

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
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Applicant's or agent's file reference
BYUV-006-WO1

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 19/51728

International filing date (day/month/year)

18 September 2019 (18.09.2019)

Priority date (day/month/year)

18 September 2018 (18.09.2018)

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

IPC - A61B 10/04, A61B 17/29, B25J 19/02 (2020.01)

CPC - A61B 10/04, A61B 17/29, B25J 19/02, A61B 1/00179, A61B 1/0623

Applicant

BRIGHAM YOUNG UNIVERSITY

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US
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Date of completion of this opinion

20 April 2020

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Box No. 1 **Basis of this opinion**

1. With regard to the **language**, this opinion has been established on the basis of:

- the international application in the language in which it was filed.
- a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

- a. forming part of the international application as filed:
- in the form of an Annex C/ST.25 text file.
- on paper or in the form of an image file.
- b. furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
- c. furnished subsequent to the international filing date for the purposes of international search only:
- in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
- on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-15	YES
	Claims	None	NO
Inventive step (IS)	Claims	1-15	YES
	Claims	None	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-15 meet the criteria of PCT Article 33(2) & 33(3) because, as will be shown, the prior art does not teach, nor does it fairly suggest, the claimed limitations.

The prior art is exemplified by (1) US 2017/0354470 A1 to Virtual Incision Corporation (hereinafter 'Virtual') and (2) US 2016/0051127 A1 to Olympus Corporation (hereinafter 'Olympus')

(1) Virtual teaches a hollow rod developable actuator tool (10 - "robotic tool", figs. 1A-B; para [0145]), the tool comprising:
 a first link (11 - "casing", fig. 1A) comprising an outer cylinder (11 - "casing", figs. 1A-B), the outer cylinder comprising:
 a first end having a first aperture (See figs. 1A_B; see top of casing 11 that open to receive camera body 12A);
 a second end having a second aperture (See figs. 1A-B; see bottom of casing 11 that opens up for arms 14 and 16),
 a first wall (See fig. 1A; see body of casing 11 extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end; and
 the first wall having a first joint (14D - "left shoulder", fig. 1A) mounted therein;

a deployment device (14 - "arm", fig. 1A) comprising:

a second link (14B - "inner link", fig. 1A) comprising a first portion of the deployment ring (See fig. 1A), the first portion comprising:
 a first end (See fig. 1A; back right end of link 14B) pivotably coupled to the first wall of the first link at the first joint (See fig. 1A; para [0145]);

a second end (See fig. 1A; see front left end of link 14B) having a second joint (14E - "elbow joint", fig. 1A); and

a body (14B - "inner link", fig. 1A) extending between first end and second end (See fig. 1A); and

a third link (14C - "outer link", fig. 1A) comprising a second portion of the deployment ring (See fig. 1A), the second portion comprising:
 a first end (See fig. 1A; back left end of link 14C) pivotably coupled to the body of the second link at the second joint (See fig. 1A; para [0145]);

a second end (See fig. 1A; front right end of link 14C); and

a body (14C - "outer link", fig. 1A) extending between the first end and second end (See fig. 1A); and

a fourth link (14A - "shoulder", fig. 1A) disposed within the central passage of the outer cylinder of the first link (See fig. 1A):

a first end having a first aperture (See fig. 2; see top end of shoulder 14A with tube that extends into it through an aperture).

(2) Olympus teaches a hollow rod developable actuator tool (1 - "manipulator", fig. 1; para [0033]), the tool comprising:

a first link (See fig. 1; outer surface of insert unit 2, operating unit 3 and extending/retracting unit 4) comprising an outer cylinder (See fig. 1), the outer cylinder comprising:

a first end (See fig. 1; see left end of manipulator 1);

a second end (See fig. 1; see right end of manipulator 1),

a first wall (See fig. 1; see wall extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end (See figs. 1 and 2); and

a first cavity (42a - "opening", fig. 5) disposed in the first wall having a first joint (41a - "protrusion", fig. 5) mounted therein;

a deployment ring (41b, d - "first and second arms", fig. 5) comprising:

a second link (top 41b - "arm", fig. 5) comprising a first portion of the deployment ring (See fig. 5), the first portion comprising:

a first end (See fig. 5; see bottom left end of top arm 41b) pivotably coupled to the first wall of the first link at the first joint (See fig. 5; para [0053]-[0054]);

a second end (See fig. 5; see top right end of top arm 41b) having a second joint (41e - "connecting portion", fig. 5); and

a body extending between first end and second end (See fig. 5); and

a third link (top 41d - "arm", fig. 5) comprising a second portion of the deployment ring (See fig. 5), the second portion comprising:

a first end (See fig. 5; see top left end of top arm 41d) pivotably coupled to the body of the second link at the second joint (See fig. 5; para [0053]-[0054]);

a second end (See fig. 5; see bottom right end of top arm 41d) pivotably connected to a third joint (41c - "second protrusion", fig. 5); and

a body extending between the first end and second end (See fig. 5); and

a fourth link (bottom 41d - "arm", fig. 5).

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In case the space in any of the preceding boxes is not sufficient.

Continuation of:

-Supplemental Box - Box V.2 - Citations and Explanations-

Regarding Claim 1, Virtual teaches a hollow rod developable actuator tool (10 - "robotic tool", figs. 1A-B; para [0145]), the tool comprising: a first link (11 - "casing", fig. 1A) comprising an outer cylinder (11 - "casing", figs. 1A-B), the outer cylinder comprising: a first end having a first aperture (See figs. 1A_B; see top of casing 11 that open to receive camera body 12A); a second end having a second aperture (See figs. 1A-B; see bottom of casing 11 that opens up for arms 14 and 16), a first wall (See fig. 1A; see body of casing 11 extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end; and the first wall having a first joint (14D - "left shoulder", fig. 1A) mounted therein; a deployment device (14 - "arm", fig. 1A) comprising: a second link (14B - "inner link", fig. 1A) comprising a first portion of the deployment ring (See fig. 1A), the first portion comprising: a first end (See fig. 1A; back right end of link 14B) pivotably coupled to the first wall of the first link at the first joint (See fig. 1A; para [0145]); a second end (See fig. 1A; see front left end of link 14B) having a second joint (14E - "elbow joint", fig. 1A); and a body (14B - "inner link", fig. 1A) extending between first end and second end (See fig. 1A); and a third link (14C - "outer link", fig. 1A) comprising a second portion of the deployment ring (See fig. 1A), the second portion comprising: a first end (See fig. 1A; back left end of link 14C) pivotably coupled to the body of the second link at the second joint (See fig. 1A; para [0145]); a second end (See fig. 1A; front right end of link 14C); and a body (14C - "outer link", fig. 1A) extending between the first end and second end (See fig. 1A); and a fourth link (14A - "shoulder", fig. 1A) disposed within the central passage of the outer cylinder of the first link (See fig. 1A): a first end having a first aperture (See fig. 2; see top end of shoulder 14A with tube that extends into it through an aperture); but does not specifically teach wherein the first link has a cavity disposed in the first wall; wherein the deployment device is a deployment ring; wherein the second end is pivotably connected to a third joint; wherein the fourth link comprises an inner cylinder; wherein the inner cylinder comprises a second end having a second aperture; a second wall extending between the first end and the second end defining an inner circumference of the hollow rod and a central passage therethrough from the first end to the second end; and a second cavity in the second wall having the third joint pivotably coupled to the body of the third link; or wherein, when the inner cylinder of the fourth link is rotated in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool, the tool transitions from a first state wherein the deployment ring is within the first cavity and the second cavity of the respective first wall and second wall to a second state where the deployment ring extends outside the outer circumference of the tool.

Further, Olympus teaches a hollow rod developable actuator tool (1 - "manipulator", fig. 1; para [0033]), the tool comprising:

a first link (See fig. 1; outer surface of insert unit 2, operating unit 3 and extending/retracting unit 4) comprising an outer cylinder (See fig. 1), the outer cylinder comprising: a first end (See fig. 1; see left end of manipulator 1); a second end (See fig. 1; see right end of manipulator 1), a first wall (See fig. 1; see wall extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end (See figs. 1 and 2); and a first cavity (42a - "opening", fig. 5) disposed in the first wall having a first joint (41a - "protrusion", fig. 5) mounted therein; a deployment ring (41b, d - "first and second arms", fig. 5) comprising: a second link (top 41b - "arm", fig. 5) comprising a first portion of the deployment ring (See fig. 5), the first portion comprising: a first end (See fig. 5; see bottom left end of top arm 41b) pivotably coupled to the first wall of the first link at the first joint (See fig. 5; para [0053]-[0054]); a second end (See fig. 5; see top right end of top arm 41b) having a second joint (41e - "connecting portion", fig. 5); and a body extending between first end and second end (See fig. 5); and a third link (top 41d - "arm", fig. 5) comprising a second portion of the deployment ring (See fig. 5), the second portion comprising: a first end (See fig. 5; see top left end of top arm 41d) pivotably coupled to the body of the second link at the second joint (See fig. 5; para [0053]-[0054]); a second end (See fig. 5; see bottom right end of top arm 41d) pivotably connected to a third joint (41c - "second protrusion", fig. 5); and a body extending between the first end and second end (See fig. 5); and a fourth link (bottom 41d - "arm", fig. 5).

However, any combination of the above references fails to teach wherein the fourth link comprises an inner cylinder; wherein the inner cylinder comprises

a second end having a second aperture; a second wall extending between the first end and the second end defining an inner circumference of the hollow rod and a central passage therethrough from the first end to the second end; and a second cavity in the second wall having the third joint pivotably coupled to the body of the third link; or wherein, when the inner cylinder of the fourth link is rotated in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool, the tool transitions from a first state wherein the deployment ring is within the first cavity and the second cavity of the respective first wall and second wall to a second state where the deployment ring extends outside the outer circumference of the tool. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the tool as claimed.

Regarding Claims 2-13, the prior art does not specifically teach or fairly suggest individually or in combination the tools as claimed since they are dependent on claim 1.

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In case the space in any of the preceding boxes is not sufficient.

Continuation of:

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Regarding Claim 14, Virtual teaches a method of using a hollow rod developable actuator tool (10 - "robotic tool", figs. 1A-B; para [0145]), the method comprising:

providing a hollow rod developable actuator tool (10 - "robotic tool", figs. 1A-B; para [0145]), the tool comprising:

a first link (11 - "casing", fig. 1A) comprising an outer cylinder (11 - "casing", figs. 1A-B), the outer cylinder comprising:

a first end having a first aperture (See figs. 1A, B; see top of casing 11 that open to receive camera body 12A);

a second end having a second aperture (See figs. 1A-B; see bottom of casing 11 that opens up for arms 14 and 16),

a first wall (See fig. 1A; see body of casing 11 extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end; and

the first wall having a first joint (14D - "left shoulder", fig. 1A) mounted therein;

a deployment device (14 - "arm", fig. 1A) comprising:

a second link (14B - "inner link", fig. 1A) comprising a first portion of the deployment ring (See fig. 1A), the first portion comprising:

a first end (See fig. 1A; back right end of 14B) pivotably coupled to the first wall of the first link at the first joint (See fig. 1A; para [0145]);

a second end (See fig. 1A; see front left end of link 14B) having a second joint (14E - "elbow joint", fig. 1A); and

a body (14B - "inner link", fig. 1A) extending between first end and second end (See fig. 1A); and

a third link (14C - "outer link", fig. 1A) comprising a second portion of the deployment ring (See fig. 1A), the second portion comprising:

a first end (See fig. 1A; back left of 14C) pivotably coupled to the body of the second link at the second joint (See fig. 1A; para [0145]);

a second end (See fig. 1A; front right end of link 14C); and

a body (14C - "outer link", fig. 1A) extending between the first end and second end (See fig. 1A); and

a fourth link (14A - "shoulder", fig. 1A) disposed within the central passage of the outer cylinder of the first link (See fig. 1A):

a first end having a first aperture (See fig. 2; see top end of shoulder 14A with tube that extends into it through an aperture);

but does not specifically teach wherein the first link has a cavity disposed in the first wall; wherein the deployment device is a deployment ring; wherein the second end is pivotably connected to a third joint; wherein the fourth link comprises an inner cylinder; wherein the inner cylinder comprises

a second end having a second aperture;

a second wall extending between the first end and the second end defining an inner circumference of the hollow rod and a central passage therethrough from the first end to the second end; and

a second cavity in the second wall having the third joint pivotably coupled to the body of the third link;

wherein, when the inner cylinder of the fourth link is rotated in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool, the tool transitions from a first state wherein the deployment ring is within the first cavity and the second cavity of the respective first wall and second wall to a second state where the deployment ring extends outside the outer circumference of the tool; or

actuating the tool by rotating the inner cylinder of the fourth link in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool to transition the tool from a first state to the second state. Further, Olympus teaches a hollow rod developable actuator tool (1 - "manipulator", fig. 1; para [0033]), the tool comprising:

a first link (See fig. 1; outer surface of insert unit 2, operating unit 3 and extending/retracting unit 4) comprising an outer cylinder (See fig. 1), the outer cylinder comprising:

a first end (See fig. 1; see left end of manipulator 1);

a second end (See fig. 1; see right end of manipulator 1),

a first wall (See fig. 1; see wall extending between the two ends) extending between the first end and second end defining an outer circumference of the hollow rod and a central passage therethrough from the first end to the second end (See figs. 1 and 2); and

a first cavity (42a - "opening", fig. 5) disposed in the first wall having a first joint (41a - "protrusion", fig. 5) mounted therein;

a deployment ring (41b, d - "first and second arms", fig. 5) comprising:

a second link (top 41b - "arm", fig. 5) comprising a first portion of the deployment ring (See fig. 5), the first portion comprising:

a first end (See fig. 5; see bottom left end of top arm 41b) pivotably coupled to the first wall of the first link at the first joint (See fig. 5; para [0053]-[0054]);

a second end (See fig. 5; see top right end of top arm 41b) having a second joint (41e - "connecting portion", fig. 5); and

a body extending between first end and second end (See fig. 5); and

a third link (top 41d - "arm", fig. 5) comprising a second portion of the deployment ring (See fig. 5), the second portion comprising:

a first end (See fig. 5; see top left end of top arm 41d) pivotably coupled to the body of the second link at the second joint (See fig. 5; para [0053]-[0054]);

a second end (See fig. 5; see bottom right end of top arm 41d) pivotably connected to a third joint (41c - "second protrusion", fig. 5); and

a body extending between the first end and second end (See fig. 5); and

a fourth link (bottom 41d - "arm", fig. 5).

However, any combination of the above references fails to teach wherein the fourth link comprises an inner cylinder; wherein the inner cylinder comprises

a second end having a second aperture;

a second wall extending between the first end and the second end defining an inner circumference of the hollow rod and a central passage therethrough from the first end to the second end; and

a second cavity in the second wall having the third joint pivotably coupled to the body of the third link; or

wherein, when the inner cylinder of the fourth link is rotated in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool, the tool transitions from a first state wherein the deployment ring is within the first cavity and the second cavity of the respective first wall and second wall to a second state where the deployment ring extends outside the outer circumference of the tool or the method comprising actuating the tool by rotating the inner cylinder of the fourth link in relation to the outer cylinder of the first link in such a way that moves the first joint and third joint away from each other along the perimeter of the tool to transition the tool from a first state to the second state. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the tool as claimed.

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Regarding Claim 15, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed since it is dependent on claim 14.

Claims 1-15 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.