PCT (ANNEX - FEE CALCULATION SHEET)

(Original in Electronic Form)

(This sheet is not part of and does not count as a sheet of the international application)

		11 March 2020 (11.03.2020)			
0	**For receiving Office use only**				
0-1	International Application No.	PCT/US20/22094			
0-2	Date stamp of the receiving Office	11 March 2020 (11.03.2020)			
0-4	**Form PCT/RO/101 (Annex) PCT Fee Calculation Sheet**				
0-4-1	Prepared Using	**ePCT-Filing for data package download Version 4.6.012 MT/FOP 20200302/1.1**			
0-9	**Applicant's or agent's file reference**	**SHOLD-013WO**			
2	**Applicant**	**SHOULDER INNOVATIONS, INC.**			
12	**Calculation of prescribed fees**	Fee amount/multiplier	Total amounts (USD)		
12-1	Transmittal fee **T**	➪	**120**		
12-2-1	Search fee **S**	➪	**1040**		
12-2-2	International search to be carried out by	**US**			
12-3	International filing fee (first 30 sheets) **i1**	**1337**			
12-4	Remaining sheets	**12**			
12-5	Additional amount **(X)**	**15**			
12-6	Total additional amount **i2**	**180**			
12-7	i1 + i2 = **i**	**1517**			
12-12	Electronic Filing reduction (Image) **R**	**-201**			
12-13	Total International filing fee (i-R) **I**	➪	**1316**		
12-17	Fee for restoration of priority rights **RP**				
	Number of requests for restoration of priority rights	**0**			
	Total amount of fees for restoration of priority rights				
12-19	**TOTAL FEES PAYABLE (T+S+I+P+RP)**	➪	**2476**		
12-21	**Mode of payment**	**Credit card**			
12-22	**Payment contact**	**erika.vermill@knobbe.com**			

PCT REQUEST

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0	**For receiving Office use only**	
0-1	International Application No.	PCT/US20/22094
0-2	International Filing Date	11 March 2020 (11.03.2020)
0-3	Name of receiving Office and "PCT International Application"	PCT INTERNATIONAL APPLICATION RO/US
0-4	**Form PCT/RO/101 PCT Request**	
0-4-1	Prepared Using	**ePCT-Filing for data package download Version 4.6.012 MT/FOP 20200302/1.1**
0-5	**Petition**	
	The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	**United States Patent and Trademark Office (USPTO) (RO/US)**
0-7	**Applicant's or agent's file reference**	**SHOLD-013WO**
I	**Title of Invention**	**TOTAL REVERSE SHOULDER SYSTEMS AND METHODS**
II	**Applicant**	
II-1	This person is	**Applicant only**
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II-6	State of nationality	**US**
II-7	State of residence	**US**
II-10	e-mail	**instructions@knobbe.com**
II-10(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	**exclusively in electronic form (no paper notifications will be sent)**
III-1	**Applicant and/or inventor**	
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IV-1	**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**
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IV-1-5(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	**exclusively in electronic form (no paper notifications will be sent)**
IV-1-6	Agent's registration No.	**34,115**
V	**DESIGNATIONS**	
V-1	**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.**	

PCT REQUEST

(Original in Electronic Form)

VI-1	**Priority claim of earlier national application**		
VI-1-1	Filing date	**11 March 2019 (11.03.2019)**	
VI-1-2	Number	**62/816,708**	
VI-1-3	Country or Member of WTO	**US**	
VI-2	**Priority document request**		
	The International Bureau is requested to obtain from a digital library a certified copy of the earlier application(s) identified above as item(s), using, where applicable, the access code(s) indicated:	**VI-1 Access code: 9457**	
VI-3	**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.		
VII-1	**International Searching Authority Chosen**	**United States Patent and Trademark Office (USPTO) (ISA/US)**	
VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	-	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	
IX	**Check list**	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	**4**	✓
IX-2	Description	**14**	✓
IX-3	Claims	**2**	✓
IX-4	Abstract	**1**	✓
IX-5	Drawings	**21**	✓
IX-6a	Sequence listing part of the description (also to be used for the purposes of international search)	-	-
IX-7	TOTAL	**42**	
	Accompanying Items	Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	-	✓
IX-20	**Figure of the drawings which should accompany the abstract**	**1**	
IX-21	**Language of filing of the international application**	**English**	

PCT REQUEST

(Original in Electronic Form)

X-1	**Signature of applicant, agent or common representative**	**/Daniel Altman, Reg. No. 34,115/**
X-1-1	Name (LAST, First)	**ALTMAN, Daniel, E.**
X-1-3	Capacity (if such capacity is not obvious from reading the request)	**Agent**

11 March 2020 (11.03.2020)

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	11 March 2020 (11.03.2020)
10-2	**Drawings:**	
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	**ISA/US**
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

SCORE Placeholder Sheet for IFW Content

Application Number: PCT/US20/22094 Document Date: 03/11/2020

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

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

- Drawing

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

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

BACKGROUND

[0001] This application claims the benefit under 35 U.S.C. § 119(e) as a nonprovisional application of U.S. Prov. App. No. 62/816,708, which is hereby incorporated by reference in its entirety.

[0002] Shoulder replacement is a commonly performed medical procedure for treatment of osteoarthritis, rheumatoid arthritis, as well as for treatment of certain deformities related to oncological indications as well as trauma. There are two primary types of articulations available to surgeons for treatment: anatomic and reverse. With anatomic, the surgeon replaces the articular surfaces with industrial materials such that the articulating surfaces are substantially the same shape as the natural anatomy. A stem can be commonly fixed inside the canal of the humerus, a metallic articular head can be rigidly fixed to the proximal aspect of the same, the articular head having a convex articular surface adapted to articulate with the glenoid implant. The glenoid implant can include on its back side (medial side) certain pegs or posts or fins adapted to be rigidly fixed within the glenoid fossa of the scapula and on its front side a concave or flat articular surface adapted to articulate with the humeral head of the humeral implant.

[0003] When a reverse prosthesis is used, the articular surface is reversed in that the metallic ball is rigidly fixed to the glenoid fossa of the scapula, and the concave articular surface is rigidly fixed to the humeral bone, thereby reversing the fashion of articulation of the prosthesis.

[0004] The surgeon chooses between the two types of prostheses by assessing a number of conditions of the patient including level of pain, patient activity level, deformity or severity of the boney degradation, the strength of surrounding soft tissues, and present or absence of prior surgery, and particularly the health and strength of the rotator cuff muscle and tendon. Disease of the rotator cuff is common among patients with arthritis of the shoulder. In this circumstance, it is commonly observed that the absence of insufficiency of the rotator cuff leads to a condition where the anatomic shoulder replacement prosthesis is

not sufficiently stabilized by surrounding soft tissue. In this case, a reverse shoulder replacement prosthesis can be preferred in some cases due to the higher inherent stability of the articulation. In addition, the reverse prosthesis can advantageously utilize the remaining muscles in a way they can be more effective in the absence of the other soft tissue structures by adjusting the position of the articular surfaces within the joint.

SUMMARY

[0005] In some embodiments, disclosed herein is a reverse shoulder system, comprising any number of a glenoid baseplate comprising a longitudinal axis, the glenoid baseplate further comprising a stem and a central channel within a sidewall of the stem, the stem comprising a longitudinal axis. The longitudinal axis of the glenoid baseplate can be angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem.

[0006] In some configurations, the glenoid baseplate comprises a generally disc-shaped portion extending radially outward from the central channel.

[0007] In some configurations, the stem comprises a sidewall that extends superiorly with respect to the disc portion.

[0008] In some configurations, the glenoid baseplate comprises a peripheral edge.

[0009] In some configurations, the peripheral edge comprises spaced-apart anti-rotation features.

[0010] In some configurations, the anti-rotation features comprise slots.

[0011] In some configurations, an inferior portion of the peripheral edge comprises a porous coating.

[0012] In some configurations, an inferior surface of the generally disc-shaped portion comprises a porous coating, but a superior surface does not comprise a porous coating.

[0013] In some configurations, the peripheral edge and/or an inferior surface of the baseplate comprises a conical geometry.

[0014] In some configurations, an inferior surface of the baseplate is concave.

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[0015] In some configurations, the stem comprises a Morse taper lock superior to a superior-most portion of the generally disc-shaped portion of the glenoid baseplate.

[0016] In some configurations, the system further comprises a glenosphere.

[0017] In some configurations, the glenosphere comprises a superior dome-shaped surface comprising a rotational control feature configured such that an inserter tool can lock the glenosphere and the baseplate to allow for rotation of the glenosphere and the baseplate together.

[0018] In some configurations, the rotational control feature comprises a spline.

[0019] In some configurations, the system further comprises a central set screw and locking nut.

[0020] In some configurations, the system further comprises a central compression screw non-integral with the baseplate and configured for placement adjacent and distal to the central set screw.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] These drawings are illustrative embodiments and do not present all possible embodiments of this invention.

[0022] FIG. 1 illustrates an embodiment of components of a total reverse shoulder system.

[0023] FIG. 2 illustrates various embodiments of humeral trays that can be utilized with total reverse shoulder systems, according to some embodiments.

[0024] FIG. 3 illustrates a variety of humeral bearing components that can be utilized with total reverse shoulder systems, according to some embodiments.

[0025] FIG. 4 illustrates schematically an embodiment of a glenoid baseplate configured to be inset into the glenoid.

[0026] FIG. 5 illustrates schematically an embodiment of a glenoid baseplate 500 configured to be inset into the glenoid.

[0027] FIG. 6 illustrates a threaded locking insert for a central channel of a stem/post, according to some embodiments.

[0028] FIG. 7 illustrates various views of glenospheres, according to some embodiments.

[0029] FIG. 8 illustrates a schematic cross-section of a fully assembled glenosphere with a locking bolt, according to some embodiments.

[0030] FIGS. 8A-8U illustrate a glenoid surgical technique, according to some embodiments.

[0031] FIG. 9 illustrates an embodiment of a sizer/angle guide.

[0032] FIG. 10 illustrates an embodiment of a stem drill guide.

[0033] FIG. 11 schematically illustrates a stem angle change with a rotational adjustment.

[0034] FIG. 12 schematically illustrates views of a glenoid baseplate inserter (alone on the left and together with a baseplate on the right), according to some embodiments. .

[0035] FIG. 13 schematically illustrates views of a calibrated central drill, according to some embodiments. .

[0036] FIG. 14 schematically illustrates views of fixed angle peripheral drill guides, according to some embodiments. .

[0037] FIG. 15 schematically illustrates views of variable angle peripheral drill guides, according to some embodiments.

[0038] FIG. 16 schematically illustrates side and top views of central screws, according to some embodiments.

[0039] FIG. 17 schematically illustrates side and top views of fixed angle peripheral compression screws, according to some embodiments.

[0040] FIG. 18 schematically illustrates side and top views of variable angle peripheral screws, according to some embodiments.

[0041] FIG. 19 schematically illustrates views of a glenosphere inserter, according to some embodiments.

DETAILED DESCRIPTION

[0042] In some embodiments, disclosed herein are various embodiments of a total reverse shoulder system, including a variety of humeral trays, humeral bearings, inset glenoid baseplates, threaded locking inserts, and glenospheres. Glenoid surgical techniques are also described, which can utilize various tools including but not limited to sizer/angle guides, stem drill guides, glenoid baseplate inserters, calibrated central drills, peripheral drill guides with fixed or variable angles, central screws, fixed angle peripheral compression screws, variable angle peripheral screws, and glenosphere inserters. Dimensions listed on the accompanying Figures are non-limiting examples only.

[0043] FIG. 1 illustrates an embodiment of components of a total reverse shoulder system, including a glenosphere 200 and a glenoid baseplate 102 which can be partially or completely inset in some embodiments. The glenoid baseplate 102 can be a generally disc-shaped structure and include a central aperture defining a surface of (e.g., integral with an elongate stem), or configured to fit an elongate stem or post therethrough. The glenoid baseplate 102 can include a longitudinal axis that is at an angle to a longitudinal axis of the elongate stem 100. The longitudinal axis of the glenoid baseplate 102 can be at an angle, such as generally oblique with respect to the longitudinal axis of the elongate stem 100. In some embodiments, the angle is an acute angle, and not a right angle. The angle between the two intersecting longitudinal axes of the respective baseplate 102 and the stem 100 could be, for example, about, at least about, or no more than about 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, or more or less degrees, or ranges including any two of the foregoing values.

[0044] FIG. 2 illustrates various embodiments of humeral trays that can be utilized with total reverse shoulder systems, according to some embodiments. The humeral trays can include various inner diameters IDs and outer diameters ODs, including 30mm, 32mm, 34mm, 36mm, 38mm, 40mm, 42mm, or more or less IDs and/or ODs, and ranges including any two of the foregoing values. The trays can include one or more pegs, such as a central peg extending from a medial surface. The trays can be neutral, or include extensions (e.g., in thickness) that can be, for example, +2, 4, 6, 8, 10, 12mm, or ranges including any two of the foregoing values. The trays can include various cross-sections, including oval or

round cross-sections. The trays can be compatible with the same poly bearing surfaces in some cases. In some embodiments, a kit can include at least four different sizes of trays (34mm oval neutral; 34mm oval +6mm extension; 38mm round neutral; 38mm round +6mm extension.

[0045] FIG. 3 illustrates a variety of humeral bearing components that can be utilized with total reverse shoulder systems, according to some embodiments, including humeral trays as illustrated and described in connection with FIG. 2. The bearing components can include, for example, a peripheral ring 302 and a central recessed portion that can be outlined radially outwardly by an inner edge of the peripheral ring, and an inner bowl-shaped portion 304. The peripheral ring can include indicia, such as a slot or other marking 399 illustrating the highest point of the bearing component. Also illustrated is the recessed poly dome 395, and a partial or full annular barb 397 around the outer circumference of the bearing component. The bearing component can include a variety of geometries include neutral, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 degree angles to horizontal, or ranges including any two of the foregoing values. In some embodiments, the bearing component does not change the joint center. In some embodiments, the bearing component can include 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45mm, or more or less spherical diameters, or ranges including any two of the foregoing values. In some embodiments, systems and methods can include an offset of 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10mm, or ranges including any two of the foregoing values.

[0046] FIG. 4 illustrates schematically an embodiment of a glenoid baseplate configured to be inset into the glenoid G as illustrated. The longitudinal axis of the baseplate can be angled with respect to the longitudinal axis of the stem/post as described, for example, with respect to FIG. 1, and can include a version change 499 to compensate for posterior bony defects. In some embodiments, the glenoid baseplate includes a central channel therethrough defining a surface of (e.g., integral with an elongate stem), or configured to fit configured to house a stem/post as shown. The glenoid baseplate can include a generally conical shape with a concave undersurface configured to rest within a reamed surface of glenoid bone, which advantageously allows for a single rotary reamer to be utilized, in contrast to conventional glenoid baseplates with flat undersurfaces that require a two-step

reaming process. The post 493 can have a length of about, at least about, or no more than about 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10, 10.5, 11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15mm or more or less, or ranges including any two of the foregoing values. In some embodiments, the central channel and/or stem can include a female Morse taper 497 of about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or more or less degrees, including ranges incorporating any two of the foregoing values. As shown in the right illustration of FIG. 4, the baseplate can be configured to pivot around the stem/taper at arrow 495 for version correction and to allow for a direct bone-implant interface without requiring augmentation. In some embodiments, the system can be configured to provide version angle corrections of, for example, about 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20 degrees or more or less, or ranges including any two of the foregoing values. In some embodiments, the baseplate could have a diameter of about, at least about, or no more than about 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40mm, or more or less, or ranges including any two of the foregoing values. The baseplate can advantageously pivot around the central stem with a Morse taper for version correction and allows for a direct bone-implant interface.

[0047] FIG. 5 illustrates schematically an embodiment of a glenoid baseplate 500 configured to be inset into the glenoid (not shown in FIG. 5). The longitudinal axis of the baseplate 500 can be angled with respect to the longitudinal axis of the stem/post 510 as described, for example, with respect to FIGS. 1 and 4 above. The baseplate 500 could have a generally arcuate peripheral edge. The peripheral edge could include spaced-apart anti-rotational slots 521 directed generally transverse to a longitudinal plane of the baseplate 500. In some embodiments, the peripheral edge of the baseplate 500 can taper (e.g., decrease) in diameter from a superior to inferior dimension. A central channel can extend through the baseplate 500, as well as include a superiorly-extending sidewall or lip 511 somewhat similar to the side slopes of a volcano. The central channel can defining a surface of (e.g., integral with an elongate stem), or configured to fit be configured to house the stem/post 510 therethrough. The baseplate 500 can also include a plurality of regularly or irregularly spaced-apart secondary (peripheral) channels 555 spaced radially outward from the central channel of the baseplate and configured to house fixed and variable angle screws therethrough. The secondary channels 555 can be asymmetric and include superiorly-

extending portions 556 that can extend into and interrupt the superiorly-extending sidewall or lip 511 of the central channel of the baseplate 500. The baseplate 500 can include a porous coating 585 on the entire, or only a part of the peripheral edge and/or an inferior surface (e.g., undersurface) of the baseplate 500 to promote bone ingrowth, for example.

[0048] Still referring to FIG. 5, the stem/post 510 could have an internal taper, such as a Morse taper, of about, at least about, or no more than about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 degrees, or more or less, or ranges including any two of the foregoing values. The stem/post 510 can also include a rotational control feature 545 along an outer diameter of the stem/post 510, and in some embodiments superiorly with respect to the uppermost surface of the sidewall 511 of the central channel of the glenoid baseplate 500 as shown. The rotational control feature 545 could be non-circular or non-arcuate, such as a hexagonal shape as shown for example. The stem/post 510 can also include a central channel and include a Morse taper lock 535 configured to mate with a glenosphere (not shown). The Morse taper lock can extend superiorly with respect to the uppermost surface of the sidewall 511 of the central channel of the glenoid baseplate 500. The central channel of the stem/post 510 can be configured to house a primary screw (not shown) therethrough, which can be a variable angle primary screw, and optionally locking.

[0049] FIG. 6 illustrates a threaded locking insert 600 for a central channel of a stem/post, according to some embodiments. The insert 600 can include an outer male thread 602 and configured to go into the central channel of a baseplate. The outer diameter of the insert can also include a hexagonal geometry portion 604 at the superior end, of about, at least about, or no more than about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10mm or more or less, or ranges including any two of the foregoing values. The hexagonal geometry portion 604 can be configured to serve as a rotational control feature in some embodiments. The insert 600 can also include a female thread 608 configured to receive a supplemental glenosphere locking screw (not shown), and a spherical surface 612, for example, at its inferior end to lock a variable angle screw.

[0050] FIG. 7 illustrates various views of glenospheres, according to some embodiments. The left image illustrates a glenosphere with a rotational control feature 702, which can include a spline, such as an asymmetric spline, and configured to advantageously

allow for rotational control about the spline and allow an inserter tool to lock and rotate the glenosphere together with another component, such as a baseplate. The glenosphere can also include one or more indicia, such as an eccentric rotational mark 704. The glenosphere can include a generally dome-shaped surface 714, a cavity 706 with an inferior-facing opening 708, and a hollow post including a morse taper lock 711 into the baseplate. The glenosphere could be a full hemisphere, or short of a full hemisphere by a distance 720 of about, at least about, or no more than about 0.5mm, 0.75mm, 1mm, 1.25mm, 1.5mm, 1.75mm, 2mm, 2.25mm, 2.5mm, 2.75mm, 3mm, or more or less, or ranges including any two of the foregoing values.

[0051] Still referring to FIG. 7, in some embodiments, the glenosphere can include an articulating diameter of about, at least about, or no more than about 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50mm, or more or less, or ranges including any two of the foregoing values. In some embodiments, systems and methods can include an offset and/or eccentric dimension of 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10mm, or ranges including any two of the foregoing values. In some embodiments, the glenosphere has a neutral geometry. In some embodiments, a glenosphere 724 is offset by about +3mm or about 6mm, for example. In some embodiments, a glenosphere 722 has an eccentric dimension of between about 2mm and about 4mm. In some embodiments, a secondary locking screw can be utilized together with the glenosphere.

[0052] FIG. 8 illustrates a schematic cross-section of a fully assembled glenosphere with a locking bolt, according to some embodiments, along with the baseplate. The glenosphere can include a central channel therethrough including a rotational control feature 702 at, for example, a superior-most portion that can be as described elsewhere herein. The central channel can also include a threaded surface 808 for an inserter/head extractor, such as inferior to the rotational control feature 702, and optionally be configured to accommodate a secondary locking screw at 810, to push and/or rotate with the post of the baseplate. A post of the glenosphere can be placed at least partially within a central channel of the baseplate as illustrated. A central set screw/locking nut 814 can be connected to, and in some cases removably attachable to a central channel, e.g., of the glenoid baseplate, and have an end adjacent or directly touching an end of a central compression screw 816, which can

include a diameter of, for example, of about, at least about, or no more than about 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10mm, or more or less, or ranges including any two of the foregoing values. The central compression screw can be configured to angulate with respect to the baseplate, and advantageously allow for the use of a locking screw.

[0053] Figures 8A-8U illustrate a glenoid surgical technique, according to some embodiments, which can include any number of the following actions. FIG. 8A illustrates a glenoid surface with an A3-E3 defect. A sizer/angle guide can be placed as in FIG. 8B. A wire guide/wire can be placed in FIG. 8C. The wire guide and sizer/angle guide can be removed, as in FIG. 8D. The glenoid surface can then be reamed for the baseplate, as in FIGS. 8E and 8F. The stem drill guide can then be placed and adjusted in FIG. 8G. A hole for a stem can then be drilled in FIGS. 8H and 8I. The baseplate can then be inserted, as shown in FIG. 8J, and the threaded rod removed, as shown in FIG. 8K. A central cavity can be drilled, and the length of a central screw to be placed determined, in FIG. 8L. The drill can be removed in FIG. 8M, and the screw and screw driver placed through the shaft, and the screw tightened in FIG. 8N. The baseplate inserter handle can be removed in FIG. 8O, and holes can be drilled for the peripheral locking screws in FIG. 8P. Holes can be drilled for variable angle screws, as shown in FIG. 8Q. The peripheral screws can be inserted and tightened in FIG. 8R. The central set screws and secondary locking nuts can be inserted and tightened in FIG. 8S. The glenosphere can be inserted in FIG. 8T, and the locking bolt inserted and tightened in FIG. 8U.

[0054] FIG. 9 illustrates an embodiment of a sizer/angle guide including an inferior tilt mechanism 902. The mechanism could be fixed to a set angle (e.g., about 0, 5, 10, 15, 20, 25 degrees, or ranges including any two of the foregoing values), or adjustable in some embodiments. The mechanism could be round or oval shaped in some embodiments, and include a slot (e.g., posterior or posterior inferior) to allow for removal. The inferior tilt mechanism 902 could include a set screw with a calibrated window, or individual depth screws in some cases.

[0055] FIG. 10 illustrates an embodiment of a stem drill guide, that can include a diameter of about, at least about, or no more than about 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40mm or more or less, or ranges including any

two of the foregoing values. The drill guide could include a version angle of, for example, about 0, 5, 10, 15, 20, 25 degrees or more or less, or ranges including any two of the foregoing vales. In some embodiments, the larger the version angle, the more stem tilt is generated as rotation occurs.

[0056] FIG. 11 schematically illustrates a stem angle change with a rotational adjustment (e.g., about 30 degrees), and an angled version plate (e.g., about 15 degrees) as a non-limiting example. Anterior-posterior and inferior-superior views are illustrated.

[0057] FIG. 12 schematically illustrates views of a glenoid baseplate inserter (alone on the left and together with a baseplate on the right), according to some embodiments. The baseplate inserter can be configured for any number of: positive rotational control; slim design to allow visualization through screw holes to know when seated; and/or a multi-function handle allows for drilling central screw hole, and inserting a central screw.

[0058] FIG. 13 schematically illustrates views of a calibrated central drill, according to some embodiments. Calibrated marks/indicia 902 at spaced-apart desired increments (e.g., 5mm increments in some embodiments) near the proximal end of the instrument can help to determine the length of a central screw that may be needed. The calibration length can start at, for example, about, at least about, or no more than about 15mm, 20mm, 25mm, 30mm, 35mm, 40mm, or more or less, including any two of the foregoing values and may advantageously allow for a surgical step to be cut out.

[0059] FIG. 14 schematically illustrates views of fixed angle peripheral drill guides, according to some embodiments. The drill guides can be configured to fit over a geometry, such as a polygonal shaped portion (e.g., octagon) on the top of the baseplate, and the operator can then determine which fixed angle screws to drill.

[0060] FIG. 15 schematically illustrates views of variable angle peripheral drill guides, according to some embodiments.

[0061] FIG. 16 schematically illustrates side and top views of central screws, according to some embodiments, including a head 1601, threaded shaft 1602, and distal tapered portion. In one embodiment, the screw can have a 6.5mm head, and 6mm threaded shaft, although various size ranges and increments are possible, including about, at least about, or no more than about 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10mm, or more

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or less head and/or threaded shaft diameters, or ranges including any two of the foregoing values. In some embodiments, a central screw can include a total or working length of about, at least about, or no more than about 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70mm, or more or less, or ranges including any two of the foregoing values. In some embodiments, anodization of the screw can optionally be present to help differentiate the screws. The screw head could have various internal feature geometries 1603, including a T20 hexalobe configuration in some embodiments.

[0062] FIG. 17 schematically illustrates side and top views of fixed angle peripheral compression screws, according to some embodiments, including a head 1701, double-lead thread 1703 proximal to a threaded shaft 1702, and distal tapered portion. The screws can be various size ranges and increments, and include T20 hexalobe or other internal head feature geometries 1704 as described elsewhere herein. In one embodiment, the head could be about 5.7mm in diameter, with a 4.5mm threaded shaft diameter, or dimensions listed elsewhere herein, such as in connection with FIG. 16 for example.

[0063] FIG. 18 schematically illustrates side and top views of variable angle peripheral screws, according to some embodiments, including a head 1801, threaded shaft 1802, and distal tapered portion. The screws can be various size ranges and increments, and include T20 hexalobe or other internal head feature geometries 1803 as described elsewhere herein. In one embodiment, the head could be about 5.7mm in diameter, with a 4.5mm threaded shaft diameter, or dimensions listed elsewhere herein, such as in connection with FIGS. 16 or 17 for example.

[0064] FIG. 19 schematically illustrates views of a glenosphere inserter, according to some embodiments, which can include a distal end with a feature complementary to a spline on the glenosphere, such as described in connection with FIG. 7, for example. The glenosphere inserter can be configured to, for example, advantageously provide positive attachment to the glenosphere; allow for solid rotational control while inserting; and/or may involve a secondary impaction step after removal.

[0065] In some embodiments, embodiments of the invention can be used or modified with use with particular advantages of using inset glenoid fixation technology in anatomic shoulder arthroplasty, such as described, for example, in U.S. Pat. Nos. 8,007,538

and/or 8,778,028 to Gunther, which are hereby incorporated by reference in their entireties. Furthermore, embodiments of the invention can be used or modified with use with systems and methods as disclosed, for example, in U.S. Pub. No. 2018/0368982 to Ball, which is hereby incorporated by reference in its entirety.

[0066] Various other modifications, adaptations, and alternative designs are of course possible in light of the above teachings. Therefore, it should be understood at this time that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein. It is contemplated that various combinations or subcombinations of the specific features and aspects of the embodiments disclosed above may be made and still fall within one or more of the inventions. Further, the disclosure herein of any particular feature, aspect, method, property, characteristic, quality, attribute, element, or the like in connection with an embodiment can be used in all other embodiments set forth herein. Accordingly, it should be understood that various features and aspects of the disclosed embodiments can be combined with or substituted for one another in order to form varying modes of the disclosed inventions. Thus, it is intended that the scope of the present inventions herein disclosed should not be limited by the particular disclosed embodiments described above. Moreover, while the invention is susceptible to various modifications, and alternative forms, specific examples thereof have been shown in the drawings and are herein described in detail. It should be understood, however, that the invention is not to be limited to the particular forms or methods disclosed, but to the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the various embodiments described and the appended claims. Any methods disclosed herein need not be performed in the order recited. The methods disclosed herein include certain actions taken by a practitioner; however, they can also include any third-party instruction of those actions, either expressly or by implication. For example, actions such as "insetting an implant into a glenoid cavity" includes "instructing the insetting of an implant into the glenoid cavity." The ranges disclosed herein also encompass any and all overlap, sub-ranges, and combinations thereof. Language such as "up to," "at least," "greater than," "less than," "between," and the like includes the number recited. Numbers preceded by a term such as "approximately", "about", and "substantially" as used herein include the recited numbers (e.g., about 10% =

10%), and also represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms "approximately", "about", and "substantially" may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and within less than 0.01% of the stated amount.

WHAT IS CLAIMED IS:

1. A reverse shoulder system, comprising:

a glenoid baseplate comprising a longitudinal axis,

the glenoid baseplate further comprising a stem and a central channel within a sidewall of the stem, the stem comprising a longitudinal axis,

wherein the longitudinal axis of the glenoid baseplate is angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem.

2. The system of Claim 1, wherein the glenoid baseplate comprises a generally disc-shaped portion extending radially outward from the central channel.

3. The system of Claim 2, wherein the stem comprises a sidewall that extends superiorly with respect to the disc portion.

4. The system of Claim 1, wherein the glenoid baseplate comprises a peripheral edge.

5. The system of Claim 4, wherein the peripheral edge comprises spaced-apart anti-rotation features.

6. The system of Claim 5, wherein the anti-rotation features comprise slots.

7. The system of Claim 4, wherein an inferior portion of the peripheral edge comprises a porous coating.

8. The system of Claim 1, wherein an inferior surface of the generally disc-shaped portion comprises a porous coating, but a superior surface does not comprise a porous coating.

9. The system of Claim 4, wherein the peripheral edge and/or an inferior surface of the baseplate comprises a conical geometry.

10. The system of Claim 1, wherein an inferior surface of the baseplate is concave.

11. The system of Claim 1, wherein the stem comprises a Morse taper lock superior to a superior-most portion of the generally disc-shaped portion of the glenoid baseplate.

12. The system of Claim 1, further comprising a glenosphere.

13. The system of Claim 12, wherein the glenosphere comprises a superior dome-shaped surface comprising a rotational control feature configured such that an inserter tool can lock the glenosphere and the baseplate to allow for rotation of the glenosphere and the baseplate together.

14. The system of Claim 13, wherein the rotational control feature comprises a spline.

15. The system of Claim 12, further comprising a central set screw and locking nut.

16. The system of Claim 15, further comprising a central compression screw non-integral with the baseplate and configured for placement adjacent and distal to the central set screw.

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

A reverse shoulder system can include, for example, a glenoid baseplate comprising a longitudinal axis, the glenoid baseplate further including a stem and a central channel within a sidewall of the stem. The stem can include a longitudinal axis. The longitudinal axis of the glenoid baseplate can be angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem. Other components including a glenosphere, tools, and methods of use are also disclosed.

Figure 1

Figure 2

Figure 3
302
306
304
339
337
315

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

FIG. 8A

FIG. 8B

FIG. 8C

Fig. 8D

Fig. 8E

Fig. 8F

Fig. 8G

FIG. 8H

FIG. 8I

Fig. 8J

FIG. 8K

Fig. 8L

Fig. 8M

Fig. 8N

Fig. 8O

Fig. 8P

FIG. 8Q

Fig. 8S

Fig. 8T

Fig. 8U

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 16

Figure 17

Figure 18

Figure 19

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	Shoulder Innovations, Inc.
Filer:	Daniel E. Altman/Erika Vermill
Attorney Docket Number:	SHOLD.013WO

Filed as Small Entity

Filing Fees for International Application (PCT) for filing in the US receiving office

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
TRANSMITTAL FEE	2601	1	120	120
PCT SEARCH FEE- NO PRIOR US APPL FILED	2602	1	1040	1040
SUPPL. INTL FILING FEE (EACH PAGE > 30)	1703	12	15	180
INTL FILING FIRST 30PGS EFS W/ ZIP FILE	1710	1	1136	1136
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2476**

Electronic Acknowledgement Receipt

EFS ID:	38836539
Application Number:	
International Application Number:	PCT/US20/22094
Confirmation Number:	5922
Title of Invention:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	Shoulder Innovations, Inc.
Customer Number:	20995
Correspondence Address:	ALTMAN, Daniel, E. KNOBBE, MARTENS, OLSON & BEAR, LLP 2040 MAIN STREET 14TH FLOOR IRVINE CA 92614 US 9497600404 erika.vermill@knobbe.com
Filer:	Daniel E. Altman/Devin Vink
Filer Authorized By:	Daniel E. Altman
Attorney Docket Number:	SHOLD.013WO
Receipt Date:	11-MAR-2020
Filing Date:	
Time Stamp:	17:08:41
Application Type:	International Application (PCT) for filing in the US receiving office
Patent Number:	

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2476
RAM confirmation Number	E20203AH09073347
Deposit Account	111410
Authorized User	Devin Vink

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

37 CFR 1.445(a)(1), (a)(2), (a)(4) and (b) (International application filing, processing and search fees)

37 CFR 1.17(m) (Acceptance of an unintentionally delayed claim for priority)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	ZIP	SHOLD013WO.zip	119498 e97cce3520b2f4ffd8629820462f4294b8e4442a	yes	

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
fees.pdf	1	1
pct101.pdf	1	4

Warnings:

Information:

2		SHOLD013WOSPECIFICATION.pdf	79036 dfe66e2aada7df9c071345925fb8f8e1999a078d	yes	17

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	14
Claims	15	16
Abstract	17	17

Warnings:

Information:

3	Drawings-other than black and white line drawings	SHOLD013WODRAWINGS.pdf	9927350 7c70ea5114765dd46c493aac9cd12103be4b1b21	no	21
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	36767 960235ad77b32ab48e6976c6e8962be8bd147886	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	10289343	

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CALIFORNIA 92614

Confirmation No: 5922

PCT

NOTIFICATION OF RECEIPT
OF SEARCH COPY

(PCT Rule 25.1)

Date of mailing *(day/month/year)*	01 Apr 2020

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
SHOLD-013WO	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/022094	11 Mar 2020	11 Mar 2019

Applicant

SHOULDER INNOVATIONS, INC.

1. **Where the International Searching Authority and the receiving Office are not the same Office:**
The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

Where the International Searching Authority and the receiving Office are the same Office:
The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

01 Apr 2020 *(date of receipt)*

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing in the form of an Annex C/ST.25 text file under PCT Rule 13*ter*.1(a) for the purposes of international search only.

3. ☐ The search copy contained a nucleotide and/or amino acid sequence listing in the form of an Annex C/ST.25 text file forming part of the international application as filed.

4. **Time limit for establishment of international search report and written opinion of the International Searching Authority**
The applicant is informed that the time limit for establishing the international search report and the written opinion of the International Searching Authority is three months from the date of receipt indicated above or nine months from the priority date, whichever time limit expires later (Rules 42.1 and 43*bis*.1(a)).

A copy of this Notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the receiving Office.

Name and mailing address of the ISA/US	Authorized officer
Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450	LaShonnah Tyson
Facsimile No. 571-273-8300	Telephone No. 571-272-6628

Form PCT/ISA/202 (January 2015)

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:

DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CALIFORNIA 92614

PCT

NOTIFICATION CONCERNING PAYMENT OF PRESCRIBED FEES

(PCT Rules 12*bis*.1(c), 14, 15 and 16 and Administrative Instructions, Sections 304, 323(b) and 707)

Date of mailing *(day/month/year)*	01 Apr 2020
Applicant's or agent's file reference: SHOLD-013WO	**PAYMENT DUE** see item 3 for time limits

International application No.	International filing date/Date of receipt *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/022094	11 Mar 2020	11 Mar 2019

Applicant: SHOULDER INNOVATIONS, INC.

1. The applicant is hereby notified that this receiving Office has received:

☒ **the payment** of all the prescribed fees, and ☐ **an overpayment**, which will be refunded in due course.

☐ **no or insufficient payment** of the prescribed fees and the applicant is hereby **invited to pay the balance due**, as summarized under item 2, within the time limit(s) indicated under item 3.

2. **Fees and payment calculation:**

2,476.00	–	2,476.00	=	0.00
Total fees payable		Amount paid		Balance

☐ The details of the calculation are given in the Annex.

3. **Time limit(s) for payment and amount(s) payable (Rules 14.1, 15.3 and 16.1(f)):**

☐ within ONE MONTH from the date of receipt of the international application **(for the transmittal fee** (if any), **the search fee** and **the international filing fee)**. The amount payable for each fee is the amount applicable on the date of receipt of the international application.

☐ within 16 MONTHS from the priority date (only for the fee for priority document). The applicant's attention is drawn to the fact that the request made by the applicant under Rule 17.1(b) will be considered not to have been made unless the fee is paid within that time limit.

4. Additional observations *(if necessary)*:

☐ The search copy will not be transmitted to the International Searching Authority until the search fee is paid (therefore the start of the international search will be delayed) (Rule 23.1(a) and (b)).

Name and mailing address of the receiving Office	Authorized officer
Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450	LaShonnah Tyson
Facsimile No. 571-273-8300	Telephone No. 571-272-6628

Form PCT/RO/102 (July 2015)

ANNEX TO FORM PCT/RO/102
CALCULATION OF THE PRESCRIBED FEES
(If a reduced fee has been applied, the reduced amount is indicated.)

International application No.
PCT/US2020/022094

[T] Transmittal Fee

Prescribed amount:		120.00 [T]	[X] correct amount
Amount paid:	–	120.00	[ ] overpayment
Balance:	=	0.00	[ ] balance due

[S] Search Fee

Prescribed amount:		1,040.00 [S]	[X] correct amount
Amount paid:	–	1,040.00	[ ] overpayment
Balance:	=	0.00	[ ] balance due

[I] International Filing Fee

Prescribed amount:

Fixed amount for first 30 sheets: 1,136.00 [i1]

12 (Number of sheets in excess of 30 *(excluding pages referred to in Section 707(a-bis))*) x 15.00 (Fee per sheet) = 180.00 [i2]

Reduction where the international application is filed
(See PCT Fee tables http://www.wipo.int/pct/en/fees.pdf):

in electronic form, the request not being in character coded format – 0.00 [r]

or

inelectronic form, the request being in character coded format – 0.00 [r]

or

in electronic form, the request, description, claims and abstract being in character coded format – 0.00 [r]

Sub-total: = 1,316.00 [i1+i2-r]

Applicants from certain States are entitled to a reduction of 90% of the international filing fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 10% of the sub-total entered at (i1+i2-r); (see Notes to the Fee Calculation Sheet as annexed to the Request Form, PCT/RO/101, for details): = 1,316.00 [I] — [X] correct amount

Amount paid: – 1,316.00 — [ ] overpayment

Balance: = 0.00 — [ ] balance due

[P] Fee for Priority Document

Prescribed amount:		0.00 [P]	[X] correct amount
Amount paid:	–	0.00	[ ] overpayment
Balance:	=	0.00	[ ] balance due

[ES] Fee for Earlier Search Documents

Prescribed amount:		0.00 [ES]	[ ] correct amount
Amount paid:	–	0.00	[ ] overpayment
Balance:	=	0.00	[ ] balance due

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CALIFORNIA 92614

Confirmation No: 5922

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.2(c))

Date of mailing *(day/month/year)*	01 Apr 2020

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
SHOLD-013WO	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/022094	11 Mar 2020	11 Mar 2019

Applicant
SHOULDER INNOVATIONS, INC.

Title of the invention
TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

☒ was transmitted to the International Bureau on 01 Apr 2020 .

☐ has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

☐ because the necessary national security clearance has not yet been obtained.

☐ because *(reason to be specified)*:

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION Completed by: LT

☐ Additional license for foreign transmittal not required. This subject matter is covered by a license already granted or the equivalent U.S. national application. Refer to that license for information concerning its scope.

☐ License for foreign transmittal not required. 37 CFR. 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).

☒ Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on 31 Mar 2020 (date) :

☐ 37 CFR 5.15(a) ☒ 37 CFR 5.15(b)

Name and mailing address of the receiving Office	Authorized officer
Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450	LaShonnah Tyson
Facsimile No. 571-273-8300	Telephone No. 571-272-6628

Form PCT/RO/105 (July 2008)

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CALIFORNIA 92614

PCT

INVITATION TO CORRECT DEFECTS IN THE INTERNATIONAL APPLICATION

(PCT Articles 3(4)(i) and 14(1) and Rule 26)

Date of mailing *(day/month/year)*	01 Apr 2020
Applicant's or agent's file reference: SHOLD-013WO	**REPLY DUE** within **TWO MONTHS** from the above date of mailing
International application No.: PCT/US2020/022094	International filing date *(day/month/year)*: 11 Mar 2020
Applicant: SHOULDER INNOVATIONS, INC.	

1. ☒ The applicant is hereby **invited**, within the time limit indicated above, to correct **in the international application as filed**, the defects specified on the attached:
   - ☐ Annex A
   - ☐ Annex B1 *(text matter of the international application as filed)*
   - ☒ Annex C1 *(drawings of the international application as filed)*

2. ☐ The applicant is hereby **invited**, within the time limit indicated above, to correct, **in the translation of the international application** furnished under Rule 12.3 or 12.4, the defects specified on the attached:
   - ☐ Annex A
   - ☐ Annex B2 *(text matter of the translation of the international application)*
   - ☐ Annex C2 *(drawings of the translation of the international application)*

Additional observations (if necessary):

HOW TO CORRECT THE DEFECTS?

Except where the defect is in the request, any correction must be submitted by filing a replacement sheet embodying the correction and a letter accompanying the replacement sheet, which shall draw attention to the difference between the replaced sheet and the replacement sheet. For a defect in the request, a correction may simply be stated in a letter if it is of such a nature that the correction can be transferred clearly onto the request record copy (Rule 26.4).

ATTENTION

Failure to correct the defects will result in the international application being considered withdrawn by this receiving Office (see Rule 26.5 for further details).

A copy of this Invitation and any attachments has been sent to the International Bureau
☒ and the International Searching Authority.

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer LaShonnah Tyson Telephone No. 571-272-6628

Form PCT/RO/106 (16 September 2012)

ANNEX A TO FORM PCT/RO/106

International application No.
PCT/US2020/022094

The receiving Office has found the following defects in the international application as filed:

1. As to the **signature** of the international application (Rules 4.15, 26.2*bis*(a) and 90.4), the request:
   - a. ☐ is not signed by the applicant or, if there is more than one applicant, by at least one of them*.
   - b. ☐ is signed by what appears to be an agent/common representative, but the international application is not accompanied by a power of attorney signed by at least one of the applicants*.
   - c. ☐ other *(specify)*:

* The applicant's attention is drawn to the fact that the national law applied by each designated Office may require, in connection with the processing of the international application in the national phase, that the applicant furnish the confirmation of the international application by the signature of any applicant for the designated State who has not signed the request (Rule 51*bis*.1(a)(vi)).

2. As to the indications concerning the **applicant*** who is entitled, according to Rule 19.1, to file the international application with the receiving Office, the request (Rules 4.4, 4.5 and 26.2*bis*(b)):
   - a. ☐ does not properly indicate the applicant's name *(specify)*:
   - b. ☐ does not indicate the applicant's address.
   - c. ☐ does not properly indicate the applicant's address *(specify)*:
   - d. ☐ does not indicate the applicant's nationality.
   - e. ☐ does not indicate the applicant's residence.

☐ Further observations about indications concerning other applicants (if applicable):

* Although Rules 4.4 and 4.5 require indications concerning the applicant, or if there are several applicants, of each of them for the purposes of Article 14(1)(a)(ii), if there is more than one applicant, it shall be sufficient that the indications required under Rule 4.5(a)(ii) and (iii) be provided in respect of one of them who is entitled according to Rule 19.1 to file the international application with the receiving Office (Rule 26.2*bis*(b)).

However, the applicant's attention is drawn to the fact that the national law applied by each designated Office may require, in connection with the processing of the international application in the national phase, that the applicant furnish any missing indication required under Rule 4.5(a)(ii) and (iii) in respect of any applicant for the designated State (Rule 51*bis*.1(a)(vii)).

3. As to the **language** of certain elements of the international application, other than the description and claims (Rules 12.1(c) and 26.3*ter*(a) and (c)):
   - a. ☐ the **request** is not in a language of publication accepted by this receiving Office; (the) language(s) accepted by this receiving Office is/are:
   - b. ☐ the **text matter of the drawings** is not in the language in which the international application is to be published, which is:
   - c. ☐ the **abstract** is not in the language in which the international application is to be published, which is:

4. The **title** of the invention:
   - a. ☐ is not indicated in Box No. I of the request (Rule 4.1(a)).
   - b. ☐ is not indicated at the top of the first sheet of the description (Rule 5.1(a)).
   - c. ☐ as appearing in Box No. I of the request is not identical with the title heading the description (Rule 5.1(a)).

5. As to the **abstract** (Rules 8 and 26.1):
   - ☐ the international application does not contain an abstract.

Catalyst v. Shoulder Innovations
PGR2025-00001
Exhibit 2002
Page 55

ANNEX B1 TO FORM PCT/RO/106

International application No.
PCT/US2020/022094

This receiving Office has found that, with regard to the presentation of the **text matter of the international application as filed**, the physical requirements are not complied with to the extent that compliance therewith is necessary for:

1. ☐ reasonably uniform international publication (Rules 11 and 26.3(a)(i)) *(defects to be specified)*:

		Request	Description	Claims	Abstract
a. ☐	the sheets do not admit of direct reproduction	☐	☐	☐	☐
b. ☐	the element does not commence on a new sheet	☐	☐	☐	☐
c. ☐	sheets are not free from creases, cracks, folds	☐	☐	☐	☐
d. ☐	sheets are not used in the upright position	☐	☐	☐	☐
e. ☐	one side of the sheets is not left unused	☐	☐	☐	☐
f. ☐	the paper of the sheets is not flexible/strong/white/smooth/non-shiny/durable	☐	☐	☐	☐
g. ☐	the sheets are not connected as prescribed (Rule 11.4(b))	☐	☐	☐	☐
h. ☐	sheets are not A4 size (29.7cm x 21cm)	☐	☐	☐	☐
i. ☐	the minimum margins on the sheets are not as prescribed (top: 2cm; left side: 2.5cm; right side: 2cm; bottom: 2cm)		☐	☐	☐
j. ☐	the file reference number indicated on the sheets does not appear in the left-hand corner of the sheets, within 1.5 cm of the top of the sheets		☐	☐	☐
k. ☐	the file reference number exceeds the maximum of 12 characters	☐	☐	☐	☐
l. ☐	the sheets of the description, claims and abstract are not numbered in consecutive Arabic numerals		☐	☐	☐
m. ☐	the sheet numbers are not centered at the top or bottom of the sheets	☐	☐	☐	☐
n. ☐	the sheet numbers are in the margin (see i. above for the size of the margins)		☐	☐	☐
o. ☐	the text matter is not typed or printed	☐	☐	☐	☐
p. ☐	the typing on the sheets is not 1½-spaced		☐	☐	☐
q. ☐	the characters in the text matter on the sheets are less than 0.28 cm high in capital letters	☐	☐	☐	☐
r. ☐	the text matter on the sheets is not in dark, indelible color	☐	☐	☐	☐
s. ☐	the element contains drawings	☐	☐	☐	☐
t. ☐	the sheets contain alterations/overwritings/interlineations/too many erasures	☐	☐	☐	☐
u. ☐	the sheets contain photocopy marks	☐	☐	☐	☐

2. ☐ satisfactory reproduction (Rules 11 and 26.3(b)(i))

Further observations *(if necessary)*:

Catalyst v. Shoulder Innovations
PGR2025-00001
Exhibit 2002
Page 56

ANNEX C1 TO FORM PCT/RO/106

International application No.
PCT/US2020/022094

This receiving Office has found that, with regard to the presentation of the **drawings of the international application as filed**, the physical requirements are not complied with to the extent that compliance therewith is necessary for:

1. ☒ reasonably uniform international publication (Rules 11 and 26.3(a)(i)) *(defects to be specified)*:

Sheets containing drawings:

a. ☐ the sheets do not admit of direct reproduction
b. ☐ the sheets are not free from creases, cracks, folds
c. ☐ one side of the sheets is not left unused
d. ☐ the paper of the sheets is not flexible/strong/white/smooth/non-shiny/durable
e. ☐ the drawings do not commence on a new sheet
f. ☐ the sheets are not connected as prescribed (Rule 11.4(b))
g. ☐ the sheets are not A4 size (29.7cm x 21cm)
h. ☒ the minimum margins on the sheets are not as prescribed (top: 2.5cm; left side: 2.5cm; right side: 1.5cm; bottom: 1cm)
i. ☐ the file reference number indicated on the sheets does not appear in the left-hand corner of the sheets, within 1.5cm of the top of the sheets
j. ☐ the file reference number exceeds the maximum of 12 characters
k. ☐ the sheets are not free from frames around usable or used surfaces
l. ☒ the sheets are not numbered in consecutive Arabic numerals (e.g. 1/3, 2/3, 3/3)
m. ☐ the sheet numbers are not centered at the top or bottom of the sheets
n. ☐ the sheet numbers are in the margin (see h. above for the size of the margins)
o. ☐ the sheets contain alterations/overwritings/interlineations/too many erasures
p. ☐ the sheets contain photocopy marks

Drawings (Rule 11.13):

a. ☐ do not admit of direct reproduction
b. ☐ contain unnecessary text matter
c. ☐ contain words so placed as to prevent translation without interference with lines thereof
d. ☒ are not executed in durable black color; the lines are not uniformly thick and well-defined
e. ☐ contain cross-sections not properly hatched
f. ☒ would not be properly distinguishable in reduced reproduction
g. ☐ contain scales not represented graphically
h. ☒ contain numbers, letters and reference lines lacking simplicity and clarity
i. ☐ contain lines drafted without the aid of drafting instruments
j. ☐ contain disproportionate elements of a figure not necessary for clarity
k. ☒ contain numbers and letters of height less than 0.32 cm
l. ☐ contain letters not conforming to the Latin, and where customary, Greek alphabets
m. ☐ contain figures on two or more sheets which form a single complete figure but which are not able to be assembled without concealing parts thereof
n. ☐ contain figures which are not properly arranged and clearly separated
o. ☐ contain different figures not numbered in consecutive Arabic numerals
p. ☐ contain different figures not numbered independently of the numbering of the sheets
q. ☐ are not restricted to reference signs mentioned in the description
r. ☐ do not contain reference signs that are mentioned in the description
s. ☐ contain the same feature denoted by different reference signs
t. ☐ are not arranged in an upright position, clearly separated from one another
u. ☐ are not presented sideways with the top of the figures at the left side of the sheets

2. ☐ satisfactory reproduction (Rules 11 and 26.3(b)(i))

Further observations *(if necessary)*:

Catalyst v. Shoulder Innovations
PGR2025-00001
Exhibit 2002
Page 57

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
PCT RECEIVING OFFICE
VIA EFS WEB FILE

Applicant	:	Shoulder Innovations, Inc.
PCT Application No.	:	PCT/US2020/022094
Filing Date	:	March 11, 2020
Title	:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
Authorized Officer	:	LaShonnah Tyson

RESPONSE TO INVITATION TO CORRECT DEFECTS IN THE INTERNATIONAL APPLICATION

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

Dear Sir or Madam:

In response to the Invitation mailed April 1, 2020, Applicant respectfully submits new drawings (21 total sheets of formal drawings) in connection with the above-referenced PCT application. Please be advised that the drawings as filed are the best quality representation available. We are hereby re-submitting these drawings with the sheets numbered in consecutive Arabic numerals.

Please file these papers with the above-referenced PCT International application before June 1, 2020.

Respectfully submitted,

KNOBBE MARTENS OLSON & BEAR, LLP

Dated: 17 April 2020

By: /Daniel Altman/

Daniel E. Altman
Registration No. 34,115
2040 Main Street, 14th Floor
Irvine, California 92614
United States of America
(949) 760-0404

32651393

Figure 1

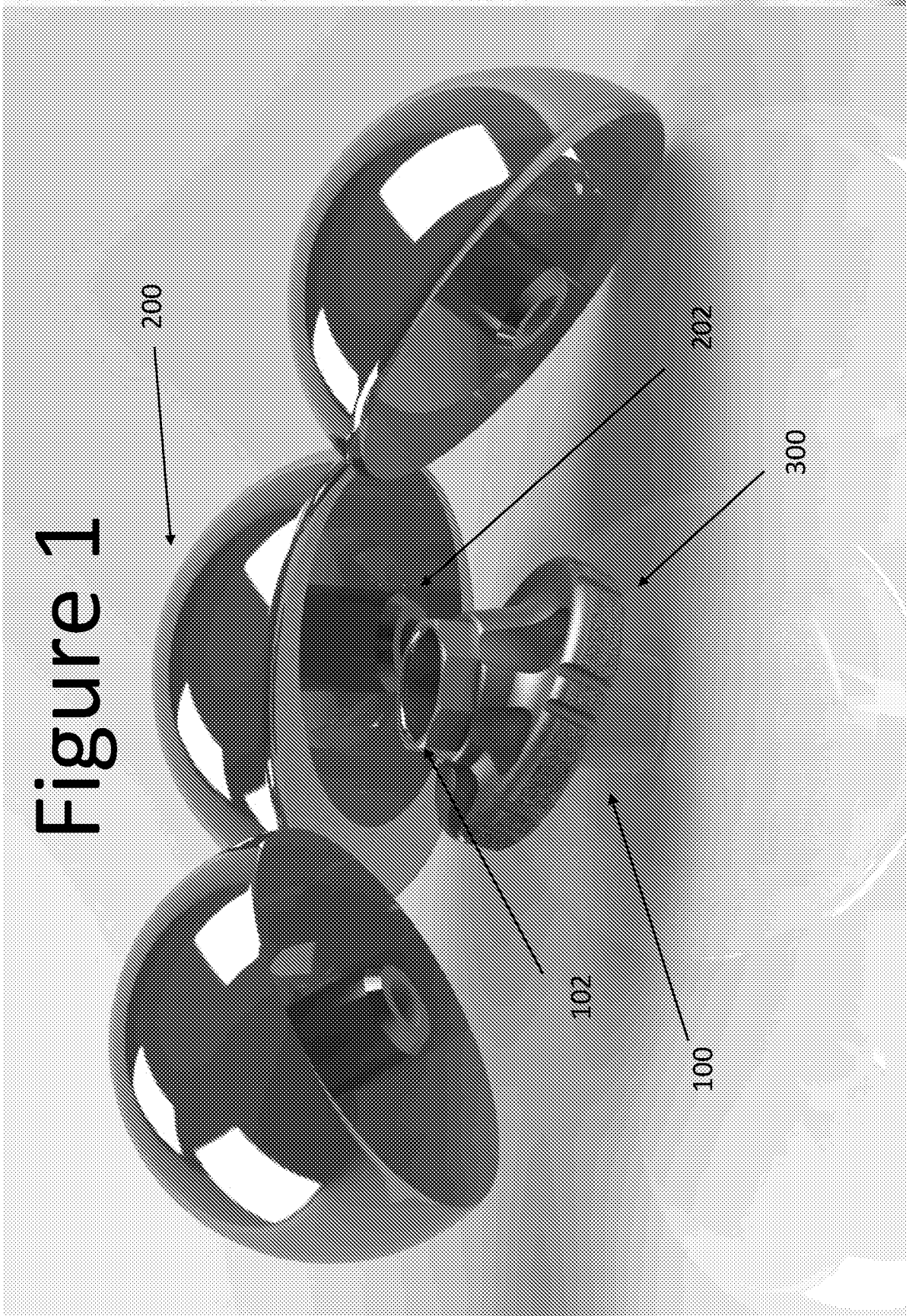


Figure 2

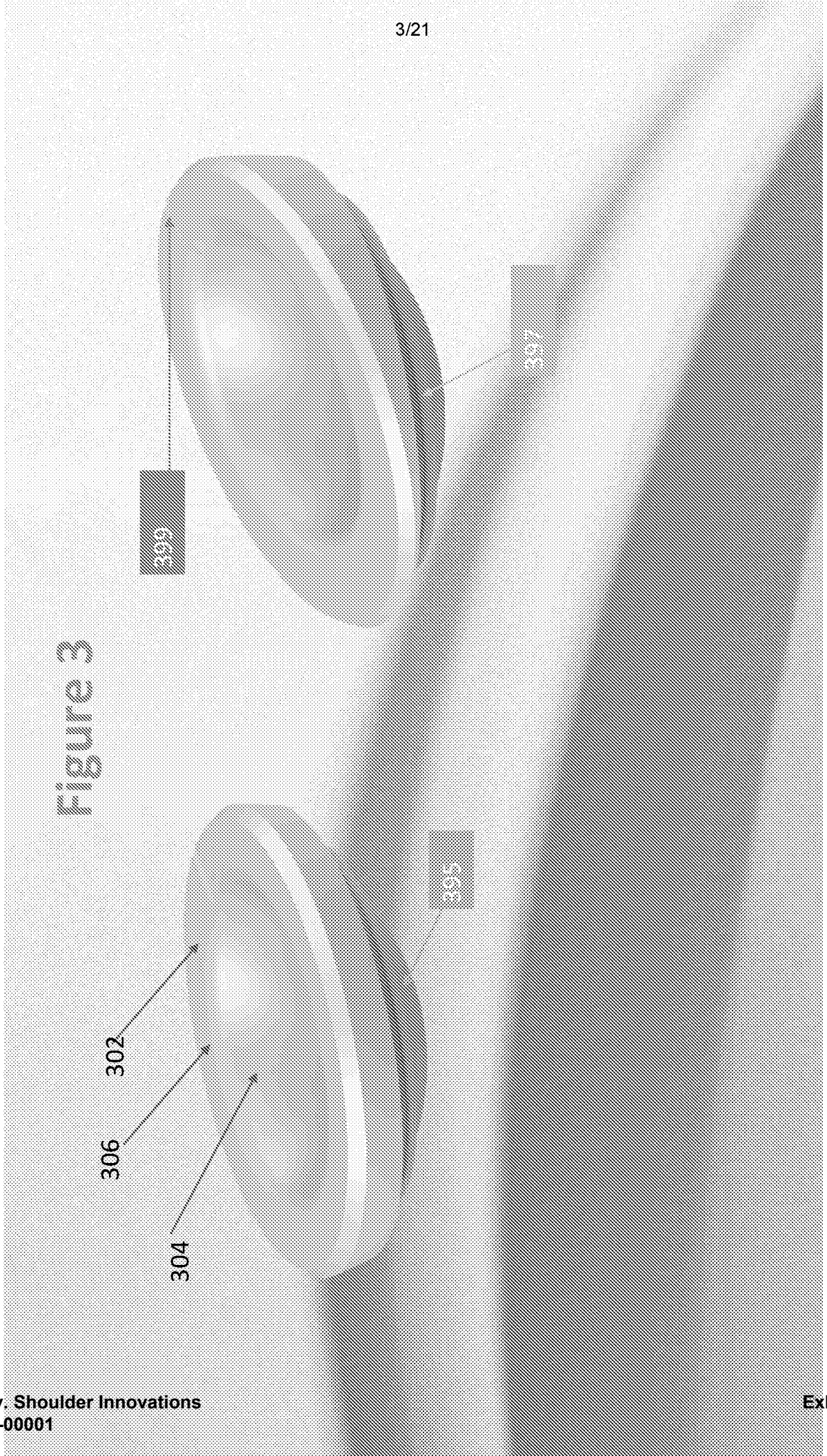


Figure 3

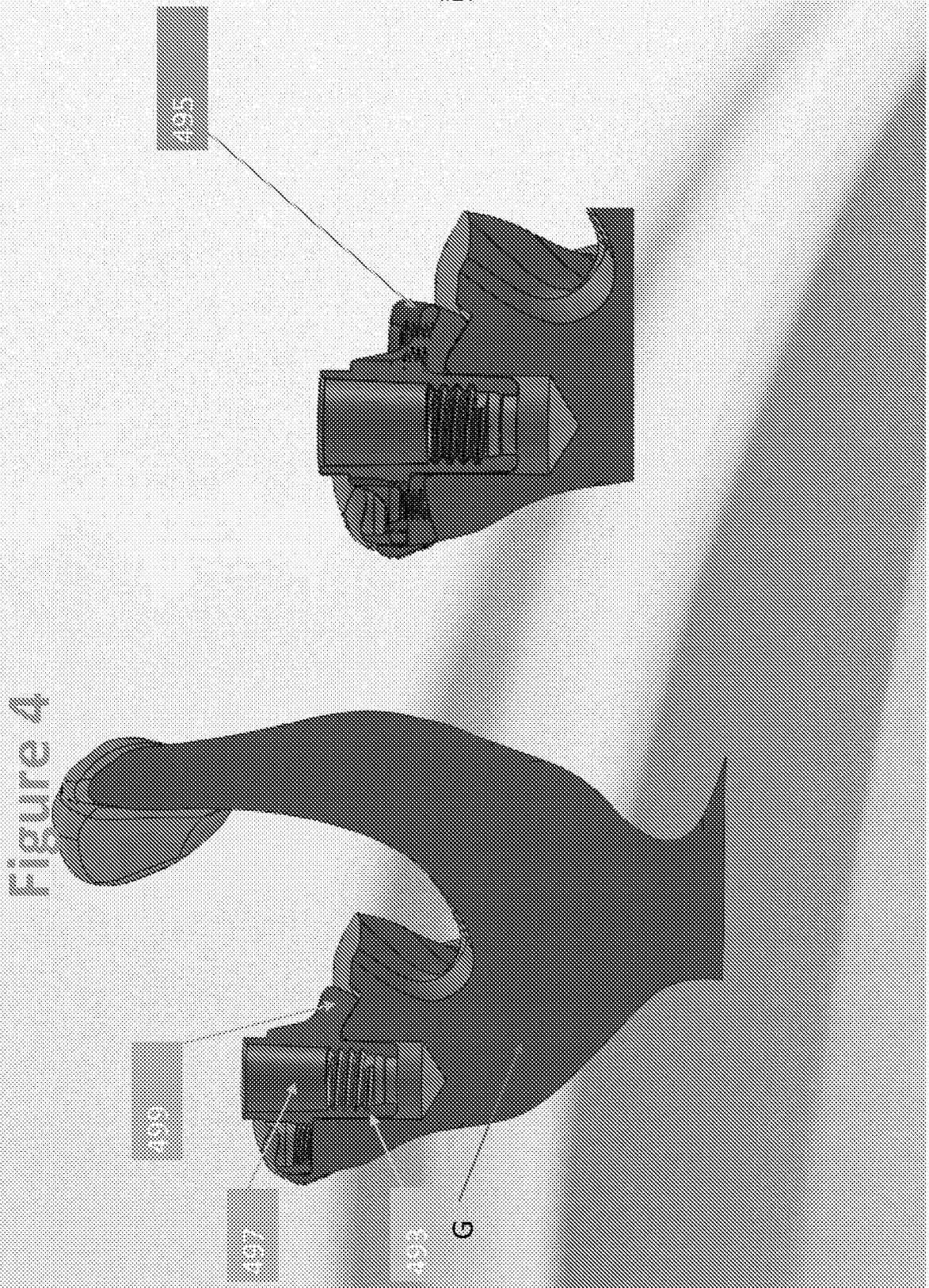


Figure 4

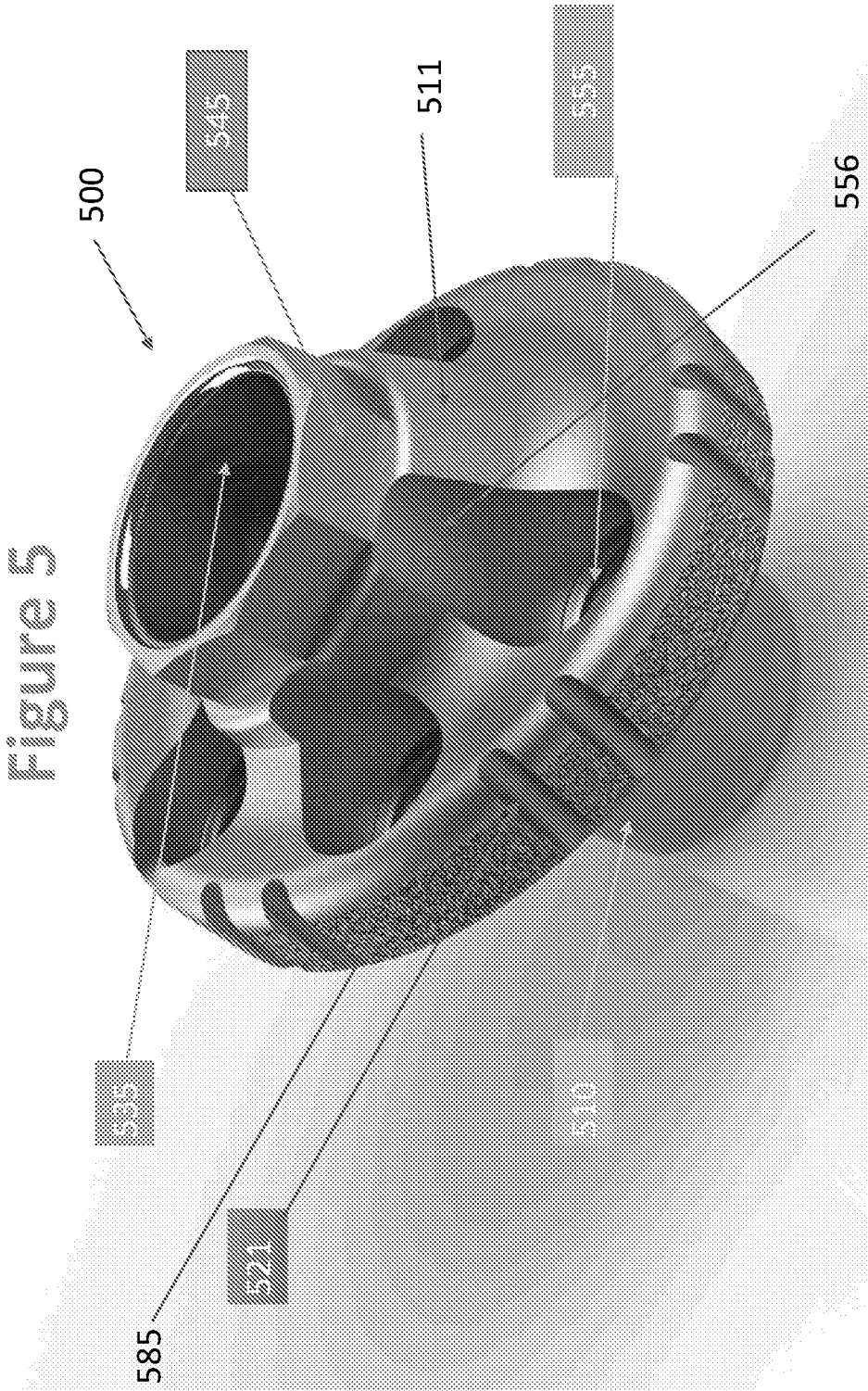


Figure 5

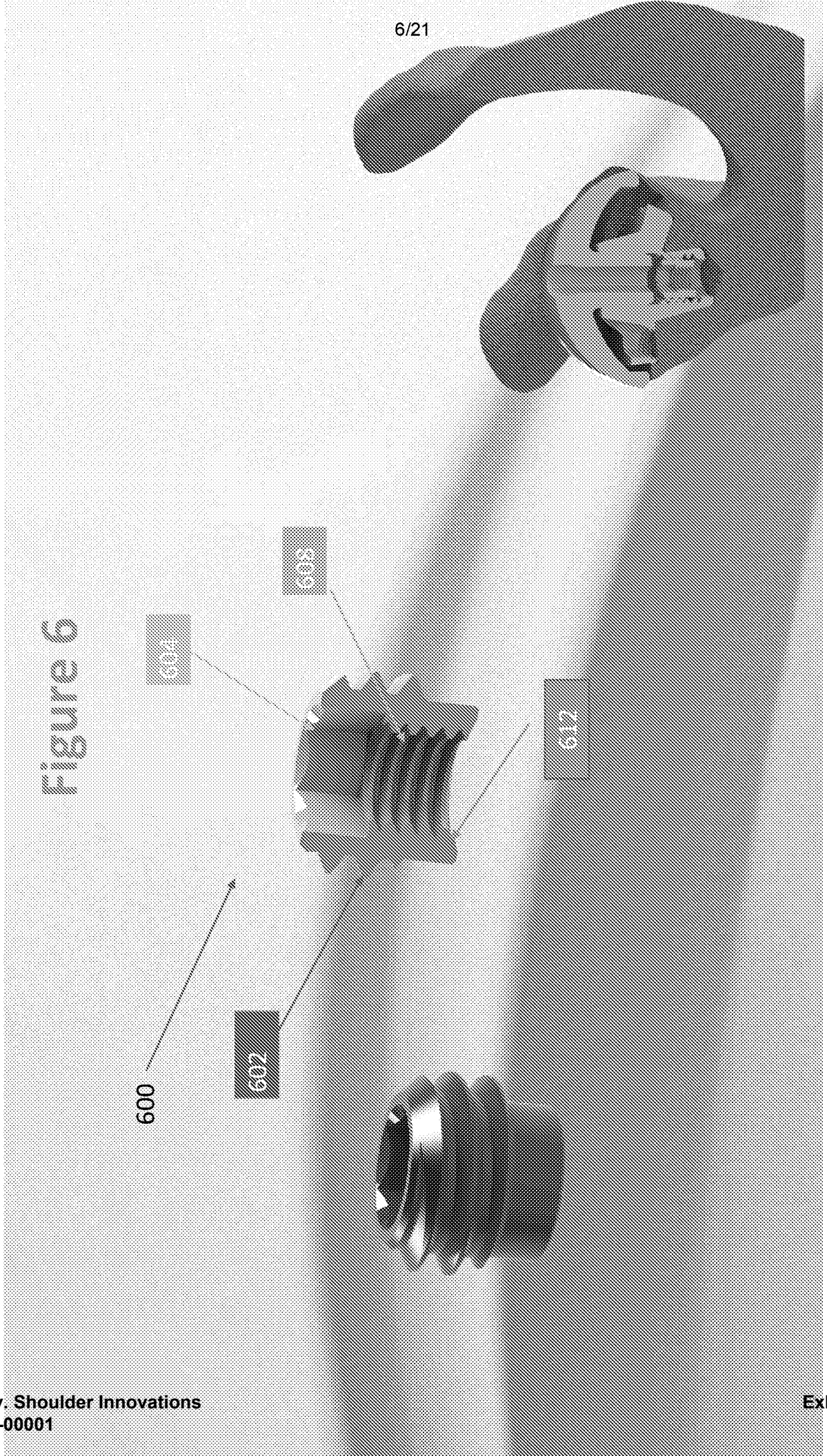


Figure 6

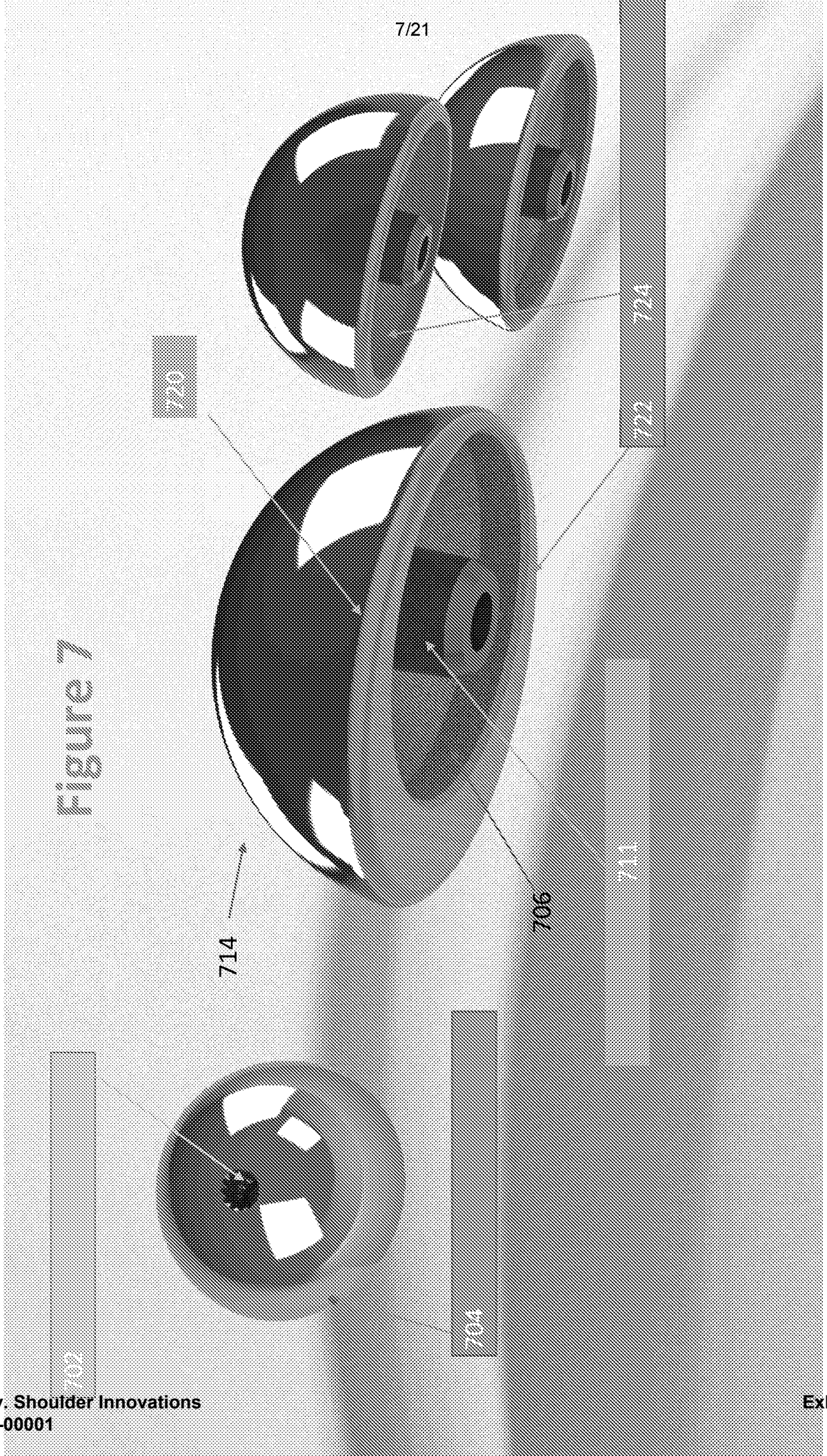
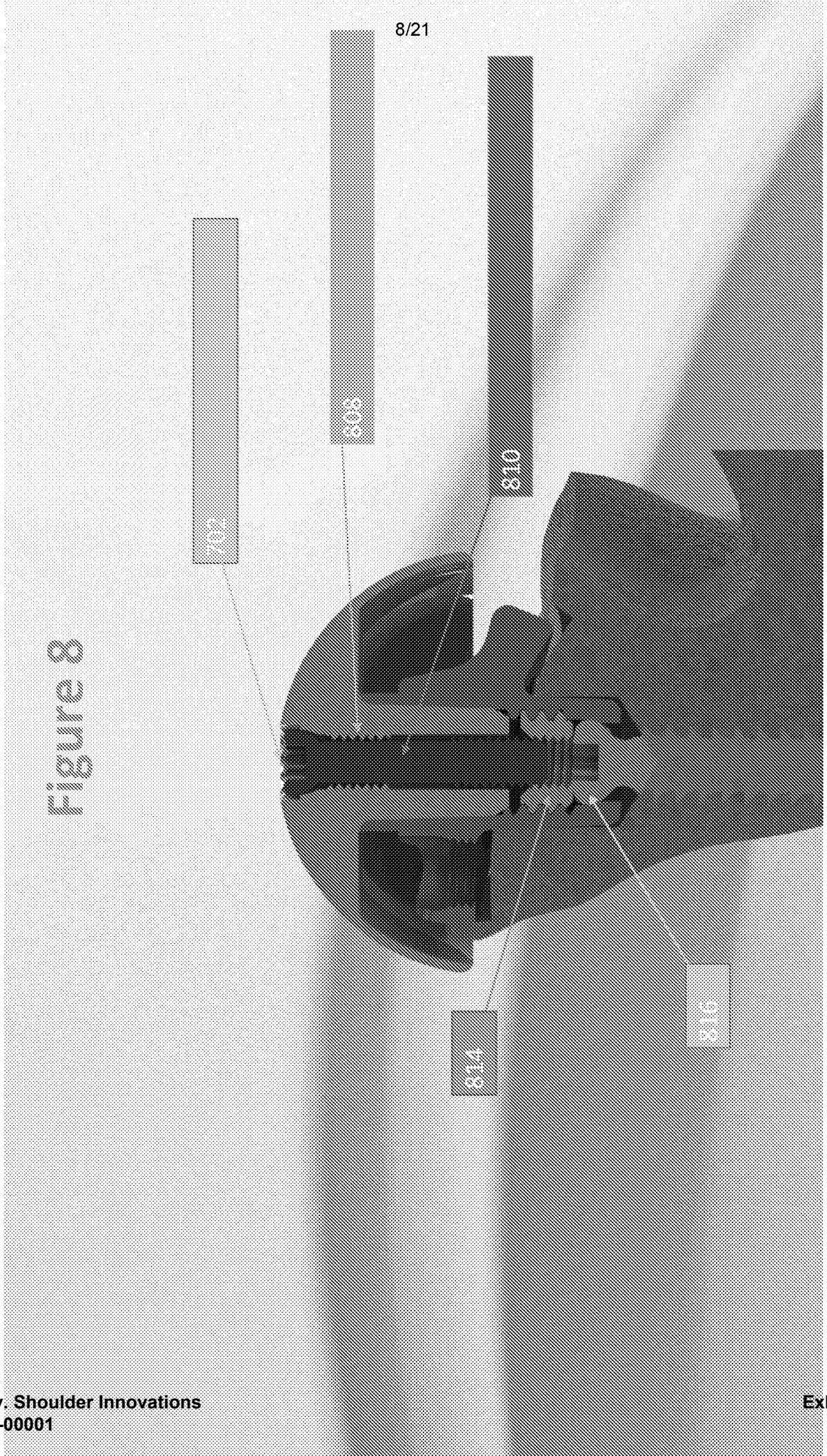


Figure 7

Figure 8



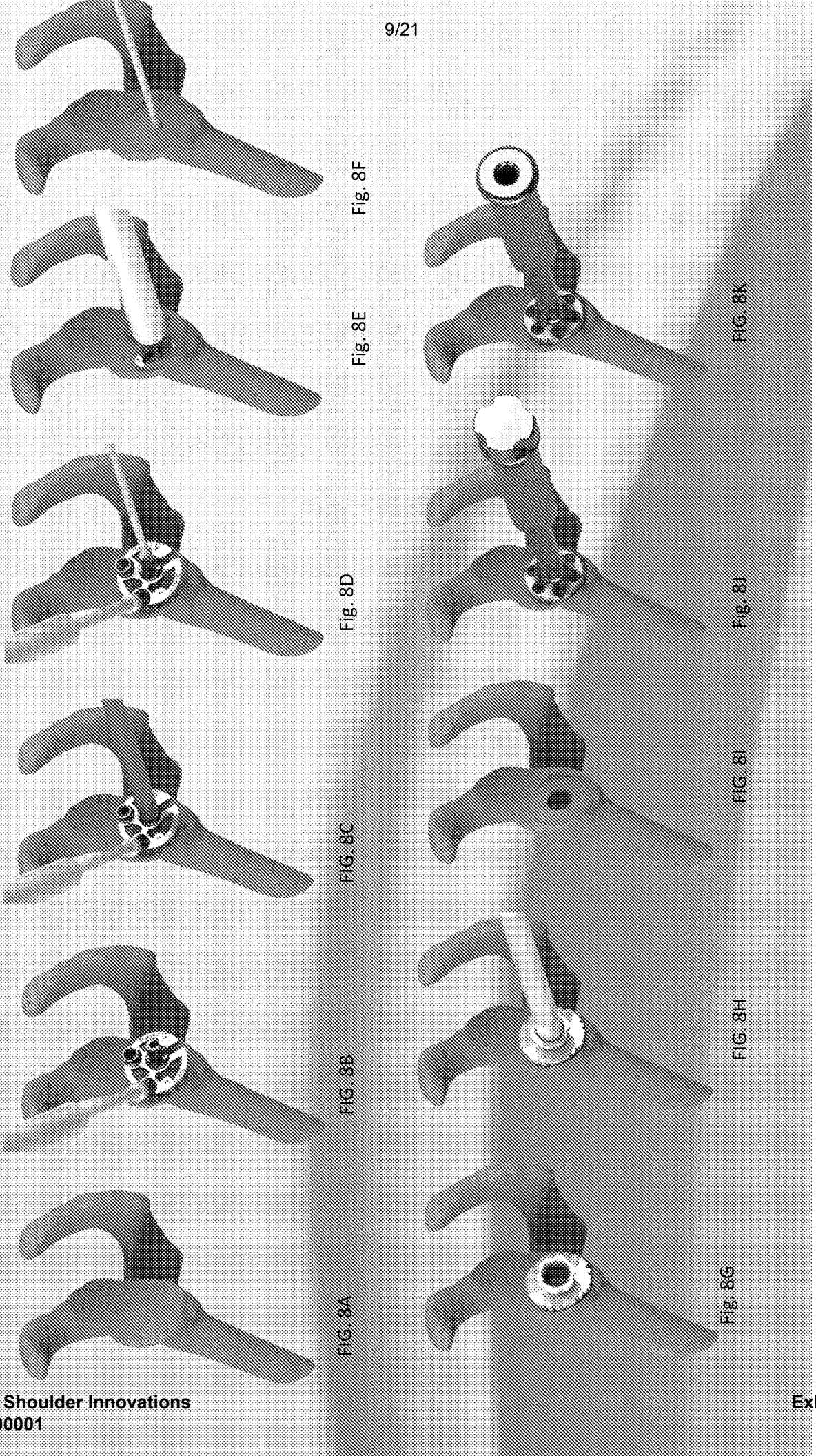


FIG. 8A FIG. 8B FIG. 8C Fig. 8D Fig. 8E Fig. 8F

Fig. 8G FIG. 8H FIG. 8I Fig. 8J FIG. 8K

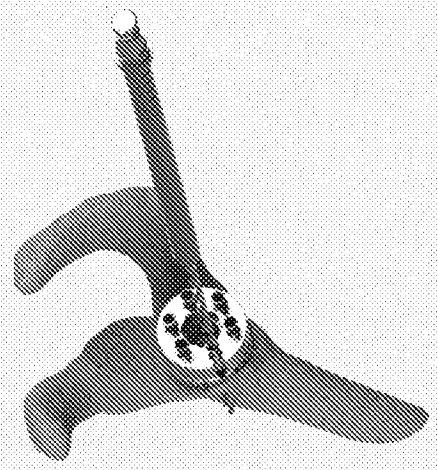


Fig. 8L

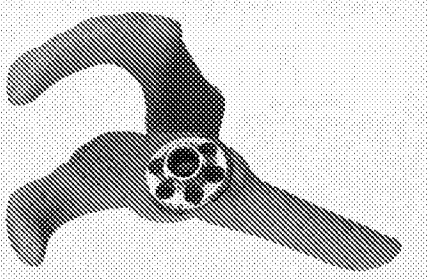


Fig. 8O

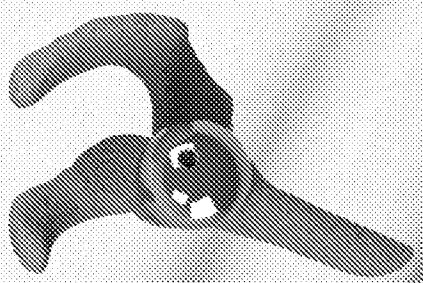


Fig. 8P

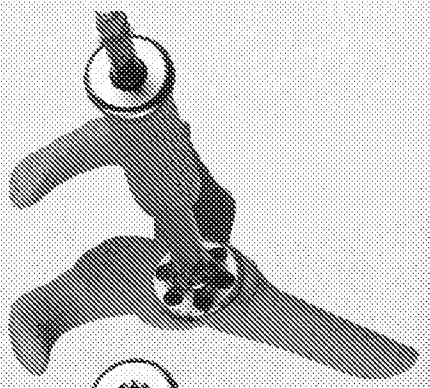


Fig. 8M

Fig. 8N

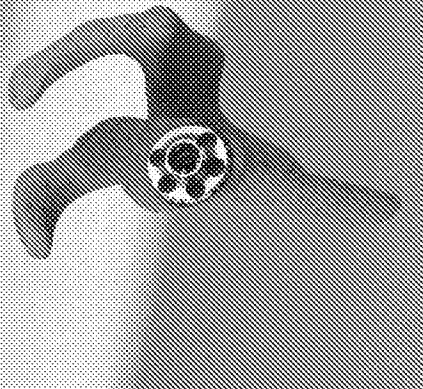


Fig. 8S

FIG. 8R

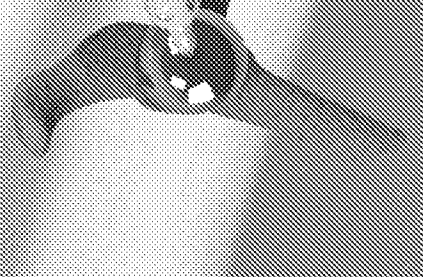


Fig. 8T

Fig. 8U

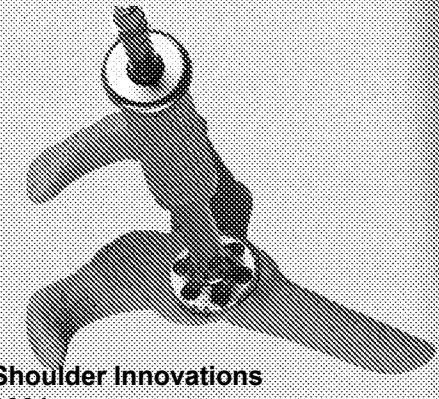
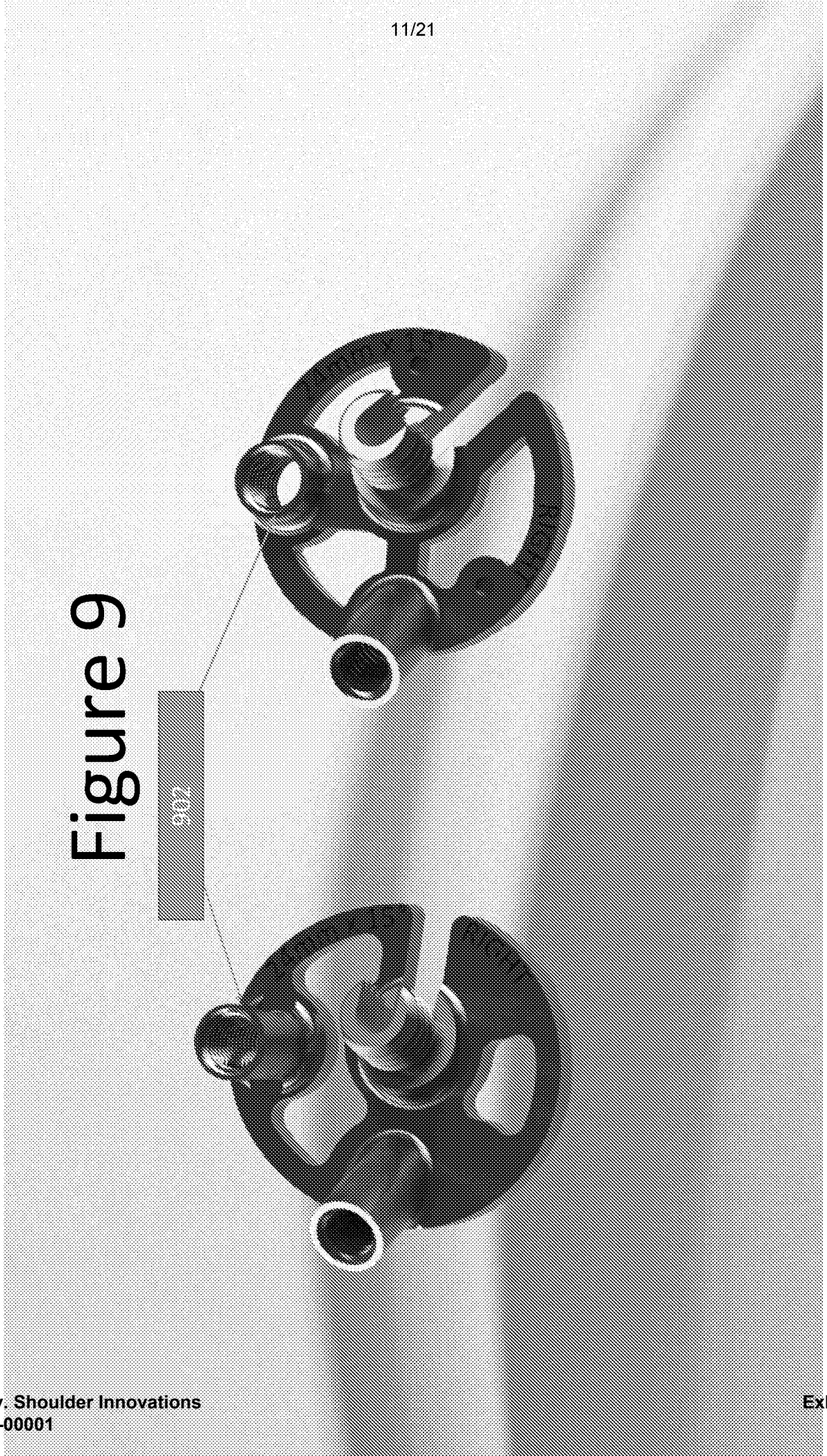


Fig. 8Q

Figure 9



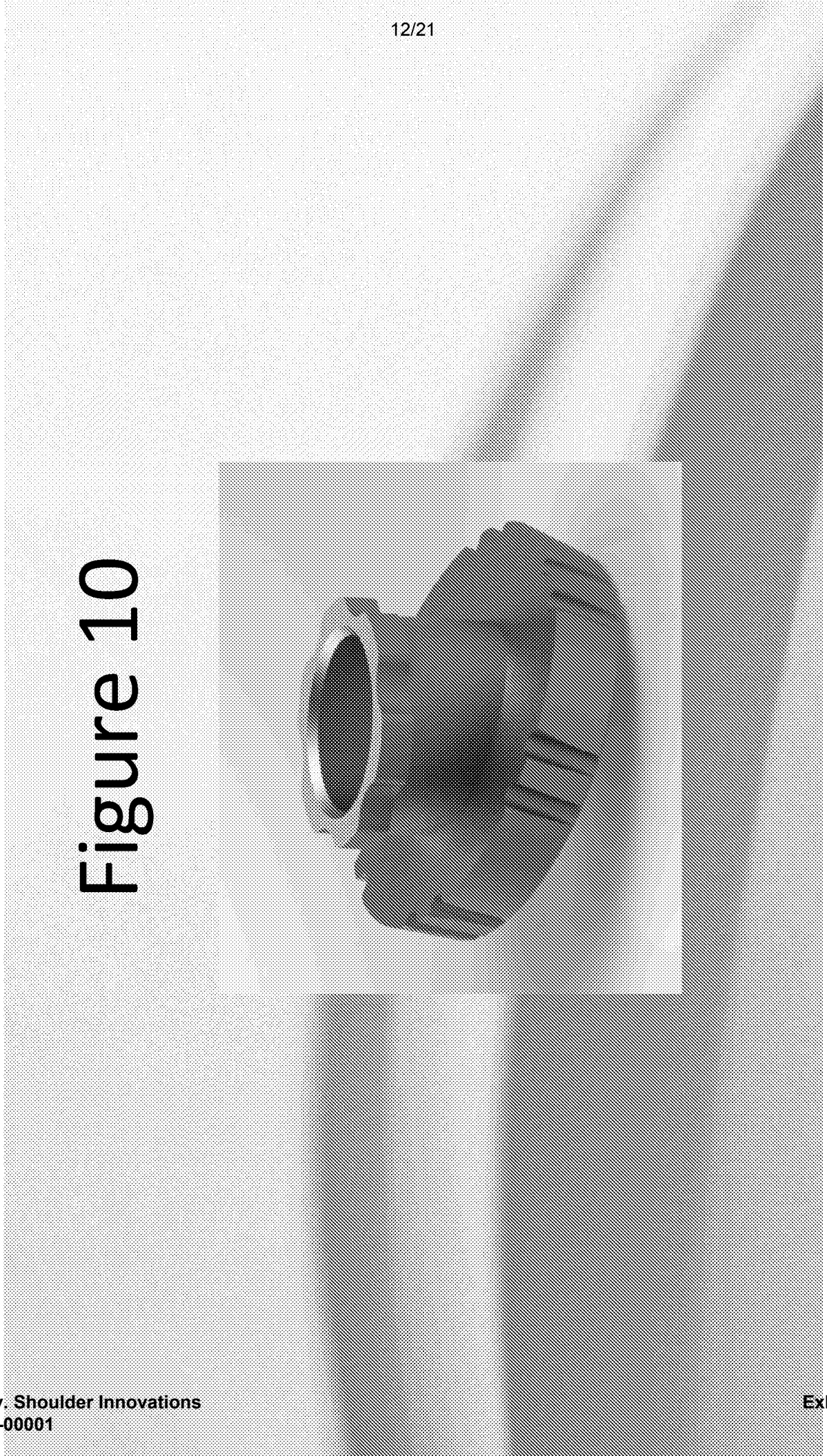


Figure 10

Figure 11

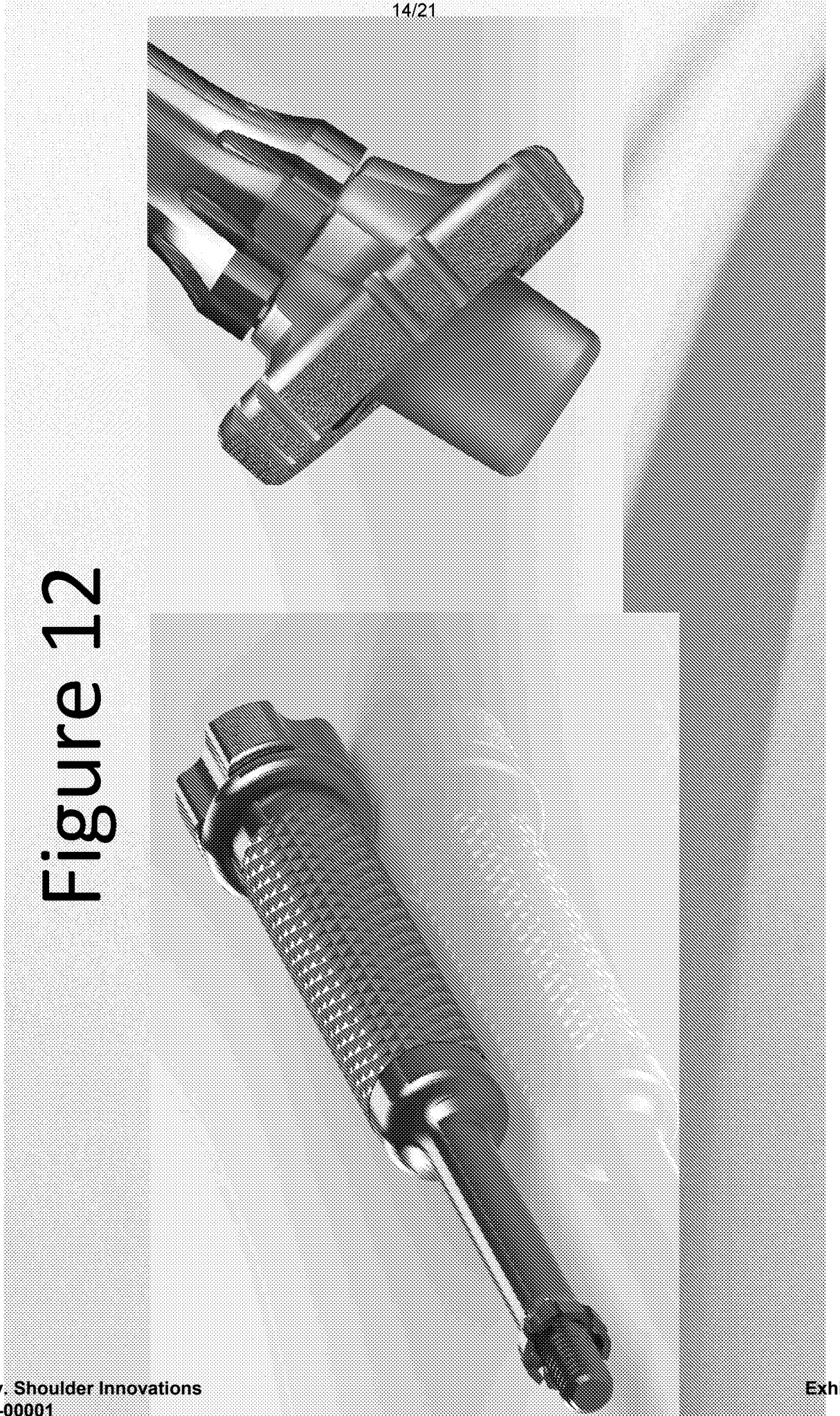
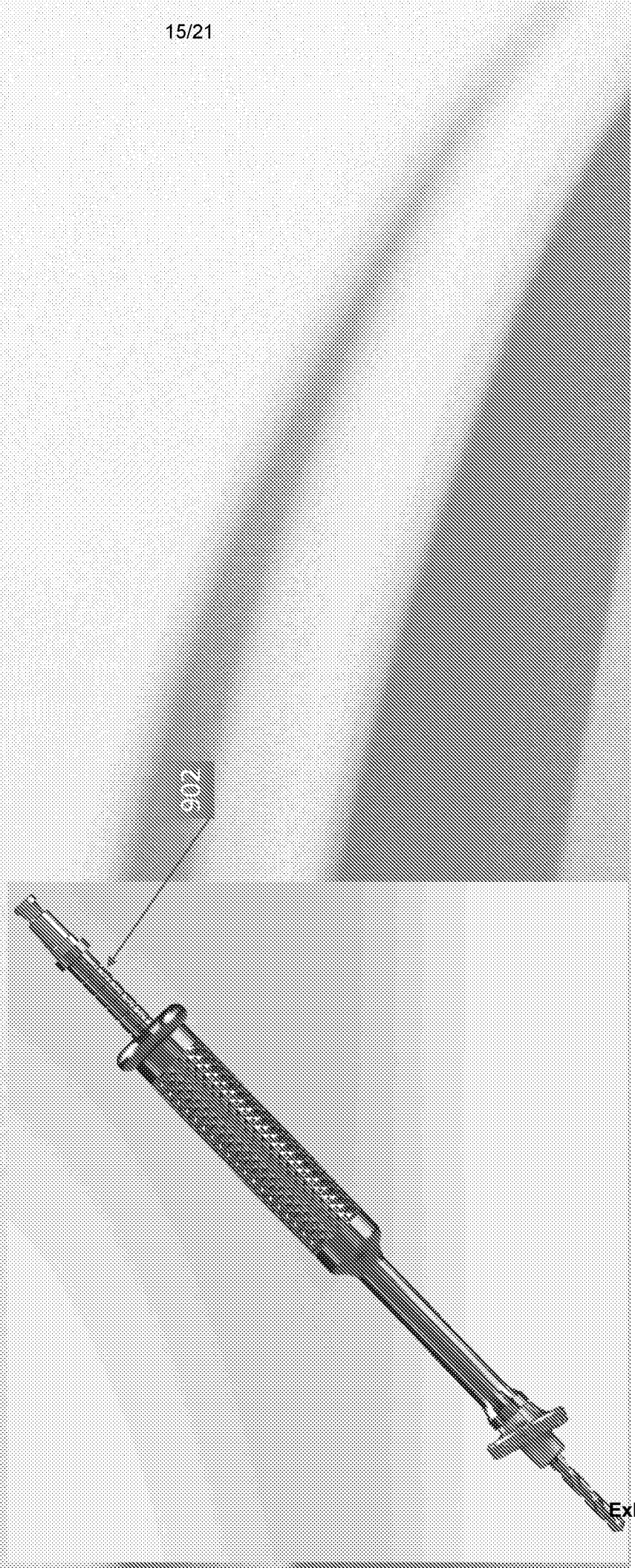


Figure 12

Figure 13



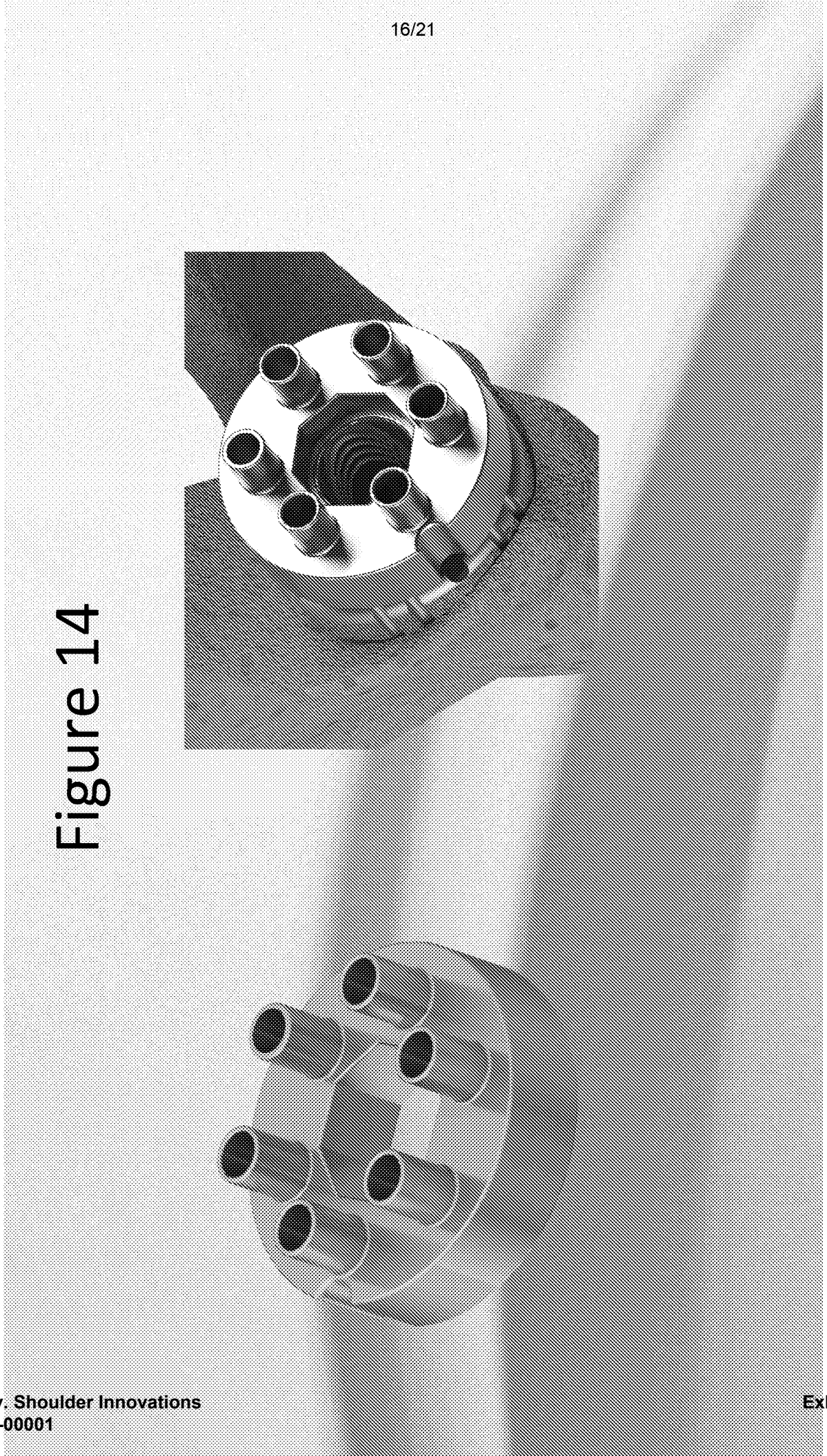


Figure 14

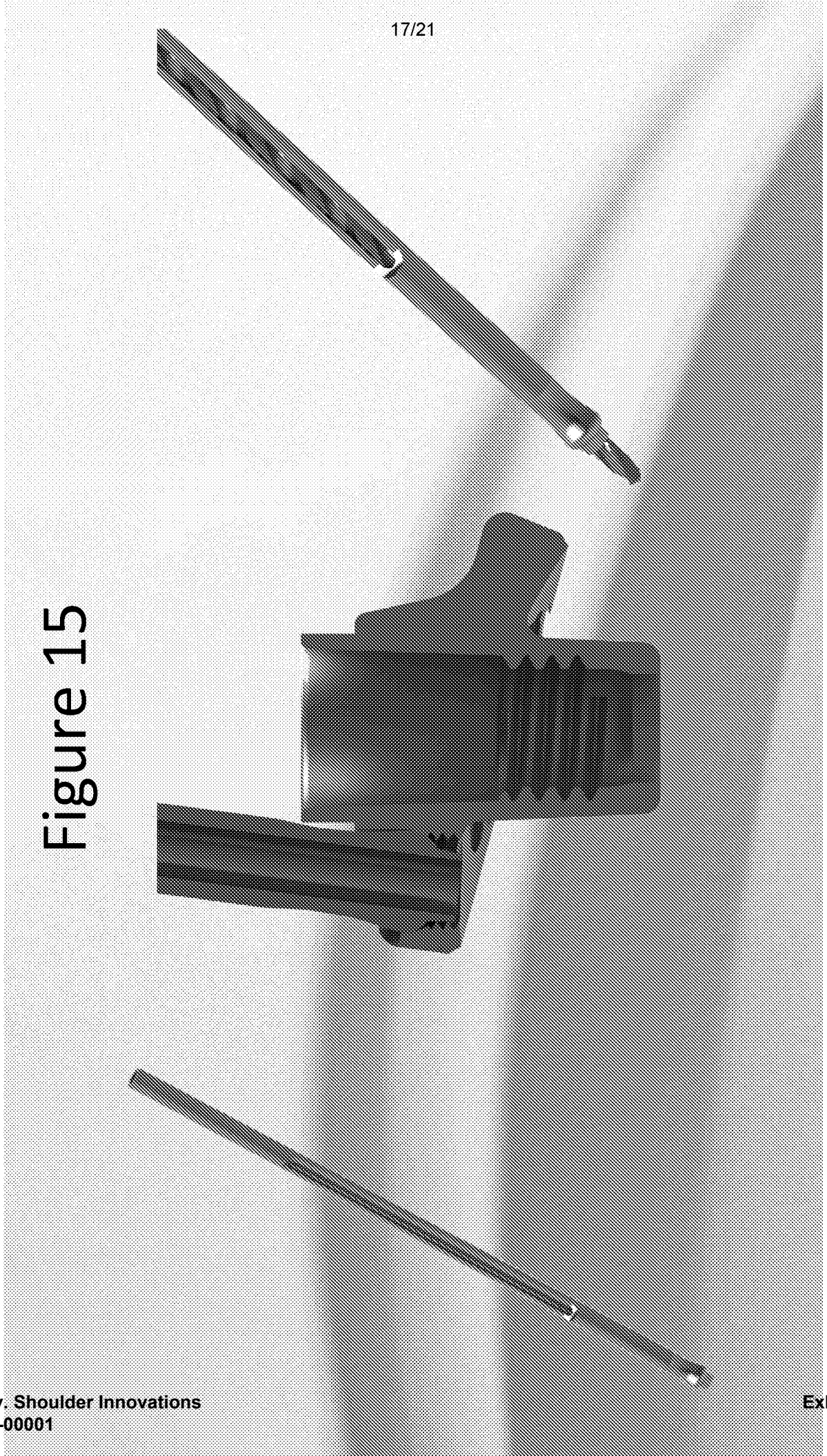
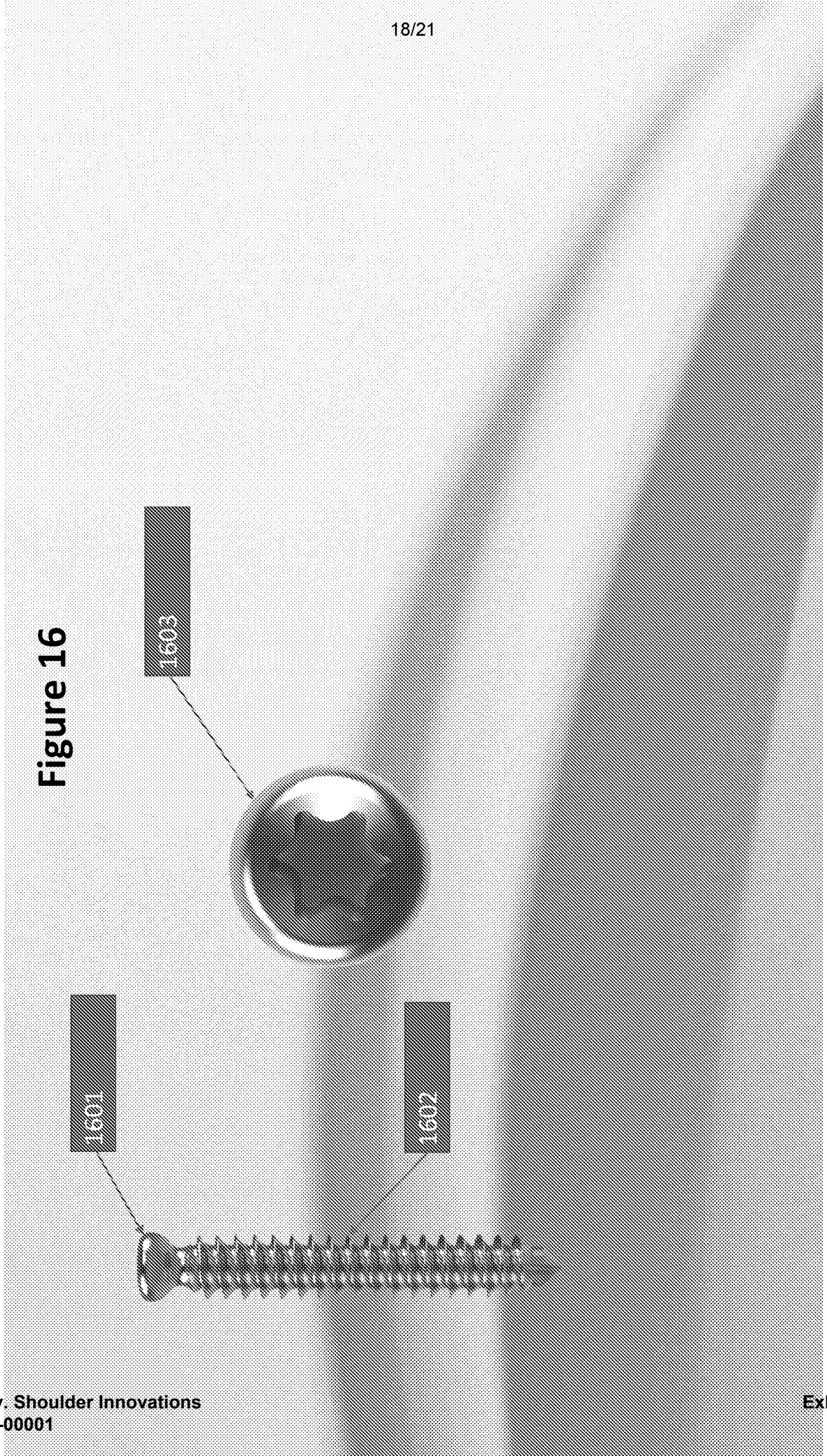


Figure 15

Figure 16



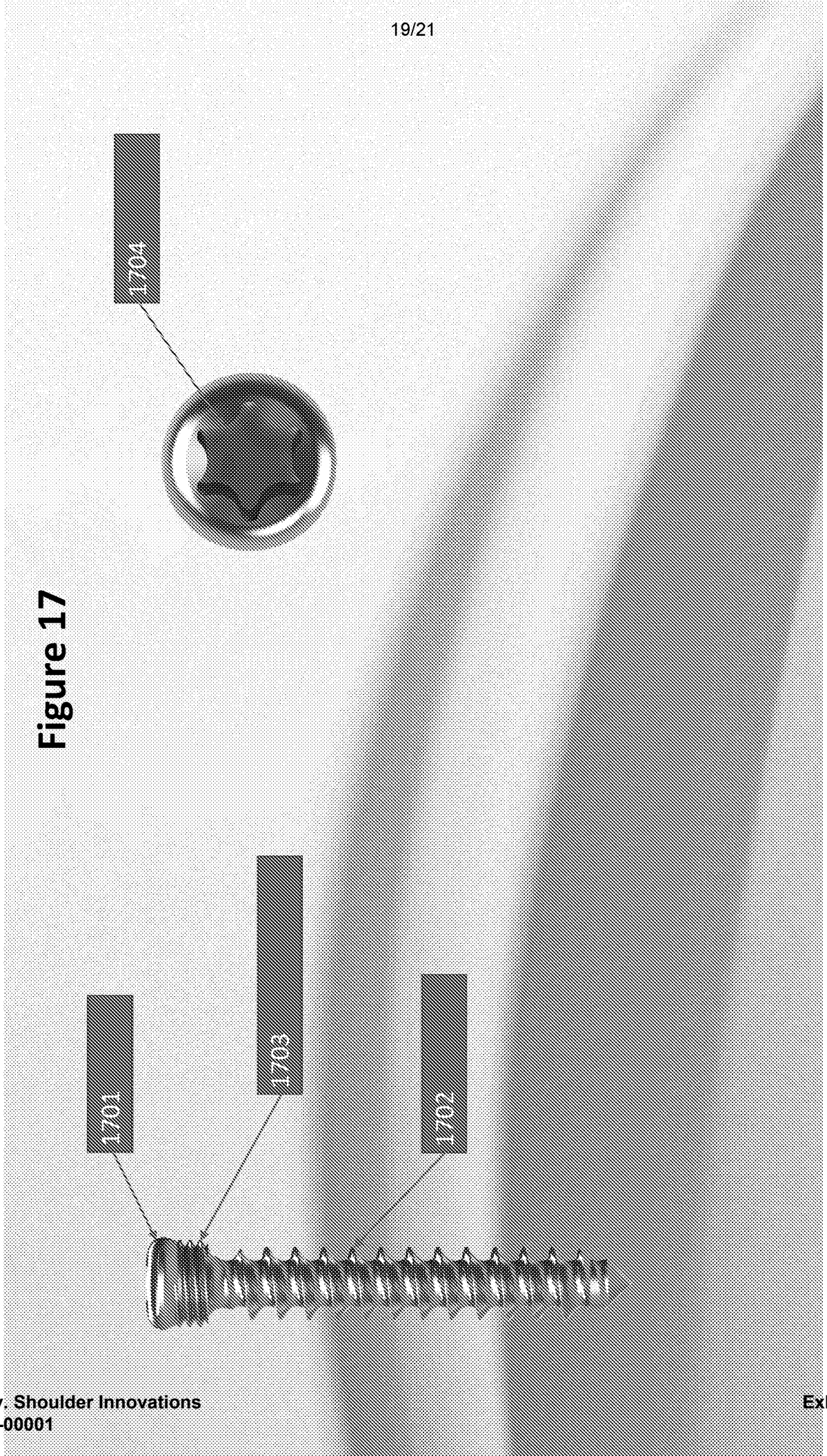
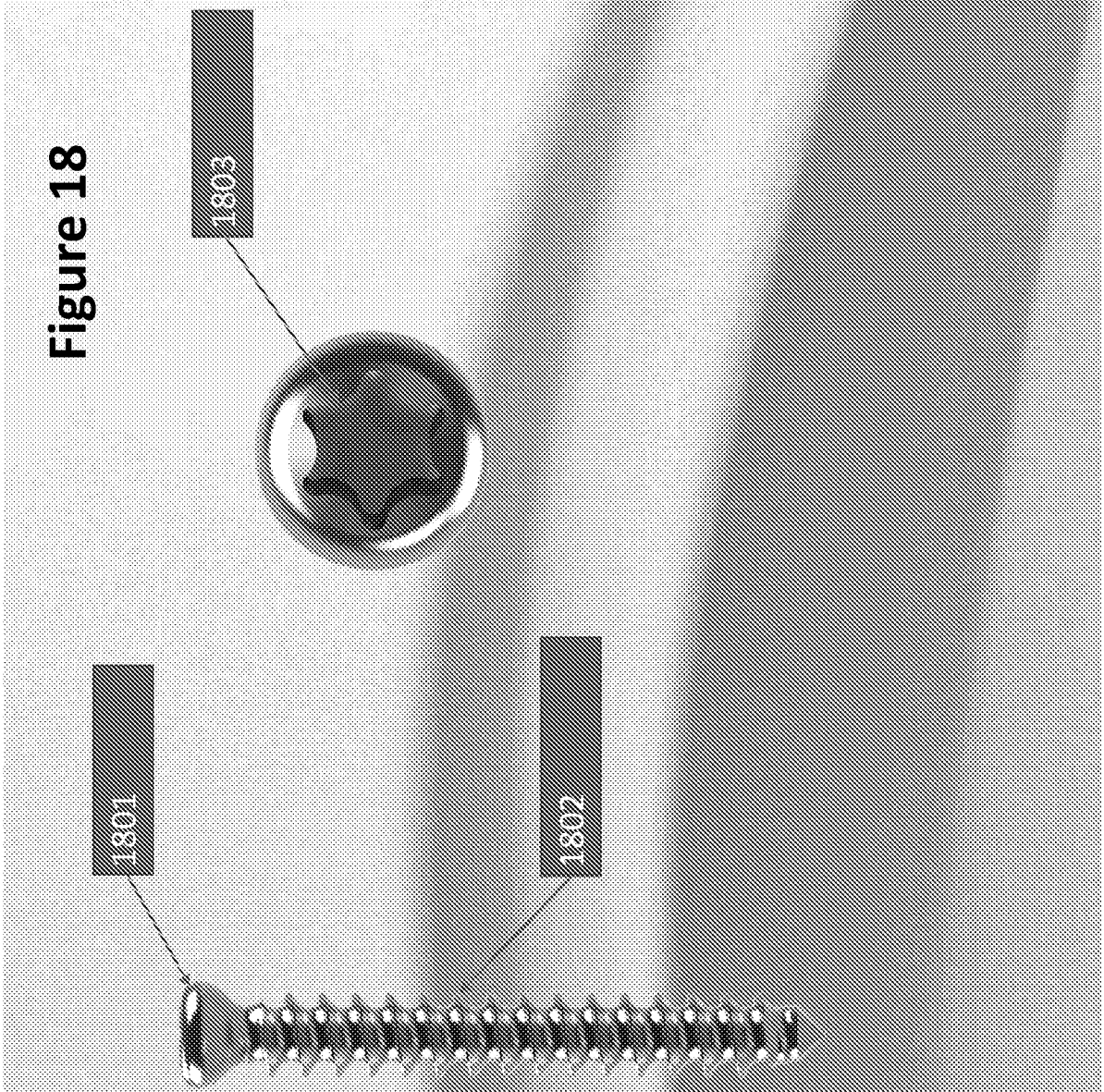


Figure 17

Figure 18



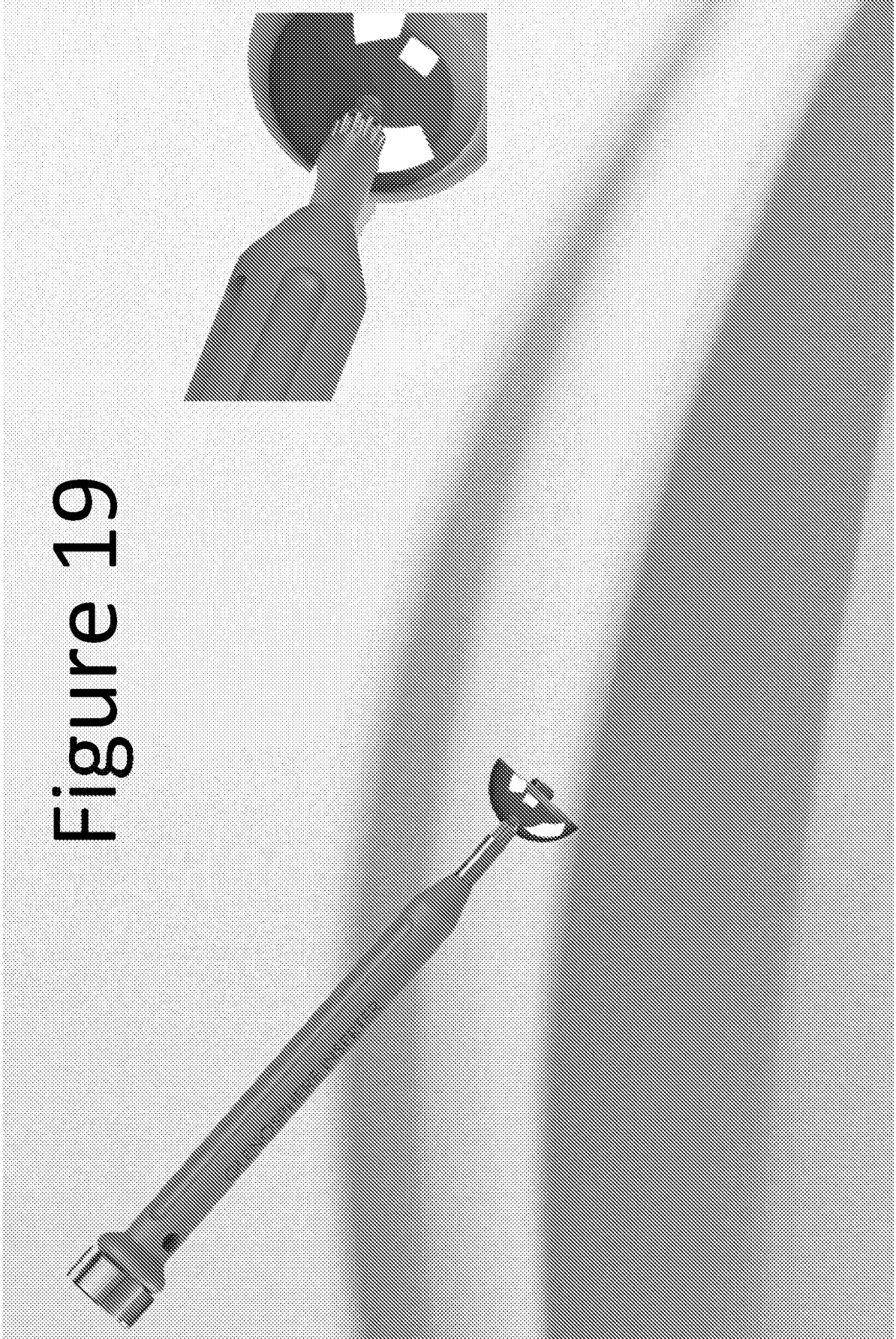


Figure 19

Electronic Acknowledgement Receipt

EFS ID:	39202535
Application Number:	
International Application Number:	PCT/US20/22094
Confirmation Number:	5922
Title of Invention:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	SHOULDER INNOVATIONS, INC.
Customer Number:	20995
Correspondence Address:	KNOBBE MARTENS OLSON & BEAR LLP - 2040 MAIN STREET FOURTEENTH FLOOR IRVINE CA 92614 US 949-760-0404 efiling@knobbe.com
Filer:	Daniel E. Altman/Neysa Perkins
Filer Authorized By:	Daniel E. Altman
Attorney Docket Number:	SHOLD-013WO
Receipt Date:	20-APR-2020
Filing Date:	11-MAR-2020
Time Stamp:	12:42:04
Application Type:	International Application (PCT) for filing in the US receiving office
Patent Number:	

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	Misc. incoming letter from Applicant - IA	SHOLD013WOLETTER.pdf	15268 b30483e614861d0f675e700c865d0bf37a2cba9d	no	1
Warnings:					
Information:					
2	Drawings-other than black and white line drawings	SHOLD013WODRAWINGS.PDF	11198729 af6fb33f341868182c4aa1b7413f6a8f80717ed2	no	21
Warnings:					
Information:					
		Total Files Size (in bytes):	11213997		

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

SCORE Placeholder Sheet for IFW Content

Application Number: PCT/US20/22094 Document Date: 04/20/2020

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

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

- Drawing

At the time of document entry (noted above):

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

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:

DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CALIFORNIA 92614

Confirmation No: 5922

PCT

COMMUNICATION IN CASES FOR WHICH NO OTHER FORM IS APPLICABLE

Date of mailing *(day/month/year)*	23 Apr 2020
Applicant's or agent's file reference: SHOLD-013WO	**REPLY DUE** See paragraph 1 below
International application No.: PCT/US2020/022094	International filing date *(day/month/year)*: 11 Mar 2020
Applicant: SHOULDER INNOVATIONS, INC.	

1. ☒ REPLY DUE within 1 months/days from the above date of mailing

☐ NO REPLY DUE, however, see below _____

☐ IMPORTANT COMMUNICATION

☐ INFORMATION ONLY

2. COMMUNICATION:

The following proposed replacement sheets filed <20 APR 2020> do not correct the defects identified in Form PCT/RO/106 mailed <01 APR 2020>. For example, <THE MARGINS ARE STILL WRONG >.The formal requirements indicated in Form PCT/RO/106 mailed <01 APR 2020> remain outstanding with respect to the sheets identified above.

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer LaShonnah Tyson Telephone No. 571-272-6628

Form PCT/RO/132 (July 1992; reprint January 2004)

SHOLD.013WO PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
PCT RECEIVING OFFICE
VIA EFS WEB FILE

Applicant	:	Shoulder Innovations, Inc.
PCT Application No.	:	PCT/US2020/022094
Filing Date	:	March 11, 2020
Title	:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
Authorized Officer	:	LaShonnah Tyson

RESPONSE TO COMMUNICATION IN THE INTERNATIONAL APPLICATION

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

Dear Sir or Madam:

In response to the Communication form PCT/RO/132 mailed April 23, 2020, Applicant will not be submitting replacement drawings at this time. Please proceed to publish the drawings as originally filed on March 11, 2020.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 7 May 2020

By: /Daniel Altman/
Daniel E. Altman
Registration No. 34,115
2040 Main Street, 14th Floor
Irvine, California 92614
United States of America
(949) 760-0404

32779990

Electronic Acknowledgement Receipt

EFS ID:	39383697
Application Number:	
International Application Number:	PCT/US20/22094
Confirmation Number:	5922
Title of Invention:	TOTAL REVERSE SHOULDER SYSTEMS AND METHODS
First Named Inventor/Applicant Name:	SHOULDER INNOVATIONS, INC.
Customer Number:	20995
Correspondence Address:	KNOBBE MARTENS OLSON & BEAR LLP - 2040 MAIN STREET FOURTEENTH FLOOR IRVINE CA 92614 US 949-760-0404 efiling@knobbe.com
Filer:	Daniel E. Altman/Jacqueline Mendoza
Filer Authorized By:	Daniel E. Altman
Attorney Docket Number:	SHOLD-013WO
Receipt Date:	07-MAY-2020
Filing Date:	11-MAR-2020
Time Stamp:	18:46:17
Application Type:	International Application (PCT) for filing in the US receiving office
Patent Number:	

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	Misc. incoming letter from Applicant - IA	SHOLD013WOLETTER.pdf	14404 26061c947e886224549a18f760ed90a430e5901b	no	1

Warnings:	
Information:	
Total Files Size (in bytes):	14404

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: DANIEL E. ALTMAN
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 MAIN STREET, 14TH FLOOR
IRVINE, CA 92614

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	12 JUN 2020
Applicant's or agent's file reference: SHOLD-013WO	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No.: PCT/US 20/22094	International filing date *(day/month/year)*: 11 March 2020 (11.03.2020)
Applicant: SHOULDER INNOVATIONS, INC.	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
SHOLD-013WO		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/22094	11 March 2020 (11.03.2020)	11 March 2019 (11.03.2019)
Applicant SHOULDER INNOVATIONS, 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.

Form PCT/ISA/210 (first sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/22094

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61F 2/40, A61F 2/30 (2020.01)

CPC - A61F 2/4081, A61F 2002/30405, A61F 2002/4085, A61F 2002/30367, A61F 2002/30011, A61B 17/8033, A61F 2/40, A61F 2/4014, A61F 2/4003, A61F 2002/4022

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)
See Search History document

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2018/0078377 A1 (Tornier, Inc.) 22 March 2018 (22.03.2018) entire document, especially title, abstract.	1-2, 4-9, 12-14 ----- 1-3, 10-11, 15-16
Y	WO 2018/022227 A1 (Tornier, Inc.) 01 February 2018 (01.02.2018) entire document, especially title, abstract.	1-3, 11
Y	US 2018/0071104 A1 (Biomet Manufacturing, LLC) 15 March 2018 (15.03.2018) entire document, especially title, abstract.	10
Y	US 2008/0177327 A1 (Malandain et al.) 24 July 2008 (24.07.2008) entire document, especially title, abstract.	15-16
A	US 2018/0161169 A1 (Tornier) 14 June 2018 (14.06.2018) entire document, especially title, abstract.	1-16
A	US 9,283,083 B2 (Winslow et al.) 15 March 2016 (15.03.2016) entire document, especially title, abstract.	1-16
A	US 9,545,312 B2 (Tornier SAS) 17 January 2017 (17.01.2017) entire document, especially title, abstract.	1-16

☒ 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
20 May 2020	12 JUN 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/22094

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 2017/0273806 A1 (Tornier) 28 September 2017 (28.09.2017) entire document, especially title, abstract.	1-16
A	US 2018/0200067 A1 (Encore Medical, L.P.) 19 July 2018 (19.07.2018) entire document, especially title, abstract.	1-16
A	US 2012/0209392 A1 (Angibaud et al.) 16 August 2012 (16.08.2012) entire document, especially title, abstract.	1-16

SEARCH HISTORY

Application Number	PCT/US 20/22094
Search Conducted By	JHB
Search Approved By	AD

CPC/IPC Classifications Searched	IPC(8): A61F 2/40, A61F 2/30 (2020.01) CPC: A61F 2/4081, A61F 2002/30405, A61F 2002/4085, A61F 2002/30367, A61F 2002/30011, A61B 17/8033, A61F 2/40, A61F 2/4014, A61F 2/4003, A61F 2002/4022
Date Conducted	19 May 2020 (19.05.2020)

Documentation Searched	IPC(8): A61F 2/40, A61F 2/30 (2020.01) CPC: A61F 2/4081, A61F 2002/30405, A61F 2002/4085, A61F 2002/30367, A61F 2002/30011, A61B 17/8033, A61F 2/40, A61F 2/4014, A61F 2/4003, A61F 2002/4022 (keyword limited; see below)
Search Terms Used	Shoulder, reverse, system, implant, implanted, glenoid, plate, stem, screw, angle, angled, angular, slant, slanted, off axis, glenosphere, sphere, hemisphere, porous, porosity, permeable, permeability, cellular, pervious, penetrable, penetrability, nut, spline, ridge, teeth, grooves, rotate, rotated, turn, bolt, insert, insertion, tool, lock, locking
Date Conducted	19 May 2020 (19.05.2020)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA

	MW OA ZA ZM ZW
Date Conducted	19 May 2020 (19.05.2020)

Search Logic:

1) ft = ((shoulder w8 (reverse or system or implant#)) and (glenoid w20 (plate# or stem# or screw#))) (452)
2) cpc = A61F2/4081 (514)
3) 2 and 1 (217)
4) 3 and ft = (angle# or angular# or slant# or (off near axis)) (172)
5) 4 and ft = ((glenosphere# or sphere#) or (porous# or porosity# or permeab# or cellular# or pervious or penetrab#) or nut# or (spline# or ridge# or teeth# or groove#)) (152)
6) 5 and ft = (rotat# or turn#) (128)
7) cpc = A61F2002/30405 (1345)
8) 7 and 1 (43)
9) cpc = A61F2002/4085 (180)
10) 9 and 1 (128)
11) cpc = A61F2002/30367 (684)
12) 11 and 1 (35)
13) cpc = A61F2002/30011 (632)
14) 13 and 1 (10)
15) cpc = A61B17/8033 (351)
16) 15 and 1 (7)
17) cpc = A61F2/40 (760)
18) 17 and 1 (168)
19) 18 and ft = (angle# or angular# or slant# or (off near axis)) (130)
20) cpc = A61F2/4014 (319)
21) 20 and 1 (133)
22) cpc = A61F2/4003 (153)
23) 22 and 1 (48)
24) cpc = A61F2002/4022 (157)
25) 24 and 1 (96)
26) ic = A61F2/40 (1481)
27) 26 and 1 (355)
28) 27 and ft = (angle# or angular# or slant# or (off near axis)) (288)
29) 28 and ft = ((glenosphere# or sphere#) or (porous# or porosity# or permeab# or cellular# or pervious or penetrab#) or nut# or (spline# or ridge# or teeth# or groove#)) (256)
30) 29 and ft = (rotat# or turn#) (226)
31) 30 and ft = (screw# or bolt#) (197)
32) 31 and ft = (tool near insert#) (44)
33) 31 not 32 and ft = (lock#) (113)
34) ic = A61F2/30 (15724)
35) 34 and 1 (319)
36) 35 and ft = (angle# or angular# or slant# or (off near axis)) (269)
37) 36 and ft = ((glenosphere# or sphere#) or (porous# or porosity# or permeab# or cellular# or pervious or penetrab#) or nut# or (spline# or ridge# or teeth# or groove#)) (245)
38) 37 and ft = (rotat# or turn#) (223)

39) 38 and ft = (screw# or bolt#) (193)
40) 39 and ft = (lock#) (150)
41) pn = WO2018/022227 (1)
42) ctb 41 or ctf 41 (13)
43) pn = US2018/0078377 (1)
44) ctb 43 or ctf 43 (155)
45) 44 and 1 (70)

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	19 May 2020 (19.05.2020)

Search Logic:

glenoid baseplate with angled longitudinal axis
About 174 results

glenoid baseplate with morse taper lock and glenosphere
About 29 results

shoulder system with glenosphere having splined opening
About 5 results

shoulder arthroplasty using artificial glenoid fossa
About 630 results

glenoid shoulder prosthetic with hemisphere rotated by splined tool
About 5 results

reverse shoulder system having stemmed baseplate with angled disc
About 1,022 results

humeral head and scapula shoulder prosthetic for artificial glenoid
About 396 results

reverse shoulder prosthetic for reconstruction of the glenoid cavity
About 244 results

modular shoulder replacement for glenoid arthroplasty
About 468 results

prosthetic glenoid having glenosphere screwed into baseplate
About 69 results

Electronic Database Searched	Google
Files Searched	Web
Date Conducted	19 May 2020 (19.05.2020)

Search Logic:

glenoid baseplate with angled longitudinal axis
About 17,800 results (0.53 seconds)

glenoid baseplate with morse taper lock and glenosphere
About 1,490 results (0.45 seconds)

shoulder system with glenosphere having splined opening
About 1,720 results (0.50 seconds)

shoulder arthroplasty using artificial glenoid fossa
About 113,000 results (0.49 seconds)

glenoid shoulder prosthetic with hemisphere rotated by splined tool
About 7,250 results (0.57 seconds)

reverse shoulder system having stemmed baseplate with angled disc
About 102,000 results (0.62 seconds)

humeral head and scapula shoulder prosthetic for artificial glenoid
About 51,700 results (0.59 seconds)

reverse shoulder prosthetic for reconstruction of the glenoid cavity
About 96,800 results (0.81 seconds)

modular shoulder replacement for glenoid arthroplasty
About 57,200 results (0.50 seconds)

prosthetic glenoid having glenosphere screwed into baseplate
About 9,800 results (0.52 seconds)

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT6252049

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
DONALD E. RUNNING	08/14/2020
ROBERT J. BALL	08/14/2020
JASON SLONE	08/13/2020

RECEIVING PARTY DATA

Name:	SHOULDER INNOVATIONS, INC.
Street Address:	13827 PORT SHELDON STREET
City:	HOLLAND
State/Country:	MICHIGAN
Postal Code:	49424

PROPERTY NUMBERS Total: 1

Property Type	Number
PCT Number:	US2020022094

CORRESPONDENCE DATA

Fax Number: (949)760-9502

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 949-760-0404
Email: efiling@knobbe.com
Correspondent Name: KNOBBE, MARTENS, OLSON & BEAR LLP
Address Line 1: 2040 MAIN STREET
Address Line 2: 14TH FLOOR
Address Line 4: IRVINE, CALIFORNIA 92614

ATTORNEY DOCKET NUMBER:	SHOLD.013WO
NAME OF SUBMITTER:	BRYAN WAHL
SIGNATURE:	/Bryan Wahl/
DATE SIGNED:	08/14/2020
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 4
source=Running, Ball and Slone Declaration Assignment - SHOLD.013WO#page1.tif
source=Running, Ball and Slone Declaration Assignment - SHOLD.013WO#page2.tif

source=Running, Ball and Slone Declaration Assignment - SHOLD.013WO#page3.tif
source=Running, Ball and Slone Declaration Assignment - SHOLD.013WO#page4.tif

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running; Robert J. Ball; Jason Slone

Declaration

This Declaration is directed to International Application No. **PCT/US2020/022094**, filed March 11, 2020 and incorporating any amendments made thereto prior to the signature date of this Declaration.

As a named inventor, I declare that:

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

Assignment from Inventors

WHEREAS, **above-identified inventors** (individuals hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas, ornamental designs, or discoveries related to **TOTAL REVERSE SHOULDER SYSTEMS AND METHODS** (collectively hereinafter referred to as the "Work") for which an application for Letters Patent in the United States (identified above) has been filed or prepared for filing with the United States Patent and Trademark Office (hereinafter the "Application"), and ASSIGNOR desires to assign or confirm assignment of the Work and the Application to the below identified Assignee.

AND WHEREAS, **SHOULDER INNOVATIONS, INC.,** with its principal place of business at **13827 Port Sheldon Street, Holland, Michigan 49424** (hereinafter the "ASSIGNEE"), desires to acquire or confirm ownership of the entire right, title, and interest in and to the Application and the Work.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred, and set over, and by these presents does hereby sell, assign, transfer, and set over, unto said ASSIGNEE, its successors, legal representatives, and assigns, the entire right, title, and interest throughout the world in and to the Application and the Work, including: all provisional applications relating to the Work and the Application (including but not limited to U.S. Provisional Application No. **62/816,708**, filed **March 11, 2019**; all nonprovisional applications claiming priority to aforementioned provisional and/or the Application, including, all divisions, continuations, continuations-in-part, and reissues, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof; and all rights of priority under International Conventions and any related Letters Patent which may hereafter be granted or filed in any country or countries foreign to the United States, all extensions, renewals, and reissues thereof.

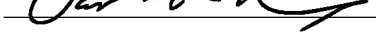
ASSIGNOR hereby authorizes and requests the Commissioner of Patents of the United States, and any Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all related Letters Patent to the ASSIGNEE, its successors, legal representatives, and assigns.

AND ASSIGNOR DOES HEREBY sell, assign, transfer, and convey to ASSIGNEE, its successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of said Letters Patent before or after issuance.

AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will: communicate to said ASSIGNEE, its successors, legal representatives, and assigns any facts known to ASSIGNOR respecting the Work; testify in any legal proceeding; assist in the preparation of any other Patent Property relating to the Application and the Work or any improvements made thereto; sign/execute all lawful papers; authorize the filing of, execute, and make all rightful oaths and/or declarations in connection with the Application and the Work including any improvements made thereto, any patent applications filed therefrom, and any continuing application filed from any of the aforementioned applications; and generally do everything possible to aid the ASSIGNEE, its successors, legal representatives, and assigns, to obtain and enforce proper patent protection for the Work in all countries.

Legal Name of Inventor: Donald E. Running

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 14 day of August, 20 20.

Signature: 

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

Legal Name of Inventor: Robert J. Ball

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this ___ day of _____, 20___.

Signature: _____

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

Legal Name of Inventor: Jason Slone

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this ___ day of _____, 20___.

Signature: _____

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

32510089

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Docket No.: SHOLD.013WO

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running; Robert J. Ball; Jason Slone

Declaration

This Declaration is directed to International Application No. **PCT/US2020/022094**, filed March 11, 2020 and incorporating any amendments made thereto prior to the signature date of this Declaration.

As a named inventor, I declare that:

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

Assignment from Inventors

WHEREAS, **above-identified inventors** (individuals hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas, ornamental designs, or discoveries related to **TOTAL REVERSE SHOULDER SYSTEMS AND METHODS** (collectively hereinafter referred to as the "Work") for which an application for Letters Patent in the United States (identified above) has been filed or prepared for filing with the United States Patent and Trademark Office (hereinafter the "Application"), and ASSIGNOR desires to assign or confirm assignment of the Work and the Application to the below identified Assignee.

AND WHEREAS, **SHOULDER INNOVATIONS, INC.,** with its principal place of business at **13827 Port Sheldon Street, Holland, Michigan 49424** (hereinafter the "ASSIGNEE"), desires to acquire or confirm ownership of the entire right, title, and interest in and to the Application and the Work.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred, and set over, and by these presents does hereby sell, assign, transfer, and set over, unto said ASSIGNEE, its successors, legal representatives, and assigns, the entire right, title, and interest throughout the world in and to the Application and the Work, including: all provisional applications relating to the Work and the Application (including but not limited to U.S. Provisional Application No. **62/816,708**, filed **March 11, 2019**; all nonprovisional applications claiming priority to aforementioned provisional and/or the Application, including, all divisions, continuations, continuations-in-part, and reissues, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof; and all rights of priority under International Conventions and any related Letters Patent which may hereafter be granted or filed in any country or countries foreign to the United States, all extensions, renewals, and reissues thereof.

ASSIGNOR hereby authorizes and requests the Commissioner of Patents of the United States, and any Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all related Letters Patent to the ASSIGNEE, its successors, legal representatives, and assigns.

AND ASSIGNOR DOES HEREBY sell, assign, transfer, and convey to ASSIGNEE, its successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of said Letters Patent before or after issuance.

AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will: communicate to said ASSIGNEE, its successors, legal representatives, and assigns any facts known to ASSIGNOR respecting the Work; testify in any legal proceeding; assist in the preparation of any other Patent Property relating to the Application and the Work or any improvements made thereto; sign/execute all lawful papers; authorize the filing of, execute, and make all rightful oaths and/or declarations in connection with the Application and the Work including any improvements made thereto, any patent applications filed therefrom, and any continuing application filed from any of the aforementioned applications; and generally do everything possible to aid the ASSIGNEE, its successors, legal representatives, and assigns, to obtain and enforce proper patent protection for the Work in all countries.

Legal Name of Inventor: Donald E. Running

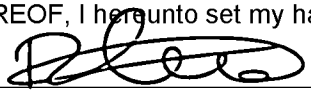
IN TESTIMONY WHEREOF, I hereunto set my hand and seal this ___ day of _____, 20___.

Signature: _____

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

Legal Name of Inventor: Robert J. Ball

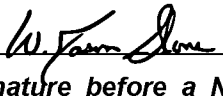
IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 14 day of August, 2020.

Signature: 

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

Legal Name of Inventor: Jason Slone

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 13 day of August, 2020.

Signature: 

Signature before a Notary is desirable but not required. *When signed in presence of a Notary, please attach the appropriate notarial documentation.*

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