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19/249,517	06/25/2025	Michael Stevens	97578-422936	1685
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Figure AI Inc. 3960 N. First Street San Jose, CA 95134			EXAMINER WATKINS, NATHANIEL WILLIAM	
			ART UNIT	PAPER NUMBER
			3617	
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			07/02/2026	ELECTRONIC

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

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

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

ip@figure.ai

Office Action Summary

Application No.

19/249,517

Applicant(s)

Stevens et al.

Examiner

NATHANIEL W WATKINS

Art Unit

3617

AIA (First Inventor to
File) Status Yes

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

Period for Reply

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

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

Status

1) ☒ Responsive to communication(s) filed on 4/16/2026.

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

2a) ☐ This action is **FINAL**.

2b) ☒ This action is non-final.

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

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

Disposition of Claims*

5) ☒ Claim(s) 1,3-7,9-21,24-28 and 30-33 is/are pending in the application.

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

6) ☐ Claim(s) ____ is/are allowed.

7) ☒ Claim(s) 1,3-7,9-21,24-28 and 30-33 is/are rejected.

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

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

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

Application Papers

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

11) ☒ The drawing(s) filed on 6/25/2025 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

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

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

Priority under 35 U.S.C. § 119

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

Certified copies:

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

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

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

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

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

Attachment(s)

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

3) ☐ Interview Summary (PTO-413)

Paper No(s)/Mail Date ____.

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)

4) ☒ Other: NPL.

Paper No(s)/Mail Date ____.

Notice of Pre-AIA or AIA Status

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

Claim Rejections - 35 USC § 112

Claim 1 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 1 recites the limitation "the first quadrant". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

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

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

Claims 1, 9-10, 25, and 28 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke (henceforth Ihrke-671, US 20110071671) in view of Ihrke (henceforth Ihrke-673, US 20110071673), and Wang (CN 115070744).

- Regarding claim 1, Ihrke-671 teaches a humanoid robot 10 ([0019], Fig. 1), comprising: an upper region including at least: (i) a head 12, (ii) a torso 14, (iii) an arm 16 ([0019], Fig. 1) having: (a) an elbow assembly B ([0020], Fig. 2), (b) a forearm assembly 24 ([0022], Fig. 3), and (c) a wrist assembly C ([0024], Fig. 3) having a wrist pivot axis and a wrist yaw axis, and wherein the forearm assembly 24 includes:

a forearm frame that includes: (i) a forearm axis that is substantially centered within an extent of the forearm frame (See annotated Fig. 3 below; the forearm axis is centered in a left-right direction of the forearm), (ii) both a first plane that extends through said forearm axis and a second plane that extends through the forearm axis, wherein said first plane is oriented perpendicular to the second plane to define four distinct quadrants (See annotated Fig. 3 below; the forearm can be divided into four quadrants by axes C2 and an axis parallel to C1), (iii) a proximal mounting portion including a proximal end coupled to an extent of the elbow assembly ([0022], Figs. 1-3; joint B mounts the forearm 24 to the upper arm assembly 22 at the proximal end of the forearm assembly; Fig. 3), (iv) a distal mounting portion including a distal end coupled to an extent of the wrist assembly C (Fig. 3),

a first plurality of actuators 26 coupled to the proximal mounting portion and arranged radially around the forearm axis (Fig. 3), and wherein a first actuator contained in the first plurality of actuators: (a) is in contact with a first tendon 34, (b) includes a first tendon departure region ([0021], Fig. 3; the tendon departure region is where the actuator connects to the tendon 34); and

a central region 15 interconnecting the upper region and the lower region ([0019], Fig. 1).

Ihrke-671 does not explicitly teach a second plurality of actuators.

However, Ihrke-673 teaches a robotic hand assembly with a first plurality of actuators 26A connected to a proximal mounting portion and a second plurality of actuators 26B coupled to the distal mounting portion and arranged radially around the forearm axis, wherein a portion of at least one actuator of the second plurality of actuators is positioned within each of the four quadrants of said forearm frame ([0033] of Ihrke-673; see annotated Fig. 6 of Ihrke-673 below), and wherein a second actuator contained in the second plurality of actuators 26B: (a) is in contact with a second tendon ([0034] of Ihrke-673), (b) is positioned in a second quadrant of the four quadrants, and wherein the second quadrant is diagonally opposed to the first quadrant (See annotated Fig. 6 of Ihrke-673 below; both pluralities of actuators 26A and 26B have at least one actuator which is partially located in each of the four quadrants), and (c) includes a second tendon departure region 53 ([0034], Figs. 6-7 of Ihrke-673; the second tendon departure region is where the actuator connects to the tendon), and

wherein the first tendon departure region 53 is at a first distance from the wrist assembly and the second tendon departure region 53 is at a second distance from the wrist assembly, and wherein the first distance is not equal to the second distance ([0033]-[0034], Figs. 6-7 of Ihrke-673; the finger actuators 26A and 26B are at different distances and have tendon ends 53 which are at different distances from the wrist); and

a lower region spaced apart from the upper region and including a pair of legs ([0022] of Ihrke-673).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the robotic hand assembly of

Ihrke-671 to have the actuators and lower region of Ihrke-673 in order to advantageously provide a robot which can approximate human movement with each joint ([0005] of Ihrke-673).

Ihrke-671 as modified teaches an end effector 19 having a knuckle assembly, a proximal assembly, and a medial assembly ([0021], Figs. 1 and 3), but does not expressly teach the claimed tendon routing structure.

However, Wang teaches a tendon routing path for a robotic hand assembly wherein a third tendon is routed: (i) below an extent of the knuckle assembly 1-7, (ii) above an extent of the proximal assembly 1-6, and (iii) below an extent of the medial assembly 1-5 (Paragraphs 2, 4, 36, 42, Figs. 3 and 5 of Wang).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to substitute the tendon routing structure of Wang for the undisclosed tendon routing structure of Ihrke-671 and the results of the substitution would have been predictable.

Additionally, and in the alternative, Ihrke-671 teaches a base device with a recognized design need for a tendon routing structure. There are a finite number of identified predictable potential solutions for routing the tendons to the finger joints. Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have pursued the known potential options with a reasonable expectation of success.

- Regarding claim 9, Ihrke-671 as modified teaches the humanoid robot further comprising an end effector 18 with more than 16 actuated degrees of freedom ([0026], Fig. 3; each finger has up to 5 degrees of freedom).

- Regarding claim 10, Ihrke-671 as modified teaches the humanoid robot further comprising a biasing member coupled to the first tendon 34 ([0021]; a spring biases the tendon for return motion).
- Regarding claim 25, Ihrke-671 as modified teaches the humanoid robot further comprising:
 - an end effector coupled to the wrist assembly and having a housing, and wherein said housing includes:
 - a first interior wall extent (See annotated Fig. 4 of Ihrke-671 below),
 - a second interior wall extent positioned a first distance from the first interior wall extent, and wherein the first distance resides within a first plane that is configured to be substantially parallel with the wrist pitch axis C1 ([0026], Fig. 3; See annotated Fig. 4 of Ihrke-671 below),
 - a third interior wall extent (See annotated Fig. 4 of Ihrke-671 below),
 - a fourth interior wall extent positioned a second distance from the third interior wall extent, and wherein: (i) the second distance resides with a second plane that is substantially parallel with the first plane (See annotated Fig. 4 of Ihrke-671 below).
- Regarding claim 28, Ihrke-671 as modified teaches further comprising a finger assembly having a member, and wherein the first tendon 34 includes a distal end that is directly coupled to the member ([0021] and [0026]-[0027], Figs. 3-4; each finger assembly contains multiple joints which are mechanically coupled to tendons).

Claims 3 and 26-27 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Ihrke-673 and Wang, and further in view of Walters (US 4834761).

- Regarding claim 3, Ihrke-671 as modified does not teach a third plurality of actuators.

However, Walters teaches a robotic hand and forearm with a proximal and distal mounting portions, each with a plurality of actuators mounted radially around the mounting portions in four quadrants of the forearm frame wherein the forearm frame further includes a medial mounting portion that is positioned between the proximal mounting portion and the distal mounting portion (See annotated Fig. 19-1 of Walters below), and wherein said forearm assembly further includes a third plurality of actuators 42b, 43b coupled to the medial mounting portion and arranged radially around the forearm axis thereby causing a portion of at least one actuator of the third plurality of actuators to be positioned within each of the four quadrants of the said forearm frame (Col. 3, lines 42-50, Figs. 5 and 19; each finger assembly has multiple actuators mounted in the proximal, medial, and distal mounting portions of the forearm frame within four quadrants).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic forearm of Ihrke-671/et.al. to have a third plurality of actuators mounted at the medial portion as Walters teaches in order to advantageously organize actuators within the frame of a robotic hand which can reproduce motion in a finger independent of a motion of the wrist or other fingers (Abstract of Walters).

Additionally, and in the alternative, Ihrke-671 as modified teaches a robotic hand which is capable of reproducing all the movements of a human finger through a tendon actuator system wherein the actuators are grouped into two pluralities mounted at the proximal and distal regions of the forearm frame. Walters teaches a robotic hand which is

capable of reproducing all the movements of a human finger through a tendon actuator system wherein the actuators are grouped into three pluralities mounted at the proximal, medial, and distal regions of the forearm frame. It would have been obvious to one having ordinary skill in the art at the time the invention was made to rearrange the actuators of the modified robotic hand of Ihrke-671/et.al. to be mounted at a proximal, medial, and distal portion of the forearm frame, within all four quadrants, since it has been held that rearranging parts of an invention involves only routine skill in the art. *In re Japikse*, 86 USPQ 70.

- Regarding claim 26, Ihrke-671 as modified does not expressly teach a guide slot.

However, Walters teaches a humanoid robot further comprising a finger assembly with a knuckle assembly 101 (See annotated Fig. 19-1 of Walters below) having an enclosure (Col. 5, lines 5-9, Figs. 15-16 of Walters; each guide slot is an enclosure), and wherein said enclosure includes a guide slot 101, 102, 103, and 104: (i) formed in a top member of said enclosure, and (ii) configured to receive a portion of the second tendon (Col. 5, lines 5-9 of Walters).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified humanoid robot of Ihrke-671/et.al. to have the guide slots of Walters in order to advantageously hold the tendons in place (Col. 5, lines 8-9 of Walters).

- Regarding claim 27, Ihrke-671 does not teach a top guide slot.

However, Walters teaches the humanoid robot wherein the finger assembly further includes a member 7: (i) positioned near a distal end of the finger assembly, and (ii) having a top guide slot 136 formed in said member 7, and said top guide slot 136 is

configured to receive a portion of the second tendon (Col. 6, lines 3-6, Figs. 19 and 21-22 of Walters).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified humanoid robot of Ihrke-671/et.al. to have the guide slots of Walters in order to advantageously hold the tendons in place (Col. 6, lines 5-6 of Walters).

Claim 4 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Ihrke-673, Wang, and Walters, and further in view of Ihrke (Henceforth Ihrke-595, US 20110068595).

- Regarding claim 4, Ihrke-671 as modified does not expressly teach a metacarpophalangeal joint.

However, Ihrke-595 teaches wherein the end effector includes a finger with an metacarpophalangeal (MCP) joint 42D, and ([0037] and [0045], Figs. 4, 6, and 11 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified end effector of Ihrke-671/et.al. to have the metacarpophalangeal joint of Ihrke-595 in order to advantageously adjust angular positions of the phalanges ([0045] of Ihrke-595).

While Ihrke-671 as modified above does not expressly teach “wherein a third actuator contained in the third plurality of actuators is in contact with a third tendon that is configured to control linear movement of the finger about the MCP joint”, it would have been obvious to one having ordinary skill in the art at the time the invention was made to route the tendons which control the metacarpophalangeal joint to the modified

third plurality of tendons, since it has been held that rearranging parts of an invention involves only routine skill in the art. *In re Japikse*, 86 USPQ 70.

Claim 6 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Ihrke-673 and Wang, and further in view of Ihrke (Henceforth Ihrke-595, US 20110068595).

- Regarding claim 6, Ihrke-671 as modified does not expressly teach the curvatures of the tendons.

However, Ihrke-595 teaches a robotic end effector with tendons, wherein the first tendon 46D has a first total curvature in an uncurled state (Fig. 15 of Ihrke-595), and the second tendon 46B has a second total curvature that is greater than the first total curvature in the uncurled state. ([0034] and [0039], Figs. 3 and 15 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified end effector of Ihrke-671/et.al. to have tendons of Ihrke-595 in order to advantageously control movement of the phalanges ([0039] of Ihrke-595).

Claim 7 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Ihrke-673 and Wang, and further in view of Ihrke (US 20140217762; henceforth Ihrke-762).

- Regarding claim 7, Ihrke-671 as modified teaches the robot further comprising: an end effector having a housing and a finger assembly 19 (Fig. 3; the hand is the end effector and contains an outer housing).

Ihrke-671 as modified does not expressly teach a carpal tunnel-like structure.

However, Ihrke-762 teaches a robot hand assembly an end effector further comprising a carpal tunnel-like structure 70 structure, configured to guide the first and

second tendons 20 from the forearm assembly 16, through the wrist assembly 14, and to a base of the housing ([0028], Figs. 1-2 of Ihrke-762).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of Ihrke-671/et.al. to have the carpal tunnel-like structure of Ihrke-762 in order to advantageously provide a robot hand which can route lengths of flexible tendon ([0005] of Ihrke-762).

Ihrke-671 as modified discloses the claimed invention except for “the carpal tunnel-like structure... positioned forward of at least one of the wrist pivot axis or the wrist yaw axis and”. It would have been obvious to one having ordinary skill in the art at the time the invention was made to move the carpal tunnel-like structure to the end effector side of the wrist pitch and yaw axes, since it has been held that rearranging parts of an invention involves only routine skill in the art. *In re Japikse*, 86 USPQ 70.

Claim 24 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Ihrke-673 and Wang, and further in view of Gazeau (US 20230033779).

- Regarding claim 24, Ihrke-671 as modified teaches an end effector 18 ([0019], Fig. 3), but is silent on the use of a glove.

However, Gazeau teaches a robotic hand assembly comprising an end effector and a glove 102 that substantially encases the end effector, and at least a portion of the wrist assembly 103 ([0130], Figs. 15-16 of Gazeau).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of

Ihrke-671/et.al. to wear a glove as Gazeau teaches in order to advantageously increase the adhesion between the tips of the fingers and objects which they grasp ([0036] of Gazeau).

Claims 11, 30, and 32 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Lee (KR 20180107353), Ihrke-595, and Wang.

- Regarding claim 11, Ihrke-671 teaches a humanoid robot 10 ([0018]), comprising:
 - an upper region including: (i) a head 12, (ii) a torso 14, (iii) an arm 16 coupled to the torso 14 and including: (a) a forearm assembly 24, (b) a wrist assembly C coupled to the forearm assembly ([0019], Fig. 3) and having a wrist pitch axis C1 ([0026], Fig. 3), and (c) an end effector 18 coupled to the wrist assembly C (Fig. 3), and wherein said end effector includes:
 - an index finger 19 assembly ([0020], Fig. 1),
 - a middle finger assembly 19 positioned proximate to the index finger assembly ([0019], Fig. 3),
 - a ring finger assembly 19 positioned proximate to the middle finger assembly ([0019], Fig. 3),
 - a little finger assembly 19 positioned proximate to the ring finger assembly ([0019], Fig. 3),
 - a thumb assembly 21 ([0019], Fig. 3),
 - a housing coupled to the index finger, middle finger, ring finger, little finger, and thumb assemblies 19, 21 (Figs. 3-4; the hand is the end effector and contains an outer housing), and
 - wherein said housing includes:
 - a first interior wall extent (See annotated Fig. 4 below),

a second interior wall extent positioned a first distance from the first interior wall extent (See annotated Fig. 4 below), and wherein the first distance resides within a first plane that is configured to be substantially parallel with the wrist pitch axis C1 (Fig. 3),

a third interior wall extent (See annotated Fig. 4 below),

a fourth interior wall extent positioned a second distance from the third interior wall extent (See annotated Fig. 4 below), and wherein (i) the second distance resides with a second plane that is substantially parallel with the first plane (Fig. 3),

a first plurality of tendons 34 coupled to at least the index finger assembly and a second plurality of tendons 34 coupled to the middle finger assembly ([0021], each finger assembly is connected to tendons which may be routed to a driving and a return actuator), and wherein the first and second plurality of tendons 34 are positioned between: (i) the first and second interior wall extents, and (ii) the third and fourth interior wall extents, ([0021] and [0025], Fig. 4; the plurality of tendons are shown entering the hand assembly between the interior wall extents).

Ihrke-671 teaches wherein the first distance is roughly 55% of the second distance (see annotated Fig. 4 of Ihrke-671 below). Ihrke-671 does not teach wherein the first distance is less than 45% of the second distance.

However, Lee teaches a robot hand with a first and second distance across the housing, wherein the first distance is less than 45% of the second distance (see annotated Fig. 7 of Lee below).

Therefore, it would have been obvious for one of ordinary skill in the art before the effective filing date of the claimed invention to modify the robot hand of Ihrke-671 to

have the proportions of Lee in order to advantageously provide a robot hand which has improved workability (Abstract of Lee).

Ihrke-671 does not teach the index finger assembly having a metacarpophalangeal (MCP) joint and being configured for lateral movement.

However, Ihrke-595 teaches wherein the end effector includes an index finger with a metacarpophalangeal (MCP) joint 42D, the index finger assembly being configured for lateral movement ([0037] and [0045], Figs. 4, 6, and 11 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified end effector of Ihrke-671 to have the metacarpophalangeal joint of Ihrke-595 in order to advantageously adjust angular positions of the phalanges ([0045] of Ihrke-595).

Ihrke-671 as modified teaches an end effector 19 having a knuckle assembly, a proximal assembly, and a medial assembly ([0021], Figs. 1 and 3), but does not expressly teach the claimed tendon routing structure.

However, Wang teaches a tendon routing path for a robotic hand assembly wherein a third tendon is routed: (i) below an extent of the knuckle assembly 1-7, (ii) above an extent of the proximal assembly 1-6, and (iii) below an extent of the medial assembly 1-5 (Paragraphs 2, 4, 36, 42, Figs. 3 and 5 of Wang).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to substitute the tendon routing structure of

Wang for the undisclosed tendon routing structure of Ihrke-671 and the results of the substitution would have been predictable.

Additionally, and in the alternative, Ihrke-671 teaches a base device with a recognized design need for a tendon routing structure. There are a finite number of identified predictable potential solutions for routing the tendons to the finger joints. Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have pursued the known potential options with a reasonable expectation of success.

- Regarding claim 30, Ihrke-671 as modified teaches wherein the index finger assembly 19 and the middle finger assembly 19 are substantially the same and are both mounted on the palm of a robotic hand ([0020], Fig. 3).

While Ihrke-671 does not expressly teach that the finger assemblies are interchangeable. It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the middle and index finger assemblies to be interchangeable duplicates of each other in order to advantageously simplify manufacturing costs. See *In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960) (Claims at issue were directed to a water-tight masonry structure wherein a water seal of flexible material fills the joints which form between adjacent pours of concrete. The claimed water seal has a "web" which lies in the joint, and a plurality of "ribs" projecting outwardly from each side of the web into one of the adjacent concrete slabs. The prior art disclosed a flexible water stop for preventing passage of water between masses of concrete in the shape of a plus sign (+). Although the reference did not disclose

a plurality of ribs, the court held that mere duplication of parts has no patentable significance unless a new and unexpected result is produced.).

- Regarding claim 32, Ihrke-671 is silent on the routing of the tendons.

However, Ihrke-595 teaches a humanoid robot 10 ([0029] of Ihrke-595) wherein the index finger assembly 19A includes a curvilinear outer surface 110 formed within a slot that is in contact with a first tendon 46B contained in the first plurality of tendons and is configured to change the direction of said first tendon ([0040] and [0052], Fig. 15 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand assembly of Ihrke-671/et.al. to have the curvilinear outer surface of Ihrke-595 in order to advantageously selectively replaceable tendon-routing structures ([0052] of Ihrke-595). Claims 12-13 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Lee, Ihrke-595, and Wang, and further in view of Engler (US 5447403).

- Regarding claim 12, Ihrke-671 as modified teaches wherein the wrist assembly C comprises:

a housing coupling component (See annotated Fig. 4 below; the bar connected between the left and right base member is the housing coupling component);

a pitch component coupled to the housing coupling component and the housing of the end effector and configured to provide up-and-down movement of the end effector (See annotated Fig; 4 below; the left and right base member function as the pitch component, allowing for up-and-down rotation about axis C1), and wherein the pitch

component only extends across a partial width of the housing of the end effector (Fig. 4);
and

a yaw component 76 coupled to the housing coupling component (Fig. 4)

Ihrke-671 as modified does not teach the yaw component coupled to a base structure that is configured to be coupled to the forearm assembly.

However, Engler teaches a robotic hand wherein a wrist assembly comprises:

a housing coupling component 14 (Col. 5, line 57-Col. 6, line 2, See annotated Fig. 2 of Engler below);

a pitch component coupled to the housing coupling component and the housing of the end effector and configured to provide up-and-down movement of the end effector (Col. 5, line 57-Col. 6, line 2, See annotated Fig. 2 of Engler below), and wherein the pitch component only extends across a partial width of the housing of the end effector (Fig. 2); and

a yaw component coupled to the housing coupling component and a base structure that is configured to be coupled to the forearm assembly (Col. 5, line 57-Col. 6, line 2, Figs. 1a and 2 of Engler).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of Ihrke-671/et.al. to have the wrist assembly of Engler in order to advantageously provide a robotic hand with enhanced control and gripper dexterity (Col. 2, lines 11-16 of Engler).

- Regarding claim 13, Ihrke-671 teaches a plurality of tendons 34 being routed around a portion of the pitch component (Fig. 4). Ihrke-671 does not expressly teach the pitch component including a cable guide.

While Ihrke-671 does not teach the cable guide, the question is what would result from the combined teachings of the references. See *in re Keller*, 642 F.2d 413, 425 (CCPA 1981). Here, that result would be the modified pitch component and corresponding wrist assembly of Engler being substituted for the modified wrist assembly of Ihrke-671/et.al. so that the tendons of Ihrke-671 are routed around a cable guide on the pitch component in the same manner as Engler teaches (Figs. 1a-1b of Engler; cables are shown being routed from actuators, around the pitch component, and into the end effector).

Claim 14 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Lee, Ihrke-595, and Wang, and further in view of Rosheim (US 4804220).

- Regarding claim 14, Ihrke-671 as modified teaches the humanoid robot further comprising a carpal tunnel-like structure 76 configured to guide the first or second plurality of tendons 34 from the forearm assembly to the housing of the end effector ([0034], Fig. 4; the palm link acts as a carpal tunnel-like structure by positioning the tendons within the end effector in an opening within the hand which it surrounds), wherein the carpal tunnel-like structure is positioned between the first interior wall extent and the second interior wall extent (Fig. 4).

Ihrke-671 as modified does not teach a sheath surrounding a plurality of tendons.

However, Rosheim teaches a carpal tunnel-like structure 40'' which secures an extent of a sheath 32' that surround a first or second plurality of tendons (Col. 8, lines 46-55, Fig. 11B of Rosheim).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of

Ihrke-671/et.al. to have the sheath surrounding the tendons coupled to the carpal tunnel-like structure as is taught by Rosheim in order to advantageously accommodate a large number of tendons into the hand assembly (Col. 8, lines 46-49 of Rosheim).

Claim 15 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Lee, Ihrke-595, and Wang, and further in view of Ren (US-20220287853).

- Regarding claim 15, Ihrke-671 as modified does not expressly teach the actuators having peak torque values.

However, Ren teaches a humanoid robotic hand further comprising a first plurality of actuators 70 positioned in the forearm assembly and having a first peak torque ([0291], Fig. 11 of Ren), and a second plurality of actuators 71 that are positioned forward of the first plurality of actuators and have a second peak torque that is greater than the first peak torque ([0291], Fig. 11 of Ren). .

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the actuators of the modified robotic hand of Walters/et.al. to have different peak output torques in order to advantageously provide a dexterous robot hand which can complex operations due to having improved adaptability ([0014] of Ren).

Regarding the limitation of “a second plurality of actuators that are positioned rearward of the first plurality of actuators”. It would have been obvious to one of ordinary skill in the art to switch the mounting locations of the first and second pluralities of actuators since it has been held that the rearrangement of parts requires only routine skill in the art. See *In re Japikse*, 181 F.2d 1019, 86 USPQ 70 (CCPA 1950) (Claims to a hydraulic power press which read on the prior art except with regard to the position of the

starting switch were held unpatentable because shifting the position of the starting switch would not have modified the operation of the device.); *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975) (the particular placement of a contact in a conductivity measuring device was held to be an obvious matter of design choice).

Claim 31 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Lee, Ihrke-595, and Wang, and further in view of Gazeau.

- Regarding claim 31, Ihrke-671 as modified does not teach a glove.

However, teaches the humanoid robot further comprising a glove 102 that substantially encases the end effector, the wrist assembly 103, and a portion of the forearm assembly 101 ([0130], Figs. 15-16 of Gazeau).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of Walters/et.al. to wear a glove as Gazeau teaches in order to advantageously increase the adhesion between the tips of the fingers and objects which they grasp ([0036] of Gazeau). Claims 16, 18, and 33 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Wang.

- Regarding claim 16, Ihrke-671 teaches a humanoid robot 10 ([0018], Fig. 1), comprising:
an upper region including: (i) a head 12, (ii) a torso 14, (iii) an arm 16 coupled to the torso 14, the arm 16 ([0019], Fig. 1) including: (a) a forearm assembly 24 ([0022], Fig. 3) having an actuator 26 and a first tendon 34 ([0021], Fig. 3), (b) a wrist assembly C coupled to the forearm assembly (Fig. 3), and (c) an end effector coupled to the wrist assembly C (Fig. 3; the hand portion is the end effector), and wherein the wrist assembly includes:

a left base member (See annotated Fig. 4 below),
a right base member (See annotated Fig. 4 below),
a rotational axis C1 that extends between the left and right base members ([0026], Figs. 3-4),

a carpal tunnel-like structure 76 directly coupled to the end effector and having an opening formed therein configured to receive an extent of the first tendon 34 ([0034], Fig. 4; the palm link acts as a carpal tunnel-like structure by positioning the tendons within the end effector in an opening within the hand which it surrounds), and wherein a centroid of the opening formed in the carpal tunnel-like structure does not reside on the rotational axis (Fig. 4; the opening is the entryway within the end effector where the tendons are routed to, and the centroid of the carpal tunnel-like structure is perpendicular to the rotational axis).

Ihrke-671 as modified teaches an end effector 19 having a knuckle assembly, a proximal assembly, and a medial assembly ([0021], Figs. 1 and 3), but does not expressly teach the claimed tendon routing structure.

However, Wang teaches a tendon routing path for a robotic hand assembly wherein a third tendon is routed: (i) below an extent of the knuckle assembly 1-7, (ii) above an extent of the proximal assembly 1-6, and (iii) below an extent of the medial assembly 1-5 (Paragraphs 2, 4, 36, 42, Figs. 3 and 5 of Wang).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to substitute the tendon routing structure of

Wang for the undisclosed tendon routing structure of Ihrke-671 and the results of the substitution would have been predictable.

Additionally, and in the alternative, Ihrke-671 teaches a base device with a recognized design need for a tendon routing structure. There are a finite number of identified predictable potential solutions for routing the tendons to the finger joints. Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have pursued the known potential options with a reasonable expectation of success.

- Regarding claim 18, Ihrke-671 as modified teaches the humanoid robot further comprising a biasing member coupled to the first tendon 34 ([0021]).
- Regarding claim 33, Ihrke-671 as modified teaches further comprising a finger assembly having a member, and wherein the first tendon 34 includes a distal end that is directly coupled to the member ([0021] and [0026]-[0027], Figs. 3-4; each finger assembly contains multiple joints which are mechanically coupled to tendons).

Claims 17, and 19-20 are rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in Wang, and further in view of Ihrke-595.

- Regarding claim 17, Ihrke-671 as modified teaches fingers driven by tendons ([0021]) but does not expressly teach a curvilinear outer surface.

However, Ihrke-595 teaches a humanoid robot 10 ([0029] of Ihrke-595) further comprising a structure that includes a curvilinear outer surface 110 that is in contact with a first tendon 46B and is configured to change the direction of said first tendon 46B ([0040] and [0052], Fig. 15 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand assembly of Ihrke-671/et.al. to have the curvilinear outer surface of Ihrke-595 in order to advantageously selectively replaceable tendon-routing structures ([0052] of Ihrke-595).

- Regarding claim 19, Ihrke-671 as modified teaches the humanoid robot further comprising a second tendon 34 that extends through the carpal tunnel-like structure (Fig. 4).

Ihrke-671 as modified is silent on the curvatures of the tendons.

However, Ihrke-595 teaches a robotic hand assembly with multiple tendons, wherein the second tendon 46D has a second total curvature that is less than a first total curvature of the first tendon 46B in the uncurled state ([0034] and [0039], Figs. 3 and 15 of Ihrke-595).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand assembly of Ihrke-671/et.al. to have the fingers and tendon routing of Ihrke-595 in order to advantageously provide a robotic hand assembly which can selectively rotate each phalange ([0005] of Ihrke-595).

- Regarding claim 20, Ihrke-671 as modified teaches the structural limitations of a first and second tendon.

Regarding the limitation of “wherein an application of force or a frequency of use that is associated with the second tendon is greater than an application of force or a frequency of use associated with the first tendon” is functional language. “[Apparatus claims cover what a device is, not what a device does.” *Hewlett-Packard Co. v. Bausch &*

Lomb Inc., 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990) (emphasis in original). A claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987.). Ihrke-671 as modified discloses the structural limitation of the claim, wherein an application of force or a frequency of use that is associated with the second tendon is greater than an application of force or a frequency of use associated with the first tendon.

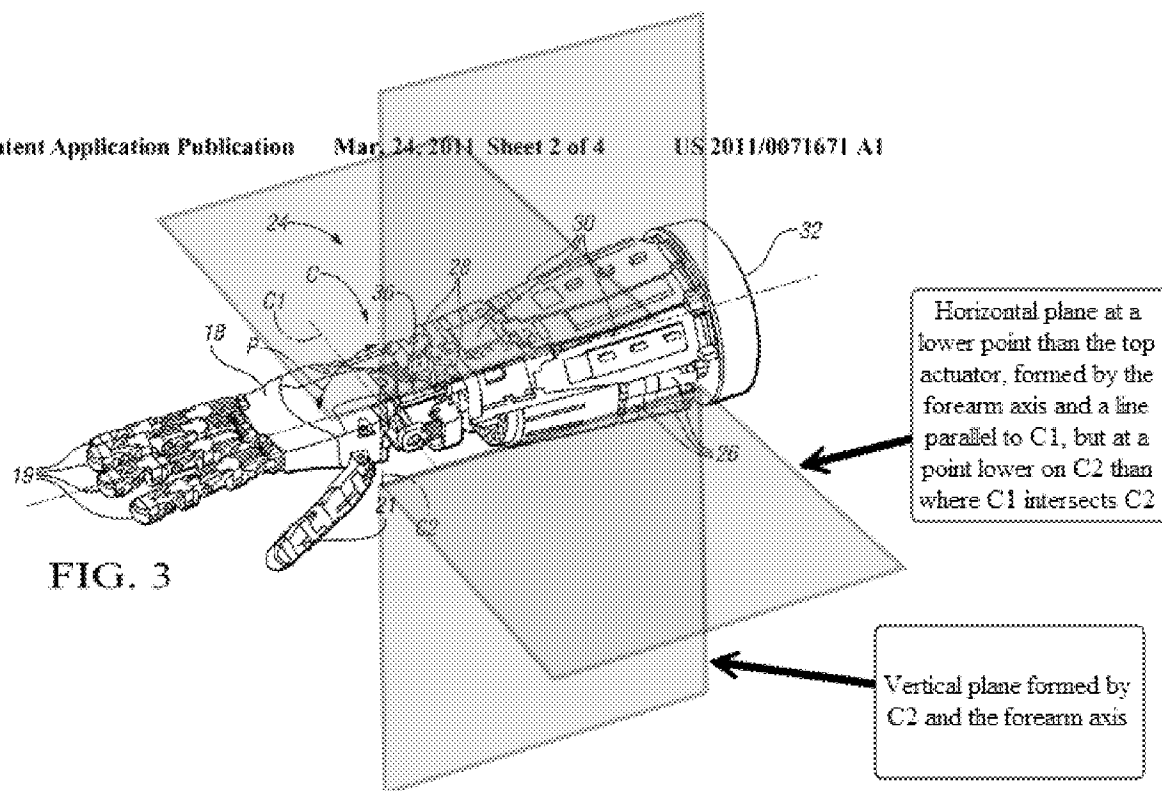
Claim 21 is rejected under 35 U.S.C. 103 as being unpatentable over Ihrke-671 in view of Wang, and further in view of Gazeau.

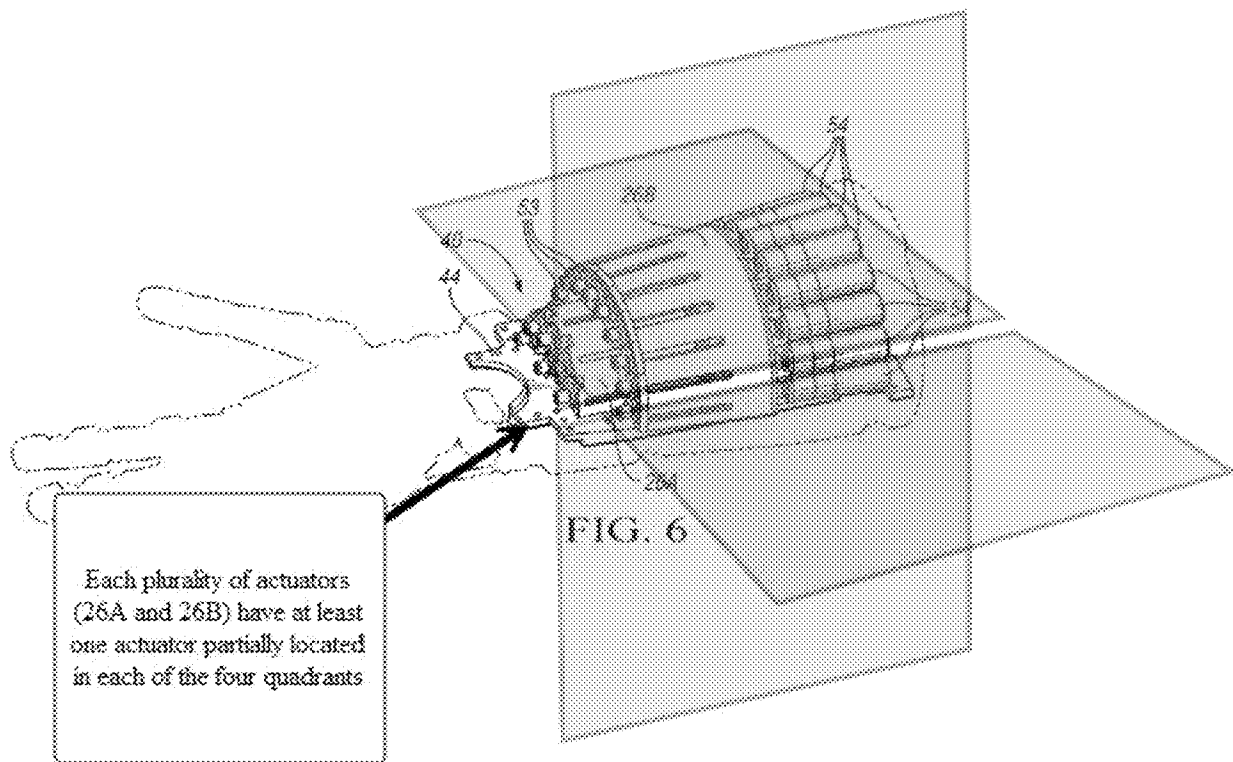
- Regarding claim 21, Ihrke-671 as modified does not expressly teach a glove.

However, Gazeau teaches the humanoid robot further comprising a glove 102 that substantially encases the end effector ([0130], Figs. 15-16 of Gazeau).

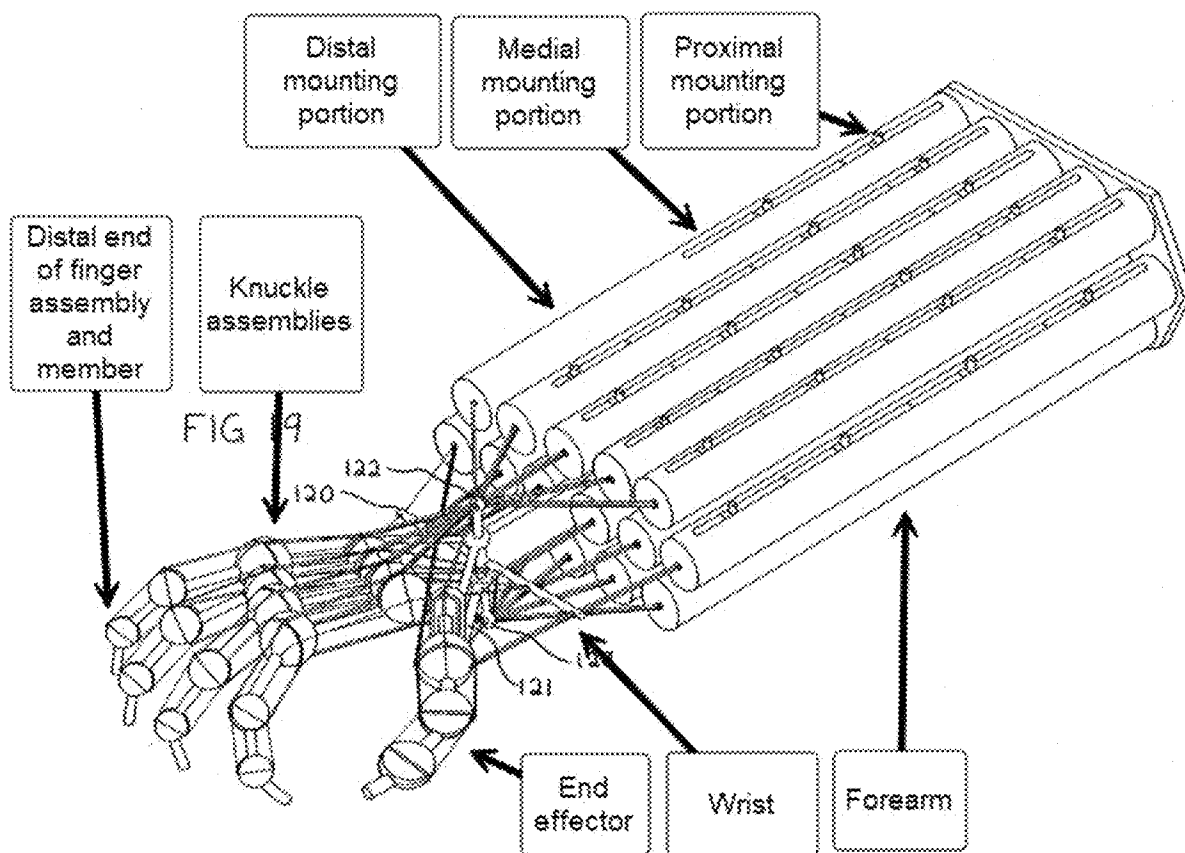
Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the modified robotic hand of Walters/et.al. to wear a glove as Gazeau teaches in order to advantageously increase the adhesion between the tips of the fingers and objects which they grasp ([0036] of Gazeau).

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U.S. Patent May 30, 1989 Sheet 15 of 15 4,834,761 Annotated Fig. 19-1



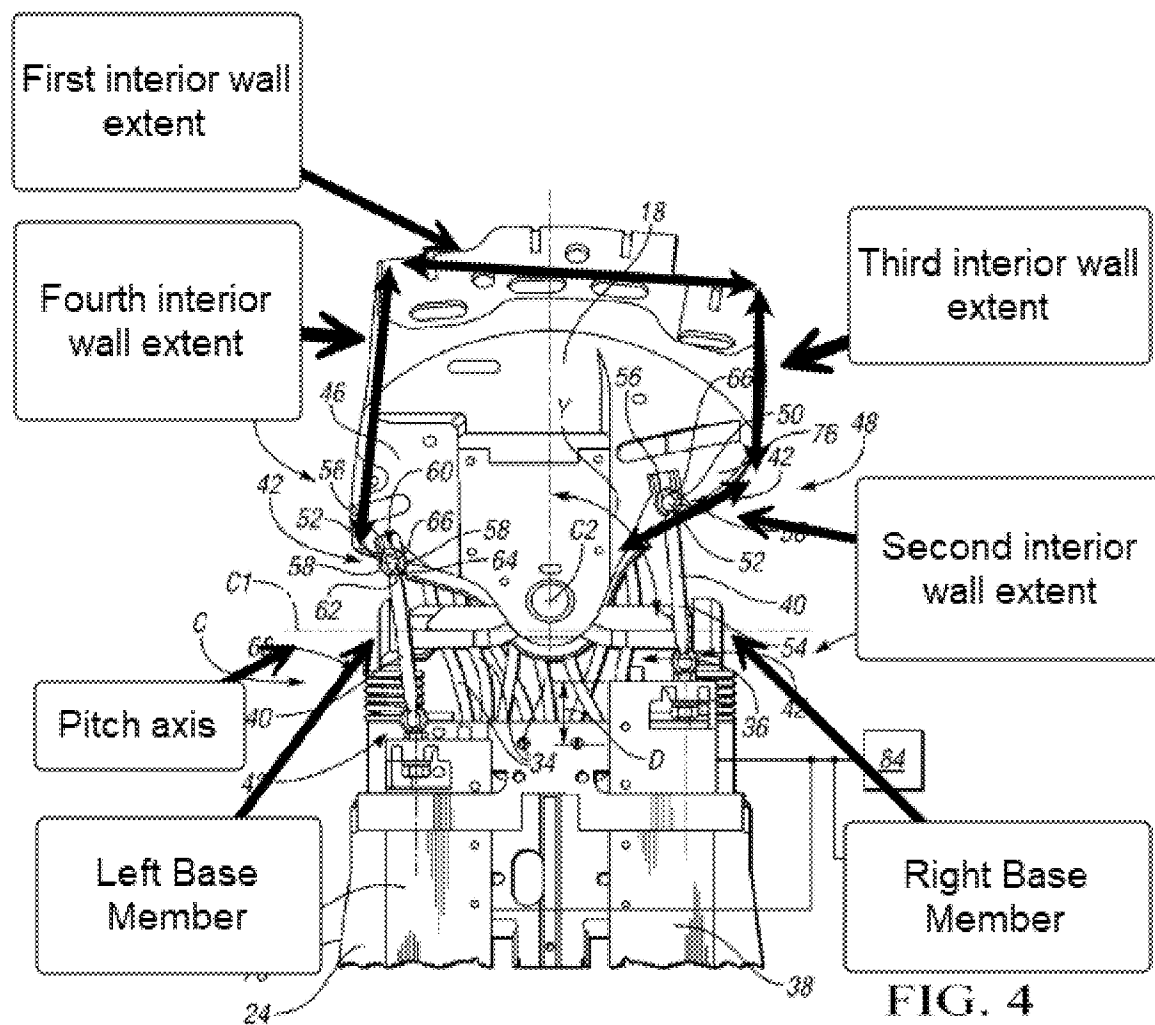
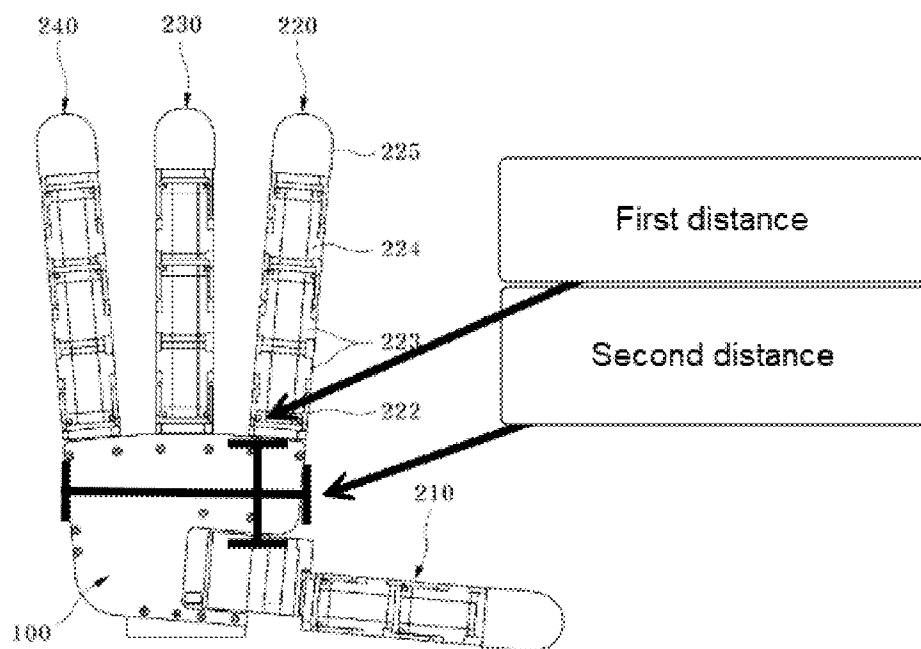
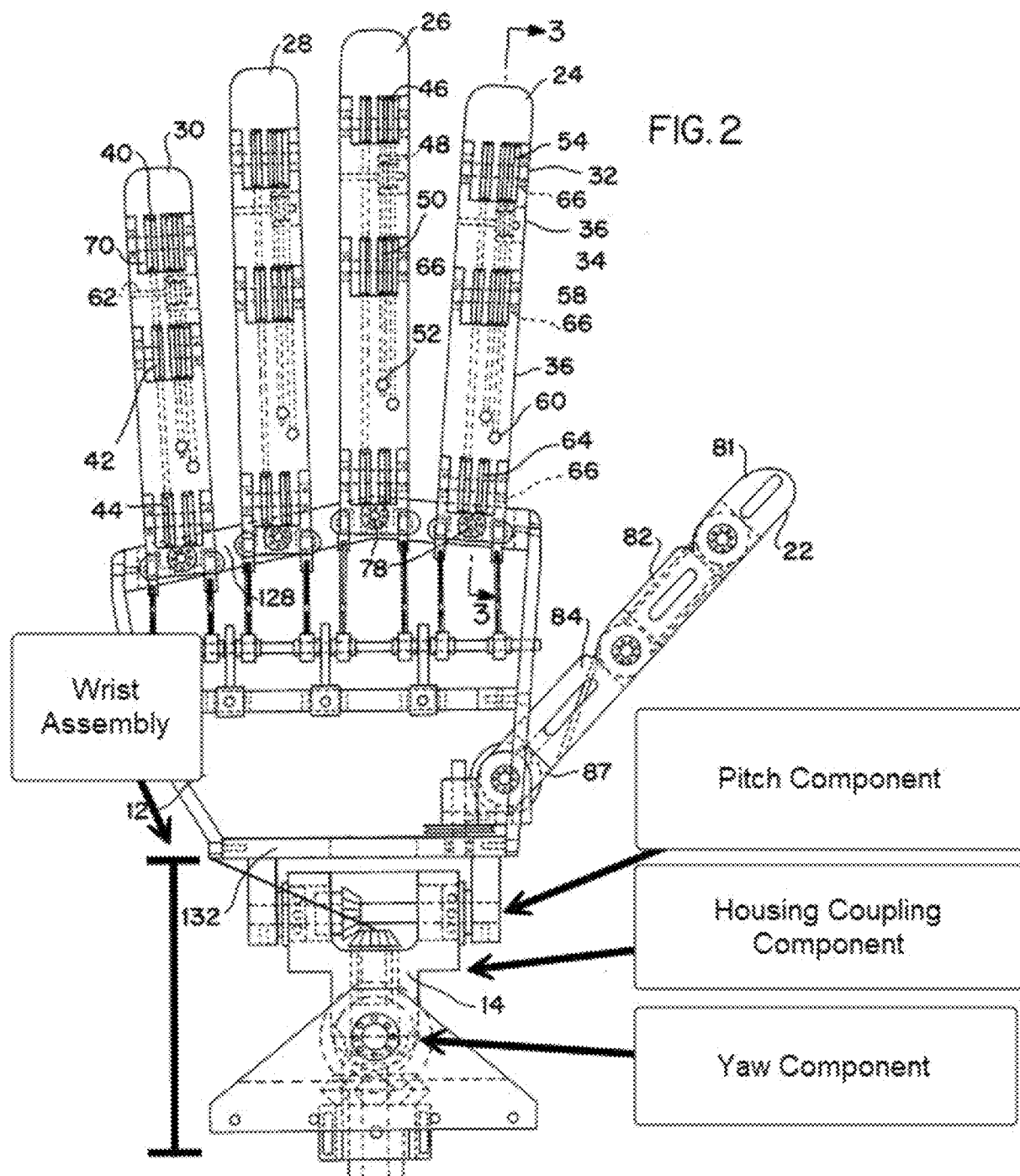


Fig. 7 (KR 20180107353)

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제 97





Conclusion

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

- US 8052185 teaches a robotic hand with slots for routing tendons through the finger joints.
- US 6244644 teaches a dexterous robotic hand with actuators in all four quadrants of the forearm frame.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NATHANIEL WILLIAM WATKINS whose telephone number is (703)756-4744. The examiner can normally be reached Monday-Thursday, 8:30 am -6:00 pm EST; Friday 8:30 am - 2:00 pm EST.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Olszewski can be reached at 5712722706. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/N.W.W./

Examiner, Art Unit 3617

/JOHN OLSZEWSKI/

Supervisory Patent Examiner, Art Unit 3617