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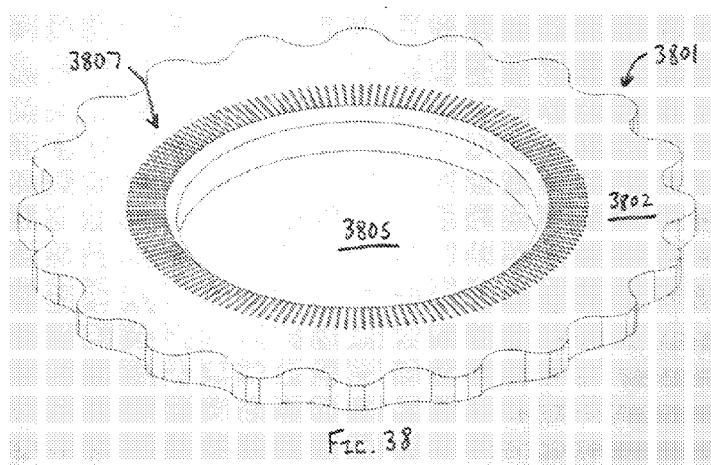
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(54) Title: APPARATUS FOR TIGHTENING THREADED FASTENERS



(57) Abstract: This Application seeks to protect Applicant's HYTORC® Z® System which involves: tools having multi-speed / multi-torque modes with torque multiplication and vibration mechanisms without use of external reaction abutments; a force transfer means to yield in-line co-axial action and reaction for use with such tools; driving means and shifting means capable of attaching to washers under the nut for use with such tools and force transfer means; associated washers and fasteners for use with such tools, force transfer means and driving means; and related accessories for use with such tools, force transfer means, driving means, washers and fasteners. The HYTORC® Z® System includes the following: Z® Washers located under nuts or bolt heads of various types having engageable perimeters of multiple shapes, sizes, geometries and serrations, such as washer/fastener radius engagement differentials, and frictionally biased faces with relatively higher friction against the flange surface and relatively lower friction against the nut, such as friction coefficient increasing treatment means of various types, sizes and locations; HYTORC Z® Guns incorporating a powerful intermittent (impact, vibration, ultrasonic, etc.) mechanism, a precise torque multiplier in the same tool combining rapid run-down with calibrated torque; HYTORC® Z® Sockets with dual drive coaxial action and reaction having outer sleeves to react on Z® Washers and an inner sleeves to turn nuts or bolt heads; HYTORC® Z® Spline Adapters and Reaction Plates for backwards compatibility with HYTORC®'s torque/tension systems including the AVANTI® and ICE® square drive systems, the STEALTH® limited clearance system, the pneu-



DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

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matic jGUN® series, the FLASH® Gun and LITHIUM Series electric multipliers and more; the combination of HYTORC Z® Washer and the HYTORC® Z® Dual Friction Washer™ including a dual friction- enhanced face washer and/or the HYTORC® Z® Nut/Bolt for counter-torque under a nut or bolt head on the other side of the joint; HYTORC® Z® Dual Drive Offset Links for tight clearances while using HYTORC®'s torque/tension systems; HYTORC® Z® Vibration Mechanisms applied thereof; Z®-Squirter® Washers; Z®- DTI Washers; HYTORC® Z® Washer and Nut Assemblies; Anti-Loosening Z® Washers; and any combinations thereof. Further disclosures include: Tapered Fastener Assemblies; Tapered Torsional Couplings; Two-Part Tapered Nut Assemblies; Two-Part Tapered Thread Nut Assemblies; HYTORC® Anti- Loosening Z® Washers, Nuts and SMARTSTUDS; and any combinations thereof.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/059438

A. CLASSIFICATION OF SUBJECT MATTER
INV. B25B21/00 B25B23/00 B25B23/14 F16B1/00 F16B43/00
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)
B25B F16B

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 10 107 325 B2 (DAVIS JOHN D [US]; SCHNEEBERGER JOHANNES P [US] ET AL.) 23 October 2018 (2018-10-23)	1-3, 5-13,40
Y	figure 1	24-26,28
X	US 2 675 844 A (KARL KNOHL FRIEDRICH) 20 April 1954 (1954-04-20)	1-4, 7-13,40
Y	figure 1	24-27
A	WO 2015/100115 A2 (HYTORC DIVISION UNEX CORP [US]) 2 July 2015 (2015-07-02) figure 1	1
Y	US 2017/130758 A1 (TURNER F JONATHAN M [US] ET AL) 11 May 2017 (2017-05-11) figure 4C	24-28
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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

"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

4 May 2020

Date of mailing of the international search report

26/05/2020

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/059438

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/176518 A2 (HYTORC DIVISION UNEX CORP [US]) 3 November 2016 (2016-11-03) figures 23, 29 -----	14-39
A	WO 2017/201119 A1 (APPLIED BOLTING TECH [US]) 23 November 2017 (2017-11-23) figures 3, 4 -----	14-23
A	US 5 946 789 A (JUNKERS JOHN K [US]) 7 September 1999 (1999-09-07) cited in the application figure 1 -----	29
A	US 5 888 041 A (JUNKERS JOHN K [US]) 30 March 1999 (1999-03-30) cited in the application figure 1 -----	29

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/059438

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-13, 24-28, 40

A reaction washer for receiving counter torque generated due to tightening or loosening of a threaded fastener including: an outer edge having a geometric shape that allows for rotational coupling with a power tool; a bottom surface having friction coefficient increasing treatment means biased in areas outward from a center bore; and a top surface characterized by

- the washer is an anti-loosening washer
- the top surface has friction coefficient increasing treatment means biased in areas toward the center bore

2. claims: 14-23

A reaction washer for receiving counter torque generated due to tightening or loosening of a threaded fastener including: an outer edge having a geometric shape that allows for rotational coupling with a power tool; a bottom surface having friction coefficient increasing treatment means biased in areas outward from a center bore; and a top surface characterized by

- the washer is a direct tension indicating washer
- the bottom surface has a discrete indentation; and
- the top surface has a discrete protuberance formed thereon.

3. claims: 29-39

A washer with a bottom surface having friction coefficient increasing treatment means biased in areas outward from a center bore characterized by an anti-loosening, self-reacting mechanical tensioning nut including: an inner sleeve; and an outer sleeve.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/059438

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