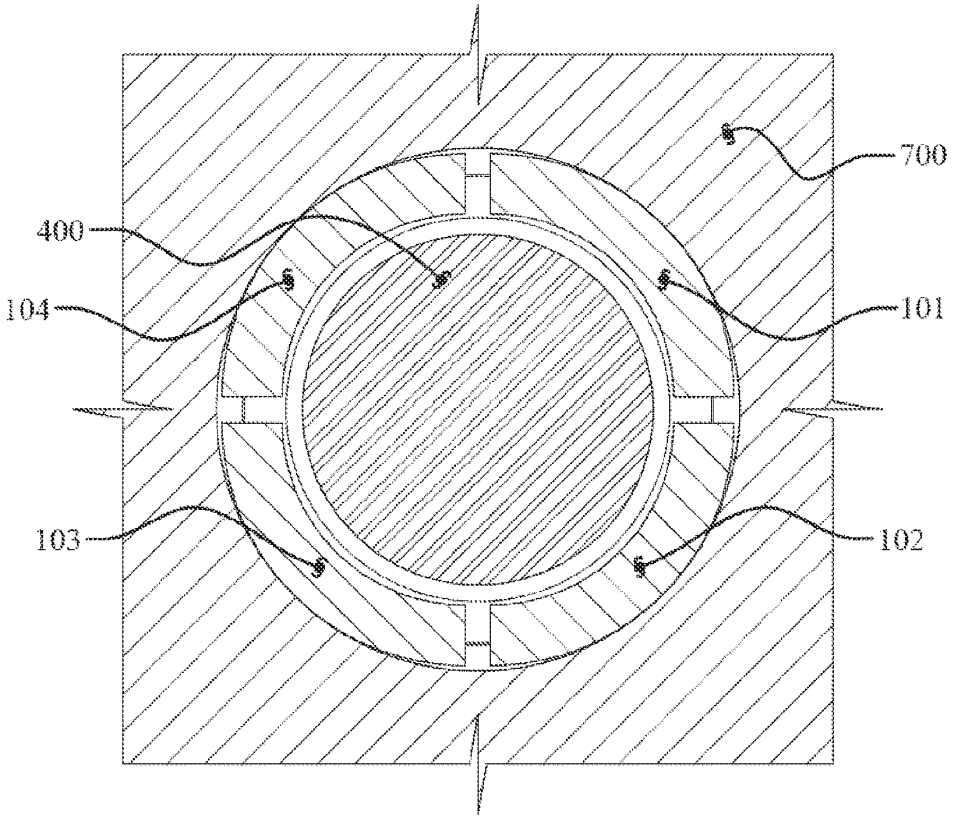


Fig. 12

Petitioner's Ex. 1003-182

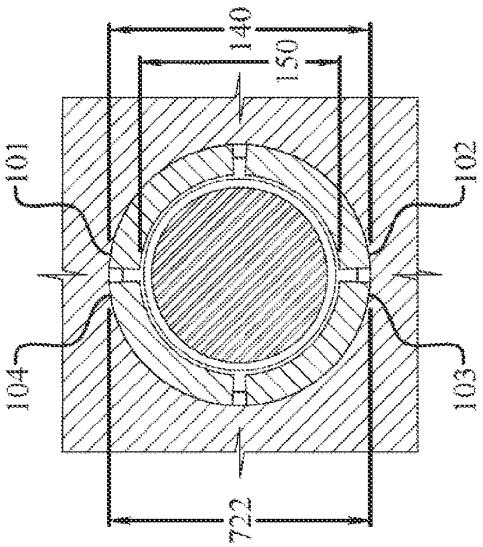


Fig. 14

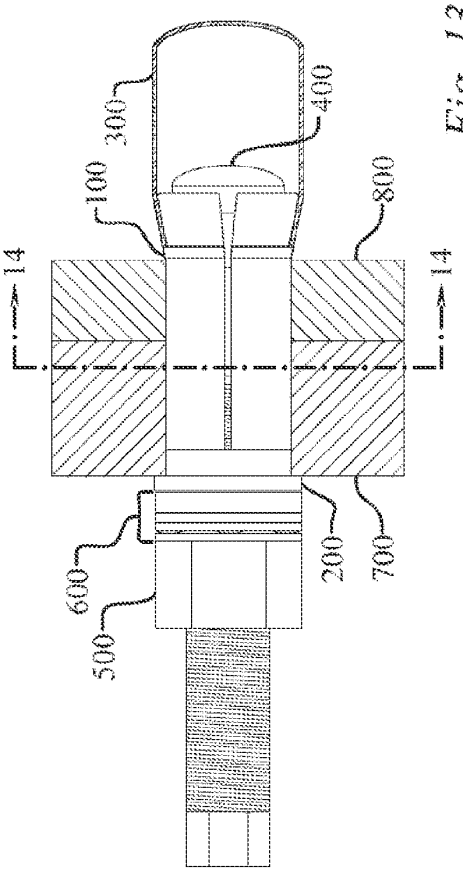


Fig. 13

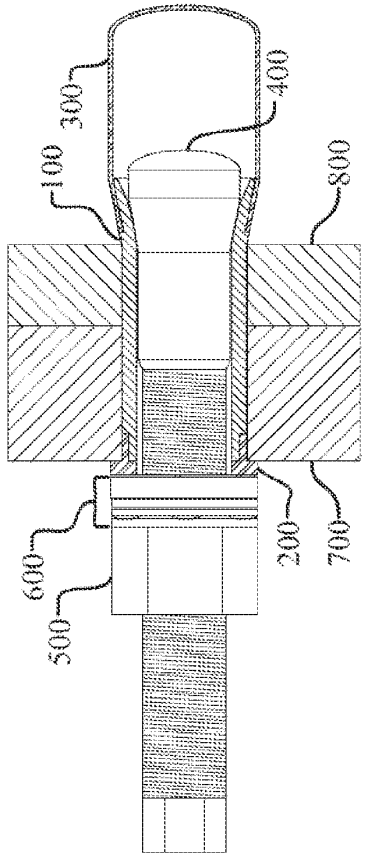


Fig. 15

Petitioner's Ex. 1003-183

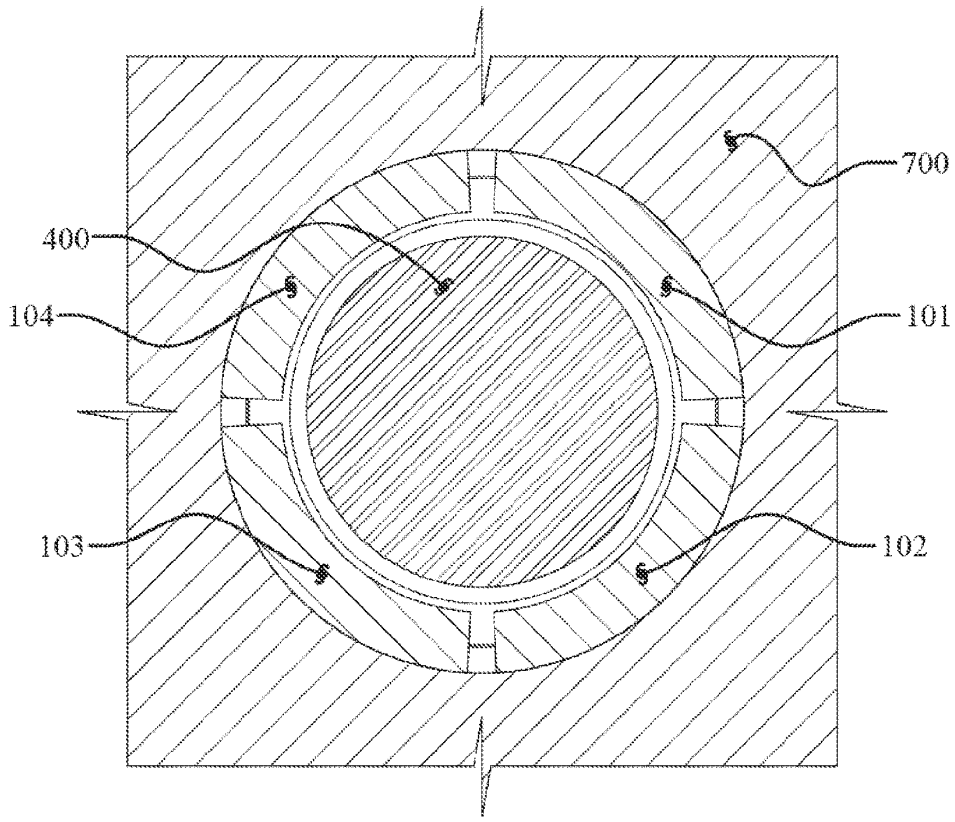


Fig. 16

Petitioner's Ex. 1003-184

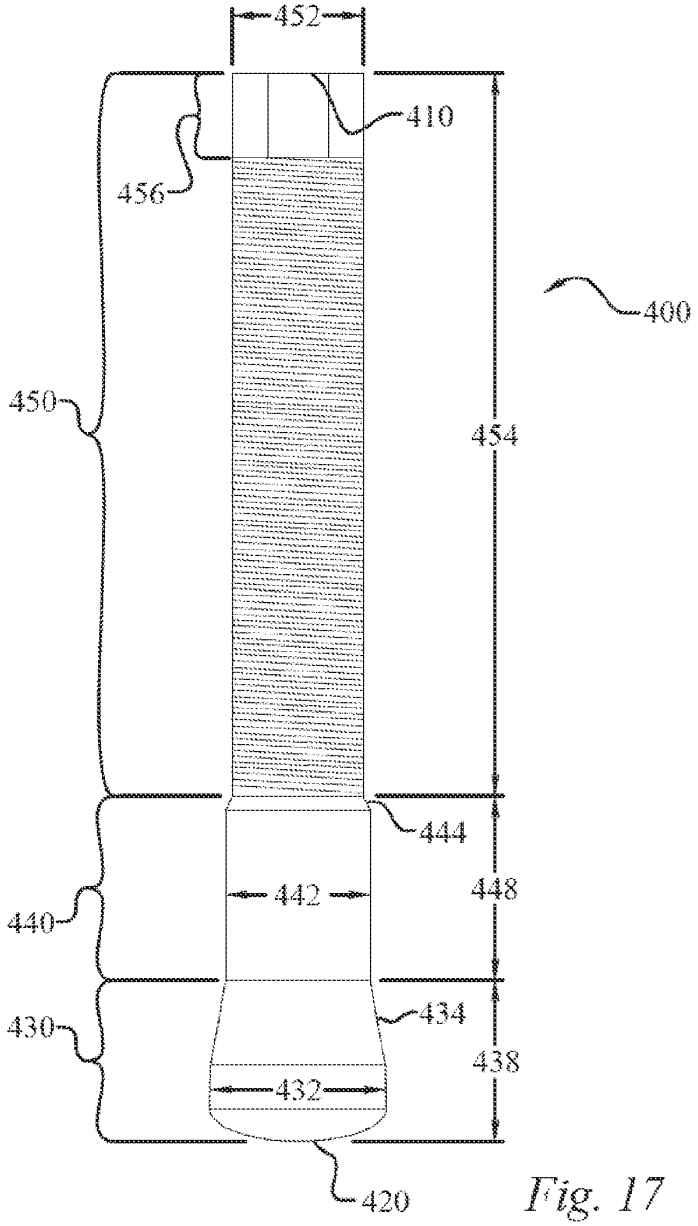


Fig. 17

Petitioner's Ex. 1003-185

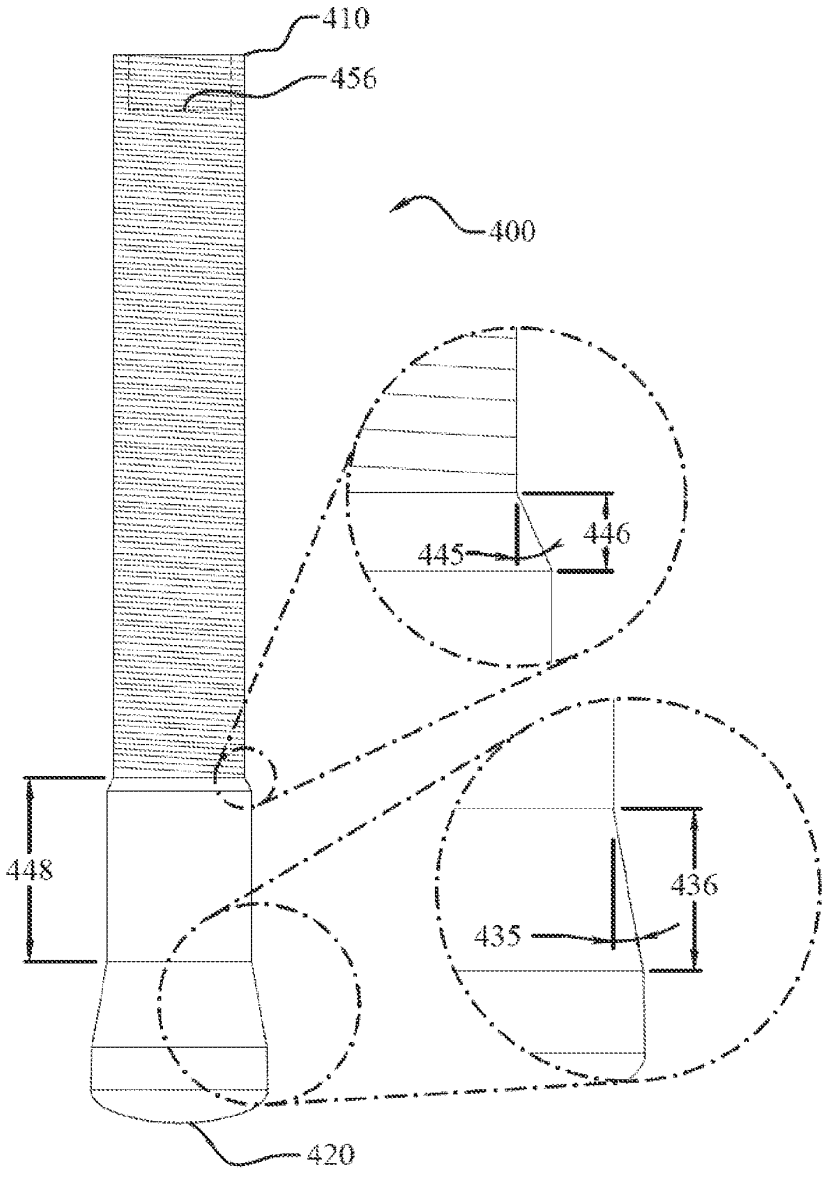
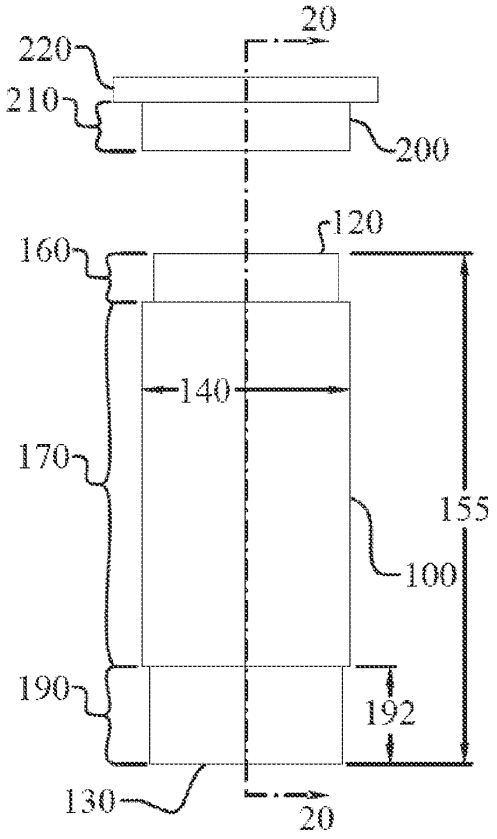
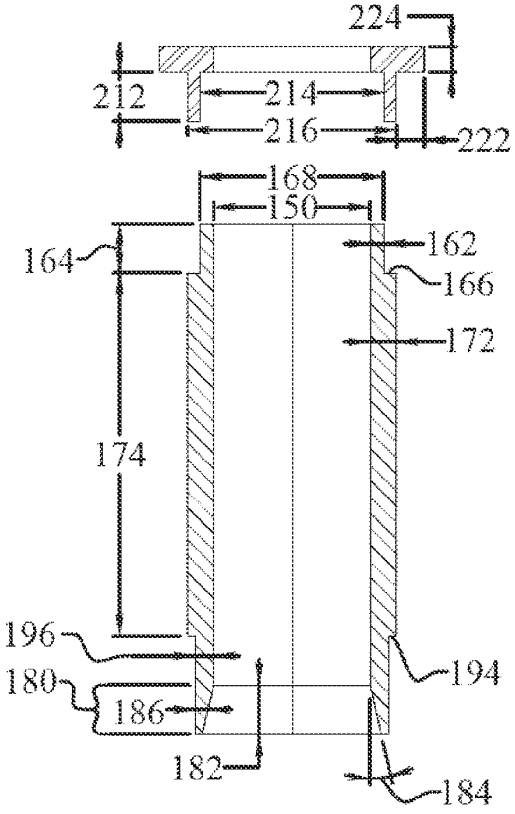


Fig. 18

Petitioner's Ex. 1003-186





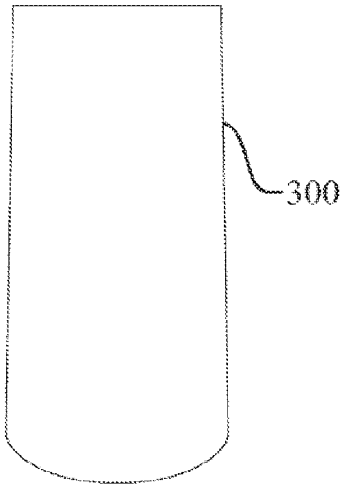


Fig. 19

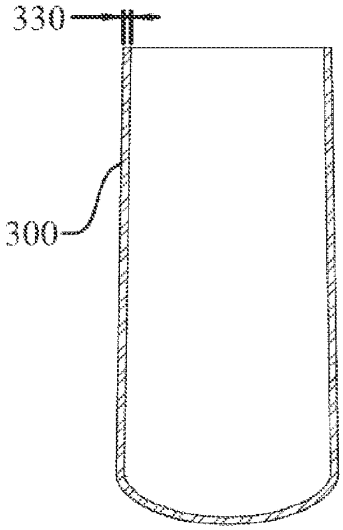
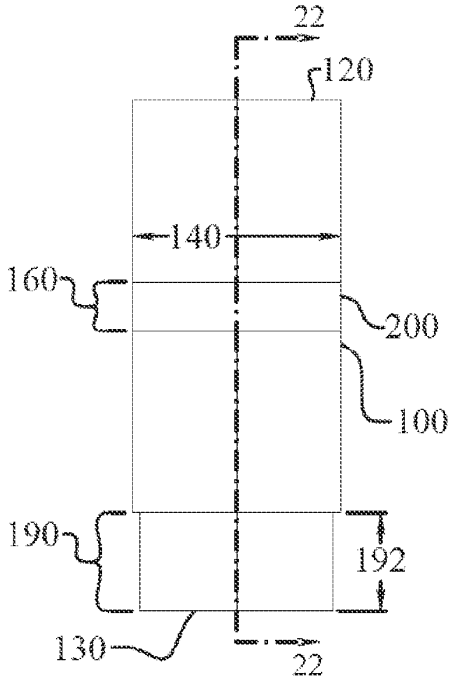
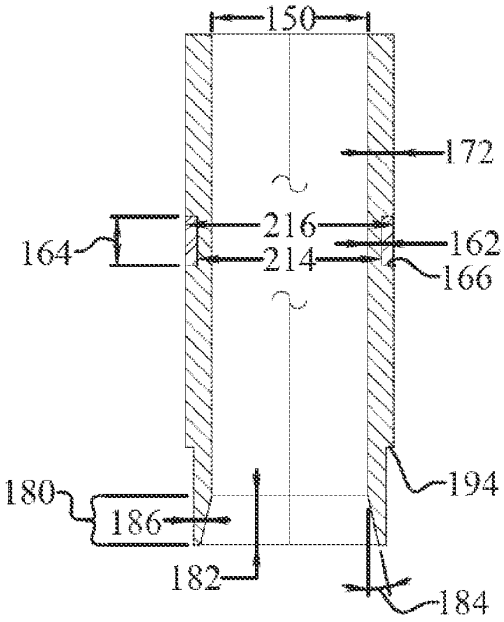


Fig. 20

Petitioner's Ex. 1003-187





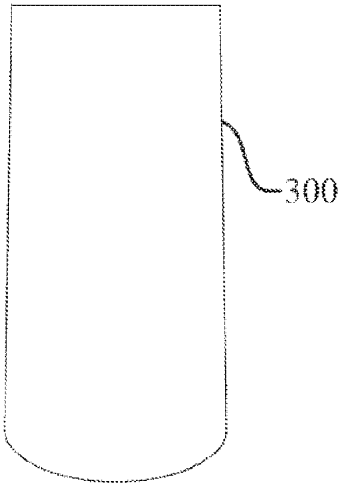


Fig. 21

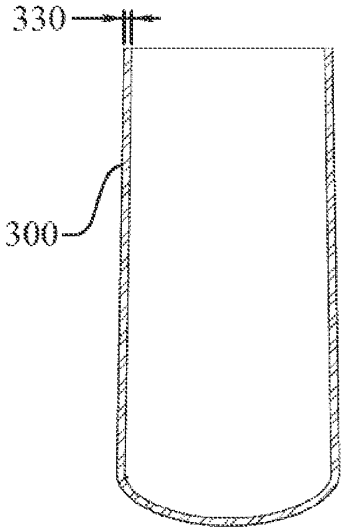


Fig. 22

Petitioner's Ex. 1003-188

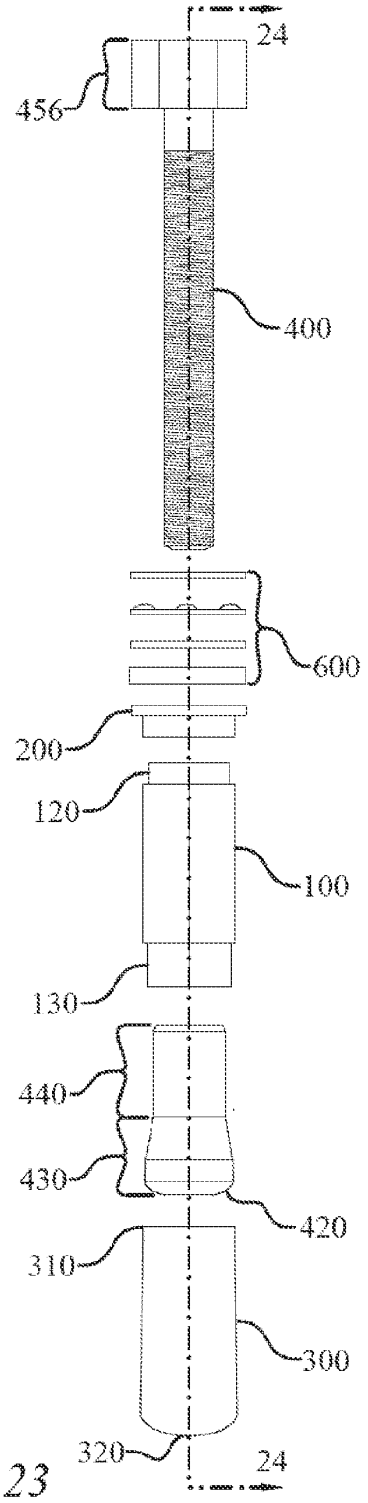


Fig. 23

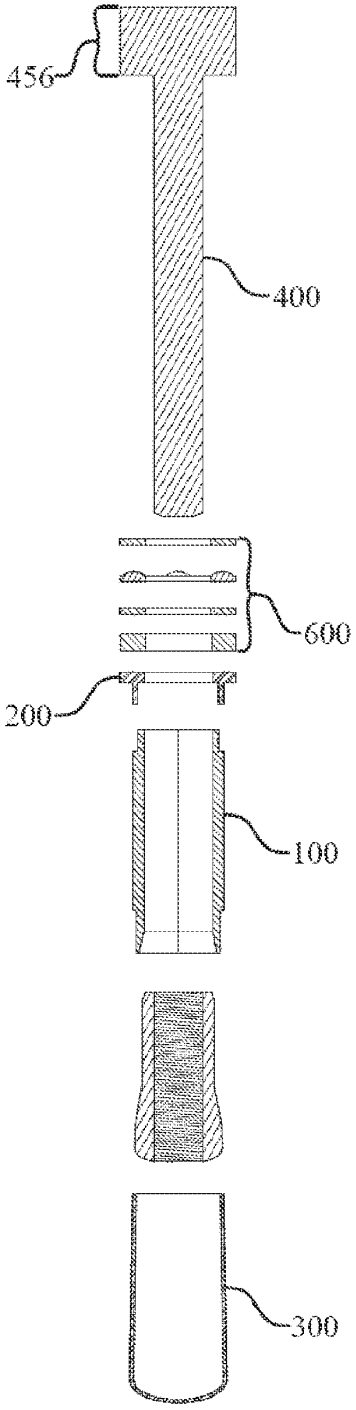


Fig. 24

Petitioner's Ex. 1003-189

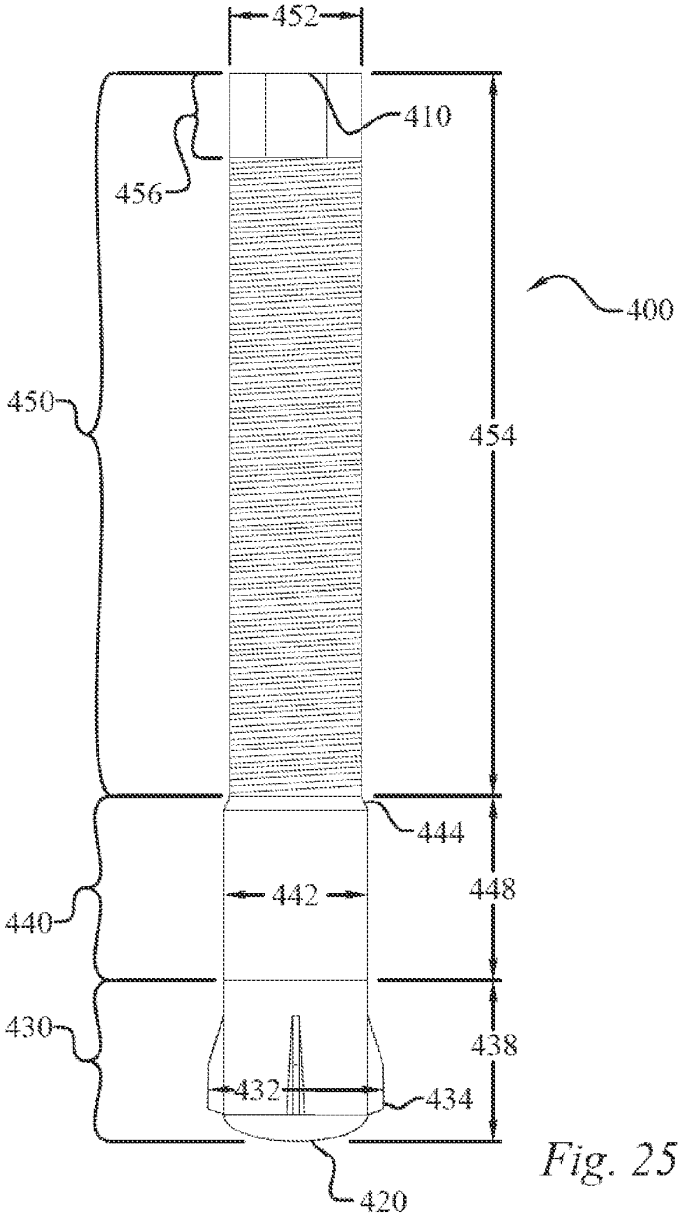


Fig. 25

Petitioner's Ex. 1003-190

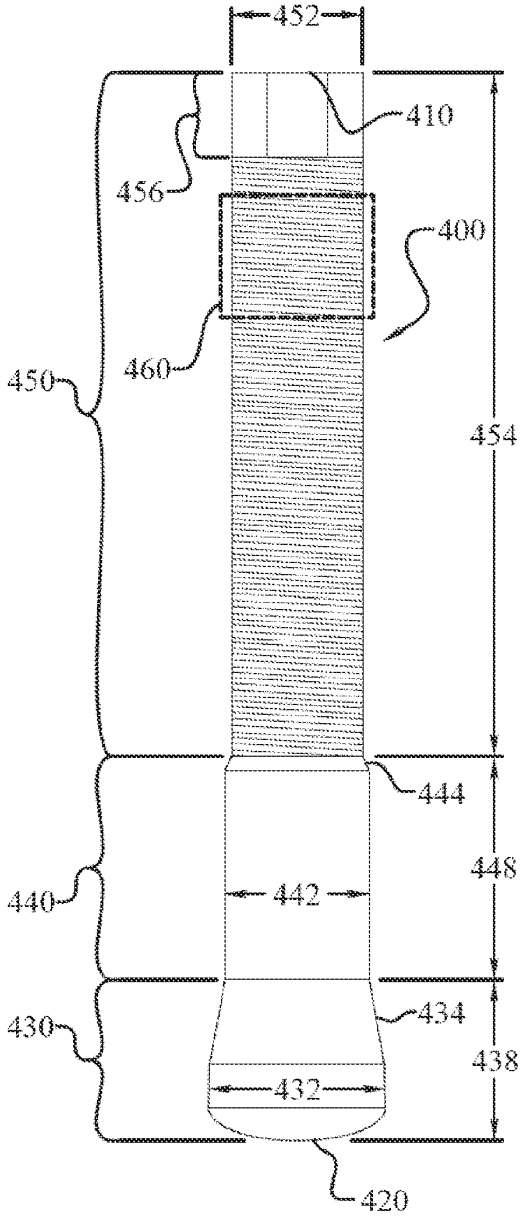


Fig. 26

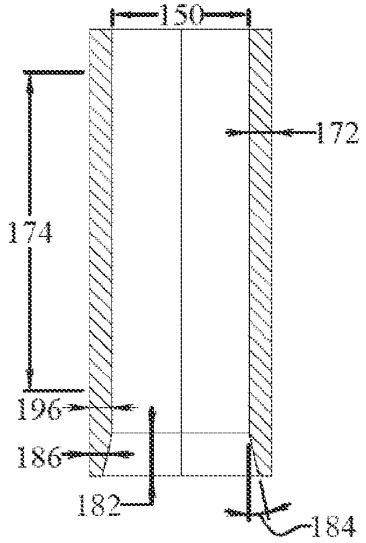


Fig. 28

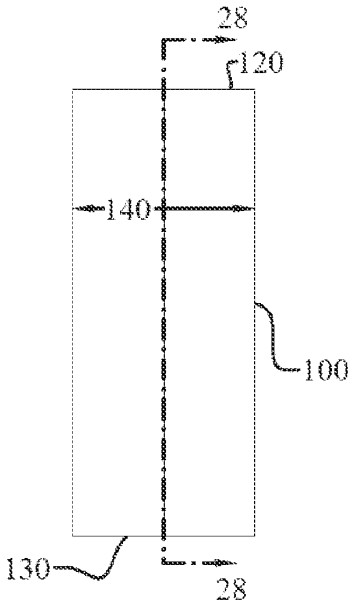


Fig. 27

Petitioner's Ex. 1003-191

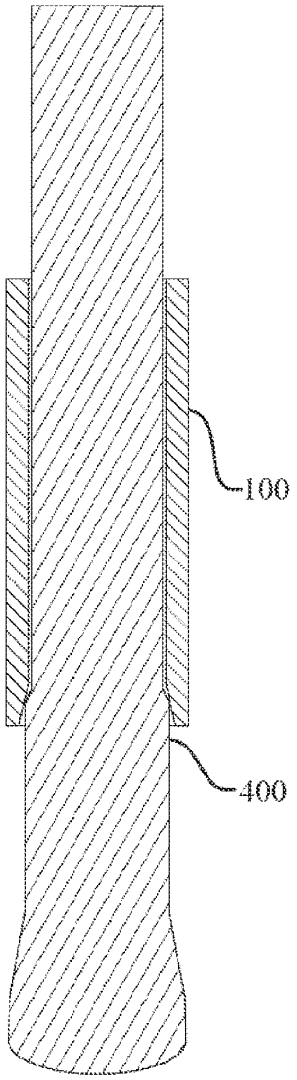


Fig. 29

Petitioner's Ex. 1003-192

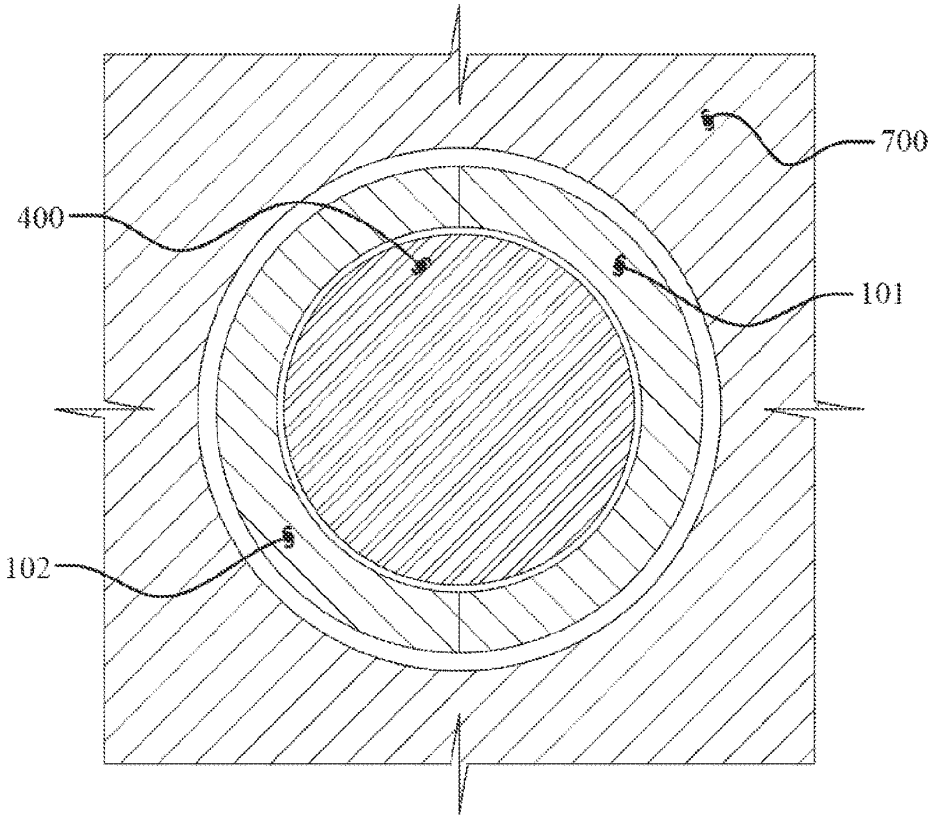


Fig. 30

Petitioner's Ex. 1003-193

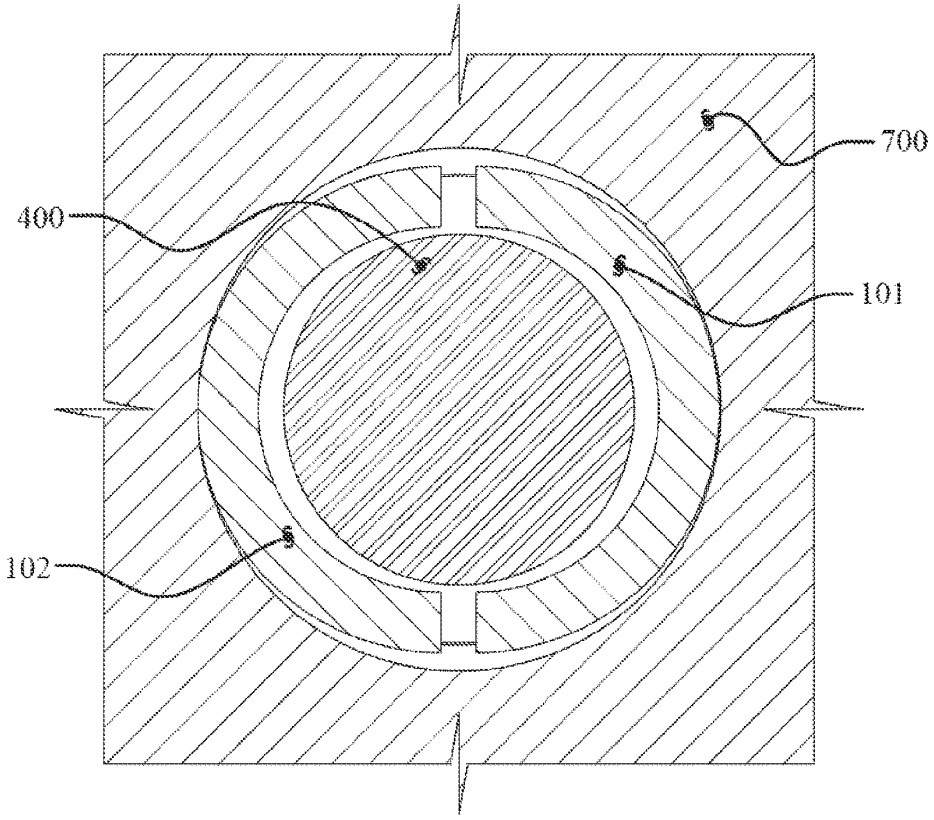


Fig. 31

Petitioner's Ex. 1003-194

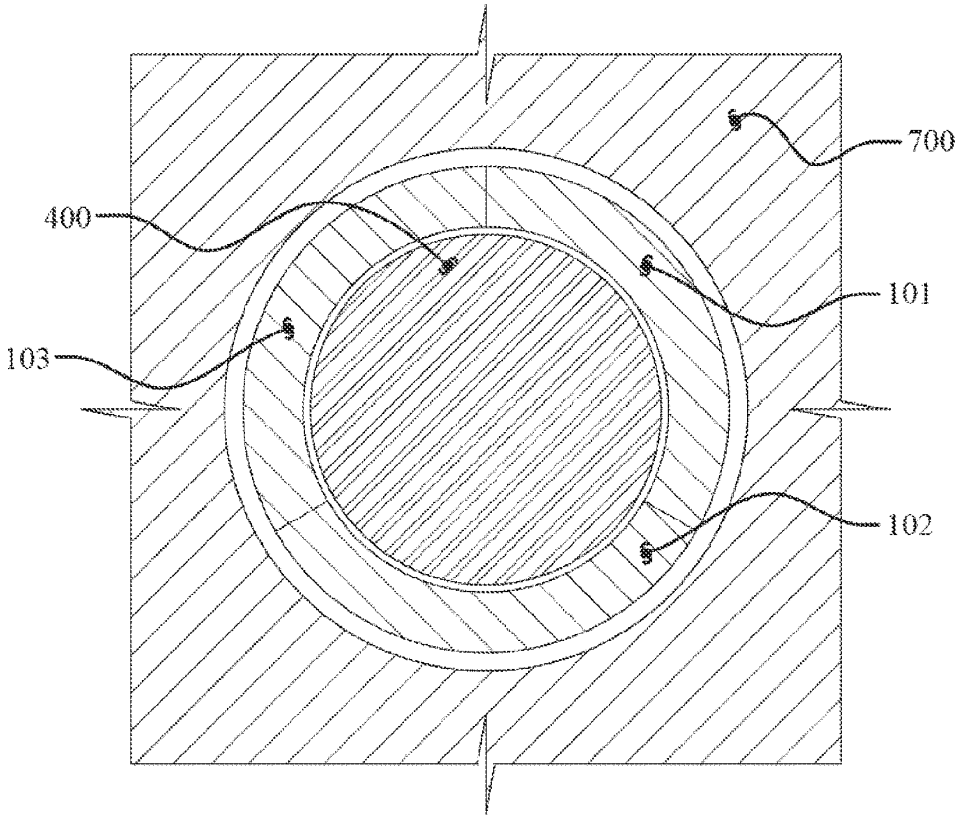


Fig. 32

Petitioner's Ex. 1003-195

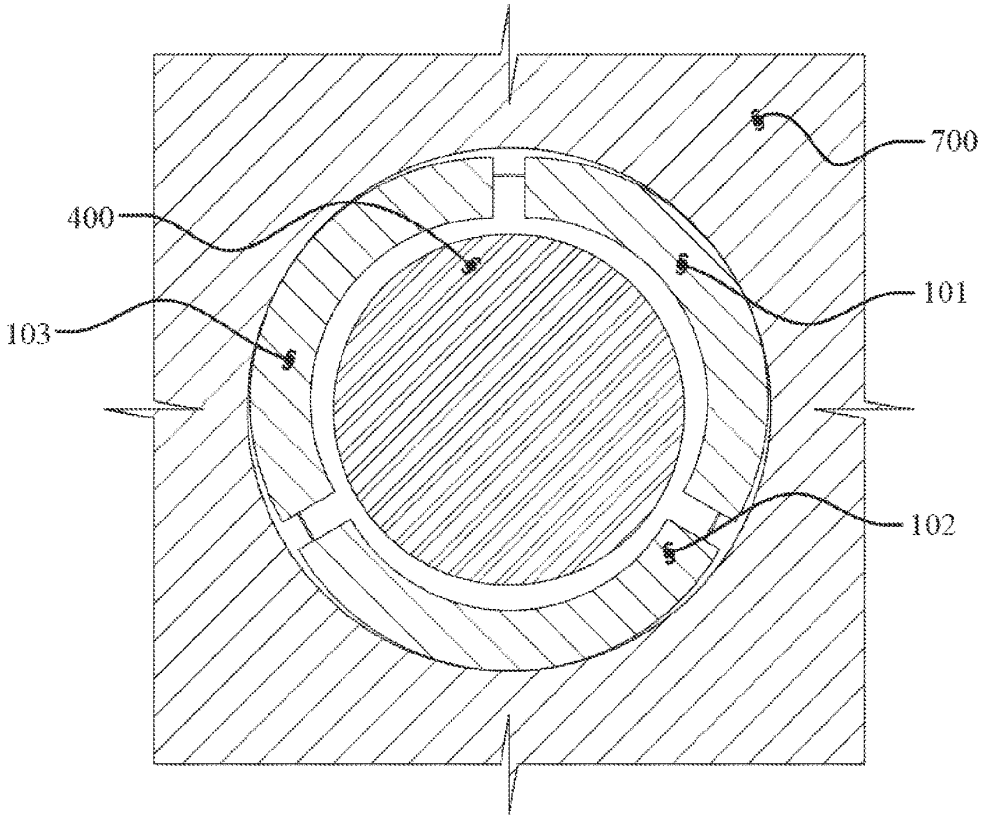


Fig. 33

Petitioner's Ex. 1003-196

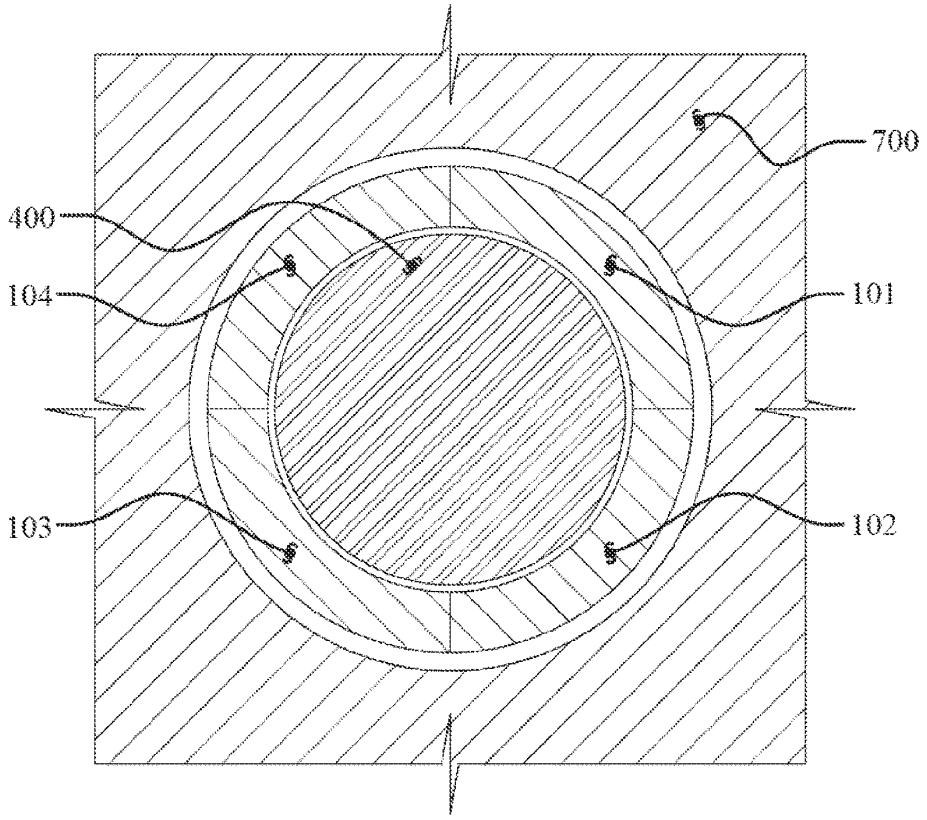


Fig. 34

Petitioner's Ex. 1003-197

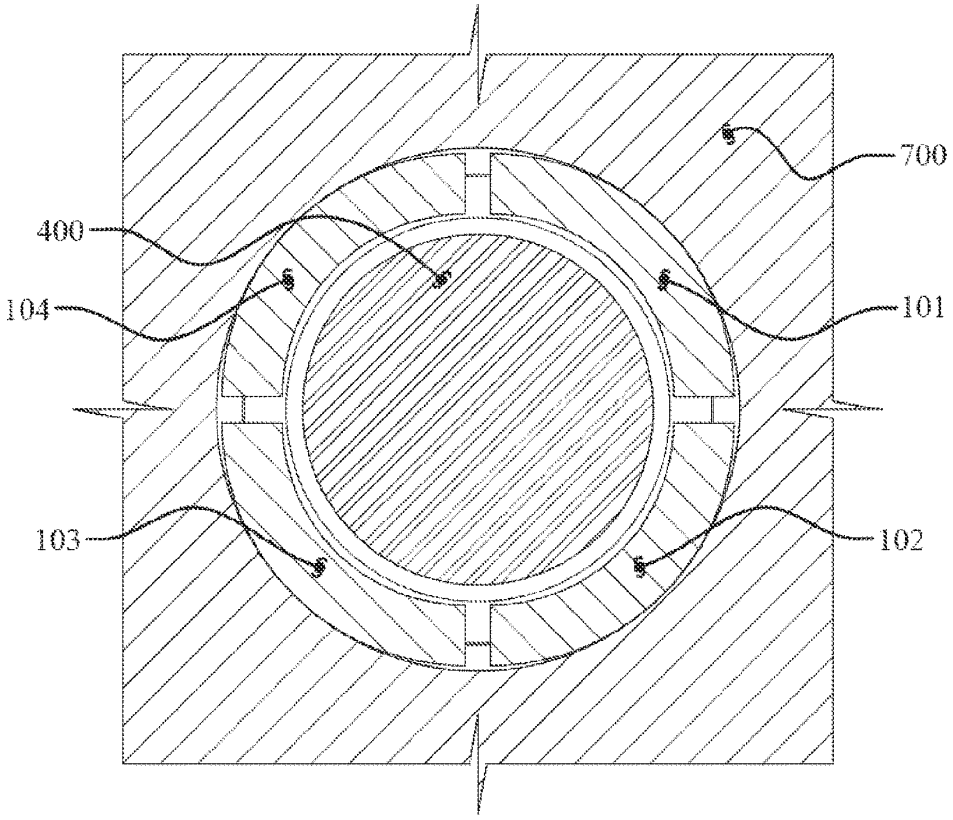


Fig. 35

Petitioner's Ex. 1003-198

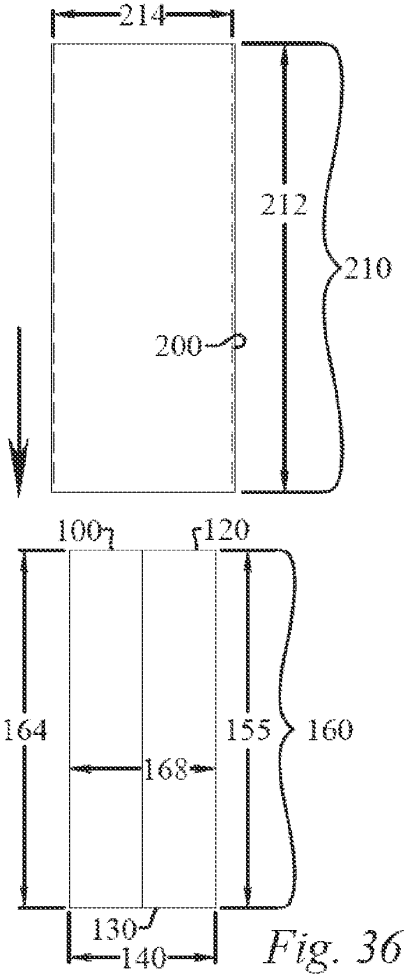


Fig. 36

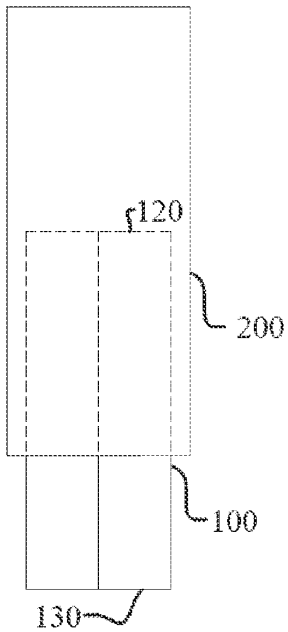


Fig. 37

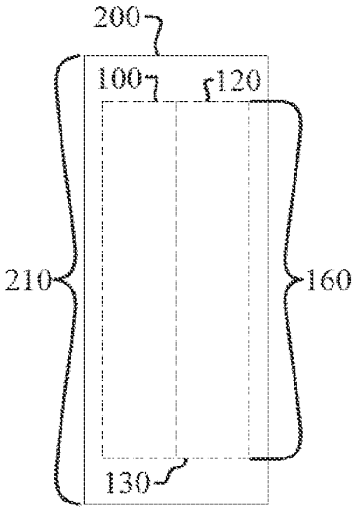


Fig. 38

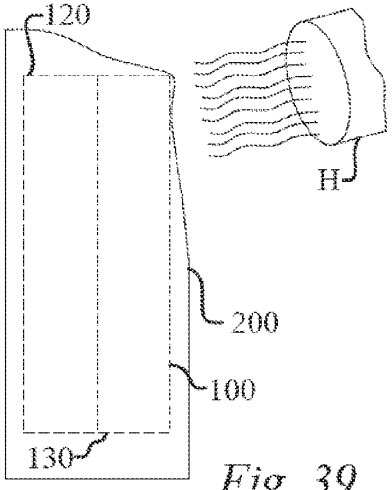


Fig. 39

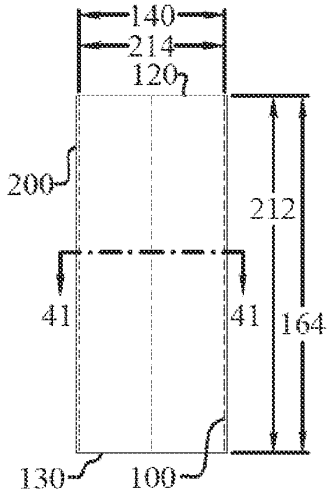


Fig. 40

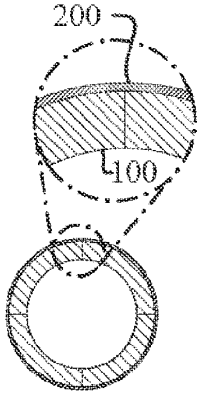


Fig. 41

Petitioner's Ex. 1003-199

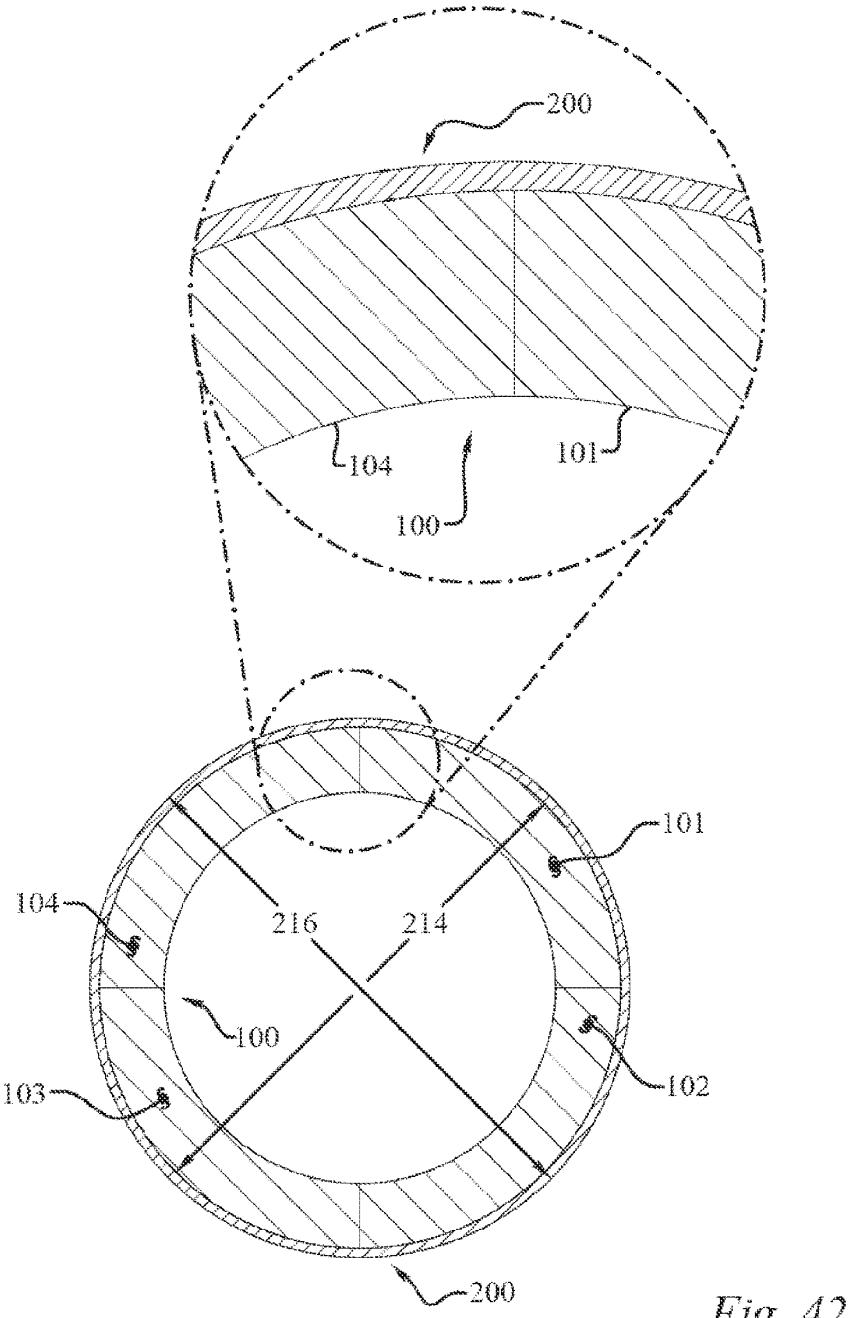


Fig. 42

Petitioner's Ex. 1003-200

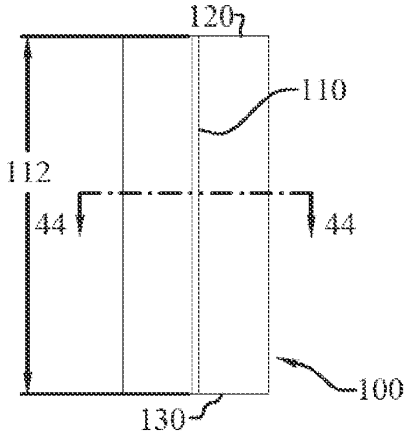


Fig. 43

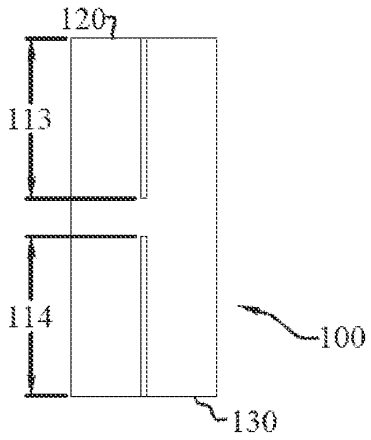


Fig. 45

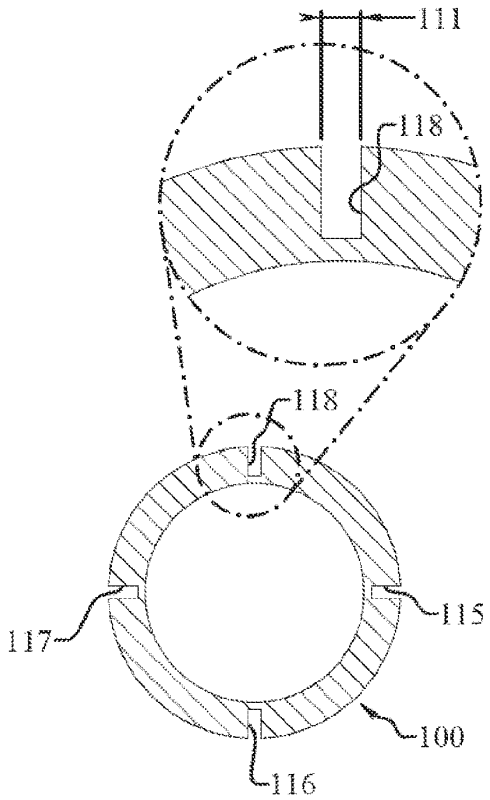


Fig. 44

Petitioner's Ex. 1003-201

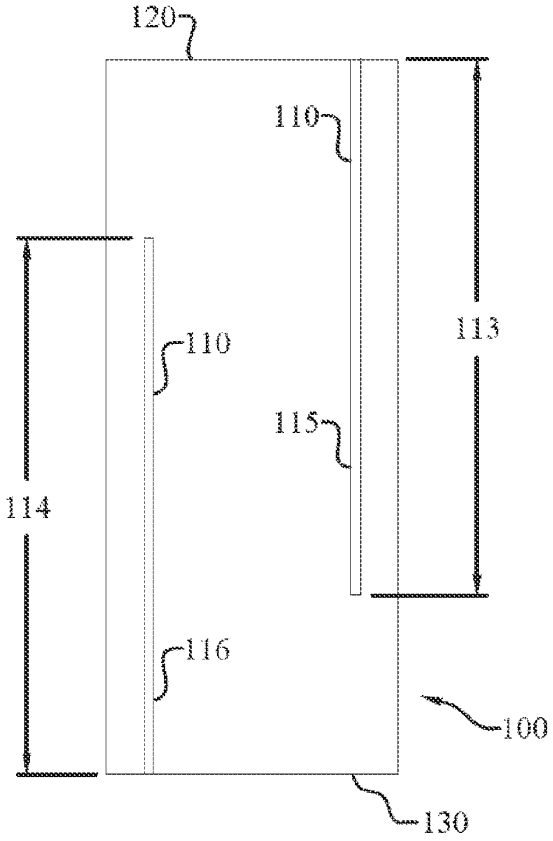


Fig. 46

Petitioner's Ex. 1003-202

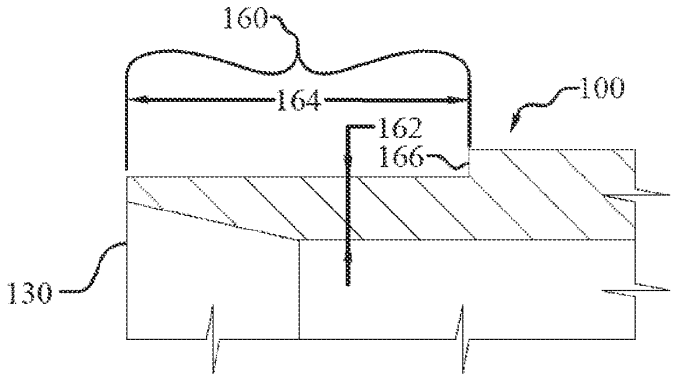


Fig. 47

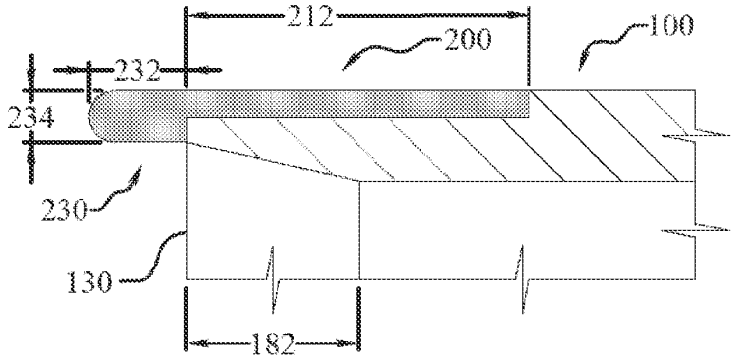


Fig. 48

Petitioner's Ex. 1003-203

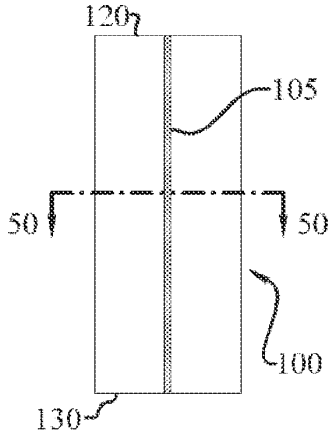


Fig. 49

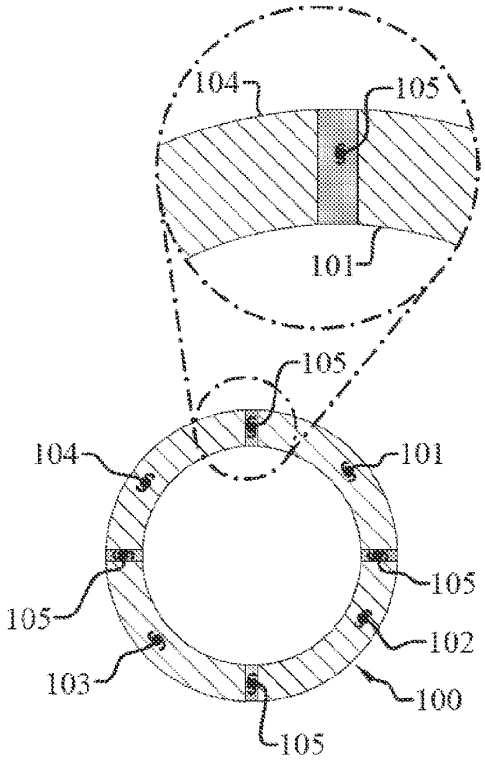


Fig. 50

Petitioner's Ex. 1003-204

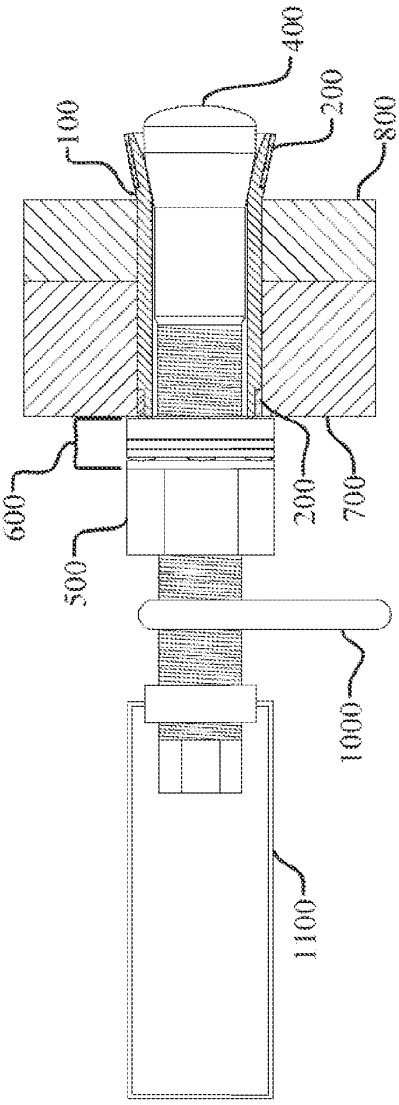


Fig. 51

Petitioner's Ex. 1003-205

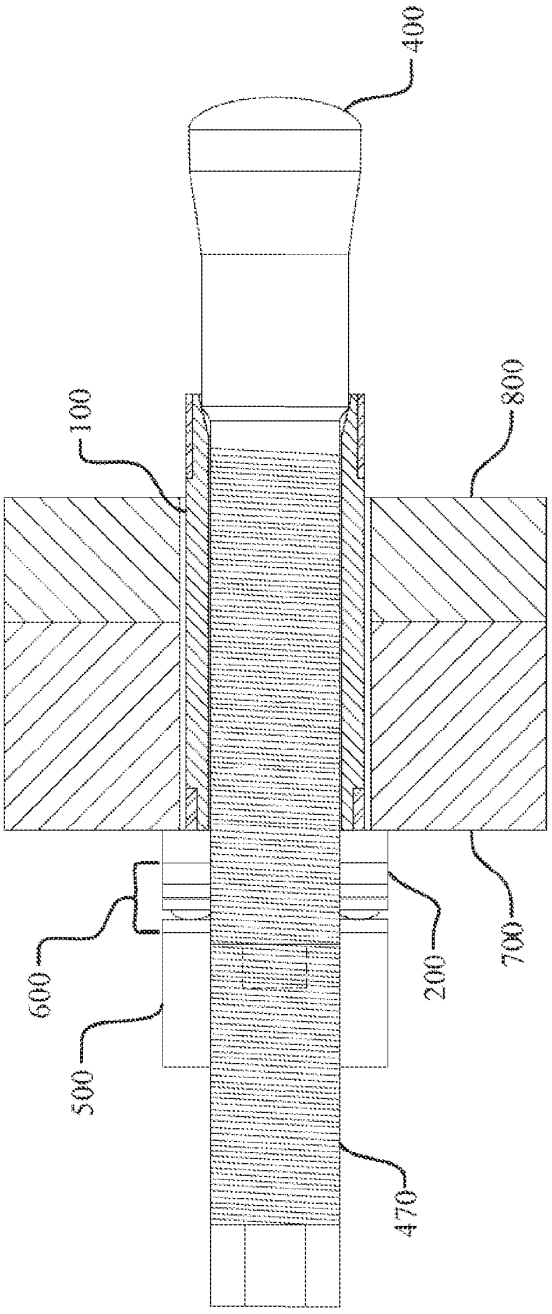


Fig. 52

Petitioner's Ex. 1003-206

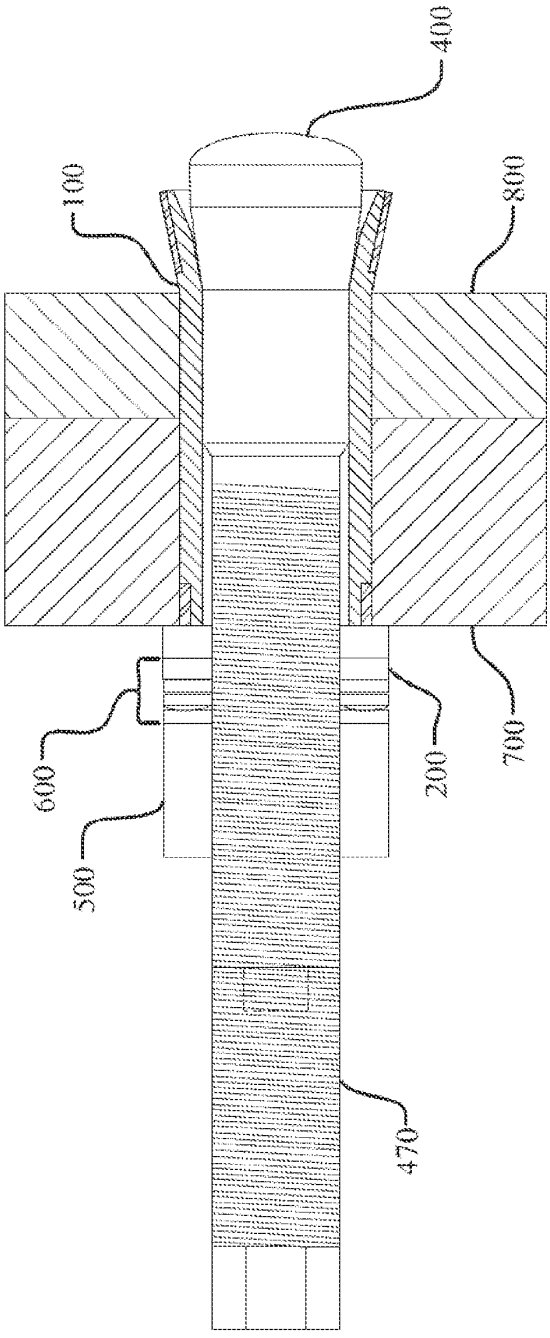


Fig. 53

Petitioner's Ex. 1003-207

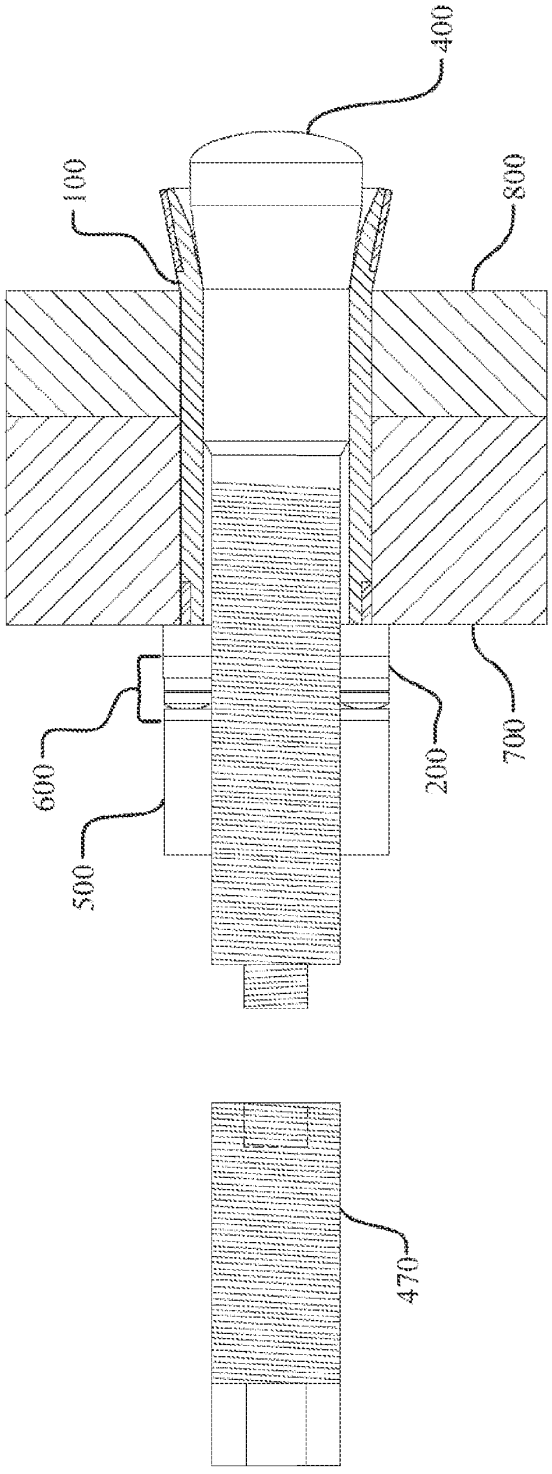


Fig. 54

Petitioner's Ex. 1003-208

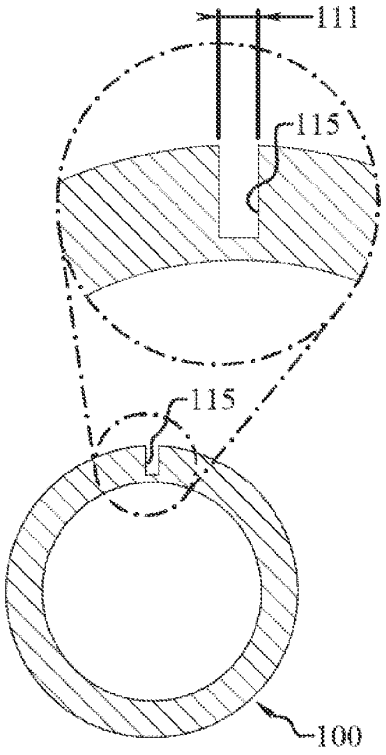


Fig. 55

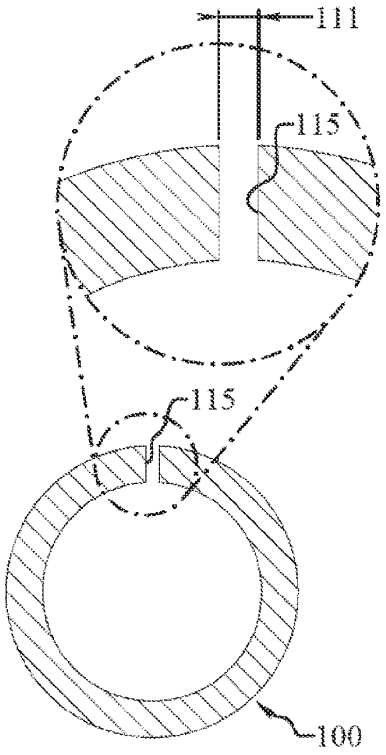


Fig. 56

Petitioner's Ex. 1003-209

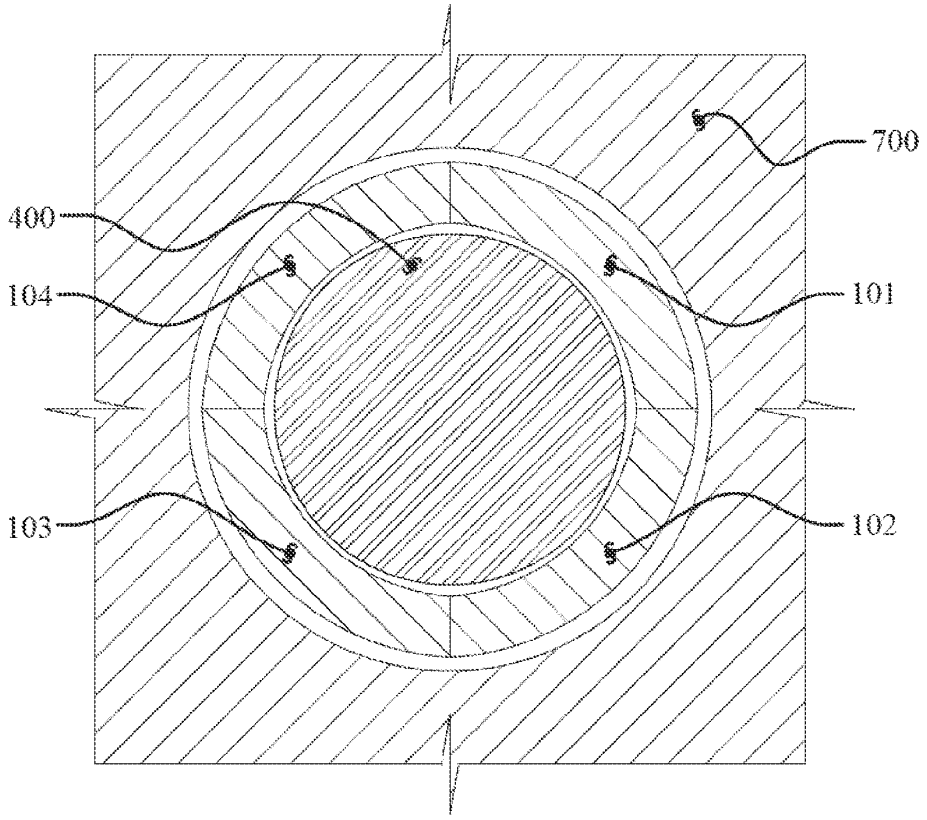


Fig. 57

Petitioner's Ex. 1003-210

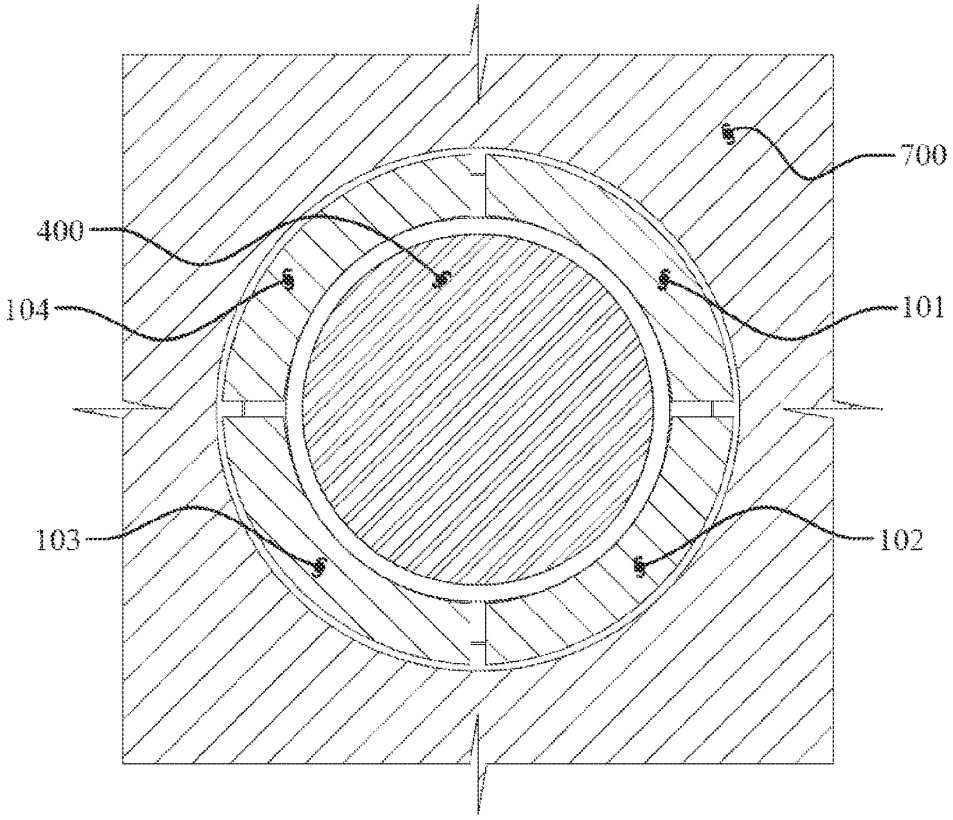


Fig. 58

Petitioner's Ex. 1003-211

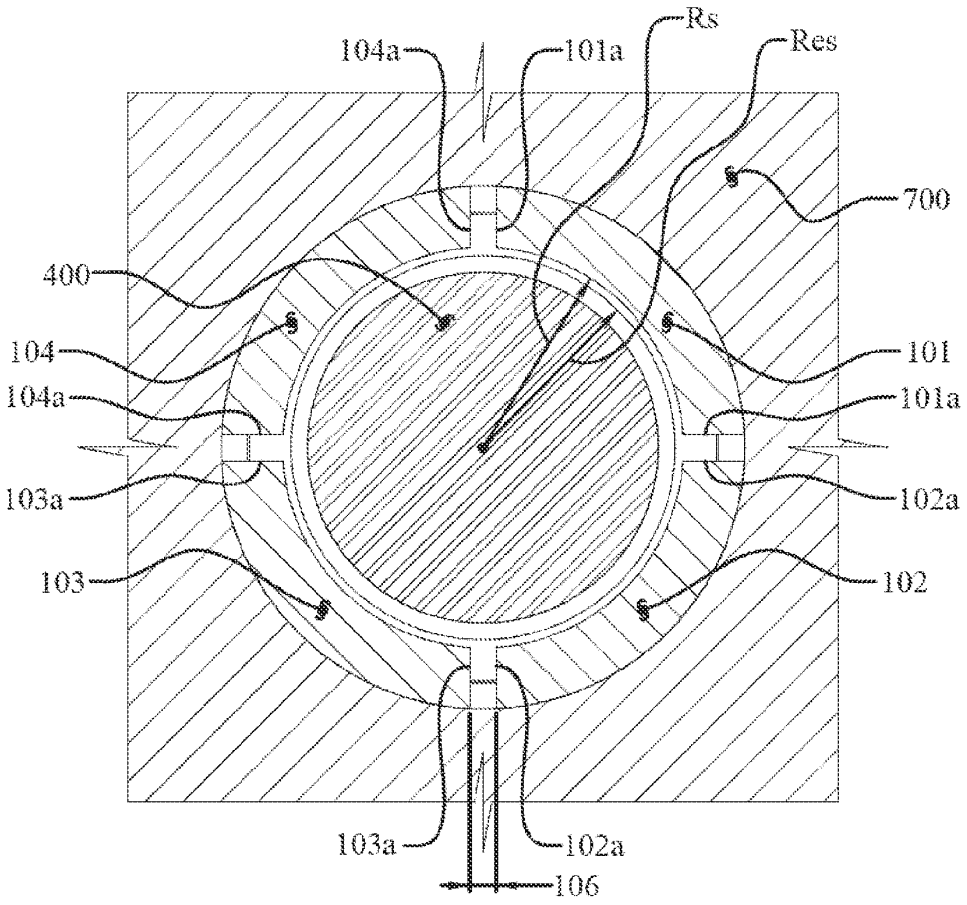


Fig. 59

Petitioner's Ex. 1003-212

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/043711

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F16B 13/06 (2015.01)
CPC - F16B 13/06 (2015.09)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F16B 13/04, 13/06, 19/10 (2015.01)
CPC - F16B 13/045, 13/06, 13/063, 13/065 13/0825 (2015.09) (keyword delimited)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 29/512, 525.1; 411/42, 43, 44, 54, 55, 57.1, 60.1, 60.2

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar, Google.com, YouTube.com
Search terms used: pull, fastener, bolt, nut, expand, lock, angle, blind, retainer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,285,121 A (SIEBOL) 15 November 1966 (15.11.1966) entire document	1-4, 12, 21-27, 35
Y	US 2007/0098518 A1 (ROSENKRANZ) 03 May 2007 (03.05.2007) entire document	1-4, 12
Y	US 4,537,541 A (GIANNUZZI) 27 August 1985 (27.08.1985) entire document	12, 21-27, 35
A	US 4,407,619 A (SIEBOL) 04 October 1983 (04.10.1983) entire document	1-43
A	US 5,141,373 A (KENDALL) 25 August 1992 (25.08.1992) entire document	1-43
A	US 6,293,743 B1 (ERNST et al) 25 September 2001 (25.09.2001) entire document	1-43

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2015	23 OCT 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

Electronic Acknowledgement Receipt

EFS ID:	46493903
Application Number:	17423980
International Application Number:	
Confirmation Number:	4184
Title of Invention:	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
First Named Inventor/Applicant Name:	Robert B. Wilcox
Customer Number:	29270
Filer:	Robert John Sovesky/Theresa Merante
Filer Authorized By:	Robert John Sovesky
Attorney Docket Number:	118508/US01/PCTNS/180639P
Receipt Date:	26-AUG-2022
Filing Date:	19-JUL-2021
Time Stamp:	11:29:20
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2nd_Supplemental_IDS.pdf	81571 ce2257c8f4d758ea52fe6c465d7865c88dc8a55b	no	3

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	WO2016028489A1.pdf	4526634 8b54127980d3db35cc997e49881a83cd4a13e0fb	no	87
Warnings:					
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			Total Files Size (in bytes):	4608205	

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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

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	1	2004/102016	WO	A1	2004-11-25	TEXTRON FASTENING SYSTEMS LIMITED		☐
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

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Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17423980
	Filing Date	2021-07-19
	First Named Inventor	Robert B. WILCOX
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	118508/US01/PCTNS/180639P

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2022-07-14
Name/Print	Robert J. Sovesky	Registration Number	73,798

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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(71) Applicant *(for all designated States except US)*: **TEXTRON FASTENING SYSTEMS LIMITED** [GB/GB]; Mundells, Welwyn Garden City, Hertfordshire AL7 1EZ (GB).

(72) Inventors; and

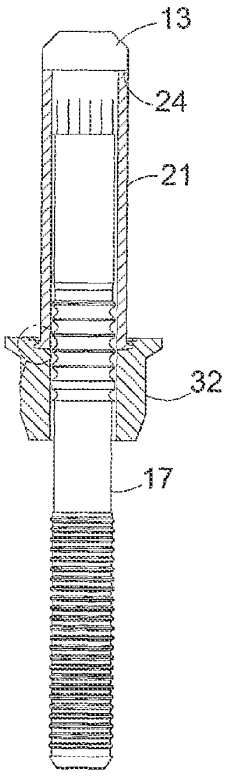
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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

[Continued on next page]

(54) Title: BLIND FASTENER AND METHOD OF REMOVING IT FROM A WORKPIECE



(57) Abstract: A blind fastener for insertion through an aperture in a workpiece, the fastener comprising a pin (11), a sleeve (21) and an abutment member (32); the pin (11) extending inside the sleeve (21) and engaging therewith at or near a first end (24) of the sleeve; the sleeve having a radially expandable portion; the abutment member (32) being adjacent the second end (25) of the sleeve and projecting radially therefrom and the pin (11) extending beyond the abutment member (32); in which the abutment member is removably secured to the sleeve by means sufficiently strong to allow handling of the assembled fastener to be inserted in the aperture in the workpiece and installed therein, but sufficiently weak to allow the abutment member to be removed from the sleeve so that the pin and sleeve can be forced out of the aperture on the workpiece, to remove the fastener therefrom.

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(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BLIND FASTENER AND METHOD OF REMOVING IT FROM A WORKPIECE

The invention relates to a blind fastener, that is, one which can be installed by access to one side only of a workpiece. More particularly the invention relates to a blind fastener of the type comprising a pin, a sleeve, and an abutment member. In use of the fastener in a workpiece comprising two or more members to be secured together, the pin and sleeve are inserted through an aperture in the workpiece so that their remote end portions protrude beyond the remote or blind face of the workpiece. The application of axial compression to the sleeve by means of a pulling force on the pin with respect to the sleeve causes the protruding end portion of the sleeve to deform into a blind head which contacts the blind face of the workpiece. The workpiece is then compressed between the blind head and the abutment member and the abutment member is then secured to the pin e.g. by swaging, to secure the workpiece members together in the compressed condition.

There are alternative possible ways of providing the necessary mechanical engagement between the various component members of the fastener. The remote end of the pin may have a radially protruding head which contacts the end of the sleeve to apply compressive force to it, or the remote end of the pin may be in threaded engagement with the sleeve.

The abutment member is secured to the near end of the sleeve, to enable correct insertion of the fastener into the aperture through the workpiece.

One such fastener is that commercially available under the trade mark "HUCK BOM", which is described in US Patent No. 2,527,307. In this fastener, the abutment is in the form of a radially enlarged head integral with the sleeve.

In use, it is sometimes found that it is necessary to remove a fastener which has been installed in a workpiece, e.g. for servicing or repairing the equipment of which the workpiece forms a part. It is extremely difficult to do this, since the abutment member is swaged on to the pin, and is integral with the sleeve. The pin is too hard to drill out. In any event, it is unacceptable for removal of the fastener to cause damage to the adjacent part of the workpiece.

The present invention is intended to provide a fastener of this type which can, if needed, be removed more easily and conveniently.

The invention provides, in one of its aspects, a blind fastener as set out in claim 1 of the accompanying claims. Further features of the invention are set out in claims 2 through 5. The invention includes a method of removing a fastener as set out in claims 6 and 7.

A specific embodiment for the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1A is an outside elevation of the pin;

Figure 1B is an axial section through the sleeve;

Figure 1C is an axial section through the abutment member;

Figure 2A shows those three parts assembled to form a fastener ready for installation;

Figure 2B is an enlargement of part of Figure 2A;

Figure 2C is a plan view on Figure 2A;

Figure 3A is a section through a fastener inserted in an aperture in a workpiece, ready for installation therein, together with an enlargement of a detail thereof;

Figures 3B and 3C are similar to Figure 3A but show other possible conditions which will be described below;

Figures 4A, 4B, 5A, 5B, 6A and 6B are similar to Figure 3A, and show successive stages of the installation of the fastener; and

Figures 7A, 7B, 7D, 8A, 8B and 8C show successive stages of the removal of an installed fastener from the workpiece, Figure 7C being a section on the line C-C of Figure 7B.

The pin, sleeve and abutment member all have circular symmetry.

The pin 11 (Figure 1A) is of medium carbon alloy steel and comprises an elongated cylindrical shank 12 with an integral radially enlarged head 13 at one end of the shank, by means of which the pin engages with one end of the sleeve. Adjacent the head 13 the pin shank has a slightly oversize portion 20 formed with longitudinal ribs 30. Next to this portion 20 is a plain portion 14, followed by a locking groove portion 15 and then a breakneck 16 which is the weakest part of the pin. Next to this there is another plain portion 17, followed by a pulling groove portion 18 which grooves are for engagement by the jaws of the fastener installation tool.

The sleeve 21 (Figure 1B) is generally cylindrical and is made of low carbon steel. It has a through bore 22 of uniform diameter which is a sliding fit on the pin shank 12, and a cylindrical shank 23 which is of uniform external diameter. At one end (the tail end) the sleeve shank has a flat end face 24 and at the other end (the head end) an integrally formed slightly radially enlarged head 25. The sleeve head comprises a flange 26 having a conical underhead face 27. As illustrated in Figure 1B, the head has a flat top face 29.

The sleeve shank includes a radially expandable portion which is centred on a softened zone 19 which, as indicated in Figure 1B, in this example extends axially from a position about halfway along the length of the sleeve shank 21 to a position about three quarters of the way from the sleeve head 26 towards the sleeve tail 24. In this example, this softened portion 19 is made softer than the remainder of the sleeve by band annealing. It has a through bore 22 which is an interference fit on enlarged portion 20 of the pin shank 12.

The abutment member (Figure 1C) is in the form of a collar 32 made of medium carbon steel. The peripheral edge of one end of the collar has a bevel 34, whilst the other end has a radially projecting flange 35. That end face 36 is flat, but is annular, since it is provided with a recess 37, which is generally circular on the axis of the collar. The outer recess 37 is of a diameter and depth suitable to receive the head flange 26 of the sleeve, having an annular bottom face 41 which surrounds the recess 37. The axial depth of the recess 37 is rather greater than the total axial thickness of the sleeve head 26.

The pin, sleeve and collar are assembled together to form a fastener in the way illustrated in Figures 2A, 2B and 2C. The sleeve is assembled on the pin shank 12 so that the sleeve end face 24 abuts the annular face of the pin head 13, there being an interference fit between the ribbed oversize portion 20 of the pin and the tail end portion of the sleeve 21 beyond the softened zone 19. The collar 32 is then assembled on to the sleeve by inserting the sleeve head flange 26 into the collar recess 37 so that the sleeve head end face 29 contacts the annular face 41 of the collar recess. The sleeve and collar are then removably secured together by staking down the collar head adjacent the recess 37 at three positions around the periphery of the recess, to deform the head material at those positions over and into contact with the conical face 27 of the sleeve head, to form three lugs or projections 38. The pin plain portion 17 protrudes from the end face of the collar 32.

As illustrated in Figure 3A, the fastener is used to secure together two structural metal panels 42, 43 which have a cylindrical aperture 44 through them in which the sleeve 21 is a clearance fit. The total thickness of the workpiece formed by the panels 42 and 43 is rather more than half of the length of the sleeve shank 23, so that the nearer end of the sleeve softened zone 19 indicated in Figure 1B lies inside the remote face 46 of the workpiece when the underhead face 36 of the collar contacts the near face 45 of the workpiece.

As illustrated in the enlarged detail of Figure 3A, the staked lugs 38 which contact the sleeve head flange 26 are undisturbed and continue to hold the sleeve and collar together.

If however there is resistance to the insertion of the fastener sleeve into the aperture 44 on the workpiece (e.g. because the aperture 44 is undersize and produces an interference fit, or the two parts of the aperture 44 are mis-aligned not shown in Figures 3B and 3C), then it may be necessary to use force to insert the fastener, by axial force on the pin, as illustrated by the arrow B in Figure 3B, e.g. by applying hammer blows to the projecting tail end of the pin. It is possible that this maybe sufficient to deform the staking lugs 38 in the way shown at 39 in Figure 3B and its enlargement. The sleeve moves so that its head 26 contacts the near face 45 of the workpiece, the radial extent of the head 26 and its strength being sufficient to hold the sleeve in this position.

If a very large axial force has to be applied to the pin to make the sleeve enter the aperture, it is possible that the retaining force between the pin and sleeve, due to the interference fit between them at portion 20 of the pin, may be overcome, so that the pin moves axially through the sleeve and the interference portion 20 protrudes from the tail end of the sleeve, as illustrated in Figure 3C. Provided that sufficient of the pin pulling groove position 18 remains outside the collar 32, it would still be possible to install the fastener in the way to be described below, but this might require two successive actuations of the installation tool.

If the pin is pushed too far into the sleeve, it cannot be installed, and the pin can be knocked completely through the sleeve. The collar can then be lifted off (since its connection to the sleeve has already been broken), and the sleeve punched through and out of the workpiece aperture. Alternatively the uninstalled fastener can be extracted by gripping and pulling the pin or the sleeve.

A fastener which has been inserted in a workpiece in the normal way as illustrated in Figure 3A is now installed by applying a progressively increasing pull to the protruding part of the pin 11 in relation to the sleeve 21. This is done by means of a standard hydraulically-powered fastener placing tool, such as that commercially available under the designation AVDEL (Registered Trade Mark) Type 722, which is used for installing pin and collar type fasteners previously referred to.

The tool includes an annular anvil 47 (Figure 4A) having an internal throat 48 shaped appropriately to swage the collar 32. The tool also includes jaws 49 which engage with the pulling grooves in the portion 18 of the pin, and a hydraulic piston and cylinder device (not shown) for applying a progressively increasing retraction force to the jaws with respect to the anvil. Such tools and their manner of use are well known to those who use blind fasteners, and need not be described in detail here.

The tool is offered up to the protruding part of the pin, so that the outer end of the anvil throat contacts the top of the collar 32 around its bevel 34, as illustrated in Figure 4A. The tool is then actuated so that its jaws engage the pulling groove portion 18 of the pin and exert a progressively increasing pull on it with respect to the anvil 47. The reaction force is transmitted through the collar 32 to its end face

36 against the workpiece, and thence via the annular face 41 face of the collar to the sleeve head 25. If, during insertion of the fastener into the aperture, the sleeve head 25 has moved away from the collar annular face 41, it will be pulled back into contact with it. The sleeve is thus axially compressed between the face of the head flange 26 and its end face 24 in contact with the pin head 13. The softened portion of the sleeve deforms by bulging outwardly, to progressively form a blind head in contact with rear face 46 of the workpiece. As the blind head progressively forms (See Figure 4B), it exerts a compressive force on the rear face 46 of rear panel 43, which urges the panels 42, 43 together (and so closes any gap which may exist between them) so that the panels are firmly in contact with each other and compressed together between the collar end face 36 and the blind head. The final form of the blind head, in this example, is illustrated at 49 in Figure 5A..

As the force applied by the tool further increases, the anvil 47 is pushed down over the exterior of the collar, so that the anvil throat 48 swages the collar 32 radially inwardly into the locking grooves 15 on the pin. The anvil stops with its lower face near the flange at the bottom of the collar. This position is illustrated in Figure 5B.

Further increase of the force applied by the tool causes the pin to break at the breakneck 16, the broken off pin tail being pulled away by the jaws, leaving a broken surface 52, as illustrated in Figure 6A. The tool is then removed, to leave the installed fastener, as illustrated in Figure 6B.

As previously mentioned, the fastener described above is advantageous in that an installed fastener can, if needed, be removed from the workpiece relatively easily.

Figure 7A shows a pair of bolt cropper blades 51 being offered up to the collar 32. These are located fully over the swaged collar, on a diametrical plane thereof, and the tool actuated to force the blades together so that they substantially cut the collar in half, as illustrated in Figures 7B and 7C.

The two halves of the collar may remain connected together by thin pieces of its material, in which case the two halves of the collar can be separated and removed by a hammer and chisel or a power chisel, leaving the pin and sleeve in the workpiece as shown in Figure 7D.

The pin and sleeve can then be removed from the workpiece, and this is conveniently done by using a single two-stage punch 52, as illustrated in Figures 8A, 8B and 8C. The punch comprises a leading narrower part 53 of appropriate diameter to enter the sleeve and push the pin, and a following wider part 54 having a diameter appropriate to enter the workpiece aperture, joined to the narrower part 53 by an annular face 55 appropriate to contact the sleeve head face. As shown in Figure 8A, the punch portion 53 is offered up to the end of the fastener pin, and axial force applied by hammering, to break the interference fit between the pin and sleeve and drive the pin through the sleeve until the punch annular face contacts the sleeve head face 29, as shown in Figure 8B including its enlarged detail. Application of further force to the punch deforms the outer peripheral part of the sleeve head flange 26, as shown in Figure 8C and its enlarged detail (in some cases, the outer peripheral part may be sheared off). Further movement of the punch drives the sleeve and pin through the far end of the workpiece aperture, thus removing the installed fastener.

It will be apparent that, in order for the fastener to be installed and removed in the way described above, there must be the correct relationship between the various axial forces needed to separate various components. Thus, the axial force needed on the sleeve to separate it from the collar (by overcoming the staked lugs 38, as described with reference to Figure 3B) must be less than the axial force needed to overcome the interference engagement between the pin and sleeve (as described with reference to Figures 3C and 8B), which in turn must be less than the force needed to push the sleeve head through the aperture (as described with reference to Figure 8C).

The three measured force values for an example fastener of sleeve outside diameter 10 mm are respectively 900 Newtons, 1900 Newtons, and between 6000 Newtons (for an aperture of maximum diameter in which sleeve head folds up, Figure 8C) and 9000 Newtons (for an aperture of minimum diameter).

The invention is not restricted to the details of the foregoing example. For instance, the sleeve and the abutment collar could be releasably connected to each other by any convenient arrangement.

Claims

1. A blind fastener for insertion through an aperture in a workpiece, the fastener comprising a pin (11), a sleeve (21) and an abutment member (32);

the pin (11) extending inside the sleeve (21) and engaging therewith at or near a first end (24) of the sleeve;

the sleeve having a radially expandable portion;

the abutment member (32) being adjacent the second end (25) of the sleeve and projecting radially therefrom and the pin (11) extending beyond the abutment member (32);

whereby, when the sleeve (21) is inserted into a suitable aperture in a workpiece of suitable thickness with the expandable portion of the sleeve (21) protruding beyond the blind or remote face of the workpiece and the abutment member (32) abutting the near face of the workpiece, and when a progressively increasing pulling force is applied to the part of the pin (11) extending beyond the abutment member (32), the pulling force being supported against the abutment member (32), so that axial compression is applied to the sleeve (21) between the abutment member (32) and its engagement with the pin (11), the radially expandable part of the sleeve (21) to radially expand to form a blind head in abutment with the remote face of the workpiece; thereby to apply compression to the workpiece between the blind head and the abutment member (32); and thereafter the abutment member can be secured to the pin (11);

in which the abutment member (32) is removably secured to the sleeve (21) by means sufficiently strong to allow handling of the assembled fastener to be inserted in the aperture in the workpiece and installed therein, but sufficiently weak to allow the abutment member (32) to be removed from

the sleeve (21) so that the pin (11) and sleeve (21) can be forced out of the aperture on the workpiece, to remove the fastener therefrom.

2. A fastener as claimed in claim1, in which the sleeve (21) and abutment member (32) are separate members and the removable securing means comprises deformation of at least one of them into engagement with the other.

3. A fastener as claimed in claim 2, in which the sleeve (21) has a radially extending head (25), the rim (25) being insufficiently strong to prevent the sleeve being driven through the aperture, the abutment member has a corresponding recess (37) in which the sleeve head (25) is received, and part of the abutment member adjacent the recess is deformed over and into contact with the sleeve head (25).

4. A fastener as claimed in claim 3, in which the abutment member is deformed as aforesaid at a plurality of positions spaced apart around the sleeve head.

5. A fastener, substantially as hereinbefore described and illustrated in the accompanying drawings.

6. A method of removing from a workpiece a fastener as claimed in any of the preceding claims which has been installed in the workpiece as aforesaid, which method comprises removing the abutment member from the sleeve, and then removing the pin and the sleeve through the blind side of the aperture.

7. A method of removing an installed fastener, substantially as hereinbefore described and illustrated in the accompanying drawings.

5

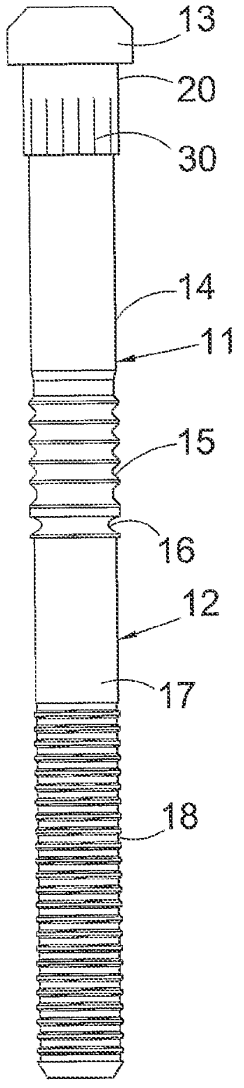


Fig. 1A

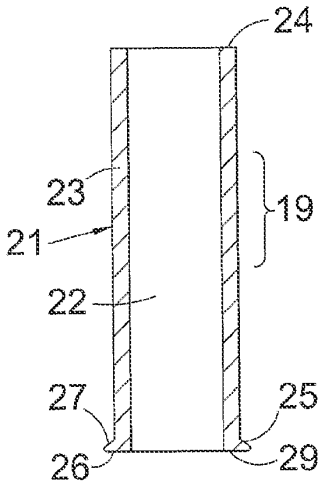


Fig.1B

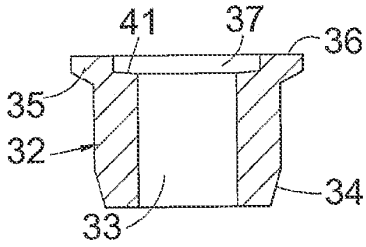


Fig.1C

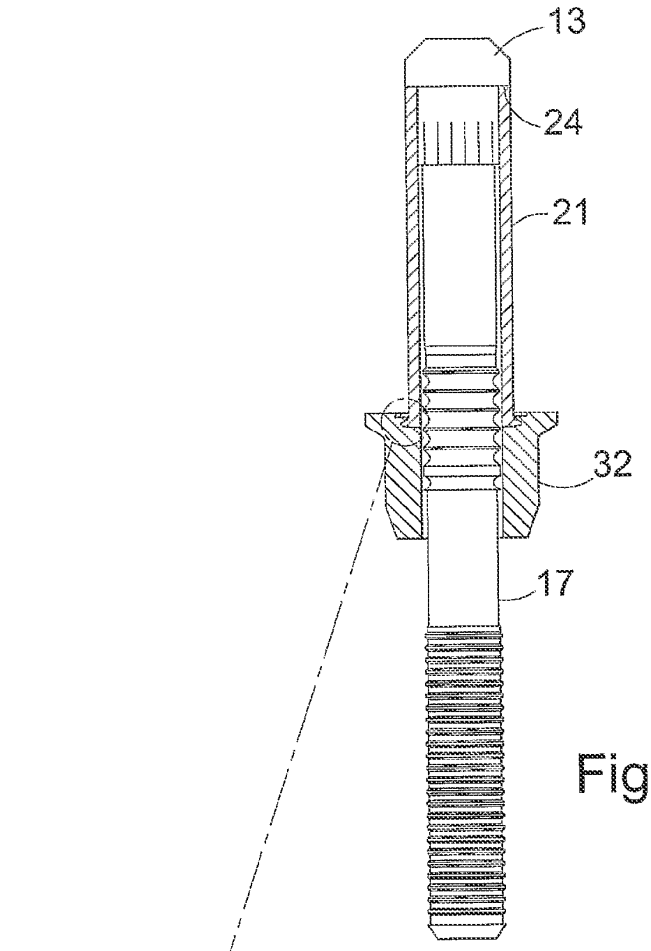


Fig. 2A

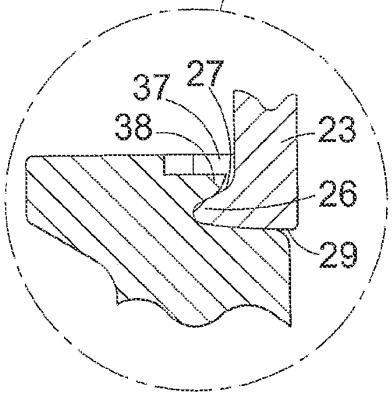


Fig. 2B

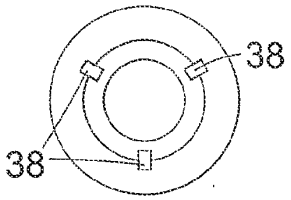


Fig. 2C

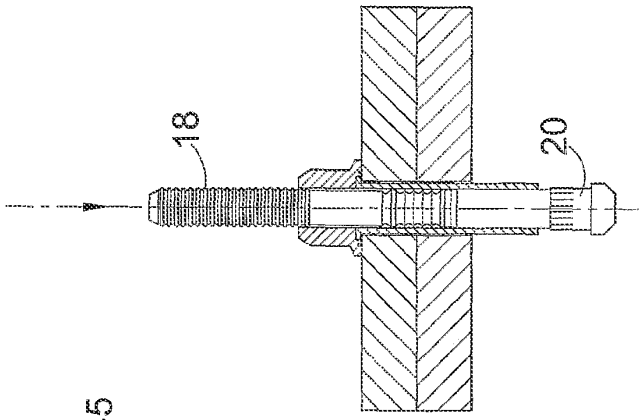


Fig.3C

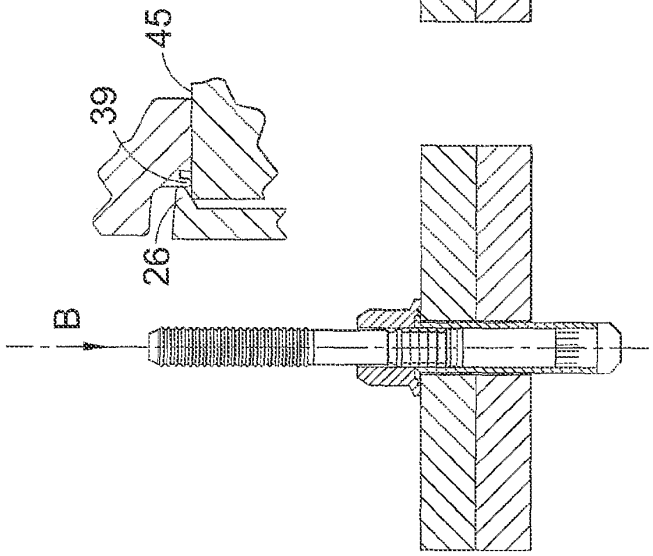


Fig.3B

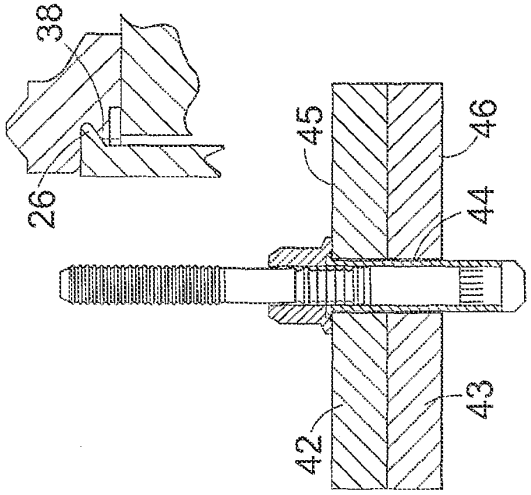


Fig.3A

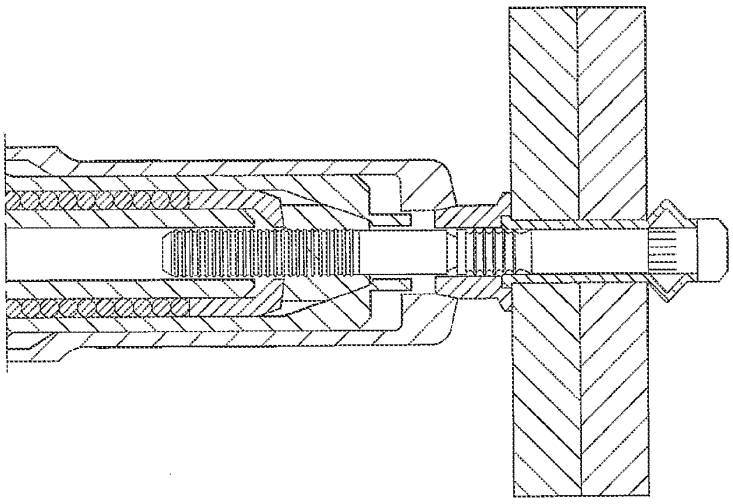


Fig. 4B

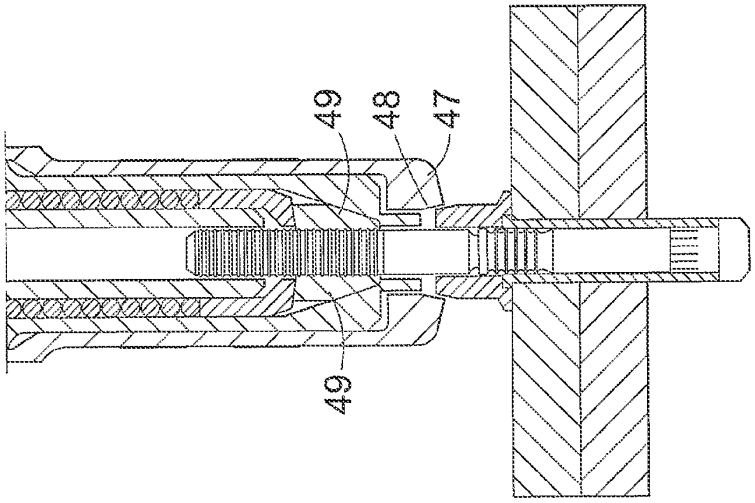


Fig. 4A

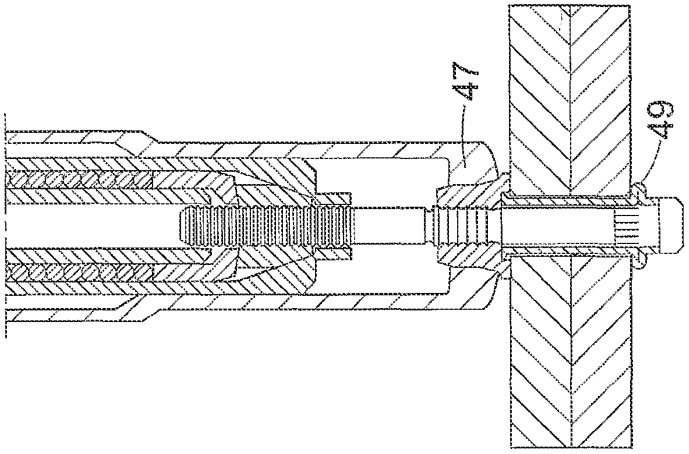


Fig. 5B

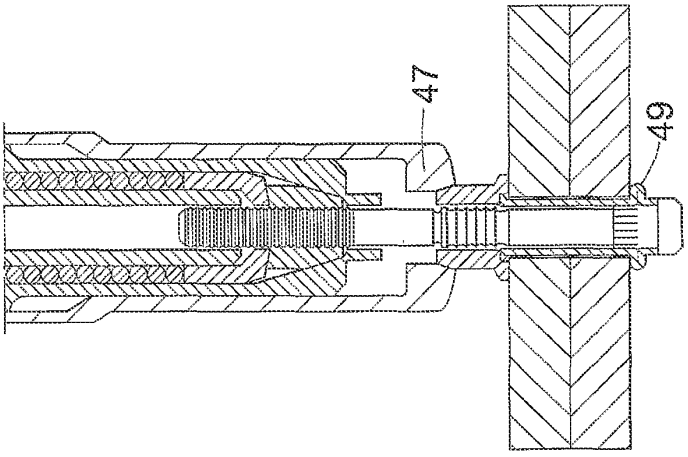


Fig. 5A

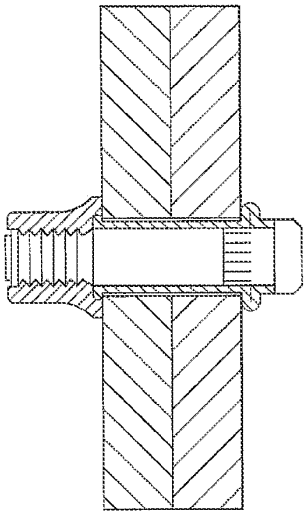


Fig. 6B

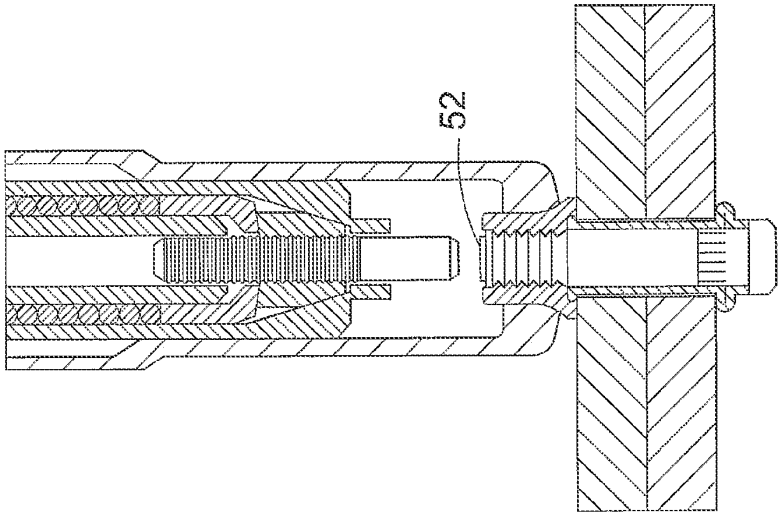


Fig. 6A

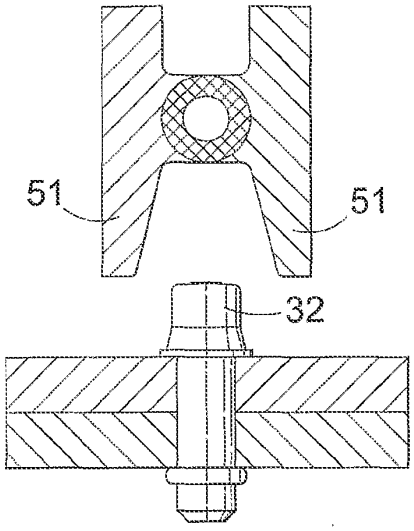


Fig.7A

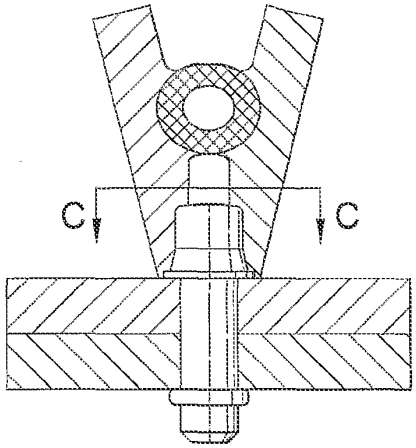


Fig.7B

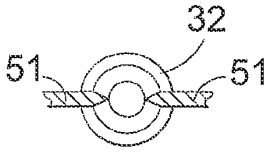


Fig.7C

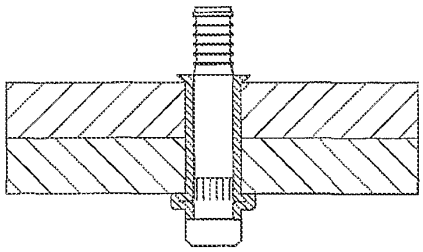


Fig.7D

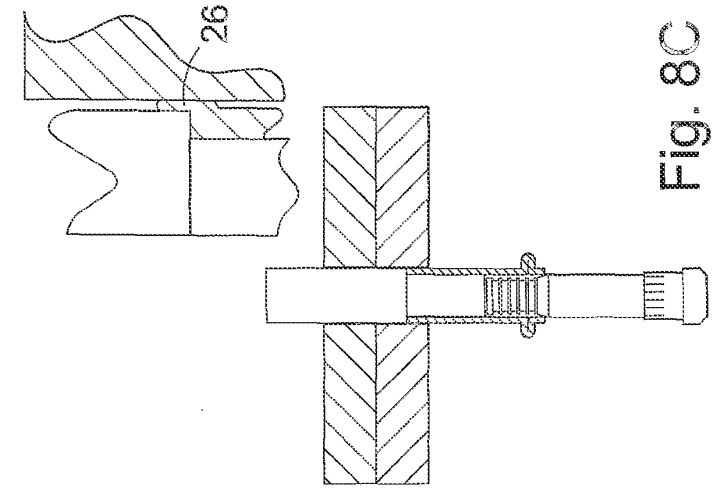


Fig. 8C

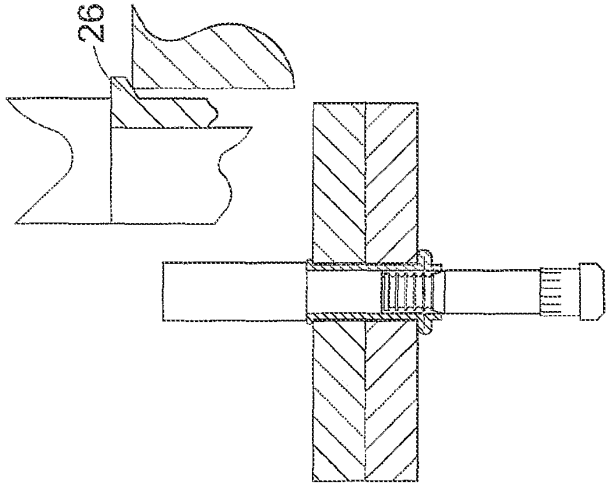


Fig. 8B

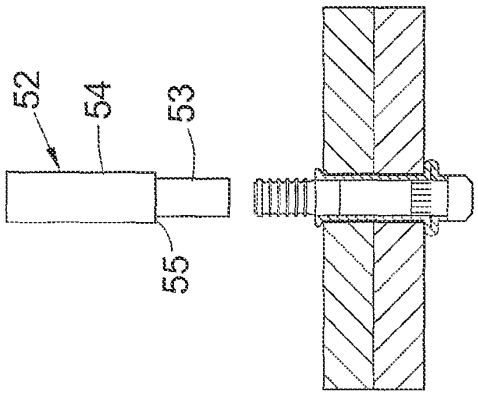


Fig. 8A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB2004/002042

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16B19/10 F16B19/05 B21J15/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16B B21J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 103 732 A (EMHART INC) 30 May 2001 (2001-05-30)	1,2,5
Y	abstract	6,7
A	column 1, line 50 - column 2, line 5 column 2, line 21 - line 48 column 3, line 4 - line 11 column 3, paragraph 14 column 3, line 55 - column 4, line 2 figures	3
Y	US 2 853 723 A (WINSLOW JAMES C) 30 September 1958 (1958-09-30) column 3, line 21 - column 4, line 26; figures	6,7
X	US 3 915 052 A (RUHL JOHN HOWLAND) 28 October 1975 (1975-10-28)	1,2,5
A	column 4, line 30 - line 46; figures 4,4a	3

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 August 2004	03/09/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax. (+31-70) 340-3016	Granger, H

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB2004/002042

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1103732 A	30-05-2001	GB 2356677 A	30-05-2001
		CN 1302961 A	11-07-2001
		EP 1103732 A2	30-05-2001
US 2853723 A	30-09-1958	NONE	
US 3915052 A	28-10-1975	BE 832635 A1	23-02-1976
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		JP 51046657 A	21-04-1976
		JP 55026325 B	12-07-1980
		NL 7509931 A ,B,	24-02-1976

Electronic Acknowledgement Receipt

EFS ID:	46194065
Application Number:	17423980
International Application Number:	
Confirmation Number:	4184
Title of Invention:	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
First Named Inventor/Applicant Name:	Robert B. Wilcox
Customer Number:	29270
Filer:	Robert John Sovesky/Theresa Merante
Filer Authorized By:	Robert John Sovesky
Attorney Docket Number:	118508/US01/PCTNS/180639P
Receipt Date:	14-JUL-2022
Filing Date:	19-JUL-2021
Time Stamp:	17:10:11
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	Supplemental_IDS.pdf	81408 684418b9244f525c9d8e90160aa263d931f92bb2	no	3
Warnings:					

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	WO2004102016A1.pdf	17329080 d8606600c464673ee053f650efb3d2a67e165f5	no	22
Warnings:					
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			Total Files Size (in bytes):	17410488	

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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

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/423,980	07/19/2021	Robert B. Wilcox	118508/US01/PCTNS/180639P

CONFIRMATION NO. 4184

29270
K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

PUBLICATION NOTICE

OC000000133320411

Title:BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Publication No.US-2022-0120306-A1
Publication Date:04/21/2022

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Petitioner's Ex. 1003-243

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/423,980

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	540
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1660

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

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U.S. APPLICATION NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
17/423,980	Robert B. Wilcox	118508/US01/PCTNS/180639P

29270
K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

INTERNATIONAL APPLICATION NO.	
PCT/US2019/016973	
I.A. FILING DATE	PRIORITY DATE
02/07/2019	

CONFIRMATION NO. 4184
371 ACCEPTANCE LETTER

OC000000131032340

Date Mailed: 01/13/2022

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office, in its capacity as a Designated / Elected Office (37 CFR 1.495), has ACCEPTED the above identified international application for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above. A Filing Receipt will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE "FILING DATE or 371(c) DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1) and (c)(2) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN BELOW.** The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363)

07/19/2021
DATE OF RECEIPT OF 35 U.S.C.
371(c)(1) and (c)(2) REQUIREMENTS

The following items have been received:

- Copy of the International Application filed on 07/19/2021
- Copy of the International Search Report filed on 07/19/2021
- Information Disclosure Statements filed on 07/19/2021
- Inventor's Oath or Declaration filed on 07/19/2021
- Request for Immediate Examination filed on 07/19/2021
- U.S. Basic National Fees filed on 07/19/2021
- Authorize Access to Search Results filed on 07/19/2021
- Power of Attorney filed on 07/19/2021
- Authorization to Permit Access filed on 07/19/2021
- Application Data Sheet (37 CFR 1.76) filed on 07/19/2021

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

ROSA M WEST

Telephone: (571) 272-1019

FORM PCT/DO/EO/903 (371 Acceptance Notice)

Petitioner's Ex. 1003-246

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
17423980	

Applicant(s) Robert Wilcox

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
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Total Claims	20		0		0	

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/423,980	07/19/2021		1660	118508/US01/PCTNS/180639P	20	2

CONFIRMATION NO. 4184

29270
K&L Gates LLP - Howmet Aerospace Inc.
K&L Gates Center
210 Sixth Avenue
Pittsburgh, PA 15222-2613

FILING RECEIPT

OC000000131032339

Date Mailed: 01/13/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

Robert B. Wilcox, McGregor, TX;
James Thomas Smith, Crawford, TX;
Troy Don Pierce, Hewitt, TX;

Applicant(s)

HOWMET AEROSPACE INC., Pittsburgh, PA;

Power of Attorney: The patent practitioners associated with Customer Number 29270

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/US2019/016973 02/07/2019

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Petitioner's Ex. 1003-248

If Required, Foreign Filing License Granted: 01/11/2022

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/423,980**

Projected Publication Date: 04/21/2022

Non-Publication Request: No

Early Publication Request: No
Title

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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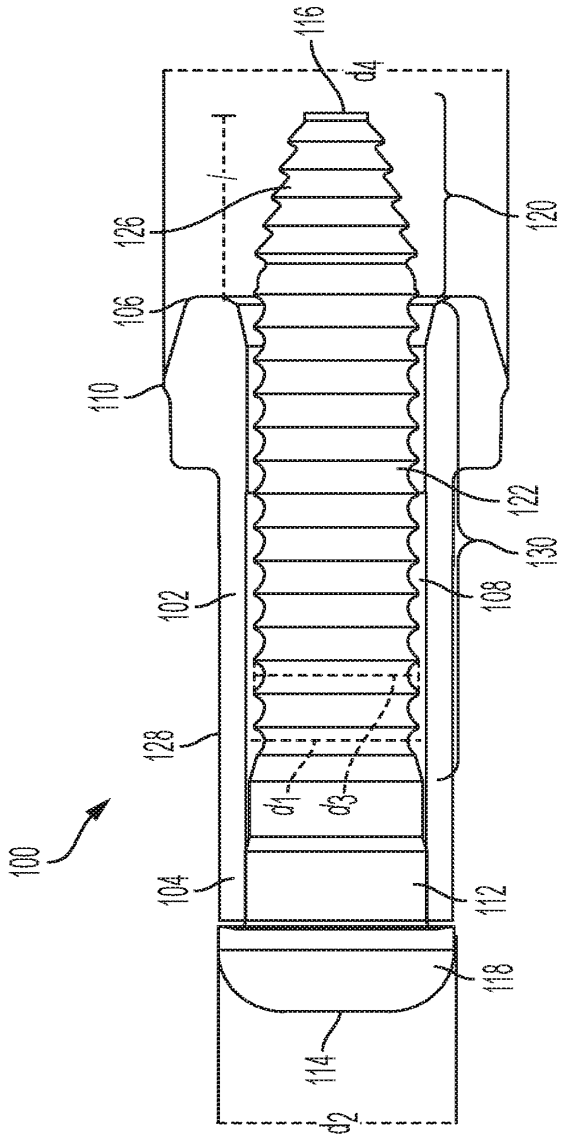

116
d4
126
120
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d1
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114
d2

FIG. 1

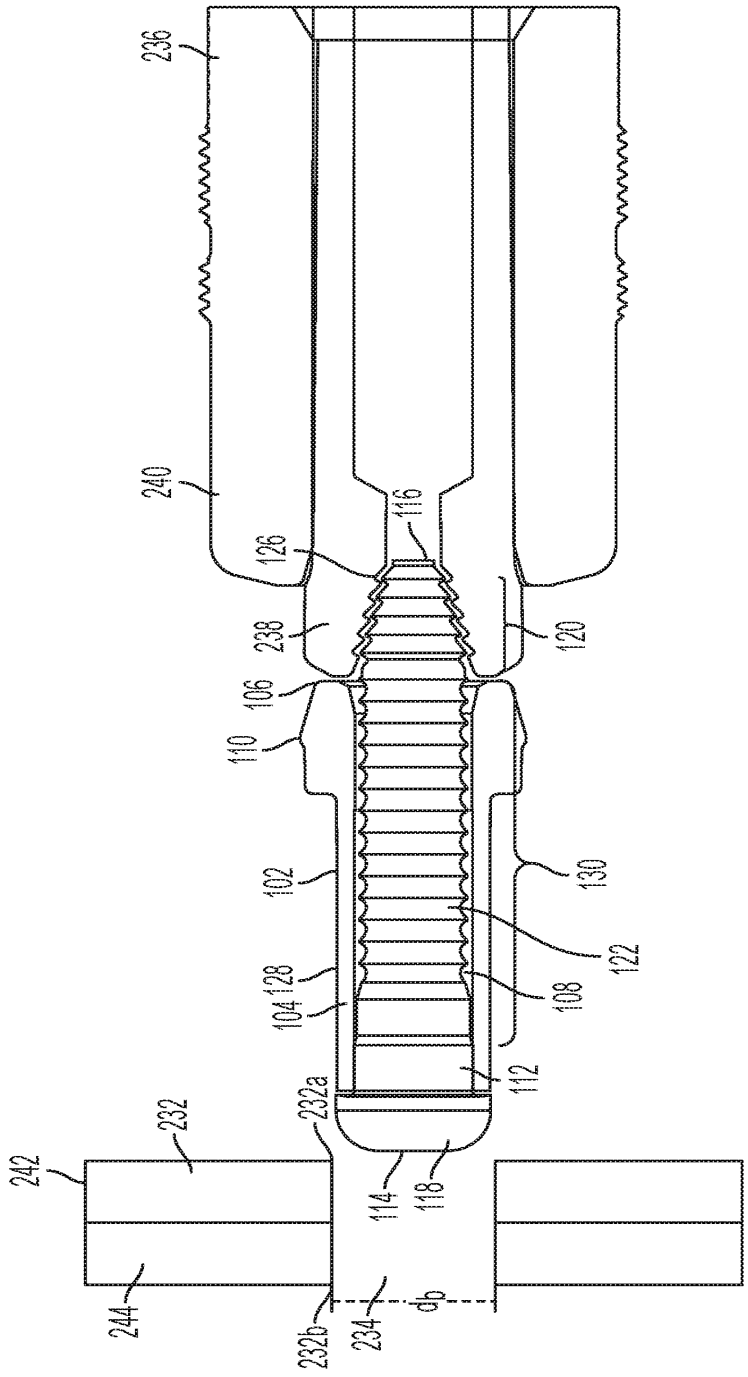


FIG. 2A

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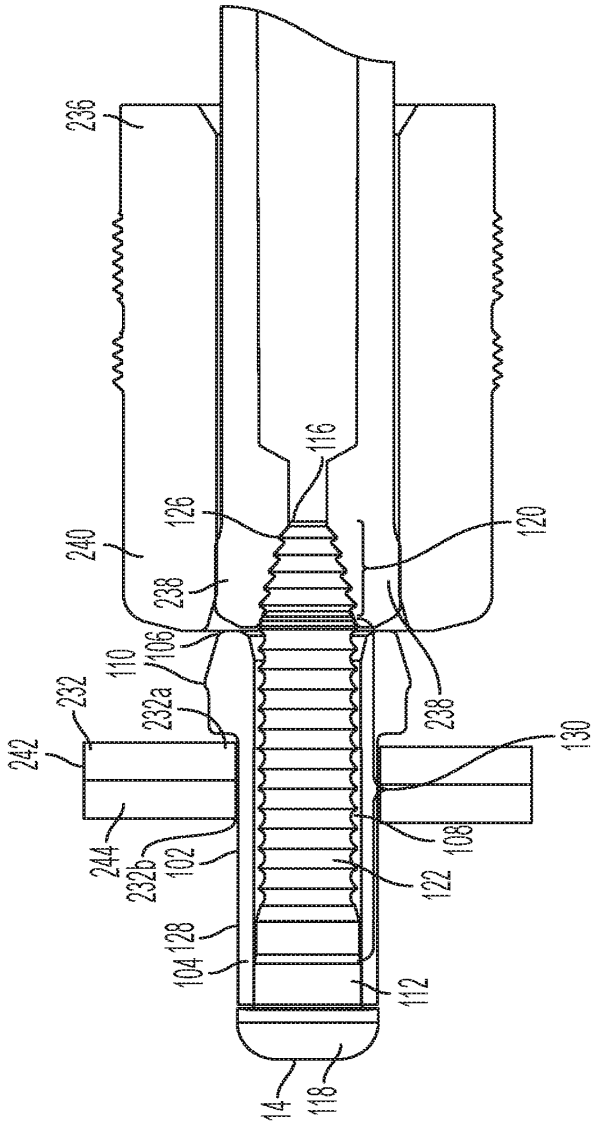


FIG. 2B

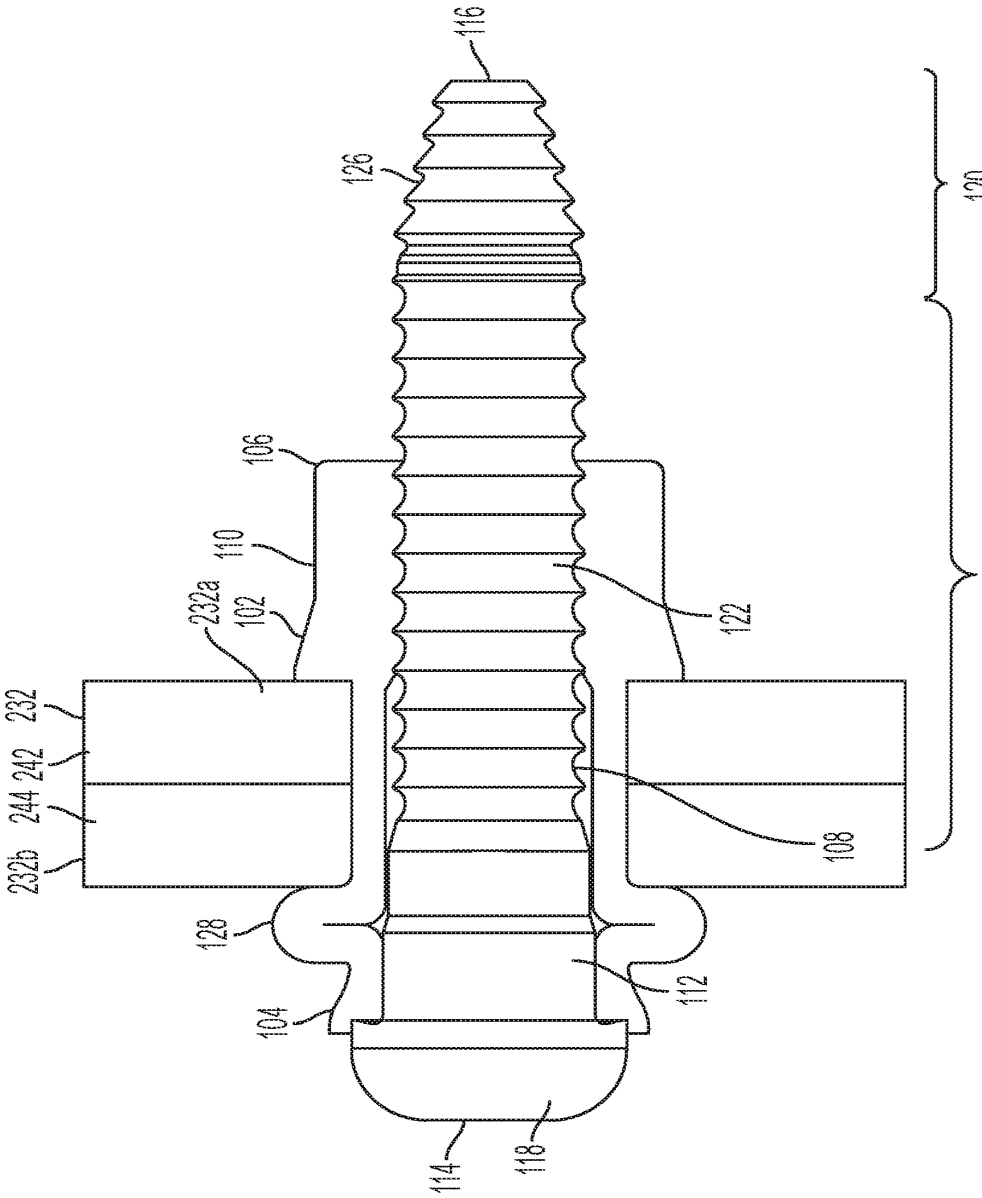

116
126
120
106
110
232a
102
122
130
232
242
244
232b
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128
112
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118

FIG. 2C

TITLE

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

FIELD OF USE

[0001] The present disclosure relates to blind fasteners and methods of installing blind fasteners.

BACKGROUND

[0002] Vehicle frames, storage racks, solar panel sub-structures, and other structures can include numerous mechanical fasteners. For example, a fastener can be installed in a bore of a vehicle frame structural component to join individual elements. Failure of a fastener in a structural component can be a result of, for example, fatigue stresses on the fastener or geometric variations in the bore in which the fastener is disposed. Designing a fastener for blind installation presents challenges.

SUMMARY

[0003] In one aspect, the present disclosure provides a blind fastener comprising a sleeve and a mandrel. The sleeve comprises a first sleeve end, a second sleeve end, and a cavity extending from the first sleeve end to the second sleeve end. The mandrel is configured to be at least partially received by the cavity of the sleeve. The mandrel comprises a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity, a second mandrel end comprising a pull region, and a shank region extending intermediate the first mandrel end and the second mandrel end. The pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool.

[0004] In another aspect, the present disclosure provides a method for fastening. The method comprises inserting a first mandrel end of a blind fastener into a bore in a structure. The blind fastener comprises a sleeve and a mandrel. The sleeve comprises a first sleeve end, a second sleeve end, and a cavity extending from the first sleeve end to the second sleeve end. The mandrel is configured to be at least partially received by the cavity of the sleeve. The mandrel comprises a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity, a

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second mandrel end comprising a pull region, and a shank region extending intermediate the first mandrel end and the second mandrel end. The pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool. A collet of the installation tool is engaged with the pull region of the blind fastener. After inserting the blind fastener into the bore in the structure, the second sleeve end of the blind fastener is forcibly contacted with an anvil of the installation tool, and the pull region is moved distal from the second sleeve end utilizing the collet of the installation tool. The portion of the sleeve on a first side of the structure is deformed, and the second sleeve end is swaged onto the shank region of the mandrel on an oppositely disposed second side of the structure, thereby securing at least a portion of the blind fastener in the structure.

[0005] It is understood that the invention disclosed and described in this specification is not limited to the aspects summarized in this Summary. The reader will appreciate the foregoing details, as well as others, upon considering the following detailed description of various non-limiting and non-exhaustive aspects according to this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The features and advantages of the examples, and the manner of attaining them, will become more apparent, and the examples will be better understood, by reference to the following description taken in conjunction with the accompanying drawings, wherein:

[0007] FIG. 1 is a partial cross-sectional side view of a non-limiting embodiment of a blind fastener according to the present disclosure;

[0008] FIG. 2A is a partial cross-sectional side view of the fastener of FIG. 1 and a structure in a first configuration;

[0009] FIG. 2B is a partial cross-sectional side view of the fastener and the structure of FIG. 2A in a second configuration; and

[0010] FIG. 2C is a partial cross-sectional side view of the fastener and the structure of FIG. 2A in a third configuration.

[0011] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate certain embodiments, in one

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form, and such exemplifications are not to be construed as limiting the scope of the appended claims in any manner.

DETAILED DESCRIPTION OF NON-LIMITING EMBODIMENTS

[0012] Various examples are described and illustrated herein to provide an overall understanding of the structure, function, and use of the disclosed articles and methods. The various examples described and illustrated herein are non-limiting and non-exhaustive. Thus, an invention is not limited by the description of the various non-limiting and non-exhaustive examples disclosed herein. Rather, the invention is defined solely by the claims. The features and characteristics illustrated and/or described in connection with various examples may be combined with the features and characteristics of other examples. Such modifications and variations are intended to be included within the scope of this specification. As such, the claims may be amended to recite any features or characteristics expressly or inherently described in, or otherwise expressly or inherently supported by, this specification. Further, Applicant reserves the right to amend the claims to affirmatively disclaim features or characteristics that may be present in the prior art. The various embodiments disclosed and described in this specification can comprise, consist of, or consist essentially of the features and characteristics as variously described herein.

[0013] Any references herein to "various embodiments," "some embodiments," "one embodiment," "an embodiment," or like phrases mean that a particular feature, structure, or characteristic described in connection with the example is included in at least one embodiment. Thus, appearances of the phrases "in various embodiments," "in some embodiments," "in one embodiment," "in an embodiment," or like phrases in the specification do not necessarily refer to the same embodiment. Furthermore, the particular described features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. Thus, the particular features, structures, or characteristics illustrated or described in connection with one embodiment may be combined, in whole or in part, with the features, structures, or characteristics of one or more other embodiments without limitation. Such modifications and variations are intended to be included within the scope of the present embodiments.

[0014] In this specification, unless otherwise indicated, all numerical parameters are to be understood as being prefaced and modified in all instances by the term "about," in which the

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numerical parameters possess the inherent variability characteristic of the underlying measurement techniques used to determine the numerical value of the parameter. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter described herein should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques.

[0015] Also, any numerical range recited herein includes all sub-ranges subsumed within the recited range. For example, a range of "1 to 10" includes all sub-ranges between (and including) the recited minimum value of 1 and the recited maximum value of 10, that is, having a minimum value equal to or greater than 1 and a maximum value equal to or less than 10. Any maximum numerical limitation recited in this specification is intended to include all lower numerical limitations subsumed therein and any minimum numerical limitation recited in this specification is intended to include all higher numerical limitations subsumed therein. Accordingly, Applicant reserves the right to amend this specification, including the claims, to expressly recite any sub-range subsumed within the ranges expressly recited. All such ranges are inherently described in this specification.

[0016] The grammatical articles "a," "an," and "the," as used herein, are intended to include "at least one" or "one or more," unless otherwise indicated, even if "at least one" or "one or more" is expressly used in certain instances. Thus, the foregoing grammatical articles are used herein to refer to one or more than one (i.e., to "at least one") of the particular identified elements. Further, the use of a singular noun includes the plural and the use of a plural noun includes the singular, unless the context of the usage requires otherwise.

[0017] As used herein, "intermediate" means that the referenced element is disposed between two elements but is not necessarily in contact with those elements. Accordingly, unless stated otherwise herein, an element that is "intermediate" a first element and a second element may or may not be adjacent to or in contact with the first and/or second elements, and other elements may be disposed between the intermediate element and the first and/or second elements.

[0018] Failure of a fastener in a structural component can be a result of in-service fatigue, overload on the structural component, and corrosion. The present disclosure provides a blind fastener and a method of installation that can reduce installation forces and increase corrosion resistance. For example, the blind fastener according to the present disclosure may be

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installed with an installation force less than a force that can fracture the mandrel. Reducing the installation force requirement and installing without a shock force occurring during fracture of the mandrel can enable lighter weight installation tools, longer life of installation tool components, limit damage to the structural components, and enhance ergonomics for operators using the installation tools.

[0019] FIG. 1 illustrates a cross-sectional side view of an embodiment of a blind fastener 100 according to the present disclosure. The blind fastener 100 can be adapted to be installed in a bore in a structure (e.g., as illustrated in FIGs. 2A-C, discussed below). The blind fastener 100 can include a sleeve 102 and a mandrel 112. In various embodiments, the sleeve 102 is generally cylindrical. FIG. 1 shows a portion of the sleeve removed, exposing the mandrel 112 therein. The sleeve 102 can comprise a first sleeve end 104, a second sleeve end 106, an elongate portion 128 disposed intermediate the first sleeve end 104 and the second sleeve end 106, and a cavity 108 extending from the first sleeve end 104 to the second sleeve end 106.

[0020] The cavity 108 of the sleeve 102 can comprise a diameter, d_1, and be configured to at least partially receive the mandrel 112 therein. For example, the mandrel 112 can comprise a shape suitable to be received by the cavity 108, such as, for example, a generally cylindrical shape. The mandrel 112 can comprise a first mandrel end 114, a second mandrel end 116, and a shank region 122. The shank region 122 can extend intermediate the first mandrel end 114 and the second mandrel end 116 and through the cavity 108. When the mandrel 112 is inserted in the cavity 108, the first mandrel end 114 can be disposed adjacent to the first sleeve end 104, and the second mandrel end 116 can be disposed adjacent to the second sleeve end 106.

[0021] The first mandrel end 114 can comprise an enlarged portion 118 comprising a diameter, d_2, which can be greater than the diameter, d_1, of the cavity 108. The enlarged portion 118 can engage the first sleeve end 104 of the cavity 108 and inhibit further movement of the first mandrel end 114 into the cavity 108 of the sleeve 102. The enlarged portion 118 can apply a force to the first sleeve end 104 and can deform the first sleeve end 104 during installation of the blind fastener 100. For example, the first sleeve end 104 can be crumpled (e.g., into a bulb shape) and/or expanded.

[0022] The second mandrel end 116 can comprise a pull region 120 configured to be engaged by an installation tool (e.g., installation tool 236, as illustrated in FIGs. 2A-B discussed

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below). The pull region 120 can comprise an axial length, l, that is no greater than 4 times a diameter, d_3, of the shank region 122, such as, for example, no greater than 3.8 times, no greater than 3.75 times, no greater than 3.5 times, no greater than 3.25 times, no greater than 3 times, no greater than 2.5 times, no greater than 2 times, no greater than 1.5 times, or no greater than 1 times the diameter, d_3, of the shank region 122. The diameter, d_3, of the shank region 122 can be the major diameter (e.g., root) of the shank region 122.

[0023] The pull region 120 can comprise a taper or a reverse taper. As illustrated, the pull region 120 can comprise a taper extending from the shank region 122. For example, as one moves along the pull region 120 away from the shank region 122 along a longitudinal axis of the blind fastener 100, the diameter of the pull region 120 can decrease. In certain other embodiments, the pull region 120 can comprise a reverse taper (not shown) where, as one moves along the pull region 120 away from the shank region 122 along the longitudinal axis of the blind fastener 100, the diameter of the pull region 120 increases. In various embodiments, the pull region 120 can be generally conical. In various other embodiments, the pull region 120 may not comprise a taper and the pull region 120 can be generally cylindrical.

[0024] The pull region 120 can comprise at least one of a generally smooth region, an annular shoulder, a groove, and a bore, or can comprise another feature, configured to be engaged by an installation tool. For example, the pull region 120 can comprise grooves 126, as illustrated in FIG. 1, that can be engaged by an installation tool.

[0025] The shank region 122 can define the longitudinal axis of the blind fastener 100. The shank region 122 can comprise at least one of a generally smooth region, a threaded region, an annular shoulder, and a groove. The threaded region, annular shoulder, and/or the groove can be external relative to the mandrel 112. In various embodiments, all or a portion of the shank region 122 includes grooves. For example, as shown in FIG. 1, the shank region 122 of the blind fastener 100 includes grooves 130. In other embodiments, all or a portion of the shank region 122 lacks grooves. In various embodiments, all or a portion of the shank region 122 includes an annular shoulder. In other embodiments, the shank region 122 lacks an annular shoulder. In various embodiments, all or a portion of the shank region 122 includes a threaded portion. In other embodiments, the shank region 122 lacks a threaded portion.

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[0026] In various embodiments of blind fastener 100, the mandrel 112 does not comprise a breakneck groove or other feature configured to fracture upon installation of the blind fastener 100. For example, the shank region 122 may not comprise a breakneck groove or other feature configured to fracture upon installation of the blind fastener 100. The mandrel 112 may remain intact after installing the blind fastener 100 into a structure. In various embodiments, the blind fastener 100 may comprise a breakneck groove or other feature configured to fracture upon installation of the blind fastener 100, and the blind fastener 100 may be installed into a structure without fracturing of the breakneck groove or other feature.

[0027] In various embodiments, the blind fastener 100 can comprise a single assembly of the sleeve 102 and the mandrel 112. In certain embodiments, the blind fastener 100 can consist of the sleeve 102 and the mandrel 112. In some embodiments, the blind fastener 100 can be a structural blind fastener, such as, for example, a structural blind rivet, structural blind bolt, or a structural blind stud.

[0028] The blind fastener 100 can comprise at least one of a metal, a metal alloy, and a composite material. For example, in various embodiments the blind fastener 100 can comprise at least one of aluminum, an aluminum alloy, titanium, a titanium alloy, nickel, a nickel alloy, iron, an iron alloy, and a carbon fiber composite material. In various embodiments, the mandrel 112 can comprise a Rockwell hardness of at least HRC 25, such as, for example, at least HRC 30, at least HRC 35, at least HRC 40, at least HRC 43, at least HRC 44, at least HRC 45, or at least HRC 50.

[0029] The sleeve 102 can comprise a collar 110 positioned adjacent to the second sleeve end 106. The collar 110 can be configured to be engaged by an installation tool (e.g., installation tool 236 illustrated in FIGs. 2A-B) in order to facilitate installation of the blind fastener 100. The sleeve 102 can be configured to deform on the exit side of the structure and swage onto the shank region 122 an oppositely disposed entrance side of a structure. For example, the first sleeve end 104 can be deformed and the collar 110 can be swaged onto the shank portion 122, as illustrated in FIG. 2C. In various embodiments, the collar 110 can be a head portion of the sleeve 102.

[0030] As illustrated in FIGs. 2A-C, the blind fastener 100 can be installed into a bore 234 in a structure 232. The bore 234 can extend through the structure 232. The structure 232 can comprise, for example, at least one of a metal, a metal alloy, and a composite. For example,

in certain embodiments, the structure 232 can comprise at least one of aluminum, an aluminum alloy, titanium, a titanium alloy, nickel, a nickel alloy, iron, an iron alloy, and a carbon fiber composite material.

[0031] In various embodiments, the structure into which the blind fastener 100 is assembled comprises aluminum and/or an aluminum alloy such as, for example, 7075 aluminum. With reference to the accompanying figures, the structure 232 can be configured as at least one of an aerospace component or structure, an automotive component or structure, a transportation component or structure, and a building and construction component or structure. The structure 232 can comprise a single layer of material or at least two layers of material. For example, as illustrated in FIGs. 2A-C, the structure 232 can comprise a first layer 242 and a second layer 244. Upon installation into the bore 234, the blind fastener 100 can secure the first layer 242 and the second layer 244 together, as illustrated in FIG. 2C.

[0032] As illustrated in FIG. 2A, in a first configuration of the blind fastener 100 and the structure 232, the first mandrel end 114 of the blind fastener 100 can be positioned in alignment with the bore 234. To facilitate alignment of the blind fastener 100 with the bore 234, the bore 234 can have a diameter, d_b, that is greater than the diameter, d_2, of the enlarged portion 118 of the first mandrel end 114, thereby allowing the mandrel 112 to readily move into and through the bore 234 when passing from a first configuration of the blind fastener 100 and the structure 232, illustrated in FIG. 2A, to a second configuration, illustrated in FIG. 2B. In various embodiments, the diameter, d_b, of the bore 234 can be less than the diameter of the sleeve 102 to allow the sleeve to readily pass into the bore 234. The diameter, d_4, of the collar can be greater than the diameter, d_b, of the bore 234. In the second configuration, shown in FIG. 2B, the first mandrel end 114 has passed into the bore 234 and the collar 110 of the sleeve 102 can be in forcible contact with the structure 232 at an entrance side 232a of the structure 232. The forcible contact between the collar 110 and the structure 232 can limit further axial movement of the sleeve 102 into the bore 234.

[0033] Before or after insertion, a collet 238 of the installation tool 236 can engage the pull region 120 of the blind fastener 100. For example, the collet 238 can be configured to forcibly contact an anvil 240 of the installation tool 236. The forcible contact can close the collet 238 around the pull region 120 where the collet 238 forcibly contacts the pull region 120. Upon engagement, the collet 238 can apply a force to the pull region 120 of the mandrel 112.

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[0034] The collet 238 can move the mandrel 112 independently of the sleeve 102. For example, the collet 238 can retract within the installation tool 236 and move the mandrel 112 as the collet 238 retracts due to the contact between the pull region 120 and the collet 238. Upon the collet 238 reaching a predetermined retraction distance into the installation tool, the anvil 240 can forcibly contact the second sleeve end 106. The forcible contact between the second sleeve end 106 and the anvil 240 can move the second mandrel end 116 in a vector different than a vector in which the second sleeve end 106 may be moving. For example, the installation tool 236 can move the pull region 120 distal from the collar 110 utilizing the collet 238 of the installation tool 236.

[0035] In various embodiments wherein a pull region 120 of the mandrel 112 comprises grooves and a taper, the collet 238 of the installation tool 236 may only be able to apply force to the pull region 120 to move the mandrel 112 if the collet 238 and the grooves 126 of the pull region 120 are fully engaged, such as is illustrated in FIG. 2B. A partially engaged collet 238 may not be able to apply a force to the pull region 120 sufficiently to appropriately move the mandrel 112 relative to the sleeve 102. The grooves and taper of the pull region 120 can reduce potential stripping of the grooves 126 due to crest-to-crest engagement.

[0036] In a third configuration of the blind fastener 100 and the structure 232 illustrated in FIG. 2C, the first sleeve end 104 and the elongate portion 128 can be deformed on an exit side 232b of the structure 232 responsive to forcible contact from mandrel 112. The second sleeve end 106 can be swaged onto the shank region 122 on an oppositely disposed entrance side 232a of the structure 232 responsive to forcible contact from the anvil 240. For example, the collar 110 can be swaged onto the shank region 122. The swaging of the second sleeve end 106 and/or deformation of the first sleeve end 104 and/or elongate portion 128 can secure at least a portion of the blind fastener 100 in the structure 232. In that way, for example, the first layer 242 and second layer 244 of the structure 232 are secured together. As shown in the embodiments illustrated in FIGs. 2A-C, the mandrel 112 need not include a breakneck groove or other feature configured to fracture upon installation of the blind fastener 100.

[0037] In various embodiments, the blind fastener 100 can be used in a method for fastening the structure 232. The method can comprise inserting the first mandrel end 114 into the bore 234 in the structure 232. The collet 238 of the installation tool 236 can engage with the pull region 120 of the blind fastener 100. After inserting the blind fastener 100 into the bore 234, the second sleeve end 106 of the blind fastener 100 can contact the anvil 240 of the

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installation tool 236. The pull region 120 can be moved distal from the collar 110 utilizing the collet 238 of the installation tool 236. The first sleeve end 104 can be deformed on the exit side 232b of the structure 232, and the second sleeve end 106 can be swaged onto the shank region 122 of the mandrel 112 on the opposite, entrance side 232a of the structure 232, thereby securing at least a portion of the blind fastener 100 in the structure 232.

[0038] The blind fastener according to the present disclosure can enable use of a smaller installation tool for installation since the force required to install the blind fastener may be less than a force that can fracture the mandrel. The blind fastener according to the present disclosure can have a variety of uses since the design of the sleeve may not have to accommodate the force required to fracture the mandrel. For example, the sleeve wall thickness can be reduced by, for example, 10% or 15%, which can save material cost.

[0039] Various aspects of the invention include, but are not limited to, the aspects listed in the following numbered clauses.

1. A blind fastener comprising: a sleeve comprising a first sleeve end, a second sleeve end, and a cavity extending from the first sleeve end to the second sleeve end; and a mandrel configured to be at least partially received by the cavity of the sleeve. The mandrel comprises a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity, a second mandrel end comprising a pull region, and a shank region extending intermediate the first mandrel end and the second mandrel end. The pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool.

2. The blind fastener of clause 1, wherein the pull region comprises an axial length no greater than 3.8 times the diameter of the shank region.

3. The blind fastener of any one of clauses 1-2, wherein the pull region comprises an axial length no greater than 2 times the diameter of the shank region.

4. The blind fastener of any one of clauses 1-3, wherein the pull region comprises a taper extending from the shank region.

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5. The blind fastener of any one of clauses 1-4, wherein the mandrel does not comprise a breakneck groove.

6. The blind fastener of any one of clauses 1-5, wherein the mandrel comprises a Rockwell hardness of at least HRC 25.

7. The blind fastener of any one of clauses 1-6, wherein the mandrel comprises a Rockwell hardness of at least HRC 43.

8. The blind fastener of any one of clauses 1-7, wherein the shank region comprises at least one of a threaded region, an annular shoulder, and a groove.

9. The blind fastener of any one of clauses 1-8, wherein the pull region comprises at least one of a threaded region, an annular shoulder, and a groove.

10. The blind fastener of any one of clauses 1-9, wherein the sleeve is generally cylindrical and the mandrel is generally cylindrical.

11. The blind fastener of any one of clauses 1-10, wherein the blind fastener comprises at least one of a metal, metal alloy, and a composite material.

12. The blind fastener of any one of clauses 1-11, wherein the blind fastener is adapted to be installed in a bore in a structure, the bore having a diameter greater than the diameter of the enlarged portion.

13. The blind fastener of clause 12, wherein the sleeve further comprises a collar, the sleeve is configured to deform on a first side of the structure, and the collar is configured to swage onto the shank region on an oppositely disposed second side of the structure.

14. The blind fastener of any one of clauses 12-13, wherein the structure comprises at least one of a metal, a metal alloy, and a composite material.

15. The blind fastener of any one of clauses 12-14, wherein the structure is configured as at least one of an aerospace component, an automotive component, a transportation component, and a building and construction component.

16. A method for fastening comprising inserting a first mandrel end of a blind fastener into a bore in a structure. The blind fastener comprises: a sleeve comprising a first sleeve end,

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a second sleeve end, and a cavity extending from the first sleeve end to the second sleeve end; and a mandrel configured to be at least partially received by the cavity of the sleeve. The mandrel comprises a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity, a second mandrel end comprising a pull region, and a shank region extending intermediate the first mandrel end and the second mandrel end. The pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool. The method further includes: engaging a collet of the installation tool with the pull region of the blind fastener; after inserting the first mandrel end into a bore, forcibly contacting the second sleeve end of the blind fastener with an anvil of the installation tool and moving the pull region distal from the second sleeve end utilizing the collet of the installation tool; and deforming the sleeve on a first side of the structure, and swaging the second sleeve end onto the shank region on an oppositely disposed second side of the structure, thereby securing at least a portion of the blind fastener in the structure.

17. The method of clause 16, wherein the pull region comprises an axial length no greater than 2 times the diameter of the shank region.

18. The method of any one of clauses 16-17, wherein the pull region comprises a taper or reverse taper extending from the shank region.

19. The method of any one of clauses 16-18, wherein the mandrel does not comprise a breakneck groove.

20. The method of any one of clauses 16-19, wherein the blind fastener comprises at least one of a metal, a metal alloy, and a composite material.

[0040] One skilled in the art will recognize that the herein described fasteners, structures, operations/actions, and objects, and the discussion accompanying them, are used as examples for the sake of conceptual clarity and that various configuration modifications are contemplated. Consequently, as used herein, the specific examples/embodiments set forth and the accompanying discussion are intended to be representative of their more general classes. In general, use of any specific exemplar is intended to be representative of its class, and the non-inclusion of specific components, devices, operations/actions, and objects should not be taken as limiting. While the present disclosure provides descriptions of various

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specific aspects for the purpose of illustrating various aspects of the present disclosure and/or its potential applications, it is understood that variations and modifications will occur to those skilled in the art. Accordingly, the invention or inventions described herein should be understood to be at least as broad as they are claimed, and not as more narrowly defined by particular illustrative aspects provided herein.

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CLAIMS

What is claimed is:

1. A blind fastener comprising:
   a sleeve comprising
      a first sleeve end,
      a second sleeve end,
      a cavity extending from the first sleeve end to the second sleeve end; and
   a mandrel configured to be at least partially received by the cavity of the sleeve, the mandrel comprising
      a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity,
      a second mandrel end comprising a pull region, and
      a shank region extending intermediate the first mandrel end and the second mandrel end,
      wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool.

2. The blind fastener of claim 1, wherein the pull region comprises an axial length no greater than 3.8 times the diameter of the shank region.

3. The blind fastener of claim 1, wherein the pull region comprises an axial length no greater than 2 times the diameter of the shank region.

4. The blind fastener of claim 1, wherein the pull region comprises a taper extending from the shank region.

5. The blind fastener of claim 1, wherein the mandrel does not comprise a breakneck groove.

6. The blind fastener of claim 1, wherein the mandrel comprises a Rockwell hardness of at least HRC 25.

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7. The blind fastener of claim 1, wherein the mandrel comprises a Rockwell hardness of at least HRC 43.

8. The blind fastener of claim 1, wherein the shank region comprises at least one of, a threaded region, an annular shoulder, and a groove.

9. The blind fastener of claim 1, wherein the pull region comprises at least one of a threaded region, an annular shoulder, and a groove.

10. The blind fastener of claim 1, wherein the sleeve is generally cylindrical and the mandrel is generally cylindrical.

11. The blind fastener of claim 1, wherein the blind fastener comprises at least one of a metal, metal alloy, and a composite material.

12. The blind fastener of claim 1, wherein the blind fastener is adapted to be installed in a bore in a structure, the bore having a diameter greater than the diameter of the enlarged portion.

13. The blind fastener of claim 12, wherein the sleeve further comprises a collar, the sleeve is configured to deform on a first side of the structure, and the collar is configured to swage onto the shank region on an oppositely disposed second side of the structure.

14. The blind fastener of claim 12, wherein the structure comprises at least one of a metal, a metal alloy, and a composite material.

15. The blind fastener of claim 12, wherein the structure is configured as at least one of an aerospace component, an automotive component, a transportation component, and a building and construction component.

16. A method for fastening, the method comprising:

inserting a first mandrel end of a blind fastener into a bore in a structure, the blind fastener comprising

a sleeve comprising

a first sleeve end,

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a second sleeve end, and

a cavity extending from the first sleeve end to the second sleeve end, and

a mandrel configured to be at least partially received by the cavity of the sleeve, the mandrel comprising

a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity,

a second mandrel end comprising a pull region, and

a shank region extending intermediate the first mandrel end and the second mandrel end,

wherein the pull region comprises an axial length no greater than 4 times a diameter of the shank region and is configured to be engaged by an installation tool;

engaging a collet of the installation tool with the pull region of the blind fastener;

after the inserting, forcibly contacting the second sleeve end of the blind fastener with an anvil of the installation tool and moving the pull region distal from the second sleeve end utilizing the collet of the installation tool; and

deforming the sleeve on a first side of the structure, and swaging the second sleeve end onto the shank region on an oppositely disposed second side of the structure, thereby securing at least a portion of the blind fastener in the structure.

17. The method of claim 16, wherein the pull region comprises an axial length no greater than 3.8 times the diameter of the shank region.

18. The method of claim 16, wherein the pull region comprises a taper or reverse taper extending from the shank region.

19. The method of claim 16, wherein the mandrel does not comprise a breakneck groove.

20. The method of claim 16, wherein the blind fastener comprises at least one of a metal, a metal alloy, and a composite material.

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(54) **Title:** BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

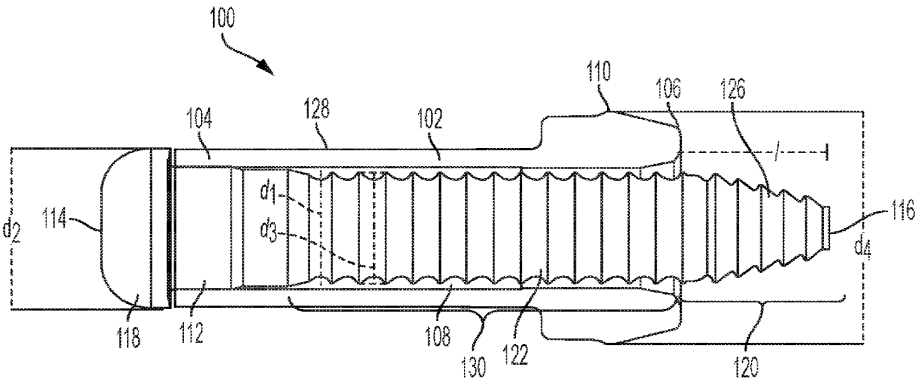


FIG. 1

(57) **Abstract:** The present disclosure relates to a blind fastener and a method of installation thereof. The blind fastener comprises a sleeve and a mandrel. The sleeve comprises a first sleeve end, a second sleeve end, and a cavity extending from the first sleeve end to the second sleeve end. The mandrel is configured to be at least partially received by the cavity of the sleeve. The mandrel comprises a first mandrel end disposed adjacent to the first sleeve end and comprising an enlarged portion having a diameter greater than a diameter of the cavity, a second mandrel end comprising a pull region, and a shank region extending intermediate the first mandrel end and the second mandrel end. The pull region comprises an axial length no greater than four times a diameter of the shank region and is configured to be engaged by an installation tool.

[Continued on next page]

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— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report (Art. 21(3))*

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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Applicant's or agent's file reference *(if desired) (25 characters maximum)*
180639PCT

Box No. I TITLE OF INVENTION

BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

Box No. II APPLICANT ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Applicant's registration No. with the Office

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Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

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- ☐ applicant and inventor
- ☒ inventor only *(If this check-box is marked, do not fill in below.)*

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State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ the States indicated in the Supplemental Box

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- ☐ applicant and inventor
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This person is applicant for the purposes of: ☐ all designated States ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

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Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

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(iii) *if, in Box No. II or in any of the sub-boxes of Box No. III,* ***the inventor or the inventor/applicant is not inventor for the purposes of all designated States****: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

(iv) *if, in addition to the agent(s) indicated in Box No. IV, there are* ***further agents****: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

(v) *if, in Box No. VI, there are* ***more than three earlier applications whose priority is claimed****: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.*

2. *If the applicant intends to make an indication of the wish that the international application be treated, in certain designated States, as an application for a patent of addition, certificate of addition, inventor's certificate of addition or utility certificate of addition: in such case, write the name or two-letter code of each designated State concerned and the indication "****patent of addition,****" "****certificate of addition,****" "****inventor's certificate of addition****" or "****utility certificate of addition,****" the number of the parent application or parent patent or other parent grant and the date of grant of the parent patent or other parent grant or the date of filing of the parent application (Rules 4.11(a)(i) and 49bis.1(a) or (b)).*

3. *If the applicant intends to make an indication of the wish that the international application be treated, in the United States of America, as a continuation or continuation-in-part of an earlier application: in such case, write "United States of America" or "US" and the indication "****continuation****" or "****continuation-in-part****" and the number and the filing date of the parent application (Rules 4.11(a)(ii) and 49bis.1(d)).*

CONTINUATION OF BOX IV

Anderson, Jaimie R.;
Blyth, Gareth M.;
Capriotti, Roberto;
Conrad, Sean M.;
Dickos, George D.;
Edgington, Thomas J.;
Geisler, Brian T.;
Ghabrial, Ragae M.;
Haggerson, Michael;
Knedeisen, Mark G.;
Kuss, William E.;
Leslie, Mark R.;
Levin, Paul D.;
Muha, Robert A.;
Murray, Laurén S.;
Pinto, Cara M.;
Wang, Eric T.;
Weaver, Michelle L.; and
Yurinko, Eric J.

all of:

K&L Gates LLP
K&L Gates Center
210 Sixth Avenue
Pittsburgh, Pennsylvania 15222-2613
US

Petitioner's Ex. 1003-275

Box No. V DESIGNATIONS

The filing of this request **constitutes under Rule 4.9(a) the designation** of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.

However,

☐ DE Germany **is not designated** for any kind of national protection

☐ JP Japan **is not designated** for any kind of national protection

☐ KR Republic of Korea **is not designated** for any kind of national protection

(The check-boxes above may only be used to exclude (irrevocably) the designations concerned if, at the time of filing or subsequently under Rule 26bis.1, the international application contains in Box No. VI a priority claim to an earlier national application filed in the particular State concerned, in order to avoid the ceasing of the effect, under the national law, of this earlier national application.)

Box No. VI PRIORITY CLAIM AND DOCUMENT

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country or Member of WTO	regional application: regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				

☐ Further priority claims are indicated in the Supplemental Box.

Furnishing the priority document(s):

☐ The **receiving Office** is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application(s) was filed with the receiving Office which, for the purposes of this international application, is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ other, see Supplemental Box

☐ The **International Bureau** is requested to obtain from a digital library a certified copy of the earlier application(s) identified above, using, where applicable, the access code(s) indicated below *(if the earlier application(s) is available to it from a digital library)*:

☐ item (1) access code _____ ☐ item (2) access code _____ ☐ item (3) access code _____ ☐ other, see Supplemental Box

Restore the right of priority: the receiving Office is requested to restore the right of priority for the earlier application(s) identified above or in the Supplemental Box as item(s) (_____). *(See also the Notes to Box No. VI; further information **must** be provided to support a request to restore the right of priority.)*

Incorporation by reference: where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if more than one International Searching Authority is competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA/ KR

Petitioner's Ex. 1003-276

Continuation of Box No. VII USE OF EARLIER SEARCH AND CLASSIFICATION RESULTS

1. Request by the applicant under Rule 4.12

1.1 ☐ The ISA indicated in Box No. VII **is requested to take into** account **the results of the earlier search(es)** indicated below (*see also Notes to Continuation of Box No. VII, item 1; use of results of more than one earlier search*)

Filing date (day/month/year)	Application Number	Country (or regional Office)

☐ **Statement (Rule 4.12(ii)):** this international application is the same, or substantially the same, as the application in respect of which the earlier search was carried out except, where applicable, that it is filed in a different language.

1.2 **Submission of the earlier search results, where necessary***

☐ **Availability of documents (Rules 12*bis*.1(c) and (d) and 12*bis*.2(b)):** the following documents **are available to the ISA** in a form and a manner acceptable to it, and therefore **DO NOT need** to be submitted by the applicant to the receiving Office, or to the ISA.

- ☐ a copy of the results of the earlier search,
- ☐ a copy of the earlier application,
- ☐ a translation of the earlier application into a language which is accepted by the ISA,
- ☐ a translation of the results of the earlier search into a language which is accepted by the ISA,
- ☐ a copy of any document cited in the earlier search results *(if known, please indicate below the documents available to the ISA)*:

☐ **Request from the applicant to the receiving Office to transmit to the ISA a copy of the earlier search results (Rule 12*bis*.1(b) and (d)):** (*where the earlier search **was not** carried out by the ISA indicated in Box No. VII **but** by the **same Office** as that which is acting as receiving Office; or where the earlier search results are otherwise **available** to the receiving Office*): the applicant **requests** the receiving Office **to prepare and transmit** to the ISA a copy of the earlier search results.

* The applicant **only** needs to furnish a copy of the earlier search results to the receiving Office, or the ISA, if none of the scenarios mentioned under item 1 applies. (*See item 10 in the check-list and also Notes to Continuation of Box No. VII, item 1*).

☐ Further earlier searches are indicated on a continuation sheet.

2. Transmission of the earlier search and classification results to the ISA by the receiving Office where the applicant DID NOT make a request under Rule 4.12

2.1 Where the international application claims priority of an earlier application, subject to Article 30(2)(a) and (3), **the receiving Office**:

- **shall transmit** a copy of the earlier search and classification results to the ISA (unless such copy is already available to the ISA), where the earlier application was filed with the **same Office** as that which is acting as **the receiving Office and** that Office **has carried out** the earlier search in respect of the earlier application (Rule 23*bis*.2(a));
- **may transmit** such a copy if the earlier application was filed with a different Office, but where the results of that earlier search and classification are nevertheless available to the receiving Office (Rule 23*bis*.2(c)).

However, where the applicant did not request the receiving Office to transmit to the ISA a copy of the earlier search results under Rule 4.12 (see above item 1), in respect of an earlier search carried out on the following earlier application, the priority of which is subsequently claimed in this international application, the applicant may consider (*see also Notes to Continuation of Box No. VII, item 2, use of more than one earlier search*):

Filing date *(day/month/year)*	Application Number	Country *(or regional Office)*

2.2 **Request not to transmit the earlier search results by the receiving Office to the ISA (Rule 23*bis*.2(b))**

☐ to **request** that the receiving Office **DOES NOT transmit** the results of the earlier search to the ISA (Rule 23*bis*.2(b)) (*may only be checked where the international application is filed with the following receiving Offices: DE, FI and SE*)

2.3 **Authorization to transmit the earlier search and classification results by the receiving Office to the ISA (Rule 23*bis*.2(a) and (e))**

☐ to **authorize** the receiving Office **to transmit** the results of the earlier search and classification to the ISA (Rule 23*bis*.2(e)) (*may only be checked where the international application is filed with the following receiving Offices: AU, CH, CZ, FI, HU, IL, JP, NO, SE, SG and US*)

☐ to **authorize** the receiving Office **to transmit** the results of the earlier international search and classification to the ISA (Rule 23*bis*.2(a) and Article 30(2)(a) and (3)) (*may only be checked where the earlier search concerns an **international application**, the priority of which is subsequently claimed in this international application and where the earlier international search was carried out by a **different** ISA than the ISA chosen in Box No. VII*)

☐ Further earlier searches are indicated on a continuation sheet.

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*:			Number of declarations
☐	Box No. VIII (i)	Declaration as to the identity of the inventor :	
☐	Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent :	
☐	Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application :	
☒	Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America) :	3
☐	Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty :	

Petitioner's Ex. 1003-277

Box No. IX CHECK LIST for EFS-Web filings - this sheet is only to be used when filing an international application with RO/US via **EFS-Web**

This international application **contains** the following:	Number of sheets
(a) request form PCT/RO/101 (including any declarations and supplemental sheets)	7
(b) description (excluding any sequence listing part of the description, see (f), below)	13
(c) claims	3
(d) abstract	1
(e) drawings (if any)	4
(f) sequence listing part of the description in the form of an **image file** (e.g. PDF)	
Total number of sheets (including the sequence listing part of the description if **filed as an image file**)	28

(g) sequence listing part of the description

- ☐ filed in the form of an **Annex C/ST.25 text file**
- ☐ WILL BE filed separately on physical data carrier(s), on the same day and in the form of an **Annex C/ST.25 text file**

Indicate type and number of physical data carrier(s) .....

This international application is **accompanied by** the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:	Number of items
1. ☒ fee calculation sheet	1
2. ☐ original separate power of attorney	
3. ☐ original general power of attorney	
4. ☐ copy of general power of attorney; reference number:	
5. ☐ priority document(s) identified in Box No. VI as item(s)	
6. ☐ Translation of international application into *(language)*:	
7. ☐ separate indications concerning deposited microorganism or other biological material	
8. ☐ *(only where item (f) is marked in the left column)* copy of the sequence listing in electronic form (Annex C/ST.25 text file) not forming part of the international application but **furnished only for the purposes of international search** under Rule 13*ter*	
9. ☐ *(only where item (f) (in the left column) and item 8 (above) are marked)* a statement confirming that "the information recorded in electronic form submitted under Rule 13*ter* is identical to the sequence listing as contained in the international application" as filed via EFS-Web:	
10. ☐ copy of results of earlier search(es) (Rule 12*bis*.1(a))	
11. ☒ other *(specify)*: Transmittal Letter	1

Figure of the drawings which should accompany the abstract:	1	**Language of filing** of the international application:	English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

/Robert J. Sovesky/

Robert J. Sovesky
Registration No. 73,798

For receiving Office use only

1. Date of actual receipt of the purported international application:	07 February 2019 (07.02.2019)
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent):	KR
6. ☐ Transmittal of search copy delayed until search fee is paid	

2. Drawings:
☐ received:
☐ not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

Petitioner's Ex. 1003-278

Sheet No. 6

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)

The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

Declaration of inventorship (Rules 4.17(iv) and 51*bis*.1(a)(iv)) for the purposes of the designation of the United States of America:

I hereby declare that I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26*ter*).

I hereby declare that the above-identified international application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Name: Robert B. Wilcox

Residence: McGregor, Texas
(city and either US state, if applicable, or country)

Mailing Address: 354 Elm Grove Circle

McGregor, Texas 76657

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

Name: James Thomas Smith

Residence: Crawford, Texas
(city and either US state, if applicable, or country)

Mailing Address: 5019 Bosque Ridge Road

Crawford, Texas 76638

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

Name: Troy Don Pierce

Residence: Hewitt, Texas
(city and either US state, if applicable, or country)

Mailing Address: 1301 Westwood Circle

Hewitt, Texas 76643

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

SOVESKY, Robert, J.
K&L Gates LLP
210 Sixth Avenue
K&L Gates Center
Pittsburgh, PA 15222-2613
États-Unis d'Amérique

Date of mailing *(day/month/year)*	
22 April 2021 (22.04.2021)	
Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
180639PCT	
International application No.	International filing date *(day/month/year)*
PCT/US2019/016973	07 February 2019 (07.02.2019)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
ARCONIC INC. 201 Isabella Street Pittsburgh, PA 15212-5858 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	E-mail address	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
HOWMET AEROSPACE INC 201 Isabella Street Pittsburgh, PA 15212-5858 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	E-mail address ☐ Notifications by e-mail authorized	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the Authority(ies) specified for supplementary search
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Al Harrasi Tariq e-mail pct.team4@wipo.int Telephone No. +41 22 338 74 04

CORRECTED VERSION

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

SOVESKY, Robert, J.
K&L Gates LLP
210 Sixth Avenue
K&L Gates Center
Pittsburgh, PA 15222-2613
États-Unis d'Amérique

Date of mailing *(day/month/year)*	
27 April 2021 (27.04.2021)	
Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
180639PCT	
International application No.	International filing date *(day/month/year)*
PCT/US2019/016973	07 February 2019 (07.02.2019)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
ARCONIC INC. 201 Isabella Street Pittsburgh, PA 15212-5858 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	E-mail address	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
HOWMET AEROSPACE INC. 201 Isabella Street Pittsburgh, PA 15212-5858 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	E-mail address ☐ Notifications by e-mail authorized	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the Authority(ies) specified for supplementary search
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Al Harrasi Tariq e-mail pct.team4@wipo.int Telephone No. +41 22 338 74 04

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	Robert B. WILCOX
	Art Unit	
	Examiner Name	
	Attorney Docket Number	118508/US01/PCTNS/180639P

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	51-101469	JP	U	1976-08-14	Huck Manufacturing Company		
	2	03-060608	JP	U	1991-06-14	Tokin Corp.		
	3	61-035214	JP	U	1986-03-04	Wakai & Co., Ltd.		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert B. WILCOX
	Art Unit	
	Examiner Name	
	Attorney Docket Number	118508/US01/PCTNS/180639P

	4	2014-029210	JP	A	2014-02-13	Newfrey LLC		
	5	10-2005-0037765	KR	A	2005-04-25	Hyundai Motor Company		X

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	International Search Report and Written Opinion for International Application No. PCT/US2019/016973 mailed November 7, 2019 10 pages.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert B. WILCOX
	Art Unit	
	Examiner Name	
	Attorney Docket Number	118508/US01/PCTNS/180639P

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert J. Sovesky/	Date (YYYY-MM-DD)	2021-07-19
Name/Print	Robert J. Sovesky	Registration Number	73798

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1.14. This collection is estimated to take 1 hour 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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 the Freedom of Information Act requires disclosure of these record s.

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 another 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 inspections 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.

Espacenet

Bibliographic data: JPH0360608 (U) — 1991-06-14

No title available

Inventor(s):

Applicant(s):

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⑲日本国特許庁（ＪＰ）　⑪実用新案出願公開

⑫公開実用新案公報（Ｕ）　平3－60608

⑤Int.Cl.⁵	識別記号	庁内整理番号	㊸公開　平成３年(1991)６月14日
Ｆ 16 Ｂ 19/10		Ｄ 6916－3Ｊ	

審査請求　未請求　請求項の数　1　（全　頁）

㊹考案の名称　芯棒つき足割りリベット

㉑実　願　平1－122424

㉒出　願　平１(1989)10月18日

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明　細　書

1　考案の名称

芯棒つき足割りリベット

2　実用新案登録請求の範囲

1.中空で足部の先端に割りを施されたリベットの中心孔に芯棒を挿入し、該芯棒を引き寄せることによりリベット足部の割りを変形させ、被組付け部材を押しつけ固定する構造の芯棒つき足割りリベットにおいて、該芯棒つき足割りリベットのリベット部の中心に、組合せられる芯棒つき足割りリベットの芯棒の中央部太さより若干太い貫通孔を設け、該リベット部のリベット鍔の反対側のリベット足部は割り加工が施され、前記リベット部に挿入される芯棒の先端部には被組付け部材の加工部穴径を通過できる程度の被組付け部材の加工部穴径より若干小さい寸法の芯棒鍔を備え、該芯棒鍔の裏面は芯棒を引き寄せることによりリベット足部先端を押し拡げ被組付け部材を固定するた

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め円弧形凹曲面に加工され、芯棒の他端にはリベット加工時に芯棒を引き寄せるための芯棒把持用溝が加工され、芯棒とリベット部と組合せたときリベット足部と係合し自然状態でリベット部が脱落しない様にリベット足部内径より若干大きい寸法に芯棒鍔部付近をテーパー加工した構造を特徴とする芯棒つき足割りリベット。

3　考案の詳細な説明

イ．考案の目的

〔産業上の利用分野〕

本考案は、二つ以上の部材を組付け固定するリベットに係りその構造に関係する。

〔従来の技術〕

従来２個の部材、例えば２枚の板を組付け固定する場合、固定個所に穴を開け、ボルト及びナットで固定するか、或いは第５図に示すように丸リベット７により固定していた。

この場合、閉鎖構造の内と外で固定する場合は、ナット又はボルトを後から中に入れたり、保持し

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たりできないため使用できず、又組付け部材の一部にねじ加工を施しボルト締めする方法も用いられるが、薄物の場合ねじ山がとれず不可能という問題があった。

又従来のリベットの場合も、組付けられる部材の両側から押しつける必要があり閉鎖状態の内外の方向で組付け加工することは困難という問題があった。

〔考案が解決しようとする課題〕

本考案は前述の問題点を解消し、閉鎖状態の内外方向で2個の部材を組付けるリベット加工をする場合や、薄物の部材を組付ける場合、外側からのみでリベット加工が可能で、しかも薄物でも部材に力をかけず、変形させることなく組付け加工が可能で、かつ短時間で自動組付けが可能な構造の芯棒つき足割りリベットを提供しようとするものである。

ロ．考案の構成

〔課題を解決するための手段〕

本考案は、前記課題を解決するため、中空の足

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割りリベットの中心に芯棒を装入したもので、芯棒にはリベット挿入側先端に鍔を設け、該鍔の外径は被組付け部材の組付け穴の径より僅かに小さく、その鍔裏面は、リベットを固定する為にリベット先端を押し拡げができるように円弧形凹曲面に加工してある。また芯棒の鍔と反対側の他端には芯棒を把持できるように溝を付け、リベット鍔部の位置を固定し、その溝部を把持しながら芯棒を引き寄せることにより、リベット足部は芯棒鍔裏面に沿って押し拡げられ、リベット足部は被組付け部材の位置まで曲げられ部材をリベットが固定する。

なお、未使用時に、リベット部が芯棒から抜け離れられないように、芯棒鍔裏付近にテーパ部を設けてリベット足部ではさみ込んでおくものとする構造の芯棒つき足割りリベットである。

即ち中空で足部の先端に割りを施されたリベットの中心孔に芯棒を挿入し、該芯棒を引き寄せることによりリベット足部の割りを変形させ、被組付け部材を押しつけ固定する構造の芯棒つき足割

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りリベットにおいて、該芯棒つき足割りリベットのリベット部の中心に、組合せられる芯棒つき足割りリベットの芯棒の芯棒中央部の太さより若干太い貫通孔を設け、該リベット部のリベット鍔の反対側のリベット足部は割り加工が施され、前記リベット部に挿入される芯棒の先端部には被組付け部材の加工部穴径を通過できる程度の被組付け部材の加工部穴径より若干小さい寸法の芯棒鍔を備え、該芯棒鍔の裏面は芯棒を引き寄せることによりリベット足部先端を押し拡げ被組付け部材を固定するため円弧形凹曲面に加工され、芯棒の他端にはリベット加工時に芯棒を引き寄せるための芯棒把持用溝が加工され、芯棒とリベット部と組合せたときリベット足部と嵌合し自然状態でリベット部が脱落しない様にリベット足部内径より若干大きい寸法に芯棒鍔部付近をテーパー加工した構造を特徴とする芯棒つき足割りリベットを提供するものである。

〔作用〕

リベットの足部を楔状に割り加工し、楔状の足

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部を押し拡げ被組付け部材位置まで曲げもどしする芯棒をリベットと１対に組合せ、しかも芯棒の鍔部の径を被組付け部材のリベット加工用穴径より小さく設定することで、一方向の操作のみでリベット組付けを可能とした。

〔実施例〕

本考案の実施例について図面を用いて説明する。

第１図は本考案の一実施例の芯棒つき足割りリベットの一部断面正面図である。

第２図は第１図に示す本考案の芯棒つき足割りリベットを用いて、板状部材の組付けを説明する断面図である。

第３図には第１図に示す芯棒つき足割りリベットを構成するリベット部の外観斜視図である。

第４図は第１図に示す芯棒つき足割りリベットを構成する芯棒の外観斜視図である。

本考案の芯棒つき足割リベットは、第１図に示すように、芯棒１と中空の足割り状のリベット部２とから構成される。芯棒１は、芯棒鍔裏面12に円弧形凹面が加工された芯棒鍔部11と、リベット

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加工するとき把持される為の溝13、及びリベット部２を軽くはめ込んで抜けないようにしておくためのテーパー部14を設けてある(第４図参照)。

他方、リベット部２は被組付け部材のリベット加工用穴を通過しない十分な大きさのリベット鍔部８を備え、反対側のリベット足部21は楕状に割りが入れられている(第３図参照)。

第２図を用いて、本実施例に示す芯棒つき足割りリベットを用いて、２個の板状部材を組付け固定する例を説明する。第２図で示すように、組付けされる二つの板状部材５、６の所定の組付け位置の穴を合わせ、第１図に示す様に、リベット部２に芯棒１を軽く通した状態で前述の第２図に示す板状部材の組付け穴に通し、リベット鍔部８を板状部材５に押し当て、然る後、芯棒１の把持用の溝13にリベット加工治具９の芯棒把持具３を掛け、その後リベット加工治具９のリベット鍔部押さえ４を押し下げ、リベット鍔部８に押しつけ、リベット鍔部押さえ４が動かない様に保持した上で内側の芯棒把治具３を更に引き上げることによ

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り、第２図に示す様に、リベット足部21は芯棒鍔部11の裏面の円弧状凹部に沿って湾曲し、外にめくれ反対側の板状部材６に覆いかぶさり圧接し、２枚の板状部材を固定する。

本実施例でわかるように、リベット加工する際、被組付け部材に力を加えることなく、リベット加工治具の芯棒把持具３とリベット鍔部押さえ４の間に力を加えることにより加工されるため、変形しやすい物や閉鎖状態にある被加工物に殆ど力をかけずに外側の一方向のみの操作でリベット加工ができる。

本実施例の芯棒つき足割りリベットを自動挿入機により挿入し自動で組付けした所、作業時間を短縮することができた。

ハ．考案の効果

〔考案の効果〕

以上述べた如く、本考案によれば、組付ける部材に大きな力をかけずに、一方向からだけでリベットの挿入・組付け加工ができるという利点をもった、新規で、かつ操作が簡単で経済的な部材組

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付け用芯棒つき足割りリベットが提供できる。

4　図面の簡単な説明

第１図は本考案の一実施例を示す芯棒つき足割りリベットの一部断面正面図。

第２図は第１図に示す本考案の芯棒つき足割りリベットを用いて、板状部材の組付けを説明する断面図。

第３図は第１図に示す本考案の芯棒つきリベットを構成するリベット部の外観斜視図。

第４図は第１図に示す本考案の芯棒つき足割りリベットを構成する芯棒の外観斜視図。

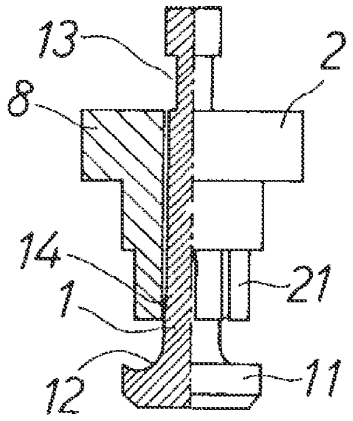
第５図は従来の丸リベットを用いて２個の板状部材を組付けた状態を示す断面図。

1…芯棒、2…リベット部、3…芯棒把持具、4…リベット鍔部押さえ、5…板状部材、6…板状部材、7…丸リベット、8…リベット鍔部、9…リベット加工治具、10…芯棒中央部、11…芯棒鍔部、12…芯棒鍔裏面、13…溝、14…テーパー部、21…リベット足部。

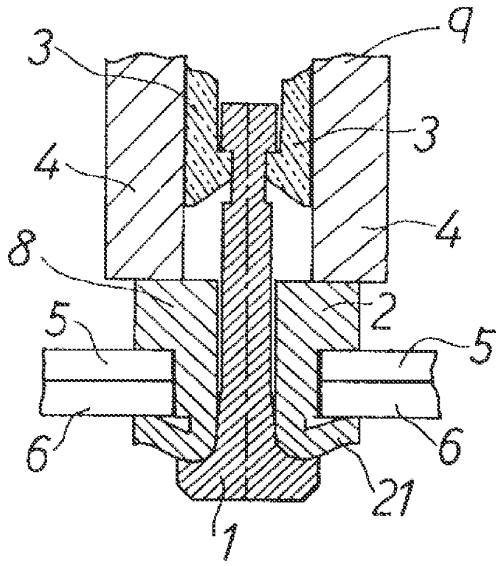
97

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第 1 図

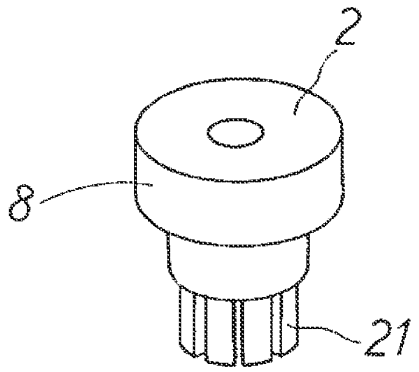


第 2 図

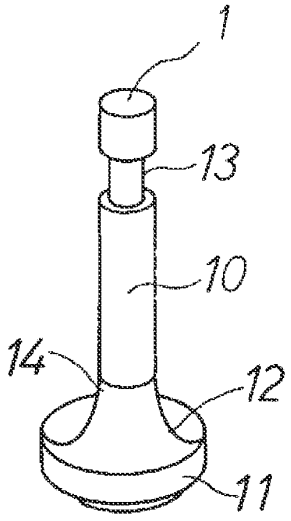


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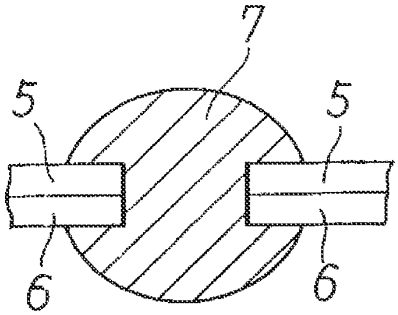
第 3 図



第 4 図



第 5 図



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Espacenet

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Applicant(s):

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Application number:	JP19840120413U 19840803
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⑲日本国特許庁（JP）　⑪実用新案出願公開

⑫公開実用新案公報（U）　昭61－35214

⑤Int.Cl.⁴	識別記号	庁内整理番号	㊸公開　昭和61年(1986)3月4日
F 16 B 37/04		Z－6814－3J	
// F 16 B 19/10		6814－3J	

審査請求　未請求　（全　頁）

㊹考案の名称　薄板への螺締用補助金具

㉑実　願　昭59－120413

㉒出　願　昭59(1984)8月3日

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㉑出願人　若井産業株式会社　東大阪市森河内西2丁目3番地

明　細　書

1　考案の名称

薄板への螺締用補助金具

2　実用新案登録請求の範囲

中空管状金具の一端に大径の座部を有する本体と、この中空部の内径よりも小なる外径の軸部とその一端に最大半径が中空部の内径半径よりも大なる非真円径の拡大部を有することを特徴とする軸からなる螺締補助金具。

3　考案の詳細な説明

「(1)産業上の利用分野」

薄鉄板などの薄板にナットを用いず、一方向から器材をビスで確実にかつ取り外し自在に固定するために用いる金具。

「(2)従来の技術」

薄板に予め適当な径の下穴をドリルを用いてあけておき、器材をあてがいタッピングビスで螺締する方法が一般的であり、他の方法としてはプラスチック製のプラグを薄板の下穴に差し込んでおき器材をあてがって別のビスで螺締しつつプラグ

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を開脚させて固定していた。

「(３)考案が解決しようとする問題点」

タッピングビスで螺締する場合、特に１㎜前後の薄板では約２㎜のピッチを有するタッピングビスのネジ山が１／２山しか掛からず本来の締結力を発揮しないという問題があった。そのために事前に薄板にバーリングと呼ばれる「返り」を形成しておき、これに螺締しようという工夫もなされているが工程が複雑になるだけでなく板が薄いため完全な締結状態は得難かった。

またプラグを用いる場合には裏面で大きく開脚する構造上３㎜未満の薄板には充分な固定状態が得られず、ネジを締めても空回りしたりガタツキが生じるという問題があった。

他の締結方法としてリベットによるものもあるが締結後の取り外しが出来ないため本案の目的とする作用は行えず用途も永久的な取り付けに限られる。

「(４)問題点を解決するための手段」

これらの問題を解決ししかも低トルクでネジ立

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てができ、かつ確実な締結を得るために充分な雌ネジが形成できる中空管状の本体と、これを予め薄板の下穴に挿入した後、拡径し固定すると同時に変形したネジ下穴を形成するための拡大部を有する軸からなる螺締補助金具である。

「(5)作用」

一端に拡大部を有する軸の他端から中空管状の本体を差し入れておいた補助金具の本体を、予めあけておいた薄板の穴に挿入し、一般にリベッターと呼ばれる簡便な工具を使用するなどして本体の座部10を押さえつつ軸のつかみ部8をつかみ、軸5を引き抜くことにより、非真円径に形成された拡大部6によって本体が拡径変形され薄板に固着されつつ非真円の変形したネジ下穴を形成し、このネジ下穴にビスをネジ込む。

「(6)実施例」

本案の実施例を添付図面により説明する。

貫通した穴12を有する中空管状体の一端に管状の変形部11の外径よりも大径の座部10を有する本体9と、この中空管状体の穴12の内径よりも小な

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る外径の軸部８とその一端に最大半径が中空部の内径半径よりも大なる非真円径の拡大部６を有することを特徴とする軸５からなる螺締補助金具である。　本体９の穴12は全長にわたって同一径である場合の他、第２図に示す実施例のように座部10側の内径をやや大きくしてもよい。

本案において最も特徴的な非真円径の拡大部６は第３図にその実施例の底面図を拡大して示しているがこの例のようにほぼ三角形状にしてもよいが、だ円形状や四角形状などの非真円径形状を選択してもよい。

第４図に示すように座部10を押さえつつ軸５を引き抜いた後に形成されたネジ下穴の形状は第６図に示されている。ネジ下穴15はその最小内径（中心からの半径）部においてタッピングビスの軸13の径（同半径）よりも大きく、最大内径部（同半径）においてタッピングビスのネジ山14の径とほぼ同じものが例示されている。ネジ下穴15に螺締されたタッピングビス３はネジ山14の深い食い込み部16と浅い食い込み部17に交互にネジ込まれ

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ている。

この変形したネジ下穴15の最大内径部においてネジ山径よりもわずかに大きい非真円形状を選択することもできるが、この場合には浅い食い込み部17においてはネジ山14は食い込まず雌ネジは部分的に形成されない。

また、軸5の引き抜きにより第5図に示すように本体9の変形部11は薄板1を座部10との間で締め付けるように拡大変形している。

この引き抜き時に多少削り取られるようにして引き上げられた本体9の内側壁の一部が座部10側へ突出することを防ぐため面取部~~19~~18を設けてもよい。

なお本体9と軸5は使用時に組み合わせてもよく、予め組み合わせておいてもよい。

使用時に組み合わせる場合は軸5は繰り返し使用が可能であるので、一本の軸に対して複数の本体が使用できる。また、予め組み合わせておく場合は第2図に示すように軸5に翼7を設けて本体9の内側壁に仮止めしておいてもよい。

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「(７)考案の効果」

本案の螺締用補助金具によると先に述べたようなタップ立ての困難な薄板に対して充分な山数のネジが掛かり器材などの確実な取り付けができ、かつ取り付け取り外しも自在である。

また本案の螺締用補助金具の薄板への取り付けは一般に広く使用されている簡便な工具で可能である。

軸５の引き抜きの最終において変形圧を解放し軸が抜けやすくし、かつより良好なカシメ状態を得るため、本体の穴12の内径を座側で大きくしてもよく、これにより本案金具の薄板への取り付けがさらに確実容易になる。

そして何よりも薄板への本案金具の取り付け時に軸５の拡大部により同時に形成される非真円径の変形したネジ下穴により、螺締時のネジ締めトルクが低減され作業性が良くなる。第６図に示すように、ネジ山14の深い食い込み部16において本体９の内側壁は食い込んだネジ山の分量とほぼ同量の素材が削り取られるか、周囲に移動せねばな

Petitioner's Ex. 1003-306

らない。一般の真円径の下穴ではタッピングビスにより削り取られあるいは移動した素材の逃げ場がないためネジ締めトルクが徐々に高くなり作業性を低下させる。本案金具によると深い食い込み部16に続いて浅い食い込み部17が形成されているため、浅い食い込み部17が素材の逃げ場となり過大なトルクを解放するため全般にネジ締めトルクが低減される。従来のドリルによる穴あけでは本案の変形した下穴は得られずビスに溝を設けるなどビス側への特殊な加工を要していた。

なお本案の金具は本体、軸のいずれも圧造により極めて量産容易である。

4　図面の簡単な説明

第1図は従来例を示す一部断面図。第2図は本案の補助金具の実施例の断面図。第3図は同拡大底面図。第4図は同薄板への取り付け時の断面図。第5図は同螺締後の断面図。第6図は同螺締時の本体変形部の横断面図。

1・・・薄板、2・・・取り付け器材、3・・・従来のタッピングビス、4・・・従来の下穴

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5・・・本案の軸、6・・・拡大部、9・・・本体、10・・・座部、12・・・穴、13・・・タッピングビスの軸、14・・・タッピングビスのネジ山
15・・・変形形成された非真円径形状の穴



実用新案登録出願人　若井産業株式会社

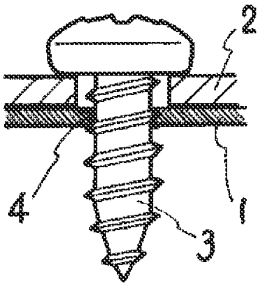
代表者　若井　隆夫



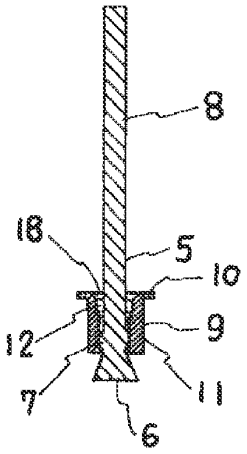
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図　　面

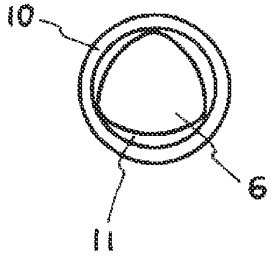
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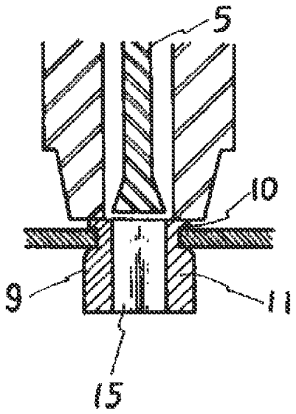
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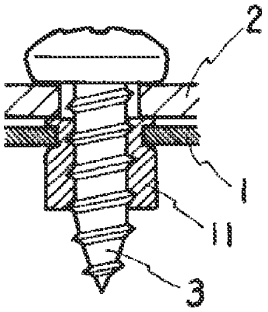
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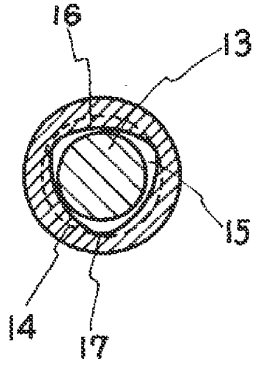
第4図



第5図



第6図



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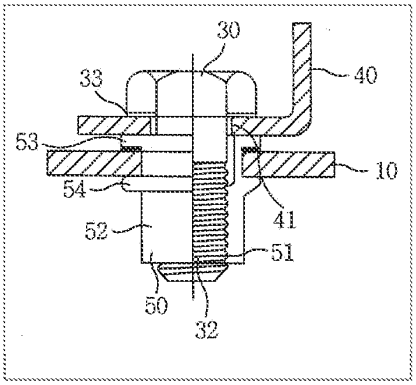
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ＦＲＰ 판넬 접합 구조 및 그 방법

FRP panel assembly structure and method thereof

Details

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(52) CPC	F16B 5/0258(2013.01) F16B 37/067(2013.01) F16B 37/0807(2013.01) F16B 39/24(2013.01)
(21) Application No.(Date)	1020030073031 (2003.10.20)
(71) Applicant	HYUNDAI MOTOR COMPANY
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(30) Priority info. (Country / No. / Date)	
Legal Status	**Rejected**
Examination Status	Decision of Refusal (General)
Trial Info	
Kind	Domestic Application / New Application
Right of Org. Application No. (Date)	
Related Application No.	
Request for an examination(Date)	Y(2003.10.20)
Number of examination claims	3



DOI
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(57) Korean Patent Abstract

PURPOSE: An FRP panel assembly structure and a method thereof are provided to suggest an easy structure of the FRP panel and a junction panel by using a coupling unit.CONSTITUTION: A junction panel(40) is jointed using a coupling unit(30) such as a bolt. The coupling unit(30) has a screw thread(32) geared with a screw thread(51) formed inside of the popnut(50). A hole(41) formed at the junction panel(40) is accorded with the inner side of the popnut(50) fixed to an FRP panel(10). If the coupling unit(30) is inserted and tightened in a state in which the junction panel(40) is interposed, the FRP panel(10) and the junction panel(40) are tightened. A rotation preventing unit(33) is used in order to prevent the rotation of the popnut(50). The diameter of the popnut(50) is larger than the diameter of the popnut(50).© KIPO 2006

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Unexamined Patent Publication(A)

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Requested Date of Examination	20031020
Agent.	HWANG, Eui In | LEE, Jung Hoon
Inventor	KI,HoJun
Applicant	HYUNDAI MOTOR COMPANY

발명의 명칭

F R P 판넬 접합 구조 및 그 방법

Title of Invention

FRP panel assembly structure and method thereof

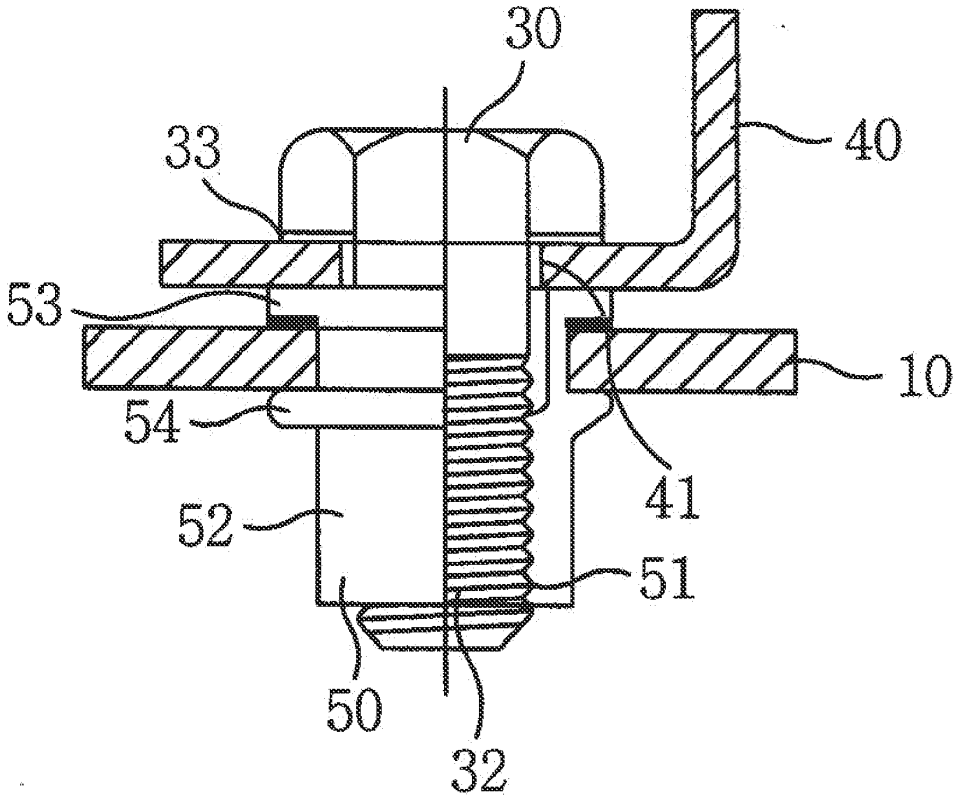
요약

본 발명은 FRP 판넬을 다른 판넬과 접합시키는 접합구조 및 그 접합 방법에 관한 것으로, 상기 FRP 판넬에 형성된 관통홀에 삽입되어 상기 제1 안착부가 FRP 판넬의 상부면인 제1 접합면에 안착된 후, 내측에 형성된 나사산과 맞물리는 나사산을 구비한 공구가 삽입되어 삽입방향과 반대방향으로 당겨짐으로써 상기 FRP 판넬의 제1 접합면과 반대면인 제2 접합면에서 외경이 넓어져 제2 안착부가 형성됨으로써 FRP 판넬에 고정되는 팝너트와, 상기 접합판넬을 사이에 두고 상기 FRP 판넬의 양측면에 고정된 팝너트의 내측에 삽입되어 조여지는 결합수단으로 구성되며, 이러한 접합구조 및 접합 방법을 사용함으로써 종래 브라켓을 사용하는 접합 구조보다 공정수를 줄일 수 있으며, 별도의 브라켓을 사용하지 않아 비용을 절감시킬 수 있다. 또한 브라켓이 차지하게 되는 공간이 필요하지 않아 공간적 제약을 비교적 받지 않는 FRP 판넬을 성형할 수 있는 장점이 있다.

Abstract

The present invention relates to the junction and the bonding method for welding the FRP panel with the dissimilar panel, and after it is inserted into the through-hole formed in the FRP panel and it is settled in the first junction in which the first mounting portion is the top surface of the FRP panel it consists of combining means which are inserted into the inner side of the pop nut, fixed to the FRP panel and the pop nut placing the junction panel in the interval and is fixed to both sides of the FRP panel since the external diameter becomes comprehensive in the second junction which is the first junction and opposite surface of the FRP panel by the tool equipped with the screw thread going in gear with the screw thread formed in the inner side being inserted and advanced to the insertion direction and opposite direction and the second mounting portion is formed and fastened up and the number of process can be reduced than the junction of using the conventional bracket by using such junction and bonding method and the expense can be reduced by nots using the separate bracket. Moreover, it has the advantage of molding the FRP panel in which the space which the bracket occupies is not necessary and which does not receive the spatial restriction.

대표도면(Representative drawing)



청구의 범위

청구 1항:

FRP 판넬과 접합판넬과의 접합 구조로서:상기 FRP 판넬에 형성된 관통홀에 삽입되어 상기 제1 안착부가 FRP 판넬의 상부면인 제1 접합면에 안착된 후, 내측에 형성된 나사산과 맞물리는 나사산을 구비한 공구가 삽입되어 삽입방향과 반대방향으로 당겨짐으로써 상기 FRP 판넬의 제1 접합면과 반대면인 제2 접합면에서 외경이 넓어져 제2 안착부가 형성됨으로써 FRP 판넬에 고정되는 팝너트와; 그리고상기 접합판넬을 사이에 두고 상기 FRP 판넬의 양측면에 고정된 팝너트의 내측에 삽입되어 조여지는 결합수단을 포함하는 것을 특징으로 하는 FRP 판넬 접합 구조.

청구 2항:

제 1 항에 있어서,상기 제1 안착부와 FRP 판넬의 제1 접합면 사이에 접착수단을 사용하며, 상기 결합수단과 접합판넬 사이에는 회전방지수단이 삽입되는 것을 특징으로 하는 FRP 판넬 접합 구조.

청구 3항:

FRP 판넬을 접합판넬에 접합시키는 접합 방법으로:상기 FRP 판넬에 관통홀을 형성하는 단계;상기 관통홀에 내측에 나사산을 구비하는 몸체와, 몸체의 상부에 제1 안착부를 구비하는 팝너트를 삽입하고 팝너트의 내측과 맞물리는 나사산을 구비한 공구를 팝 너트의 내측으로 삽입시켜 팝 너트를 FRP 판넬의 상부면인 제1 접합면에 밀착시키는 단계; 상기 공구를 삽입방향과 반대방향으로 당김으로써, FRP 판넬의 제1 접합면과 반대면인 제2 접합면에서 팝너트의 외경을 넓혀 제2 안착부를

Scope of Claims

Claim 1:

As the junction between the FRP panel and the junction panel: the FRP panel junction it is inserted into the through-hole formed in the FRP panel and it is settled in the first junction in which the first mounting portion is the top surface of the FRP panel ; and of comprising combining means which are inserted into the inner side of the pop nut which places the pop nut fixed to the FRP panel and Lee solid junction panel in the interval since the external diameter becomes comprehensive in the second junction which is the first junction and opposite surface of the FRP panel by the tool equipped with the screw thread going in gear with the screw thread formed in the inner side being inserted and advanced to the insertion direction and opposite direction and the second mounting portion is formed and fixed to both sides of the FRP panel and are fastened up.

Claim 2:

As for claim 1, the FRP panel junction it uses the bonding method between the first junction of the FRP panel and the first mounting portion ; and where the anti-rotation means is inserted between the combining means and junction panel.

Claim 3:

To the bonding method for welding the FRP panel to the junction panel: the FRP panel bonding method comprising: inserting to the inner side of the pop nut the tool inserting the pop nut equipped with the body, and the first mounting portion in the upper portion of the body equipped with the step of forming the through-hole on the FRP panel, and the screw thread in the inner side in the through-hole and includes the screw thread going in gear with the inner side of the pop nut to place in the interval and

형성하고, 팝너트의 제1 안착부와 제2 안착부가 FRP 판넬의 제1 접합면 및 제2 접합면과 밀착되도록 하는 단계; 그리고 상기 팝 너트와 맞물리는 나사산을 구비한 결합수단을, 접합판넬을 사이에 두고 상기 팝 너트에 삽입하여 조이는 단계를 포함하는 것을 특징으로 하는 FRP 판넬 접합 방법.

insert into the pop nut and tighten the junction panel the combining means, equipped with the step of adhering the pop nut closely to the first junction, the step that it experiences the tool due to the insertion direction and opposite direction ; the second junction, and the screw thread going in gear with the pop nut; the step of adhering the pop nut closely to the first junction is the top surface of the FRP panel; and the step that it experiences the tool due to the insertion direction and opposite direction ; the second junction is the first junction and opposite surface of the FRP panel broadens the external diameter of the pop nut and it forms the second mounting portion ; and the first mounting portion and the second mounting portion of the pop nut adhere closely with the first junction and the second junction of the FRP panel.

배경기술

Background Art

본 발명은 FRP 재질의 판넬과 다른 판넬과의 접합 구조 및 그 접합 방법에 관한 것이다. 보다 상세하게는 별도의 브라켓을 사용하지 않고 팝너트(pop nut)를 사용하여 FRP 판넬과 다른 판넬을 용이하게 접합시킬 수 있는 접합 구조 및 그 접합 방법에 관한 것이다.

The present invention relates to the junction with the panel different from the panel of the FRP material and bonding method. More specifically, it is about the junction and the bonding method for using the separate bracket and welding the panel different from the FRP panel as the easily using the pop nut.

일반적으로 FRP재질의 판넬, 특히 자동차의 크래쉬 패드(crash pad) 등에 사용되는 판넬은 핸드 레이업(hand lay up) 공법에 의해서 만들어진다. 핸드 레이업 공법은 FRP를 한층 한층 적층하여 소정의 두께를 가지도록 하는 방법으로 적층시에 FRP의 내부에 보스 또는 클립 등 다른 부품과 결합하기 위한 수단을 설치할 수 없는 문제점이 있다. 따라서 이러한 핸드 레이업 공법에 의해서 제조되는 FRP 판넬을 다른 판넬과 접착시키기 위해서는 별도의 결합수단을 사용하여야 한다.

Generally, the panel used for the panel of the FRP material, especially, the crash pad of the vehicle etc. is made with the hand layup (hand lay up) construction method. There is a problem that means for combining inside FRP with the different part cannot be set up in the method in which the hand layup construction method more and more laminates FRP in more and more and having the predetermined thickness in the laminate. Therefore, it does using the separate combining means the FRP panel manufactured by such hand layup construction method is adhered with the dissimilar panel.

핸드 레이업 공법에 의해서 제조된 FRP 판넬 중의 하나인 자동차의 크래쉬 패드(crash pad)를 크래쉬 패드 하부 판넬과 접합시키기 위해서 종래에는 도 1 및 도 2에 도시된 같이 FRP 판넬(10) 중 접합시키고자 하는 면(11)에 별도의 브라켓(20)을 설치하고 볼트 등의 결합수단(30)을 이용하여 크래쉬 패드 하부 판넬(40)을 결합시키는 방법을 사용하였다.

The method for setting up the separate bracket (20) and binding the crash pad bottom panel (40) in the side (11) to weld among the FRP panel (10) conventionally shown in figures 1 and 2 using the combining means (30) including the bolt etc. in order to weld the crash pad of the vehicle which was one of FRP panel manufactured by the hand layup construction methods with the crash pad bottom panel, was used.

구체적으로, 상기 브라켓(20)은 중앙면(21)과, 중앙면(21)의 좌우측에 날개부(22)을 구비하며, 상기 중앙면(21)은 좌우측 날개부(22)와 단차를 이루는 구조를 가지고 있다. 상기 중앙면(21)에는 볼트등의 결합수단(30)이 관통되는 관통홀(210)이 형성되어 있으며, 중앙면(21)의 후면에는 상기 볼트 등과 맞물리는 너트(31)가 용접 등에 의해서 고정 결합되어 있다. 또한 상기 좌우측 날개부(22)에는 리벳팅을 위한 리벳홀(220)이 형성되어 있다.

Specifically, the bracket (20) has the structure it includes the middle side (21), and the wing portion (22) in left and right of the middle side (21) and where the middle side (21) is comprised left and right wing portion (22) and stepped pulley. In the middle side (21), the through-hole (210) in which the combining means (30) including the bolt etc. is penetrated is formed and the nut (31) going in gear with the bolt etc. is fixed to and combined in the rear surface of the middle side (21) with the welding lamp. Moreover, left and right wing portion (22) may be provided with the rivet hole (220) for the riveting.

상기 브라켓(20)의 좌우측 날개부(22)는 리벳홀(220)을 통해서 리벳(221)을 사용하여 FRP 판넬(10)에 결합된다. 이후에 접합시키고자 하는 크래쉬 패드 하부 판넬(40, 설명의 편의를 위해서 이하 #34#접합판넬#34#이라 한다.)을 상기 브라켓(20)의 중앙면(21)에 위치시킨다. 상기 접합판넬(40)에는 미리 볼트 등의 결합수단이 통과하는 홀(41)이 형성되어 있다. 이후 상기 볼트 등의 결합수단(30)을 상기 홀(41) 및 브라켓(20)에 형성된 관통홀(210)에 삽입시켜 조이게 되면, 브라켓(21)에 고정된 너트(31)에 의해서 브라켓(20)과 접합판넬(40)이 접착하게 되고, 이에 따라 브라켓(20)이 고정된 FRP판넬(10)이 접합판넬(40)에 접합된다.

Left and right wing portion (22) of the bracket (20) are combined in the FRP panel (10) through the rivet hole (220) using the rivet (221). Thereafter, the crash pad bottom panel (it for the sake of convenience in illustration says to be hereinafter the " junction panel " this with 40.) to weld is positioned at the middle side (21) of the bracket (20). The junction panel (40) may be provided with the hole (41) through which in advance, the combining means including the millivolt etc pass. Then, if the combining means (30) including the bolt etc. is inserted on the through-hole (210) formed in the hole (41) and bracket (20) and it tightens , the bracket (20) and junction panel (40) stick with the nut (31) fixed to the bracket (21) and the FRP panel (10) in which accordingly the bracket (20) is fixed is welded into the junction panel (40).

이와 같은 종래의 접합방법은 FRP 판넬 및 브라켓의 날개부에 리벳팅을 위한 홀을 형성하고 브라켓을 FRP 판넬에 리벳 접합시키는 공정, 다시 브라켓을 접합판넬을 접합시키는 공정 등 작업 공정수가 늘어나게 되고, 별도로 브라켓 등의 부품이 필요하게 되어 비용이 많이 소요되는 문제점을 가지고 있다. 또한, 브라켓을 수용할 별도의 공간이 필요하게 되어 FRP 판넬의 성형성을 제한하는 문제점이 있다.

This kind of the conventional bonding method has the FRP panel and the process of the rivet welding the bracket to the FRP panel it forms the hole for the riveting on the wing portion of the bracket, and the problem the number of work process welding the junction panel including the process etc. increases the bracket and that the process need the part including the bracket etc. and

발명의 내용

발명의 효과

상기 살펴본 바와 같이, 본 발명은 팝너트를 FRP 판넬의 양면(제1 및 제2 접합면)과 밀착고정시킬 수 있도록 제1 안착부와 제2 안착부를 형성하도록 한 후, 결합수단을 접합판넬을 사이에 두고 팝너트에 삽입하여 죔으로써 FRP 판넬과 접합판넬을 접합시키는 접합 구조 및 그 방법을 제공함으로써, 종래 브라켓을 사용하는 구조보다 공정수를 줄일 수 있으며, 별도의 브라켓을 사용하지 않아 비용을 절감시킬 수 있다. 또한 브라켓이 차지하는 공간이 필요하지 않아 공간적 제약을 비교적 받지 않는 FRP 판넬을 성형할 수 있는 장점이 있다.

기술적 과제

본 발명은 상기 문제점을 해결하기 위한 것으로, FRP 판넬에 홀을 형성하고 팝 너트를 FRP 판넬에 고정시킨후, 접합판넬을 사이에 두고 볼트 등의 결합수단을 상기 팝 너트에 결합시킴으로써 FRP 판넬과 접합판넬을 용이하게 접합시킬 수 있는 접합 구조 및 접합 방법을 제공하는 것을 목적으로 한다.

발명의 구성 및 작용

상기 목적을 달성하기 위해서, 본 발명은 FRP 판넬과 접합판넬과의 접합 구조로서: 그 내측에 나사산이 형성된 원통형상의 몸체와 그 상부에 제1 안착부를 구비하며, 상기 FRP 판넬에 형성된 관통홀에 삽입되어 상기 제1 안착부가 FRP 판넬의 상부면인 제1 접합면에 안착된 후, 내측에 형성된 나사산과 맞물리는 나사산을 구비한 공구가 삽입되어 삽입방향과 반대방향으로 당겨짐으로써 상기 FRP 판넬의 제1 접합면과 반대면인 제2 접합면에서 외경이 넓어져 제2 안착부가 형성됨으로써 FRP 판넬에 고정되는 팝너트와; 그리고, 상기 접합판넬을 사이에 두고 상기 FRP 판넬의 양측면에 고정된 팝너트의 내측에 삽입되어 조여지는 결합수단을 포함하여 FRP 판넬과 접합판넬을 별도의 브라켓 없이 결합시킬 수 있다.

또한, 본 발명의 상기 제1 안착부와 FRP 판넬의 제1 접합면 사이에 접착수단을 사용하며, 상기 결합수단과 접합판넬 사이에는 회전방지수단이 삽입되어 있어서 FRP 판넬에 대해서 팝너트가 밀착 고정되고 회전되지 않도록 한다.

또한, 본 발명은 FRP 판넬을 접합판넬에 접합시키는 접합 방법으로: 상기 FRP 판넬의 접합면에 관통홀을 형성하는 단계; 상기 관통홀에 내측에 나사산을 구비하는 몸체와, 몸체의 상부에 제1 안착부를 구비하는 팝너트를 삽입하고 팝너트의 내측과 맞물리는 나사산을 구비한 공구를 팝 너트의 내측으로 삽입시켜 팝 너트를 FRP 판넬의 상부면인 제1 접합면에 밀착시키는 단계; 상기 공구를 삽입방향과 반대방향으로 당김으로써, FRP 판넬의 제1 접합면과 반대면인 제2 접합면에서 팝너트의 외경을 넓혀 제2 안착부를 형성하고, 팝너트의 제1 안착부와 제2 안착부가 FRP 판넬의 제1 접합면 및 제2 접합면과 밀착되도록 하는 단계; 그리고 상기 팝 너트와 맞물리는 나사산을 구비한 결합수단을, 접합판넬을 사이에 두고 상기 팝 너트에 삽입하여 조이는 단계를 포함하는 것을 특징으로 하는 FRP 판넬 접합 방법을 제공한다.

cost is very much required. Moreover, there is a problem that the separate space accommodating the bracket is necessary and the moldability of the FRP panel is limited.

Summary of Invention

Effects of the Invention

As shown in it looks into the above the invention provides the FRP panel and the junction of welding the junction panel it tightens the combining means is inserted into the pop nut the junction panel is placed in the interval the first mounting portion and the second mounting portion are formed the pop nut is made with both sides (first and second junction) and close adhesion fixation of the FRP panel and method thereof. In that way the number of process can be reduced than the structure of using the conventional bracket and the expense can be reduced by nots using the separate bracket. Moreover, it has the advantage of molding the FRP panel in which the space which the bracket occupies is not necessary and which does not receive the spatial restriction.

Technical Task

The object of the invention is to provide the FRP panel, the junction and the bonding method for welding the junction panel as the easily the combining means including the bolt etc. is bound in the pop nut the junction panel is placed in the interval the pop nut is fixed to the FRP panel with the hole is formed on the FRP panel for solving the problem.

Structure & Operation of the Invention

To accomplish the above objects, the invention relates to the junction between the FRP panel and the junction panel: the first mounting portion is included in the inner side in the body and upper portion of the threaded cylindrical shape and after it is inserted into the through-hole formed in the FRP panel and the body are settled in the first junction in which the first mounting portion is the top surface of the FRP panel the FRP panel and junction panel can be bound including the combining means which is inserted into the inner side of the pop nut which places the pop nut, fixed to the FRP panel and junction panel in the interval since the external diameter becomes comprehensive in the second junction which is the first junction and opposite surface of the FRP panel by the tool equipped with the screw thread going in gear with the screw thread formed in the inner side being inserted and advanced to the insertion direction and opposite direction and the second mounting portion is formed and fixed to both sides of the FRP panel and is fastened up without the separate bracket.

Moreover, the bonding method is used between the first junction of first mounting portion and FRP panel of the present invention and the anti-rotation means is inserted between the combining means and junction panel and the pop nut is closely fixed about the FRP panel and it is not rotated.

Moreover, to the bonding method in which the invention welds the FRP panel to the junction panel: the step: tool of inserting the tool equipped with the screw thread inserting the pop nut equipped with body, and the first mounting portion in the upper portion of the body equipped with the step of forming the through-hole on the junction of the FRP panel, and the screw thread in the inner side in the through-hole and goes in gear with the inner side of the pop nut to the inner side of the pop nut and adhering the pop nut closely to the first junction which is the top surface of the FRP panel is suffered due to the insertion direction and opposite direction. In that way the second junction which is the first junction and opposite surface of the FRP panel broadens the external diameter of the pop nut and the second mounting po

rtion is formed and the FRP panel bonding method comprising t he step of placing the junction panel in the interval and insertin g the step that the first mounting portion and the second mount ing portion of the pop nut adhere closely with the first junction and the second junction of the FRP panel and the combining me ans equipped with the screw thread going in gear with the pop nut into the pop nut and tightening is provided.

이하, 첨부된 도면을 참조하여, 본 발명에 따르는 FRP 판넬 접합 구조 및 그 방법에 대해서 보다 상세하게 설명한다. 도 3은 팝너트가 FRP 판넬에 삽입된 상태를 나타내는 도면이며, 도 4는 공구를 이용하여 팝너트에 제2 안착부를 형성하는 과정을 나타내는 도면이며, 도 5는 공구를 제거하는 과정을 나타내는 도면이며, 그리고 도 6은 결합수단을 이용하여 FRP 판넬과 접합판넬이 접합된 상태를 나타내는 도면이다.

Hereinafter explain more specifically about referring to the figur e, the FRP panel junction according to the invention and the att ached method thereof. It is drawing in which fig. 3 shows the st ate where the pop nut is inserted into the FRP panel. It is drawi ng in which fig. 4 shows the process of forming the second mou nting portion on the pop nut using the tool. It is drawing in whic h fig. 5 shows the process of removing the tool. And figure 6 is drawing showing the FRP panel and the state where the junctio n panel is welded using the combining means.

도 3에 도시된 것과 같이, 본 발명에 사용되는 팝너트(50)는 두께가 얇아 탭을 낼 수 없는 판넬 등을 접합시킬 때 사용하는 것으로, 그 내측에 나사산(51)을 구비하는 원통형상의 몸체(52)와 상기 몸체(52)의 머리부분에 형성되는 제1 안착부(53)로 구성된다. 상기 팝너트(50)는 접합시키고자 하는 FRP 판넬(10)에 형성된 관통홀(110)에 삽입된다. 제1 안착부(53)가 FRP 판넬(10)과 접합되는 면은 제1 접합면(12)을 이룬다. 상기 제1 안착부(53)와 제1 접합면(12) 사이에는 FRP 전용 접착제 등의 접착수단(111)을 사용하여 팝너트(50)가 FRP 판넬(10)에 수용되어 회전하지 않도록 할 수 있다.

As shown in Figure 3, the pop nut (50) is the thickness used for the invention when welding panel etc., is thin and cannot make the tap it uses. It consists of the first mounting portion (53) for med in the head part of the body (52) and the cylindrical body (52) including the screw thread (51) in the inner side. It is inser ted into the through-hole (110) formed in the FRP panel (10) w hich the pop nut (50) welds. The side in which the first mountin g portion (53) is welded to the FRP panel (10) is comprised the first junction (12). The pop nut (50) is adopted to the FRP panel (10) between the first mounting portion (53) and the first juncti on (12) using the bonding method (111) including the FRP exclu sive adhesive etc. and it does not rotate.

도 3 내지 도 5를 참조하면, FRP 판넬(10)에 안착된 팝너트(50)에 대해서 공구(60)를 사용하여 팝너트(50)에 제2 안착부(54)를 형성하는 과정을 알 수 있다. 상기 공구(60)는 외주면에, 상기 팝너트(50) 내측에 형성된 나사산(51)과 맞물리는, 나사산이 형성된 공구봉(61)을 구비하며, 공구(60)를 팝너트(50)에 삽입한 후 도 1의 화살표 방향으로 회전시키게 되면 공구봉(61)과 팝너트(50)의 나사산(51)이 맞물리게 된다. 공구봉(61)이 팝너트(50)에 완전히 삽입되면, 팝너트(50)의 제1 안착부(53)는 FRP 판넬(10)의 제1 접합면(12)에 더욱 밀착된다. 이때, 상기 제1 안착부(53)와 제1 접합면(12)는 그 사이에 삽입되는 접착수단(111)에 의해서 더욱 견고히 고정될 수 있다. 이후, 공구봉(61)이 맞물린 상태를 유지한 채, 공구봉(61)을 삽입방향과 반대방향으로 잡아당기게 되면, 팝너트(50)가 공구봉(61)에 의해서 맞물려 있어 잡아당기는 힘이 팝너트(50)에 전달된다. 이로 인해 FRP 판넬(10)의 제1 접합면(12)과 반대 측면인 제2 접합면(13)에서 팝너트(50)가 외측으로 넓어지는 변형을 일으키게 되어 제2 안착부(54)가 형성된다(도 4 및 도 5 참조). 이후, 공구(60)를 회전시켜 팝너트(50)로부터 분리시킨다.

Referring to figures 3 through 5, the process of forming the sec ond mounting portion (54) on the pop nut (50) using the tool (6 0) can be known about the pop nut (50) settled in the FRP pane l (10). In the tool (60) is the outer periphery, the threaded tool rod (61) going in gear with the screw thread (51) formed in the pop nut (50) inner side is included and if it rotates at the arrow direction of fig. 1 after the tool (60) is inserted into the pop nut (50), the screw thread (51) of the pop nut (50) and tool rod (6 1) goes in gear. If the tool rod (61) is completely inserted into t he pop nut (50) , the first mounting portion (53) of the pop nut (50) more adheres closely to the first junction (12) of the FRP p anel (10). Then, it can be more adamantly fixed with the bondin g method (111) in which the first mounting portion (53) and the first junction (12) are inserted into the interval. Then, the state where the tool rod (61) goes in gear is maintained. If the tool r od (61) is dragged by the insertion direction and opposite direct ion , the power in which the pop nut (50) goes in gear with the tool rod (61) and pulled is delivered to the pop nut (50). Due to this, in the second junction (13) which is the first junction (12) and opposite face of the FRP panel (10), the deformation in whi ch the pop nut (50) widens to the outside is caused and the sec ond mounting portion (54) is formed (fig. 4 the , refer to Figure 5). Then, the tool (60) is rotated and it separates from the pop nut (50).

이에 따라, 팝너트(50)는 도 5에 도시된 것과 같이, 제1 안착부(53) 및 제2 안착부(54)가 FRP 판넬(10)의 제1 접합면(12) 및 제2 접합면(13)과 밀착 고정된다. 이후 도 6에 도시한 것과 같이 볼트 등의 결합수단(30)을 사용하여 접합판넬(40)을 접합시킨다. 상기 결합수단(30)은 외측에 상기 팝너트(50)의 내측에 형성된 나사산(51)과 맞물리는 나사산(32)이 형성되어 있다. 접합과정을 살펴보면, 접합판넬(40)에 형성된 홀(41)을 FRP 판넬(10)에 고정결합된 팝너트(50)의 내측과 일치하도록 하고, 접합판넬(40)을 사이에 두고 결합수단(30)을 삽입시켜 조이면, FRP 판넬(10)과 접합판넬(40)이 접합된다. 이때 팝너트(50)의 회전을 방지하기 위해서 접합판넬(40)과 결합수단(30)의 머리부 사이에 와셔 등의 회전방지수단(33)을 사용할 수 있다. 특히 상기 회전방지수단(33)의 직경은 상기 팝너트(50)의 직경과 동일한 것을 채택하는 것이 팝너트(50)의 회전방지에 효과적이다.

Accordingly, the first mounting portion (53) and the second mo unting portion (54) the pop nut (50) are closely fixed in as sho wn in Figure 5 with the first junction (12) and the second juncti on (13) of the FRP panel (10). The junction panel (40) is welded with as shown in after is 6 using the combining means (30) incl uding the bolt etc. The combining means (30) the screw thread (32) going in gear with the screw thread (51) formed in the inn er side of the pop nut (50) is formed in the outside. As to the ju nction process, the hole (41) formed in the junction panel (40) i s coincided with the inner side of the pop nut (50) fixed to and combined with the FRP panel (10) and if the junction panel (40) is placed in the interval and the combining means (30) is insert ed and it tightens , the FRP panel (10) and junction panel (40) are welded. Then, the anti-rotation means (33) including the wa sher etc. can be used between the head unit of the combining means (30) and junction panel (40) in order to prevent the rota tion of the pop nut (50). Especially, it is effective for the anti-rot ation of the pop nut (50) to adopt that the diameter of the anti-

rotation means (33) is identical with the diameter of the pop nu t (50).

도면에 대한 간단한 설명

도 1은 종래의 FRP 판넬의 접합 구조를 나타내는 분리 사시도;

도 2는 종래의 FRP 판넬의 접합된 상태를 나타내는 단면도;

도 3은 팝너트가 FRP 판넬에 삽입된 상태를 나타내는 도면;

도 4는 공구를 이용하여 팝너트에 제2 안착부를 형성하는 과정을 나타내는 도면;

도 5는 공구를 제거하는 과정을 나타내는 도면; 그리고

도 6은 결합수단을 이용하여 FRP 판넬과 접합판넬이 접합된 상태를 나타내는 도면이다.

003c# 도면의 주요 부분에 대한 부호의 설명 003e#

10 : FRP 판넬 12 : 제1 접합면

13 : 제2 접합면 30 : 결합수단

33 : 회전방지수단 40 : 접합판넬

50 : 팝너트 51 : 나사산

52 : 몸체 53, 54 : 제1 및 제2 안착부

60 : 공구 61 : 공구봉

Brief explanation of the drawing

Figure 1 is an isolation perspective view :

showing the junction of the conventional FRP panel Figure 2 is a cross-sectional view :

showing the welded state of the conventional FRP panel Figure 3 is a drawing:

showing the state where the pop nut is inserted into the FRP pa nel Figure 4 is a drawing:

showing the process of forming the second mounting portion on the pop nut using the tool Figure 5 is drawing and

showing the process of removing the tool Figure 6 is drawing sh owing the FRP panel and the state where the junction panel is w elded using the combining means.

The description 003e #

of the denotation about the main part of 003c# drawing. 10: th e FRP panel 12: the first junction

. 13: the second junction 30: the combining means

. 33: the anti-rotation means 40: the junction panel

. 50: the pop nut 51: the screw thread

. 52: the body 53, 54: first and second mounting portion

. 60: the tool 61: the tool rod

.

Disclaimer

본 문서는 특허 및 과학기술문헌 전용의 첨단 자동번역 시스템을 이용해 생성되었습니다. 따라서 부분적으로 오역의 가능성이 있으며, 본 문서를 자격을 갖춘 전문 번역가에 의한 번역물을 대신하는 것으로 이용되어서는 안 됩니다. 시스템 및 네트워크의 특성때문에 발생한 오역과 부분 누락, 데이터의 불일치등에 대하여 본원은 법적인 책임을 지지 않습니다. 본 문서는 당사의 사전 동의 없이 권한이 없는 일반 대중을 위해 DB 및 시스템에 저장되어 재생, 복사, 배포될 수 없음을 알려드립니다.
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 180639PCT	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/US2019/016973**	International filing date *(day/month/year)* **07 February 2019 (07.02.2019)**	(Earliest) Priority Date *(day/month/year)*
Applicant **ARCONIC INC.**		

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of :
      ☒ the international application in the language in which it was filed
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:
5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☒ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

Petitioner's Ex. 1003-317

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/016973

A. CLASSIFICATION OF SUBJECT MATTER

F16B 7/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16B 7/14; F16B 19/10; F16B 37/00; F16B 37/04; F16B 5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: rivet, sleeve, mandrel, pull, anvil

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 51-101469 U (HUCK MANUFACTURING COMPANY) 14 August 1976 See claim 1 and figures 1-2.	1-20
Y	JP 03-060608 U (TOKIN CORP.) 14 June 1991 See claim 1 and figures 1-5.	1-20
A	JP 61-035214 U (WAKAI & CO., LTD.) 04 March 1986 See claim 1 and figures 4-5.	1-20
A	JP 2014-029210 A (NEWFREY LLC.) 13 February 2014 See paragraphs [0031]-[0036] and figures 1-5.	1-20
A	KR 10-2005-0037765 A (HYUNDAI MOTOR COMPANY) 25 April 2005 See paragraphs [0024]-[0027] and figures 3-6.	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 November 2019 (06.11.2019)	**07 November 2019 (07.11.2019)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
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Petitioner's Ex. 1003-318

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2019/016973

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 51-101469 U	14/08/1976	None	
JP 03-060608 U	14/06/1991	None	
JP 61-035214 U	04/03/1986	JP 01-021216 Y2	26/06/1989
JP 2014-029210 A	13/02/2014	CN 101981330 A	23/02/2011
		CN 101981330 B	12/02/2014
		EP 2240700 A1	20/10/2010
		EP 2240700 B1	23/07/2014
		GB 2457105 A	05/08/2009
		GB 2457105 B	21/09/2011
		JP 2011-511224 A	07/04/2011
		JP 5736425 B2	17/06/2015
		KR 10-2010-0114919 A	26/10/2010
		US 2010-0329811 A1	30/12/2010
		US 2013-0287516 A1	31/10/2013
		US 8491243 B2	23/07/2013
		US 8851813 B2	07/10/2014
		WO 2009-098431 A1	13/08/2009
KR 10-2005-0037765 A	25/04/2005	None	

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SOVESKY, Robert, J.

K&L Gates LLP 210 Sixth Avenue K&L Gates Center
Pittsburgh, PA 15222-2613 USA

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	**07 November 2019 (07.11.2019)**
Applicant's or agent's file reference 180639PCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2019/016973	**07 February 2019 (07.02.2019)**	

International Patent Classification (IPC) or both national classification and IPC

F16B 7/14(2006.01)i

Applicant
ARCONIC INC.

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR	Date of completion of this opinion	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	06 November 2019 (06.11.2019)	HWANG, Chan Yoon Telephone No. +82-42-481-3347

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:
      ☐ in the form of an Annex C/ST.25 text file.
      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: JP 51-101469 U (HUCK MANUFACTURING COMPANY) 14 August 1976
D2: JP 03-060608 U (TOKIN CORP.) 14 June 1991

I. Novelty and Inventive Step (PCT Article 33(2) and (3))

1. Claims 1-15

1.1. Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a blind fastener comprising: a sleeve (5) comprising a first sleeve end (9), a second sleeve end (8), a cavity (7) extending from the first sleeve end to the second sleeve end; and a mandrel (6) configured to be at least partially received by the cavity of the sleeve, the mandrel comprising a first mandrel end disposed adjacent to the first sleeve end (9) and comprising an enlarged portion (11) having a diameter greater than a diameter of the cavity (7), a second mandrel end comprising a pull region (20), and a shank region extending intermediate the first mandrel end and the second mandrel end, wherein the pull region (20) comprises an axial length greater than 4 times a diameter of the shank region (see claim 1 and figures 1-2).

Claim 1 differs from D1 in that a pull region comprises an axial length no greater than 4 times a diameter of a shank region and is configured to be engaged by an installation tool. However, D2 discloses that a pull region comprises an axial length no greater than 4 times a diameter of a shank (10) and is configured to be engaged by an installation tool (9) (see claim 1 and figures 1-5).

Continued on Supplemental Box

Petitioner's Ex. 1003-322

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 4-12, 14-15 and 19-20 do not comply with PCT Rule 6.4(a) because multiple dependent claims should not serve as a basis for any other multiple dependent claim.
(Note: The written opinion has been established on the assumption that claims 4-12, 14-15 are dependent on claim 1; and that claims 19-20 are dependent on claim 16.)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Box No. V

Accordingly, claim 1 would have been obvious over D1 in view of D2. Therefore, claim 1 does not involve an inventive step.

1.2. Claims 2-15

The additional features of claims 2-3 would be easily conceived from the disclosure of D2 considering that a pull region has a length and that a length of the pull region is easily modified or optimized by the person skilled in the art (see claim 1 and figures 1-5).

The additional feature of claim 4 would be easily conceived from the disclosure of D1 considering that a pull region (20) comprises a taper extending from a shank region (see claim 1 and figures 1-2).

The additional feature of claim 5 would be easily conceived from the disclosure of D2 considering that a mandrel (1) does not comprise a breakneck groove (see claim 1 and figures 1-5).

The additional features of claims 6-7 are merely matters of design option when the general technical knowledge about the state of the art is used.

The additional features of claims 8-9 would be easily conceived from the disclosure of D1 considering that a mandrel (6) comprises threaded region and a groove (see claim 1 and figures 1-2).

The additional feature of claim 10 would be easily conceived from the disclosure of D1 considering that a sleeve (5) is generally cylindrical and a mandrel (6) is generally cylindrical (see claim 1 and figures 1-2) .

The additional feature of claim 11 is well known in this technical field.

The additional feature of claim 12 would be easily conceived from the disclosure of D1 considering that a blind fastener is adapted to be installed in a bore in a structure (2,3), the bore having a diameter greater than the diameter of an enlarged portion (11) (see claim 1 and figures 1-2).

Continued on The Next Page

Petitioner's Ex. 1003-324

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Previous Page

The additional feature of claim 13 would be easily conceived from the disclosure of D1 considering that a second sleeve end (8) comprises a collar (10), the sleeve end (8) is configured to deform on a first side of the structure (see claim 1 and figures 1-2).

The additional features of claims 14-15 are well known in this technical field.

Accordingly, claims 2-15 would have been obvious over D1 in view of D2. Therefore, claims 2-15 do not involve an inventive step.

2. Claims 16-20

2.1. Claim 16

D1, which is considered to be the closest prior art to the subject matter of claim 16, discloses a blind fastener comprising: a sleeve (5) comprising a first sleeve end (9), a second sleeve end (8), a cavity (7) extending from the first sleeve end to the second sleeve end; and a mandrel (6) configured to be at least partially received by the cavity of the sleeve, the mandrel comprising a first mandrel end disposed adjacent to the first sleeve end (9) and comprising an enlarged portion (11) having a diameter greater than a diameter of the cavity (7), a second mandrel end comprising a pull region (20), and a shank region extending intermediate the first mandrel end and the second mandrel end, wherein the pull region (20) comprises an axial length greater than 4 times a diameter of the shank region (see claim 1 and figures 1-2).

Claim 16 differs from D1 in that it further comprises: engaging a collet of the installation tool with the pull region of the blind fastener; after the inserting, forcibly contacting the second sleeve end of the blind fastener with an anvil of the installation tool and moving the pull region distal from the second sleeve end utilizing the collet of the installation tool; and deforming the sleeve on a first side of the structure, and swaging the second sleeve end onto the shank region on an oppositely disposed second side of the structure, thereby securing at least a portion of the blind fastener in the structure. However, D1 discloses that a sleeve end (8) is configured to deform on a first side of a structure (see claim 1 and figures 1-2) and D2 discloses that a pull region comprises an axial length no greater than 4 times a diameter of a shank (10) and is configured to be engaged by an installation tool (9) and a collet (3) of the

Continued on The Next Page

Petitioner's Ex. 1003-325

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Previous Page

installation tool (9) is engaged with a mandrel (1) of a blind fastener (see claim 1 and figures 1-5).

Accordingly, claim 16 would have been obvious over D1 in view of D2. Therefore, claim 16 does not involve an inventive step.

2.2. Claims 17-20

The additional feature of claim 17 would be easily conceived from the disclosure of D2 considering that a pull region has a length and that a length of the pull region is easily modified or optimized by the person skilled in the art (see claim 1 and figures 1-5).

The additional feature of claim 18 would be easily conceived from the disclosure of D1 considering that a pull region (20) comprises a taper extending from a shank region (see claim 1 and figures 1-2).

The additional feature of claim 19 would be easily conceived from the disclosure of D2 considering that a mandrel (1) does not comprise a breakneck groove (see claim 1 and figures 1-5).

The additional feature of claim 20 is well known in this technical field.

Accordingly, claims 17-20 would have been obvious over D1 in view of D2. Therefore, claims 17-20 do not involve an inventive step.

II. Industrial Applicability (PCT Article 33(4))

Claims 1-20 are industrially applicable.

Petitioner's Ex. 1003-326

Espacenet

Bibliographic data: JPS51101469 (U) — 1976-08-14

No title available

Inventor(s):

Applicant(s):

Classification: **- international:** ***F16B19/10;*** (IPC1-7): F16B19/10
- cooperative:

Application number: JP19750017000U 19750207

Priority number(s): JP19750017000U 19750207

Abstract not available for JPS51101469 (U)

Petitioner's Ex. 1003-327

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DESCRIPTION JPS51101469

BRIEF DESCRIPTION OF THE DRAWINGS FIG. 1 is a partial side sectional view showing a state in which a fastener according to the present invention is attached to a plate but not yet fixed, and FIG. 2 is the same as FIG. However, tightening is a figure which shows the state by which the tool was completely fixed and the tail part of the pin was cut | disconnected. DESCRIPTION OF SYMBOLS 1 ... Tighten the whole tool, 2, 3 ... Both plates to be fastened, 5.6 ... Sleeve and pin of fastener, 7 ... Axial direction hole of sleeve, 8 ... • Sleeve head, 9 ... Sleeve tube shape, 10 ... Sleeve flange, 11 ... Pin head, 12 ... Tension groove, 13 ... Cut-off part, 14 ... Groove for fixing, 15 ... longitudinal rib, 16 ... plane, 11 ... cut end, 19 ... finger made by cutting tubular portion 9, 20 ... tension groove, That is, the grasping part. 157-Akisho 5l-101469 (2) 158-

DETAILED DESCRIPTION OF THE INVENTION The present invention relates to a joint 111, that is, a fastener that is pulled from one side of the group of plates to be clamped together in order to fix a plurality of plates together. (1) \ " The present invention provides an important improvement over Japanese Patent No. 210,300. It is particularly important that the noodles as described in the present invention can be phase-fixed according to the number of sheet metal of II number of various thicknesses. A much broader grasp of i than the one shown in the patent! ! Especially for those using toys, Jin is the same as before. Also, it is possible to work by providing a certain number of grooves, ie, 13 in a large number, that is, in total. It can also be used with several different tightening guns (tensile workers) of Kti, this means that the length of the part having the pulling groove extends to the total length of the pin, Hirohiro 5- In other words, the previous tightening can be performed by providing a larger number of tensions 1111t than in the tool. This will be described below with reference to the accompanying drawings. In WAK, the tightening of a two-body structure according to the present invention is indicated by l as a whole, and J / O1 # is attached A / l! If the plate and j are twisted, they can also be used to draw them. Plates J and J are one stitch thickness. (J) Shown in quasi-X, i.e. in one gripping part, 砿 11 refers to the application range for fastening the drawing board, i.e. increases until the total thickness of

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the plate and J reaches the above 曾Then, a 4-tool O-tightening tool can be used. The holes in the plates 3 and 3 are made in advance, and the fasteners are inserted into the holes of the 7L and others as shown in FIG. Tighten the tool as a whole! And a pin indicated by 6 as a whole, and this sleeve and pin! And 6 are made of a metal such as steel or aluminum. The sleeve JK is formed with an axial hole 7, and an annular head l is made near three yzFi-1ll, and an annular taper portion is made near the outer end of the heel □ doll. 1スリーブ j r ! On the opposite side, a small and narrow tube-shaped portion f is contained, and the epiphysical heptolK is formed into an integral ring-shaped 7-lung (or shoulder means) / ll at one neck of the tube-shaped portion t. The pin 4ri has an elongated aS ridge penetrating a hole in the head 17 warping plate made in advance, and the head (reference), S? , / 1aFi Almost to the taste of the tube-shaped part close to this. In the opposite end of the pin 4 diameter, a large number of VCFi tension grooves are formed, 1t, this groove forms a grip for the tension tool, and in this design a number of tension # / The length of the tension II 鄭 (bunch I1 portion) formed in the process 2 is about の-of the total length of the pin group.

A bi-jKi 'group of tension # 12 and a group of fixing rods / 4L are formed into a ilK ring-shaped small-diameter portion / J, and this small-diameter ii1. / J forms a cut neck. l i ! The i fixed @ / tei is a nine-wheeled heel made between the cut 4C neck 13 and pinhept ti, and has several long one-way ribs / 3 spaced apart in the bin head / 1KFi circumference j side direction. The rib tHs pin serves to provide a press fit between the rib tHs pin and the hole of the sleeve close thereto. One of the excellent features of the structure according to the present invention is the one shown in the previous% 畦. Compared to ll Noah 11, this is to make the 擲 z, vm no 擲 ad 擲, and by this characteristic construction, the conventional tightening grasps a wide range of length O * more than anything. The real benefit is that it is made possible. (The 777 bottle "bin 6 is formed with a number of flats ikl / 4 that form an angle with respect to the axis of the bottle, and this plane / 6 forms an outward th as shown in FIGS. To do. In this design, 1 hei flat IIrI / 4Fij is made, and the line of intersection between these surfaces forms one cut end l with an equal distance wh in the peripheral direction. As shown in FIG. 1, the two parts (j6) of the fastener are passed through the hole 7 of the bottle 1rt sleeve, and the group of tension ridges 1 protrudes from the end of the sleeve head l, and the flange IIFi. 1 is set up so as to overlap the hole 1 of the plate 2, and in this state is placed near the end of the hept // Fi tube section of the bottle, and the cut end l (inclined outward) -1 tube shape Located close to the edge of the part. The tightening tool is a known tensioner AK 1 mounting C-, and the tool has a bundle II '+ step that engages the tension groove l and a metal al that is pressed against the taper portion of the head t. Cut when pulled against bottle 4 or sleeve JK? Engages with the lie @ of the tube-shaped portion and cuts into the above-mentioned end, and gradually cuts the tube-shaped portion into KjllO fingers with an error. The finger I9 is gradually carved, and at the same time (4) is bent, and at the final stage of fixing (fixing) not shown in FIG. Touch the surface. How to touch the top 11 is not important in the important It11 title, im * is a finger 19 is bent toward the board, and the meat board (, 2, j) t-sufficiently grasped It is a flexible t-4 long enough to provide a possible contact. Since the

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reaction force (of the tensile force) is exerted on the gold J1 head 1 of the pulling tool, the single drawing plate (λ , J) is pulled even if it is engaged.

When the pin herd // reaches a position close to the plate 3 as shown in FIG. 1, the metal in the tube-shaped portion of the sleeve close to this, that is, the metal close to the base of the finger / 9 is pressed against the plate 3. So, Pi / 4 and sleeve! The relative movement between and is tightened. After 1,000, the dust of the tension tool rises up the head, and the metal of the head l is caused to flow into the fixed groove / 41, and the two parts of the tightening tool! And 4 are determined. Next, the metal cannot be further advanced, the pulling force on the pin is increased, the pin is cut at the cutting neck / JO point, and the fastening is finally performed as shown in FIG. In this state, in 1 to (7) -7, the pin tail pull # 112 group is clamped away from the tool. As shown in FIG. 2, the number of immlml grooves is increased and nine pins, that is, a hook provided with thirteen fixing grooves, the -m of the pin jumps out from the end of hept l. In addition to the grips up to the thickness of the two plates (H + thickness), there is still a light fixing groove for fixing the sleeve and the pin and the metal phase. As shown in FIG. 2, there are still two extra locking grooves inside the heptit (between /// and the base of l). It can also be used for gripping thicknesses that are slightly thinner than the total thickness of the plates 3 and 3. -Face 10 @ obscene deblurring 1I! ! 1iFi for the invention! A partial Gion cross-sectional view showing the state 1 It- before being fastened or fixed to the plate. FIG. 1 is the same as FIG. 7, but the tightening is a diagram showing a state in which the tool is completely fixed and the tail of the pin is cut. である。 l: Tighten the whole, co, J ... Both tightened <1)%. σ: 9. -One board! , G. Tighten the tool sleeve and pin. 7 ... Axial direction hole of sleeve, l ... sleeve of sleeve, t ... tubular portion of sleeve, 10 ... sleeve O flange / l ... head of pin, l・ ・ Tension groove / 3 ・ ・ ・ Cut neck, l ・ ・ ・ Fixing groove + / 3 ・ ・ ・ Longitudinal direction 2-74 flat ・ '" ° ° ° Cut end ・" "、 =、 p-shaped part is made by biting, t finger, W... pulling groove f / * am part, that is, grasping part. Applicant agent # Saisei (?)> 1-Sorry v, l 娑:, drama 1 \\ v (1 set ("\ 2- \ Nh: 1.!』 -> 1, '-, -1") d> "\\\ watch,> \>, \ to%)> c"-□ -one leg, -1f灸 -to 1k-! 1] 1 guard attached, ° F class PA II) ()) 1 specification (2) Fig. 11 'communication (3) fIE form, machine concealment-and O-1 Otsugi (4) Applicant * Inventions other than the 1111th century, the utility model registration applicant or agent representative (mail pot 4I100), Tokyo sr Shirota-ku, Maru 0-Yen, 3rd J 2-3-3-1] Yukichi Sato · Dosho 1 · 68 Dotomi-Sakai-1 l

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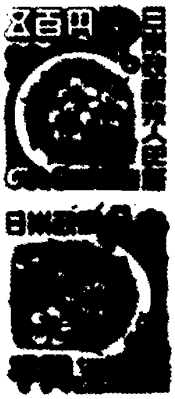
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CLAIMS JPS51101469

[Claims for utility model registration] A blind fastening for phase-locking a plurality of stacked members substantially having a coaxial center qL is a part of which 9 is one of the stacked members. A tube 5 placed in the hole so that it is on the side, a head 11 having a diameter substantially equal to the outer diameter of the portion of the tube, and a radius towards the head up near the head A pin 6 having at one end a ring-shaped surface 16 inclined outward in the direction, the pin further passing through the tube-shaped body, and the ring-shaped surface of the tube-shaped body on the one side of the stacked member A diameter part for being placed substantially concentrically with and in contact with the end, and a member on the opposite side of the member on the diameter part, the head of the pin being overlaid Shaped by a number of annular pull grooves 12 for pulling the pin so that it is moved toward The grasping portion 20 is about 45% of the total length of the pin, and the pin further extends the portion 9 of the tubular body in the longitudinal direction along the predetermined line. In order to cut, and thus the ring-shaped surface gradually contacts the cut parts and bends these parts laterally rearwardly, they were made on the inclined surface 16 at equal intervals in the peripheral direction. A plurality of cutting ends 17, and the pin further includes at least thirteen ring-shaped fixing grooves 14 formed between the bin head 11 and the grasping portion 20, and the tubular body is formed on the pin head. Opposite and annular shoulder means 10 for grasping the overlapped member between the carved portion 19 and the plurality of fixing grooves 14 placed on the outside of the shoulder means. The pin is fixed to a part and fixed to the tube shape With blind fastening having a portion 8 of the 惺Ttame In concrete.



実用新案登録願

(1500円)

昭和 50 年 2 月 7 日

特許庁長官 斎藤英雄 殿

考案の名称 ハンドツール
盲締付け具

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50-017000

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明　　細　　書

考案の名称　　盲締付け具

実用新案登録請求の範囲

実質的に同軸心の孔を有する重ねられた複数の部材を相固定する為の盲締付け具に於て、その一部分が上記重ねられた部材の一方の側にある様に上記孔中に置かれる管形体5、及び、上記管形体の上記部分の外径と実質的に等しい直径のヘッド11及び、上記ヘッド近くに於て上記ヘッドに向けて半径方向外方に傾斜する輪形面16を一端に有するピン6を有し、上記ピンはさらに上記管形体を貫通し、上記輪形面が上記重ねられた部材の上記一方の側にある上記管形体の端と実質的に同心にかつこの端に接して置かれる様にする為の径部、及び、上記径部上に於て上記部材の反対側にあり、上記ピンのヘッドが上記重ねられた部材に向けて動かされる様に上記ピンを引張る為の多数の輪形引張り溝12により形成された把握部20、を有し、

(1)

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上記把握部20の長さは上記ピンの全長の約43%であり、上記ピンはさらに、上記管形体の上記部分9を予定線に沿って長手方向に切分け、よって上記輪形面が次第に上記切分けられた部分に接触してこれらの部分を横方向後方に曲げる様にする為に、上記傾斜面16上に周辺方向等間隔を置いて作られた多数の切断端17を有し、上記ピンはさらに、上記ピンヘッド11と上記把握部20との間に作られた少なくとも13個の輪形固定用溝14を有し、上記管形体は、上記ピンヘッドに対向し、上記切分けられた部分19との間に上記重ねられた部材を把握する為の輪形肩部手段10、及び、上記肩部手段の外側上に置かれ、上記多数の固定用溝14の一部に固定されて上記ピンを上記管形体に対して固定位置に保つ為の部分8を有する締付け具。

考案の詳細な説明

本考案は、締付け具、即ち複数の板を相固定する為に上記板群の一方の側から引張られて取付けられる締付け具に関する。

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本考案は日本特許230,300号に対する重要な改良を提供するものである。

本考案の如き型の締付け具に於ては種々な厚さの複数の板を相引き寄せて相固定し得る事が特に重要であるが、本考案による締付け具は上述の特許に示されたものより遙かに広い把握厚さ範囲に亘って使用するものに特に適し、この事は従前のものより多数の即ち総数に於て13個に及ぶ固定用溝を設けた事により可能にされる。

さらに本考案による締付け具は数種の異る型の引張りガン（引張り工具）とともに用いられ得、この事は引張り溝を有する部分の長さをピンの総長の約45%に及ぶ様にした事、換言すれば従前の締付け具に於けるよりも多数の引張り溝を設けた事により可能にされる。

以下添附図面に従って説明する。

図に於て、本考案による二体構造の締付け具は全体として1で示され、この締付け具1は板2と3とが離れている場合にはこれらを引寄せる為にも用いられ得る。板2及び3は一つの合計厚さ、

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即ち一つの把握部に於て示され、破線"は両板を締付ける為の適用範囲を示す、即ち板2と3との合計厚さが上記線"に達する迄増大されてもこの締付け具が用いられ得る。

両板2、3中の孔は予め作られ、締付け具はこれらの孔中に第1図に示す如く挿入される。

締付け具は全体として4で示すスリーブ及び全体として6で示すピンを有し、このスリーブ及びピン4及び6は鋼またはアルミニウムの如き金属で作られる。

スリーブ4には軸心方向孔7が作られ、スリーブ4は一端近くに輪形ヘッド8を有し、このヘッド8の外方端近くには輪形テーパ部が作られる。

スリーブ4は反対端に小径の細長い管形部9を有し、前記ヘッド8にはこれと管形部9との接合部に一体の輪形フランジ(または肩部手段)10が作られる。

ピン6は一端に予め作られたヘッド11及び孔中の孔を貫通する細長い径部を有し、締付け具の両部分が第1図に示す如く組立てられた時にヘッド

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11はこれに近い管形部9の端にほぼ衝接する。

ピン6の径部の反対端部中には多数の引張り溝12が作られ、この溝12は引張り工具の為の把握部を形成し、この設計に於ては多数の引張り溝13により形成された引張り溝部（把握部）20の長さはピン6の総長の約45%である。

ピン6には一群の引張り溝12と一群の固定用溝14との間に輪形小径部13が作られ、この小径部13は切断頸部を形成する。固定用溝14は切断頸部13とピンヘッド11との間に作られた輪形溝であり、ピンヘッド11には周辺方向に間隔を置いた数個の長手方向リブ15が作られ、このリブ15はピンとこれに近いスリーブ9の孔との間に圧入嵌合を与える役をする。

本考案による構造の重要な特徴の一つは従前の特許に示されたものより多くの固定用溝を有する事、即ち従前の7個に比して13個の上記溝を有する事であり、この特徴的構造により、従前の締付け具より遙かに広い範囲の厚さの板を把握する事が可能にされるという実質的利益が与えられる。

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ピン6にはピンの軸心に対して角度をなす多数の平面16が作られ、この平面16は第1及び2図に示す如き外方に広がる面を形成する。この設計に於ては上記平面16は5個作られ、これらの面間の交線は周辺方向に等間隔を距てた5個の切断端17を形成する。

締付け具の二部分（5　6）は第1図に示す如く、即ちピン6はスリーブの孔7中を貫通し、一群の引張り溝12はスリーブのヘッド8の端から飛出し、フランジ10は板2の孔上に重なる様に組立てられ、この状態に於てピンのヘッド11は管形部9の端近くに置かれ、切断端17（外方に傾斜する）は管形部9の端に密接して置かれる。

締付け具は既知の引張り工具により取付けられ、上記工具は引張り溝12に係合する把握手段及びヘッド8のテーパ部に押付けられる金環を有する。ピン6がスリーブ3に対して引張られる時に切断17は管形部9の内面の端に係合して上記端中に切込み、よって管形部を次第に5個の指19に切分けて行く。指19は次第に切分けられて行くと同時に

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折曲げられ、第2図に示す取付け（固定）の最終段階に於ては指19は折曲げられて、これに近い板3の面に接触する。上記接触のし方の如何は重要な問題では無く、重要な事は指19が、板に向けて折曲げられて、両板（2、3）を充分に把握し得る接触を与えるに足りる長さを有す可き事である。

引張り工具の上記金型はヘッド8に対して（引張り力の）反力を及ぼすから、両板（2、3）はもし離れていても引寄せられる。ピンのヘッド11が第2図に示す如く板3に近い位置に達すると、これに近いスリーブの管形部9中の金属、即ち指19の基部に近い金属は板3に押付けられ、よってピン6とスリーブ5との間の相対運動が締められ、その後は引張り工具の金型がヘッド8上に乗り上がり、これによりヘッド8の金属が固定同溝14中へ流動させられて締付け具の二部分5と6とが相固定される。ついで金型がさらに進む事が不可能になると、ピンへの引っ張り力が増大して、ピンは切断頸部13の所で切断され、締付け具は最終的に第2図に示す如く固定され、この状態に於ては

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ピン尾部の引張り溝12の群は締付け具から分離されている。

第2図に示す如く固定用溝の数を増した事、即ち13個の固定用溝を設けた事によりピンの一部はヘッド8の端より飛出し、従って第1図中の破線4で示す厚さ（両板の合計厚さ）迄の把握に対してもなお、スリーブとピンとを相固定するための充分な固定用溝14が与えられ、また同じく第2図に示す如く、ヘッド11の内方（11と8の基部との間）にはなお2個の余分な固定用溝が残されているから、この設計の締付け具は図示の板2と3との合計厚より薄い把握厚さに対しても用いられ得る。

図面の簡単な説明

第1図は本考案による締付け具が板に取付けられたが固定される前の状態を示す一部側面断面図、第2図は第1図と同様であるが、締付け具が完全に固定されピンの尾部が切断された状態を示す図、である。

1…締付け具全体、　2，3…締付けられる両

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板、　5、6…締付け具のスリーブ及びピン、7…スリーブの軸心方向孔、　8…スリーブのヘッド、　9…スリーブの管形部、　10…スリーブのフランジ、　11…ピンのヘッド、　12…引張り溝、　13…切断預部、　14…固定用溝、　15…長手方向リブ、　16…平面、　17…切断端、　19…管形部9を切られて作られた指、　20…引張り溝部、即ち把握部。

出願人代理人　　猪　股　　清

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FIG. 1.
FIG. 2.
20
101469

67

添附書類の目録

(1) 明細書 1通
(2) 図面 1通
(3) 委任状、法人証明書およびその訳文各1通
(4) 出願審査請求書 1通

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(EN) VARIABLE GRIP BLIND RIVET
(JA) 可変グリップ式ブラインドリベット

Abstract
(EN)
PROBLEM TO BE SOLVED: To provide a rivet capable of reliably fixing a mandrel head in a rivet body during mounting the rivet.

SOLUTION: A variable grip blind rivet 2 comprises a rivet body 4 having a first shank 8 adapted to be inserted into a hole in a workpiece and having an axial bore, and a flange 10 at a second end of the first shank 8 for abutting the workpiece when the first shank 8 is inserted into the hole in the workpiece. A mandrel 6 has a head 20 for engaging a second end of the first shank 8, and a second shank 24 adapted to extend through the axial bore and to be pulled by a tool to set the rivet 2. The head has an abutment portion 28 for abutting the first end of a first shank 8, and the second shank 24 has a first reduced diameter portion 26 adapted to break when a predetermined tensile is loaded applied thereto during setting of the rivet 2.

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(JA)
【課題】リベット取り付け中、マンドレル頭部をリベット本体内に確実に固定できるリベットを提供する。
【解決手段】可変グリップ式ブラインドリベット２は、加工物の穴に挿入するように適合され、軸方向ボアを有する第１のシャンク８と、第１のシャンク８が加工物の穴に挿入されたときに加工物に当接するための、第１のシャンク８の第２の端部にあるフランジ１０とを有するリベット本体４を含む。マンドレル６は、第１のシャンク８の第２の端部と係合するための頭部２０と、軸方向ボアを通って延び、リベット２を取り付けるために工具によって引き込まれるよう適合された第２のシャンク２４とを有する。頭部は、第１のシャンク８の第１の端部と当接するための当たり部分２８を有し、第２のシャンク２４は、リベット２の取り付け中に所定の引張荷重が加えられたときに破断するように適合された第１の直径減少部分２６を有する。
【選択図】図１

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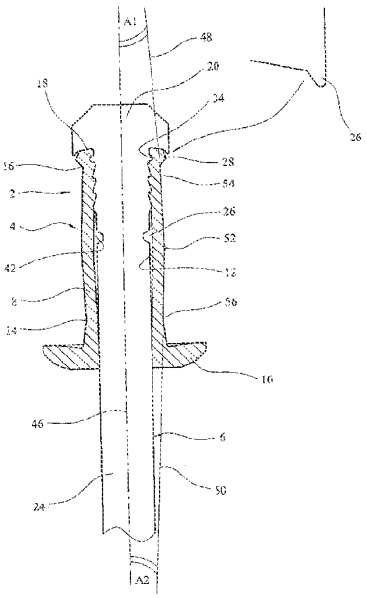
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(54)【発明の名称】可変グリップ式ブラインドリベット

(57)【要約】　（修正有）
【課題】リベット取り付け中、マンドレル頭部をリベット本体内に確実に固定できるリベットを提供する。
【解決手段】可変グリップ式ブラインドリベット２は、加工物の穴に挿入するように適合され、軸方向ボアを有する第１のシャンク８と、第１のシャンク８が加工物の穴に挿入されたときに加工物に当接するための、第１のシャンク８の第２の端部にあるフランジ１０とを有するリベット本体４を含む。マンドレル６は、第１のシャンク８の第２の端部と係合するための頭部２０と、軸方向ボアを通って延び、リベット２を取り付けるために工具によって引き込まれるよう適合された第２のシャンク２４とを有する。頭部は、第１のシャンク８の第１の端部と当接するための当たり部分２８を有し、第２のシャンク２４は、リベット２の取り付け中に所定の引張荷重が加えられたときに破断するように適合された第１の直径減少部分２６を有する。
【選択図】図１



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【特許請求の範囲】
【請求項１】
加工物の穴に挿入されるように構成された第１のシャンク（８）を有し、前記第１のシャンク（８）に軸方向ボアが形成され、前記第１のシャンクは、該第１のシャンクが前記加工物の前記穴に挿入されたときに該加工物と当接するためのフランジ（１０）を第１の端部に有するリベット本体（４）と、
前記第１のシャンク（８）の前記第１の端部とは反対側の端部である第２の端部に係合するための頭部（２０）と、前記頭部から前記第１シャンクの前記軸方向ボアを通って延びる第２のシャンク（２４）とを有し、前記リベットの取り付けに際して前記第２のシャンクが工具によって引き込まれるように構成されたマンドレル（６）と、
を含むリベットであって、
前記マンドレル（６）の前記頭部（２０）は、前記第１のシャンクの前記第２の端部に当接するための当接部分を有し、
前記第２のシャンクは、前記リベットの取り付け中に所定の引張荷重が加えられたとき破断するように構成された第１の直径減少部分（２６）と、リベットの取り付け中に該第１のシャンクの該第２の端部を受けるキャビティ（３８）を前記頭部（２０）の前記当接部分との間に定めるように、前記当接部分に隣接して形成された突起部（３４）とを有し、
前記マンドレルの前記頭部の周りには、リベットの取り付け中に前記リベット本体の材料が該マンドレルの該頭部の周りに移動するのに抵抗するように作用するリップ（３０）が設けられ、
前記第２のシャンクには、前記突起部と前記第１の直径減少部分との間に、さらに環状のリブ（３６）が少なくとも１つ形成され、該環状のリブは前記第２のシャンクに溝を形成しており、
前記環状のリブ（３６）は、前記突起部から前記第１の直径減少部分に向かって直径方向外向きに拡がるように、リベットの軸に対して１０度から２０度までの角度で傾斜した面（４０）を有する
ことを特徴とするリベット。
【請求項２】
前記リベット本体は、前記マンドレルに取り付けられており、前記第１のシャンクは、該第１のシャンクの前記第１の端部に隣接して第２の直径減少部分が形成され、該第１のシャンクの前記第２の端部に隣接して第３の直径減少部分が形成されたことを特徴とする、請求項１に記載のリベット。
【請求項３】
前記リベット本体は、前記第２の直径減少部分と前記第３の直径減少部分との間に直径増加部分を有し、該リベット本体の長手方向軸を通る、これと平行な平面において、最大外径の領域を最小外径の領域の少なくとも１つに結ぶ線と、該リベット本体の長手方向軸との間の角度は、１．０度から１．９度までの間であることを特徴とする、請求項２に記載のリベット。
【請求項４】
前記第２のシャンクの部分を受け、前記第３の直径減少部分を定めるための、該第２のシャンク上の少なくとも１つの第１の溝をさらに含むことを特徴とする、請求項２又は請求項３に記載のリベット。
【請求項５】
少なくとも１つの前記第１の溝は、前記第２のシャンクの長手方向軸に対してそれぞれの第１の鋭角で傾斜された、それぞれの第１の面を定めることを特徴とする、請求項４に記載のリベット。
【請求項６】
少なくとも１つの前記第１の鋭角は、前記第２のシャンクの長手方向軸に対して１０度から２０度までの間であることを特徴とする、請求項５に記載のリベット。

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【請求項７】
前記リベット本体の前記直径減少部分は、該リベットが組み立てられたとき、前記第１の直径減少部分の両側に配置されることを特徴とする、請求項３から請求項６までのいずれか１項に記載のリベット。
【請求項８】
前記第１の直径減少部分は、複数の陥凹部によって定められることを特徴とする、前記請求項のいずれか１項に記載のリベット。
【請求項９】
前記当たり部分は、前記第２のシャンクの長手方向軸に対して、それぞれの第２の鋭角で傾斜した少なくとも１つの第２の表面を含むことを特徴とする、前記請求項のいずれか１項に記載のリベット。
【請求項１０】
少なくとも１つの前記第２の鋭角は、前記第２のシャンクの長手方向軸に対して７３度から７８度までの間であることを特徴とする、請求項９に記載のリベット。
【請求項１１】
前記当たり部分は、前記第２の表面から又は該第２の表面の各々から半径方向に外方に配置されたリップをさらに含み、前記リップは該第２の表面の各々に隣接するそれぞれの第３の表面を定め、前記第３の表面又は該第３の表面の各々は、前記第２のシャンクの長手方向軸に対して、対応する前記第２の鋭角より小さい第３の鋭角で傾斜することを特徴とする請求項９又は請求項１０に記載のリベット。
【請求項１２】
少なくとも１つの前記突出部は、それぞれの第１のリブを含むことを特徴とする、前記請求項のいずれか１項に記載のリベット。
【請求項１３】
前記マンドレル頭部は、前記加工物の穴に前記リベットを挿入するのを助けるための、前記第２のシャンクの長手方向軸に対して傾斜した少なくとも１つの第４の表面を有することを特徴とする、前記請求項のいずれか１項に記載のリベット。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、ブラインドリベットに関する。
【背景技術】
【０００２】
ブラインドリベットは、薄板の固定から比較的厚い部品の固定まで、様々な用途に用いられ、鋼鉄からプラスチックまで様々な材料で用いられている。ブラインドリベットは、安価な組み立ての実現を可能にするだけではなく、結果として得られる接合部又は取り付けの強度及び完全性も寄与する。例えば、接合される１対の加工物のシートが僅かに湾曲している場合、リベットによりシートを互いにクランプする必要がある。
【０００３】
ブラインドリベットは、一般に、加工物のシートが加えられる振動により摩耗し又加えられる荷重により揺動するのを防ぐために、高い剪断強度を有すること、及び、リベット本体とリベットが挿入される加工物の穴との間のいずれかの隙間に膨張することが必要である。このことは、自動車産業において特に重要である。
【０００４】
一般的に、リベットは、取り付けられたとき、加工物のブラインド側上に単一のロール型の膨出した取り付け部を有し、美的外観を与えながら、加えられる荷重に対する増大した引張抵抗を与える必要もある。
【０００５】
さらに、一般的に、リベットのマンドレルは、リベットフランジの領域において同一平面になるように破断し、接合部の剪断抵抗の増大に寄与することが望ましい。これらの要

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件を達成するために、特により高い強度のブラインドリベットの場合、マンドレル頭部は、組み立て時にリベット本体の末端部に固定され、取り付け中及び取り付け後に所定の位置にとどまり、よって、リベット本体のボアを通る湿気の浸入に対する抵抗をもたらすことが必要である。さらに、マンドレル頭部をリベット本体内に固定することにより、取り付けられたリベット内のマンドレル頭部のがたつきが回避される。

【０００６】

特許文献１は、リベットのマンドレル頭部の下に凹部を有するブラインドリベットを開示する。リベット本体の末端部が、マンドレル頭部の下の楕円形状の凹部内にクリンプされ、リベット本体のフランジ部分に近くに、更に別の陥凹部が設けられる。

【０００７】

特許文献２は、頭部の下に面取りした面をもつマンドレル頭部を有するブラインドリベットを開示する。このリベットは、グリップ範囲が比較的狭いという欠点を有する。

【０００８】

特許文献３は、マンドレル頭部の下に溝が設けられたマンドレルを有するブラインドリベットを開示する。このリベットの組み立ての際、リベット本体の末端部は、溝の中にかしめられ、製造中にマンドレルを所定の位置に保持する。リベットを取り付けるためにマンドレル・ステムが引き込まれると、マンドレル頭部の下のマンドレルにかしめられたリベット本体のその部分が膨出して外方に押し出され、マンドレル・ステム内の溝との係合から外れるようになる。膨出プロセスが取り付けと共に進み、マンドレルが引き続きリベット本体を通って移動するに従って、マンドレル溝が内部の膨出したボアと係合するようになり、マンドレルが所定の位置に固定される。しかしながら、このリベットは、リベット本体に対するマンドレル頭部の移動を防止ために、リベット本体へのマンドレルの係合が不十分であることが多いという欠点を有する。さらに、最小のグリップ厚で取り付けられたとき、このリベットは、単一のロール型取り付け部ではなく、幾重にも折り畳まれた取り付け部が設けられるという不利な点を有する。

【０００９】

特許文献４は、マンドレル頭部の下に、マンドレルに溝が設けられた、ブラインドリベットを開示する。このリベットは、リベット本体が、鋼のようなより丈夫な材料で形成された場合、リベットを取り付けるのに必要な取り付け荷重がより大きくなることにより、取り付けが完了する前に、マンドレル頭部がリベット本体内に引き込まれてしまうという欠点を有する。

【００１０】

特許文献５は、マンドレル頭部の下に、リベット本体の末端部が形成される凹部を有するブラインドリベットを開示する。このリベットには、鋼のような特定の材料についての取り付け荷重が大きく、最大荷重に近づくにつれて、リベット本体の端部が変形し、内部ボアが、マンドレル頭部の下に形成された凹部から遠ざかるという欠点がある。これにより、間隙が凹部とリベット本体との間に形成され、そのため、マンドレルが破断したとき、マンドレル頭部がリベット本体に対して移動することが可能になる。

【００１１】

特許文献６は、マンドレル頭部の下に一連の環状溝が設けられたブラインドリベットを開示する。この種のリベットは、適切なグリップ範囲を提供するが、リベットを取り付けるために必要とされる荷重が他のブラインドリベットと比較して高く、その結果、リベット取り付け完了時にマンドレルが破断するとき、反動力を受けてマンドレル頭部が緩みやすい。

【先行技術文献】

【特許文献】

【００１２】

【特許文献１】欧州特許第０６７７６６６号
【特許文献２】英国特許第４０２８１３号
【特許文献３】英国特許第２２３１９３２号

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【特許文献４】米国特許第６００４０８６号
【特許文献５】欧州特許第１１０６８４５号
【特許文献６】英国特許第２４１６５７５号
【発明の概要】
【発明が解決しようとする課題】
【００１３】
従って、上記のリベットのいずれも、リベットの取り付け中に、マンドレル頭部を十分な程度までリベット本体内に固定するのが困難であるという欠点を有する。本発明の好ましい実施形態は、従来技術の上記の欠点の１つ又はそれ以上を克服しようと努める。
【課題を解決するための手段】
【００１４】
本発明によると、
加工物の穴に挿入されるように構成された第１のシャンクを有し、該第１のシャンクに軸方向ボアが形成され、該第１のシャンクは、該第１のシャンクが加工物の穴に挿入されたときに該加工物と当接するためのフランジを第１の端部に有するリベット本体と、
該第１のシャンクの第１の端部とは反対側の端部である第２の端部に係合するための頭部と、該頭部から第１シャンクの軸方向ボアを通って延びる第２のシャンクとを有し、リベットの取り付けに際して該第２のシャンクが工具によって引き込まれるように構成されたマンドレルと、
を含むリベットであって、
該マンドレルの頭部は、第１のシャンクの該第２の端部に当接するための当接部分を有し、
該第２のシャンクは、リベットの取り付け中に所定の引張荷重が加えられたとき破断するように構成された第１の直径減少部分と、リベットの取り付け中に該第１のシャンクの該第２の端部を受けるキャビティを頭部の当接部分との間に定めるように、該当接部分に隣接して形成された突起部とを有し、
マンドレルの頭部の周りには、リベットの取り付け中にリベット本体の材料が該マンドレルの該頭部の周りに移動するのに抵抗するように作用するリップが設けられ、
第２のシャンクには、該突起部と第１の直径減少部分との間に、さらに環状のリブが少なくとも１つ形成され、該環状のリブは第２のシャンクに溝を形成しており、
該環状のリブは、上記の突起部から第１の直径減少部分に向かって直径方向外向きに拡がるように、リベットの軸に対して１０度から２０度までの角度で傾斜した面を有する
ことを特徴とするリベットが提供される。
【００１５】
リベットの取り付け中に第１のシャンクの第１の端部を受ける凹部を定めるための、当たり部分に隣接する少なくとも１つの突起部を設けることにより、リベットの取り付け中に、マンドレル頭部をリベット本体内により確実に保持するという利点がもたらされ、これにより、マンドレル頭部がリベット本体に対して動くのが防止され、その後、リベット取り付け後にマンドレル頭部がリベット本体内でがたつくのが防止される。
【００１６】
好ましい実施形態において、リベット本体は、マンドレルに取り付けられ、かつ、第１のシャンクの第１の端部に隣接する第２の直径減少部分と、第１のシャンクの第２の端部に隣接する第３の直径減少部分とを有する。
【００１７】
このことは、リベット取り付け中にリベット本体が膨出するのを助ける、リベット本体のパレル形状の部分をもたらすという利点を提供する。
【００１８】
リベット本体は、第２の直径減少部分と第３の直径減少部分との間に直径増加部分を有することができ、リベット本体の長手方向軸を通る、これと平行な平面において、最大外径の領域を最小外径の領域の少なくとも１つに結ぶ線と、リベット本体の長手方向軸との

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間の角度は、１．０度から１．９度までの間である。
【００１９】
リベットは、第２のシャンクの部分を受け、第３の直径減少部分を定めるための、第２のシャンク上の少なくとも１つの第１の溝をさらに含むことができる。
【００２０】
少なくとも１つの第１の溝は、第２のシャンクの長手方向軸に対して第１の鋭角で傾斜した、それぞれの第１の面を定めることができる。
【００２１】
少なくとも１つの第１の鋭角は、第２のシャンクの長手方向軸に対して１０度から２０度までの間とすることができる。
【００２２】
リベット本体の直径減少部分は、リベットが組み立てられたとき、第１の直径減少部分の両側に配置することができる。
【００２３】
第１の直径減少部分は、複数の陥凹部によって定めることができる。
【００２４】
当たり部分は、第２のシャンクの長手方向軸に対して、それぞれの第２の鋭角で傾斜した少なくとも１つの第２の表面を含むことができる。
【００２５】
少なくとも１つの第２の鋭角は、第２のシャンクの長手方向軸に対して、７３度から７８度までの間とすることができる。
【００２６】
当たり部分は、第１の表面から又は該第１の表面の各々から半径方向に外方に配置されたリップをさらに含み、このリップは、第２の表面の各々に隣接するそれぞれの第３の表面を定め、第３の表面又は第３の表面の各々は、第２のシャンクの長手方向軸に対して、対応する第２の鋭角より小さいそれぞれの第３の鋭角で傾斜する。
【００２７】
少なくとも１つの突起部は、それぞれの第１のリブを含むことができる。
【００２８】
マンドレル頭部は、加工物の穴にリベットを挿入するのを助けるための、第２のシャンクの長手方向軸に対して傾斜した少なくとも１つの第４の表面を含むことができる。
【００２９】
ここで、本発明の好ましい実施形態を、添付の図面を参照して、限定的な意味ではなく、単なる例証として説明する。
【図面の簡単な説明】
【００３０】
【図１】本発明を具体化する、組み立てられたブラインドリベットの断面立面図である。
【図２】図１のリベットのマンドレル頭部の側立面図である。
【図３】図２のマンドレル頭部の下からの断面図である。
【図４】図３の線Ａ－Ａに沿った断面立面図である。
【図５】図３の線Ｂ－Ｂに沿った断面立面図である。
【図６】種々の厚さで取り付けられた、図１のリベットを示す。
【発明を実施するための形態】
【００３１】
図１は、本発明を具体化する、組み立てられたブラインドリベット２の断面立面図を示す。リベット２は、マンドレル６に取り付けられたリベット本体４を有し、このリベット本体は、第１のシャンク８と、該第１のシャンク８が加工物（図示せず）の穴に挿入されたときに該加工物に当接するように設計された直径拡大フランジ部分１０とを有する。２つの直径減少部分１４、１６により形成されたバレル部分１２がフランジ部分１０から延び、リベット本体４の末端部１８がマンドレル６の頭部２０の下面に当接する。

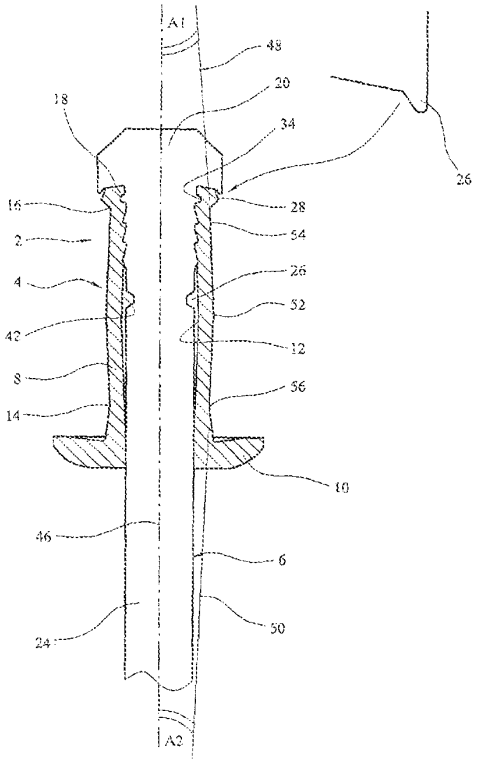
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【００３２】
図２乃至図５を参照すると、マンドレル頭部２０は、リベット２が加工物の穴に容易に入るのを可能にするための面取りした外面２２を有し、第２のシャンク２４が、マンドレル頭部２０から延び、かつ、マンドレル６に加えられる特定の引張荷重を超えたときに、第２のシャンクが破断するのを可能にするように設けられた、４つの陥凹部によって形成された破断ネック２６を有する。
【００３３】
各々がマンドレル６のシャンク２４の接線２５を形成する４つの傾斜面２８が、マンドレル頭部２０の下側に設けられ、この面２８の各々は、第２のシャンク２４の長手方向軸に対して、７３度から７８度までの間、好ましくは７５度の角度で傾斜される。リベットが取り付けられるにつれてリベット本体の材料がマンドレル頭部２０の周りに移動する傾向に対する抵抗を与えるために、マンドレル頭部２０の周りにリップ３０も設けられる。
【００３４】
一連の溝３２が、破断ネック２６とマンドレル頭部２０との間に設けられ、これらの溝３２は、一連の環状リブ３４、３６を定める。最上部のリブ３４は、マンドレル頭部２０と第２のシャンク２４との間にキャビティ３８を形成し、取り付けプロセス中及び取り付けプロセス後、このキャビティ３８の中にリベット本体４の材料が閉じ込められ、閉じ込められたままになる。最上部のリブ３４の存在は、マンドレル６が破断するときにマンドレル頭部２０がリベット本体４内に移動する傾向、又は、マンドレル６の破断により生じる反動力の下でマンドレル頭部２０がリベット本体４に対して上方に移動する傾向を抑える。
【００３５】
最上部リブ３４以外に、リブ３６の各々は、マンドレル・シャンク２４の長手方向軸に対して１０度から２０度までの間、好ましくは１５度で傾斜した傾斜面４０を有する。
【００３６】
組み立てられたリベット２を形成するために、リベット本体の材料を溝３２内にかしめて上部直径減少部分１６と、下部直径減少部分１４とを形成し、直径減少部分１４、１６を形成することにより、リベット本体４の僅かな湾曲によりバレル部分１２が形成され、リベット本体４のボアとマンドレル６のシャンク２４との間に僅かな間隙４２（図１）が生じる。リベット本体４の外面の湾曲角度（すなわち、リベット本体４の長手方向軸４６を通って、これに平行な平面において、最大外径５２の領域を、最小外径５４、５６の領域のそれぞれと結ぶそれぞれの線４８、５０と、リベット本体４の長手方向軸４６との間の角度A_1又はA_2）は、１．０度から１．９度までの間であり、好ましくは１．５度である。
【００３７】
リベット２を取り付けるために、取り付け工具のノーズピースでフランジ１０を支持しながら、取り付け工具（図示せず）により、マンドレル６のシャンク２４が引き込まれる。図６に最も良く示されるように、マンドレル６のシャンク２４が引き込まれると、リベット本体４は、膨出し、長さが短くなって加工物の穴を充填し、次に、崩壊してブラインド側膨出部４４をもたらす。リベット本体４の膨出部又は崩壊部は、他の種類のリベットよりも本体の端部の近くに生じるので、膨出部は小さいものの、該膨出部により、本体材料は、マンドレル・シャンク２４の溝との係合から外れるように移動する。しかしながら、本体材料がマンドレル頭部２０の下の凹部３８内に保持され、マンドレル６をリベット本体４に閉じ込めるので、リベットの取り付け中及び取り付け後、マンドレル頭部２０及びリベット本体４が互いによりしっかりと取り付けられる。このように、その後のリベットのがたつきが回避され、リベット接合部の完全性及び強度が向上する。
【００３８】
当業者であれば、上記の実施形態は、限定的な意味ではなく、単なる例示として説明され、添付の特許請求の範囲に定められたような本発明の範囲から逸脱することなく、様々な変更及び修正が可能であることを理解するであろう。

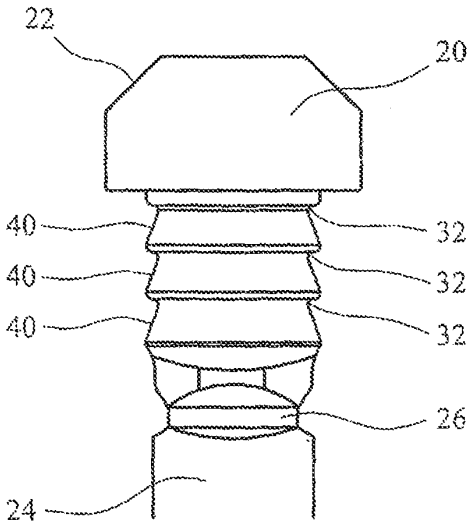
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【符号の説明】
【００３９】
２：ブラインドリベット
４：リベット本体
６：マンドレル
８：第１のシャンク
１０：フランジ部分
１２：バレル部分
１４、１６：直径減少部分
１８：末端部
２０：マンドレル頭部
２２：面取りした外面
２４：第２のシャンク
２６：破断ネック
２８：傾斜面
３２：溝
３４、３６：環状リブ
３８：キャビティ
４０：傾斜面
４２：間隙
４６：長手方向軸
５２：最大外径
５４、５６：最小外径

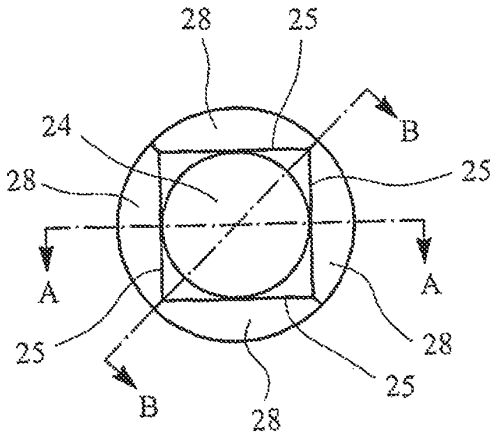
【図１】



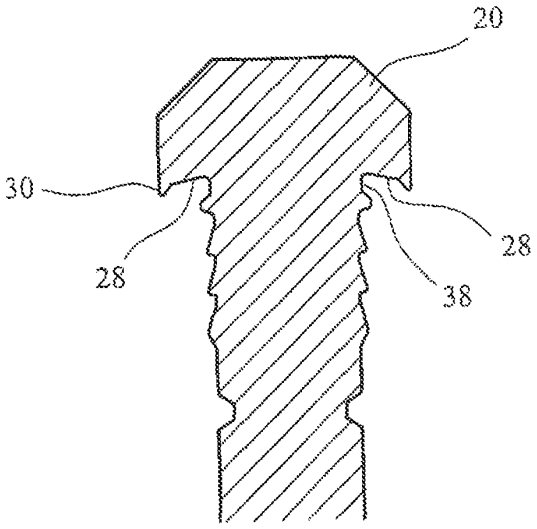
【図２】



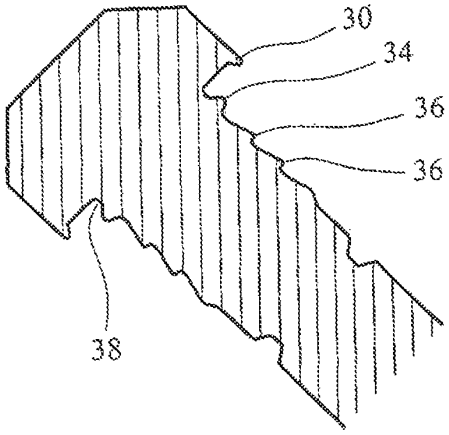
【図３】



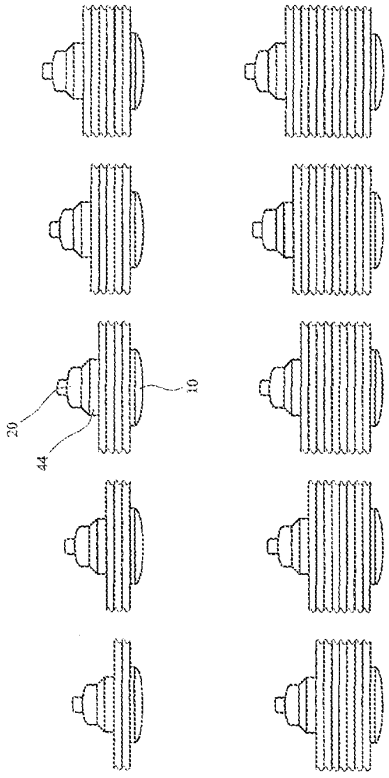
【図４】



【図５】



【図６】



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First Named Inventor/Applicant Name:	Robert B. Wilcox
Filer:	Robert John Sovesky/Amanda Kernan
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Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
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NATIONAL STAGE FEE	1631	1	320	320
NATL STAGE SEARCH FEE - REPORT PROVIDED	1642	1	540	540
NATIONAL STAGE EXAM - ALL OTHER CASES	1633	1	800	800
Pages:				
Claims:				
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Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1660**

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File Listing:

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1	Transmittal of New Application	371-Transmittal.pdf	205670 b360e825125e00f717d69e782cbadfdab89bc29f	no	3
Warnings:					
Information:					
2	Application Data Sheet	ADS.pdf	1256107 b6df6fa99cc9e5920faeb7cbe751acdb2ad76f0e	no	9
Warnings:					
Information:					
3	Documents submitted with 371 Applications	ISR-and-WO.pdf	8710844 64bf8d0949a82ad004fe64b27e5218b8f8ae7afd	no	10
Warnings:					
Information:					
4	Power of Attorney	POA.pdf	1241427 afff180cb729a48cec8ed84f2ee2e3089374a0ff	no	2
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5	Oath or Declaration filed	Copy-of-PCT-Declaration.pdf	101363 99c44605c37798156b1f64a825d80534bfe262e1	no	1
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7	Foreign Reference	JPH0360608U.pdf	497442 9b360e50aaf8c77d6dfecf3ceda21574fc1a372a	no	13
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10	Other Reference-Patent/App/Search documents	NPL-ISR-and-WO.pdf	8710844 64bf8d0949a82ad004fe64b27e5218b8f8ae7afd	no	10
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Title of Invention
BLIND FASTENER AND METHOD OF INSTALLATION THEREOF

First Named Inventor
Robert B. WILCOX

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). NOTE: The express request under 35 U.S.C. 371(f) will not be effective unless the requirements under 35 U.S.C. 371(c)(1), (2), and (4) for payment of the basic national fee, copy of the International Application and English translation thereof (if required), and the oath or declaration of the inventor(s) have been received.
2. ☐ A copy of the International Application (35 U.S.C. 371(c)(2)) is attached hereto (not required if the International Application was previously communicated by the International Bureau or was filed in the United States Receiving Office (RO/US)).
3. An English language translation of the International Application (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
4. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))
   a. ☒ is attached.
   b. ☒ was previously filed in the international phase under PCT Rule 4.17(iv).

Items 5 to 8 below concern amendments made in the international phase.

PCT Article 19 and 34 amendments

5. ☐ Amendments to the claims under PCT Article 19 are attached (not required if communicated by the International Bureau) (35 U.S.C. 371(c)(3)).
6. ☐ English translation of the PCT Article 19 amendment is attached (35 U.S.C. 371(c)(3)).
7. ☐ English translation of annexes (Article 19 and/or 34 amendments only) of the International Preliminary Examination Report is attached (35 U.S.C. 371(c)(5)).

Cancellation of amendments made in the international phase

8a. ☐ Do not enter the amendment made in the international phase under PCT Article 19.

8b. ☐ Do not enter the amendment made in the international phase under PCT Article 34.

NOTE: A proper amendment made in English under Article 19 or 34 will be entered in the U.S. national phase application absent a clear instruction from applicant not to enter the amendment(s).

The following items 9 to 17 concern a document(s) or information included.

9. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
10. ☐ A preliminary amendment.
11. ☒ An Application Data Sheet under 37 CFR 1.76.
12. ☐ A substitute specification. NOTE: A substitute specification cannot include claims. See 37 CFR 1.125(b).
13. ☒ A power of attorney and/or change of address letter.
14. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821-1.825 (not required if sequence listing in text format was indicated on the PCT Request as part of the International Application and the sequence listing was published as part of the international application).
15. ☐ Assignment papers *(cover sheet and document(s))*. Name of Assignee: _____
16. ☐ 37 CFR 3.73(c) Statement *(when there is an Assignee)*.

This collection of information is required by 37 CFR 1.414 and 1.491-1.492. 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 15 minutes 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. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

U.S. APPLN. No. (if known – see 37 CFR 1.5)	INTERNATIONAL APPLICATION No.	ATTORNEY DOCKET No.
	PCT/US2019/016973	118508/US01/PCTNS/180639PCTUS

17. ☒ Other items or information:

International Search Report and Written Opinion of the International Search Authority for International Application No. PCT/US2019/016973 mailed November 7, 2019.

The following fees have been submitted.	CALCULATIONS
18. ☒ Basic national fee (37 CFR 1.492(a)) **$320**	$ $320
19. ☒ Examination fee (37 CFR 1.492(c)) • If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** • All other situations **$800**	$ 800
20. ☒ Search fee (37 CFR 1.492(b)) • If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** • Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority ..... **$140** • International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB..... **$540** • All other situations **$700**	$ 540
TOTAL OF 18, 19, and 20 =	$ 1,660
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). Fee for each additional 50 sheets of paper or fraction thereof **$420**	$

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round up to a whole number)	RATE
- 100 =	/ 50 =		x **$420**

Surcharge for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)) **$160**	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	20 - 20 =	0	x **$100**	$ 0
Independent claims	2 - 3 =	0	x **$480**	$ 0
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$860**	$

Fee for submission of Sequence Listing text file of 300 MB to 800 MB (37 CFR 1.21(o)(1)) **$1,060**	$
Fee for submission of Sequence Listing text file of more than 800 MB (37 CFR 1.21(o)(2)) **$10,500**	$
Processing fee for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)) ..... **$140** +	$
TOTAL OF ABOVE CALCULATIONS =	$ 1,660
☐ **Applicant asserts small entity status.** See 37 CFR 1.27. Fees above are reduced by ½.	
☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Fees above are reduced by ¾. Applicant must attach form PTO/SB/15A or B or equivalent.	
TOTAL NATIONAL FEE =	$ 1,660
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) ..... **$50.00** per property +	$
TOTAL FEES ENCLOSED =	$ 1,660

Petitioner's Ex. 1003-363

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 02-1818 in the amount of $ 1,860 to cover the above fees.

c. ☒ The Director is hereby authorized to charge additional fees which may be required, or credit any overpayment, to Deposit Account No. 02-1818 as follows:

i. ☐ any required fee.

ii. ☒ any required fee except for excess claims fees required under 37 CFR 1.492(d) and (e) and multiple dependent claim fee required under 37 CFR 1.492(f).

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR**. To protect your information, it is recommended to pay fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013, and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE 1: By providing this statement under 37 CFR 1.55 or 1.78, **this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA**.

NOTE 2: A U.S. national stage application may not claim priority to the international application of which it is the national phase. The filing date of a U.S. national stage application is the international filing date. See 35 U.S.C. 363.

Correspondence Address

☒ The address associated with Customer Number: 29270 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone			
Email					

Signature	/Robert J. Sovesky/	Date	July 19, 2021
Name (Print/Type)	Robert J. Sovesky	Registration No. (Attorney/Agent)	73,798

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert	B.	Wilcox	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
McGregor	TX	US

Mailing Address of Inventor:

Address 1	354 Elm Grove Circle
Address 2	

City	State/Province	Postal Code	Country
McGregor	TX	76657	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	James	Thomas	Smith	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Crawford	TX	US

Mailing Address of Inventor:

Address 1	5019 Bosque Ridge Road
Address 2	

City	State/Province	Postal Code	Country
Crawford	TX	76638	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Troy	Don	Pierce	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

Petitioner's Ex. 1003-365

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

City	Hewitt	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	1301 Wentwood Circle		
Address 2			
City	Hewitt	**State/Province**	TX
Postal Code	76643	**Country**	US

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

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	29270		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF		
Attorney Docket Number	118508/US01/PCTNS/180639P	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

PTO/AIA/14 (02-18)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)
Customer Number	29270		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	a 371 of international	PCT/US2019/016973	2019-02-07

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Petitioner's Ex. 1003-369

PTO/AIA/14 (02-18)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	HOWMET AEROSPACE INC.		
Mailing Address Information For Applicant:			
Address 1	201 Isabella Street		
Address 2			
City	Pittsburgh	**State/Province**	PA
Country	US	Postal Code	15212-5858
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Robert J. Sovesky/			Date (YYYY-MM-DD)	2021-07-19
First Name	Robert	Last Name	Sovesky	Registration Number	73798

Additional Signature may be generated within this form by selecting the Add button. Add

Petitioner's Ex. 1003-371

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	118508/US01/PCTNS/180639P
	Application Number	
Title of Invention	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF	

This collection of information is required by 37 CFR 1.76. 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 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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 the Freedom of Information Act requires disclosure of these records.

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 CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another 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 inspections 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.

Petitioner's Ex. 1003-373

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 180639PCT	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/US2019/016973**	International filing date *(day/month/year)* **07 February 2019 (07.02.2019)**	(Earliest) Priority Date *(day/month/year)*
Applicant **ARCONIC INC.**		

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of :
      ☒ the international application in the language in which it was filed
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:
5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☒ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

Petitioner's Ex. 1003-374

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/016973

A. CLASSIFICATION OF SUBJECT MATTER

F16B 7/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16B 7/14; F16B 19/10; F16B 37/00; F16B 37/04; F16B 5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: rivet, sleeve, mandrel, pull, anvil

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 51-101469 U (HUCK MANUFACTURING COMPANY) 14 August 1976 See claim 1 and figures 1-2.	1-20
Y	JP 03-060608 U (TOKIN CORP.) 14 June 1991 See claim 1 and figures 1-5.	1-20
A	JP 61-035214 U (WAKAI & CO., LTD.) 04 March 1986 See claim 1 and figures 4-5.	1-20
A	JP 2014-029210 A (NEWFREY LLC.) 13 February 2014 See paragraphs [0031]-[0036] and figures 1-5.	1-20
A	KR 10-2005-0037765 A (HYUNDAI MOTOR COMPANY) 25 April 2005 See paragraphs [0024]-[0027] and figures 3-6.	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 November 2019 (06.11.2019)	**07 November 2019 (07.11.2019)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
HWANG, Chan Yoon
Telephone No. +82-42-481-3347

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2019/016973

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 51-101469 U	14/08/1976	None	
JP 03-060608 U	14/06/1991	None	
JP 61-035214 U	04/03/1986	JP 01-021216 Y2	26/06/1989
JP 2014-029210 A	13/02/2014	CN 101981330 A	23/02/2011
		CN 101981330 B	12/02/2014
		EP 2240700 A1	20/10/2010
		EP 2240700 B1	23/07/2014
		GB 2457105 A	05/08/2009
		GB 2457105 B	21/09/2011
		JP 2011-511224 A	07/04/2011
		JP 5736425 B2	17/06/2015
		KR 10-2010-0114919 A	26/10/2010
		US 2010-0329811 A1	30/12/2010
		US 2013-0287516 A1	31/10/2013
		US 8491243 B2	23/07/2013
		US 8851813 B2	07/10/2014
		WO 2009-098431 A1	13/08/2009
KR 10-2005-0037765 A	25/04/2005	None	

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SOVESKY, Robert, J.

K&L Gates LLP 210 Sixth Avenue K&L Gates Center
Pittsburgh, PA 15222-2613 USA

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	**07 November 2019 (07.11.2019)**
Applicant's or agent's file reference 180639PCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2019/016973	**07 February 2019 (07.02.2019)**	

International Patent Classification (IPC) or both national classification and IPC

F16B 7/14(2006.01)i

Applicant
ARCONIC INC.

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR	Date of completion of this opinion	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	06 November 2019 (06.11.2019)	HWANG, Chan Yoon Telephone No. +82-42-481-3347

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:
      ☐ in the form of an Annex C/ST.25 text file.
      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Petitioner's Ex. 1003-378

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: JP 51-101469 U (HUCK MANUFACTURING COMPANY) 14 August 1976
D2: JP 03-060608 U (TOKIN CORP.) 14 June 1991

I. Novelty and Inventive Step (PCT Article 33(2) and (3))

1. Claims 1-15

1.1. Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a blind fastener comprising: a sleeve (5) comprising a first sleeve end (9), a second sleeve end (8), a cavity (7) extending from the first sleeve end to the second sleeve end; and a mandrel (6) configured to be at least partially received by the cavity of the sleeve, the mandrel comprising a first mandrel end disposed adjacent to the first sleeve end (9) and comprising an enlarged portion (11) having a diameter greater than a diameter of the cavity (7), a second mandrel end comprising a pull region (20), and a shank region extending intermediate the first mandrel end and the second mandrel end, wherein the pull region (20) comprises an axial length greater than 4 times a diameter of the shank region (see claim 1 and figures 1-2).

Claim 1 differs from D1 in that a pull region comprises an axial length no greater than 4 times a diameter of a shank region and is configured to be engaged by an installation tool. However, D2 discloses that a pull region comprises an axial length no greater than 4 times a diameter of a shank (10) and is configured to be engaged by an installation tool (9) (see claim 1 and figures 1-5).

Continued on Supplemental Box

Petitioner's Ex. 1003-379

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2019/016973

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 4-12, 14-15 and 19-20 do not comply with PCT Rule 6.4(a) because multiple dependent claims should not serve as a basis for any other multiple dependent claim.
(Note: The written opinion has been established on the assumption that claims 4-12, 14-15 are dependent on claim 1; and that claims 19-20 are dependent on claim 16.)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Box No. V

Accordingly, claim 1 would have been obvious over D1 in view of D2. Therefore, claim 1 does not involve an inventive step.

1.2. Claims 2-15

The additional features of claims 2-3 would be easily conceived from the disclosure of D2 considering that a pull region has a length and that a length of the pull region is easily modified or optimized by the person skilled in the art (see claim 1 and figures 1-5).

The additional feature of claim 4 would be easily conceived from the disclosure of D1 considering that a pull region (20) comprises a taper extending from a shank region (see claim 1 and figures 1-2).

The additional feature of claim 5 would be easily conceived from the disclosure of D2 considering that a mandrel (1) does not comprise a breakneck groove (see claim 1 and figures 1-5).

The additional features of claims 6-7 are merely matters of design option when the general technical knowledge about the state of the art is used.

The additional features of claims 8-9 would be easily conceived from the disclosure of D1 considering that a mandrel (6) comprises threaded region and a groove (see claim 1 and figures 1-2).

The additional feature of claim 10 would be easily conceived from the disclosure of D1 considering that a sleeve (5) is generally cylindrical and a mandrel (6) is generally cylindrical (see claim 1 and figures 1-2) .

The additional feature of claim 11 is well known in this technical field.

The additional feature of claim 12 would be easily conceived from the disclosure of D1 considering that a blind fastener is adapted to be installed in a bore in a structure (2,3), the bore having a diameter greater than the diameter of an enlarged portion (11) (see claim 1 and figures 1-2).

Continued on The Next Page

Petitioner's Ex. 1003-381

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Previous Page

The additional feature of claim 13 would be easily conceived from the disclosure of D1 considering that a second sleeve end (8) comprises a collar (10), the sleeve end (8) is configured to deform on a first side of the structure (see claim 1 and figures 1-2).

The additional features of claims 14-15 are well known in this technical field.

Accordingly, claims 2-15 would have been obvious over D1 in view of D2. Therefore, claims 2-15 do not involve an inventive step.

2. Claims 16-20

2.1. Claim 16

D1, which is considered to be the closest prior art to the subject matter of claim 16, discloses a blind fastener comprising: a sleeve (5) comprising a first sleeve end (9), a second sleeve end (8), a cavity (7) extending from the first sleeve end to the second sleeve end; and a mandrel (6) configured to be at least partially received by the cavity of the sleeve, the mandrel comprising a first mandrel end disposed adjacent to the first sleeve end (9) and comprising an enlarged portion (11) having a diameter greater than a diameter of the cavity (7), a second mandrel end comprising a pull region (20), and a shank region extending intermediate the first mandrel end and the second mandrel end, wherein the pull region (20) comprises an axial length greater than 4 times a diameter of the shank region (see claim 1 and figures 1-2).

Claim 16 differs from D1 in that it further comprises: engaging a collet of the installation tool with the pull region of the blind fastener; after the inserting, forcibly contacting the second sleeve end of the blind fastener with an anvil of the installation tool and moving the pull region distal from the second sleeve end utilizing the collet of the installation tool; and deforming the sleeve on a first side of the structure, and swaging the second sleeve end onto the shank region on an oppositely disposed second side of the structure, thereby securing at least a portion of the blind fastener in the structure. However, D1 discloses that a sleeve end (8) is configured to deform on a first side of a structure (see claim 1 and figures 1-2) and D2 discloses that a pull region comprises an axial length no greater than 4 times a diameter of a shank (10) and is configured to be engaged by an installation tool (9) and a collet (3) of the

Continued on The Next Page

Petitioner's Ex. 1003-382

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of : Previous Page

installation tool (9) is engaged with a mandrel (1) of a blind fastener (see claim 1 and figures 1-5).

Accordingly, claim 16 would have been obvious over D1 in view of D2. Therefore, claim 16 does not involve an inventive step.

2.2. Claims 17-20

The additional feature of claim 17 would be easily conceived from the disclosure of D2 considering that a pull region has a length and that a length of the pull region is easily modified or optimized by the person skilled in the art (see claim 1 and figures 1-5).

The additional feature of claim 18 would be easily conceived from the disclosure of D1 considering that a pull region (20) comprises a taper extending from a shank region (see claim 1 and figures 1-2).

The additional feature of claim 19 would be easily conceived from the disclosure of D2 considering that a mandrel (1) does not comprise a breakneck groove (see claim 1 and figures 1-5).

The additional feature of claim 20 is well known in this technical field.

Accordingly, claims 17-20 would have been obvious over D1 in view of D2. Therefore, claims 17-20 do not involve an inventive step.

II. Industrial Applicability (PCT Article 33(4))

Claims 1-20 are industrially applicable.

Petitioner's Ex. 1003-383

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	
First Named Inventor	Robert B. WILCOX
Title	BLIND FASTENER AND METHOD OF INSTALLATION THEREOF
Art Unit	
Examiner Name	
Attorney Docket Number	118508/US01/PCTNS/180639PCTUS

SIGNATURE of Applicant or Patent Practitioner

Signature	/Robert J. Sovesky/	Date (Optional)	
Name	Robert J. Sovesky	Registration Number	73,798
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 minutes 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 29270

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Howmet Aerospace Inc.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	April 2, 2020
Name	Frederic T. Tenney		
Title	Chief Intellectual Property Counsel / Howmet Aerospace Inc.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 minutes 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. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Sheet No. 6

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)

The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

Declaration of inventorship (Rules 4.17(iv) and 51*bis*.1(a)(iv))
for the purposes of the designation of the United States of America:

I hereby declare that I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26*ter*).

I hereby declare that the above-identified international application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Name: Robert B. Wilcox

Residence: McGregor, Texas
(city and either US state, if applicable, or country)

Mailing Address: 354 Elm Grove Circle

McGregor, Texas 76657

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

Name: James Thomas Smith

Residence: Crawford, Texas
(city and either US state, if applicable, or country)

Mailing Address: 5019 Bosque Ridge Road

Crawford, Texas 76638

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

Name: Troy Don Pierce

Residence: Hewitt, Texas
(city and either US state, if applicable, or country)

Mailing Address: 1301 Wentwood Circle

Hewitt, Texas 76643

US

Inventor's Signature: [signature] Date: 2/6/2019
(The signature must be that of the inventor, not that of the agent)

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".