

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference FBWX022PCT	FOR FURTHER ACTION		See item 4 below
International application No. PCT/US2020/032396	International filing date (<i>day/month/year</i>) 11 May 2020 (11.05.2020)	Priority date (<i>day/month/year</i>) 10 May 2019 (10.05.2019)	
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237			
Applicant FABWORX SOLUTIONS, INC.			

1.	This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 <i>bis</i> . I(a).																								
2.	This REPORT consists of a total of 7 sheets, including this cover sheet.																								
In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.																									
3.	This report contains indications relating to the following items: <table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: center;">☒</td> <td style="width: 30%;">Box No. I</td> <td style="width: 60%;">Basis of the report</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>	☒	Box No. I	Basis of the report	☐	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 Article 35(2) with regard to novelty, inventive step or 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
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4.	The International Bureau will communicate this report to designated Offices in accordance with Rules 44 <i>bis</i> .3(c) and 93 <i>bis</i> .1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44 <i>bis</i> .2).																								

	Date of issuance of this report 16 November 2021 (16.11.2021)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Sun Hwa Lee e-mail pct.team1@wipo.int

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JOHN FORTKORT
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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

29 SEP 2020

Applicant's or agent's file reference
FBWX022PCT

FOR FURTHER ACTION

See paragraph 7 below

International application No.

PCT/US 20/32396

International filing date (day/month/year)

11 May 2020 (11.05.2020)

Priority date (day/month/year)

11 May 2019 (11.05.2019)

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

IPC - H01G 4/012; H01G 4/02; H01G 4/224 (2020.01)

CPC - H01G 2/10; H01G 4/012; H01G 4/02; H01G 4/224

Applicant FABWORX SOLUTIONS, INC.

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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

17 July 2020

Authorized officer

Lee Young

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 20/32396

Box No. I Basis of this opinion

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

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

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

**WRITTEN OPINION OF THE
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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:
- ☐ paid additional fees.
- ☐ paid additional fees under protest and, where applicable, the protest fee.
- ☐ paid additional fees under protest but the applicable protest fee was not paid.
- ☒ not paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:
- This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.
- Group I: Claims 1-11 directed to A gas capacitor in combination with a semiconductor tool, wherein said semiconductor tool comprises: a gas supply line which supplies gas from a remote gas source and which is equipped with (a) a one-way valve, (b) a central chamber, and (c) a plurality of process chambers.
- Group II: Claims 12-17 directed to a system, comprising: a gas supply; a fluidic circuit which includes first and second sub-circuits.
- Group III: Claims 18-20 directed to A method for operating a semiconductor tool, comprising: providing a gas capacitor in combination with said semiconductor tool.
- The inventions listed as Groups I- III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:
- Special Technical Features:**
- Group II requires a system comprising: a fluidic circuit which includes first and second sub-circuits wherein said first sub-circuit includes a first one-way valve, and wherein said second sub-circuit includes a second one-way valve and a gas capacitor disposed downstream of said second one-way valve; and a pneumatically operated semiconductor tool in fluidic communication with said gas supply by way of said fluidic circuit, not required by groups I or III.
- Group III requires a method for operating a semiconductor tool, comprising: wherein said one-way valve is characterized by a cracking pressure P_{crack} ; at pressures above P_{crack} , maintaining the one-way valve in an open state in which fluidic flow between the gas reservoir and the gas supply line occurs; and at pressures below P_{crack} , maintaining the one-way valve in a closed state in which no fluidic flow between the gas reservoir and the gas supply line occurs not required by groups I or II.
- Common Technical Features:**
- Groups I-III share the technical feature of gas supply, a one-way valve, a gas capacitor, and a pneumatically operated semiconductor tool in fluidic communication with said gas supply.
- Groups I and II share the technical feature of a gas capacitor in combination with a semiconductor tool, wherein said semiconductor tool comprises: a gas supply line which supplies gas from a remote gas source and which is equipped with (a) a one-way valve, (b) a central chamber, and (c) a plurality of process chambers, wherein each of said plurality of process chambers is equipped with a pneumatically actuated valve which is in fluidic communication with the gas supply line and which transforms the process chamber from a first state in which the process chamber is in fluidic communication with said central chamber, to a second state in which the process chamber is fluidically isolated from said central chamber; and wherein said gas capacitor includes a pressurized gas reservoir which is disposed downstream from said one-way valve, and which is in fluidic communication with said plurality of process chambers.
- See Next Supplemental Box--
4. Consequently, this opinion has been established in respect of the following parts of the international application:
- ☐ all parts.
- ☒ the parts relating to claims Nos. 1-11

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

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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	1-11	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-11	NO
Industrial applicability (IA)	Claims	1-11	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-3 lack an inventive step under PCT Article 33(3) over US 6,612,317 B2 to Costantini et al. (hereinafter Costantini) in view of US 2015/0322938 A1 to Integrated Designs L.P. et al. (hereinafter Integrated Designs).

Regarding claim 1, Costantini teaches a gas capacitor (col. 3, ln. 52-54 ...The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber..., capacitor is considered to be where gas is dispensed when pressure is different than anticipated therefore the pressurized receiver tank can be considered a gas capacitor) in combination with a semiconductor tool (col. 14, ln. 42-45 ...The invention extends to a fluid delivery and recovery system in combination with at least one batch operated process chamber, where the supercritical phase process is the cleaning and processing of semiconductor wafers...) wherein said semiconductor tool comprises (col. 14, ln. 29-31 ...A continuous flow fluid delivery and recovery system for supporting the operation of a supercritical phase process in a batch-operated process chamber, comprising...): a gas supply line (col. 14, ln. 56-57 ...with at least one gas supply line connecting to the pressure chamber...) which supplies gas from a remote gas source (col. 3, ln. 52-54 ... The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber..., where the bulk storage tank is the remote gas source) and which is equipped with (a) a one-way valve (col. 4, ln. 59-61 ...pressurized gas or gas mixture from tank 1 is fed by valve 2 through check valve 3...) and (c) a plurality of process chambers (col.7 ln. 42-46 ... It will be readily evident to those skilled in the art that the system may support multiple process chambers in a parallel piping arrangement, with the addition of the necessary isolation valves and chamber-specific components...) wherein each of said plurality of process chambers (col.7 ln. 42-46 ...It will be readily evident to those skilled in the art that the system may support multiple process chambers in a parallel piping arrangement, with the addition of the necessary isolation valves and chamber-specific components...) is equipped with a pneumatically actuated valve (col 11, ln. 20-22...Pump 202 generates the CO2 process flow while a backpressure valve 252 on the downstream side of process chamber 250 generates the process pressure..., since indicated that the chamber-specific components will need to be multiplied the backpressure valves will also need to be multiplied) which is in fluidic communication with the gas supply line (col. 11, ln. 29-35...To increase the flow, backpressure valve 252 has to be opened, which, at constant pumping Speed would drop the pressure. In order to compensate for this the pumping Speed of pump 202 has to be increased resulting in an increase of the flow rate. An electronic control system is used to manage the settings of pump 202 and backpressure valve 252...) wherein said gas capacitor includes a pressurized gas reservoir (col. 3, ln. 52-54 ...The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber...) which is disposed downstream from said one-way valve (see Fig. 3), but does not teach (b) a central chamber and which transforms the process chamber from a first state in which the process chamber is in fluidic communication with said central chamber, to a second state in which the process chamber is fluidically isolated from said central chamber; and which is in fluidic communication with said plurality of process chambers. However, Integrated Designs teaches wherein (b) a central chamber (para[0082]...As seen in Fig 5., incompressible actuating fluid is stored in the central chamber or cavity 207 of the actuation mechanism...) and which transforms the process chamber from a first state in which the process chamber is in fluidic communication with said central chamber (para[0026]...Actuating fluid flows only into the pumping chambers having at least one outlet valve opened, resulting in displacement of process fluid from the associated pumping chamber...), to a second state in which the process chamber is fluidically isolated from said central chamber (para[0106]...Assuming that each system is completely primed and full of process fluid, all valves are closed and a unit is ready to process a first wafer...); and which is in fluidic communication with said plurality of process chambers (para[0026]...Actuating fluid flows only into the pumping chambers having at least one outlet valve opened, resulting in displacement of process fluid from the associated pumping chamber...). Therefore it would have been obvious to someone skilled in the art to combine these references in an attempt to provide a more efficient transfer between process chambers.

Regarding claim 2, Costantini in view of Integrated Designs teaches the apparatus of claim 1. Costantini further teaches wherein said gas reservoir is disposed in said semiconductor tool (see figure 3).

Regarding claim 3, Costantini in view of Integrated Designs teaches the apparatus of claim 1. Costantini further teaches wherein said gas reservoir is disposed proximal to said semiconductor tool (see figure 1, since all parts are proximal to the process chamber in the diagram).

--See Supplemental Box--

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Supplemental Box

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

Continuation of:

---Box V2: Citations and Explanations---

Claims 4-11 lack an inventive step under PCT Article 33(3) over Costantini in view of Integrated Designs in further view of the document entitled "Check Valves" to Vickers.

Regarding claim 4, Costantini in view of Integrated Designs teaches the apparatus of claim 1. Costantini further teaches fluidic flow between the gas reservoir and the gas supply line occurs (see figure 1) and no fluidic flow between the gas reservoir (col. 6, ln. 37-39 ...A valve 53 is provided for venting or sampling as needed, at the discretion of the operator...) but does not teach wherein said first one-way valve is characterized by a cracking pressure P_{crack} ; wherein, at pressures above the cracking pressure, the one-way valve assumes an open state in which fluidic flow between the gas reservoir and the gas supply line occurs; and wherein, at pressures below the cracking pressure, the one-way valve assumes a closed state in which no fluidic flow between the gas reservoir and the gas supply line occurs. However, Vickers does teach wherein said first one-way valve is characterized by a cracking pressure P_{crack} ; wherein, at pressures above the cracking pressure, the one-way valve assumes an open state in which fluidic flow occurs (page 2, second paragraph...The valve starts to pass fluid at a pressure equivalent to the spring cracking pressure level...); and wherein, at pressures below the cracking pressure, the one-way valve assumes a closed state in which no fluidic flow occurs (page 2, second paragraph ...A light spring holds the valve poppet in its normally closed position...). Therefore it would be obvious to someone skilled in the art to combine these references in order to set a cracking pressure to minimize low flow through the valve which decreases unnecessary use of the equipment downstream and to minimize too heavy of flow so that the valve and equipment downstream does not deteriorate quicker than industry standard.

Regarding claim 5, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 4. Costantini teaches wherein the gas supply line experiences operating pressure fluctuations while the semiconductor tool is in operation (col. 14, ln. 56-60 ...with at least one gas supply line connecting to the pressure chamber and a liquid supply line connecting to the chamber; the lines having respective chamber inflow control valves which are controlled by the computer control system...) but does not teach wherein the operating pressure fluctuations are characterized by a maximum pressure P_{max} and a minimum pressure P_{min} , and wherein $0 < P_{crack} < P_{min}$. However, Vickers teaches wherein the operating pressure fluctuations (page 4, see Pressure Drop graph, as there are changes shown across the valve for different flow rates) are characterized by a maximum pressure P_{max} (page 4, "Maximum Operating Pressure") and a minimum pressure P_{min} , and wherein $0 < P_{crack} < P_{min}$ (page 4, paragraph 2 ...The valve starts to pass fluid at a pressure equivalent to the spring cracking pressure level..., P_{min} has to be larger than P_{crack} because P_{crack} is the first instance of fluid flowing through the valve so in order to have constant flow the operating pressure minimum must be higher than this).

Regarding claim 6, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5, but does not teach wherein $P_{min} > 50$ psi. However, since P_{min} lies between P_{crack} and P_{max} it would have been obvious to someone skilled in the art to choose greater than 50 psi as the limit by routine experimentation.

Regarding claim 7, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5, but does not teach wherein $P_{min} \geq 60$ psi. However, since P_{min} lies between P_{crack} and P_{max} it would have been obvious to someone skilled in the art to choose greater than or equal to 60 psi as the limit by routine experimentation.

Regarding claim 8, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5. Vickers further teaches $P_{max} < 100$ psi (see page 4, "Maximum Operating Pressure", since the maximum operating pressure can be up to those pressures therefore it can be less which is in the range here).

Regarding claim 9, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5. Vickers further teaches wherein $P_{max} \leq 90$ psi (see page 4, "Maximum Operating Pressure", since the maximum operating pressure can be up to those pressures therefore it can be less which is in the range here).

Regarding claim 10, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5. Vickers further teaches wherein $10 \text{ psi} < P_{crack} < 60 \text{ psi}$ (see page 4, "cracking pressure" "30 psi").

Regarding claim 11, Costantini in view of Integrated Designs in further view of Vickers teaches the apparatus of claim 5. Vickers further teaches wherein $20 \text{ psi} < P_{crack} < 50 \text{ psi}$ (see page 4, "cracking pressure" "30 psi").

Claims 1-11 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

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Supplemental Box

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

Continuation of:

Box No. IV Lack of unity of invention

However, these shared technical features do not represent a contribution over prior art, because the shared technical feature is being anticipated by US 6,612,317 B2 to Costantini et al. (hereinafter Costantini) in further view of US 2015/0322938 A1 to Laessle et al. (hereinafter Laessle). Costantini teaches a gas capacitor (col. 3, ln. 52-54 ...The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber..., capacitor is considered to be where gas is dispensed when pressure is different than anticipated therefore the pressurized receiver tank can be considered a gas capacitor) in combination with a semiconductor tool (col. 14, ln. 42-45 ...The invention extends to a fluid delivery and recovery system in combination with at least one batch operated process chamber, where the supercritical phase process is the cleaning and processing of semiconductor wafers...) wherein said semiconductor tool comprises (col. 14, ln. 29-31 ...A continuous flow fluid delivery and recovery system for supporting the operation of a supercritical phase process in a batch-operated process chamber, comprising...):

a gas supply line (col. 14, ln. 56-57 ...with at least one gas supply line connecting to the pressure chamber...) which supplies gas from a remote gas source (col. 3, ln. 52-54 ... The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber..., where the bulk storage tank is the remote gas source) and which is equipped with (a) a one-way valve (col. 4, ln. 59-61 ...pressurized gas or gas mixture from tank 1 is fed by valve 2 through check valve 3...) and (c) a plurality of process chambers (col.7 ln. 42-46 ... It will be readily evident to those skilled in the art that the system may support multiple process chambers in a parallel piping arrangement, with the addition of the necessary isolation valves and chamber-specific components...) wherein each of said plurality of process chambers (col.7 ln. 42-46 ...It will be readily evident to those skilled in the art that the system may support multiple process chambers in a parallel piping arrangement, with the addition of the necessary isolation valves and chamber-specific components...) is equipped with a pneumatically actuated valve (col. 11, ln. 20-22...Pump 202 generates the CO2 process flow while a backpressure valve 252 on the downstream side of process chamber 250 generates the process pressure..., since indicated that the chamber-specific components will need to be multiplied the backpressure valves will also need to be multiplied) which is in fluidic communication with the gas supply line (col. 11, ln. 29-35...To increase the flow, backpressure valve 252 has to be opened, which, at constant pumping Speed would drop the pressure. In order to compensate for this the pumping Speed of pump 202 has to be increased resulting in an increase of the flow rate. An electronic control system is used to manage the settings of pump 202 and backpressure valve 252...) wherein said gas capacitor includes a pressurized gas reservoir (col. 3, ln. 52-54 ...The gas supply system includes a bulk storage tank, filter, condenser, pressurized receiver tank, delivery pump, and discharge chamber...) which is disposed downstream from said one-way valve (see Fig. 3), but does not teach (b) a central chamber and which transforms the process chamber from a first state in which the process chamber is in fluidic communication with said central chamber, to a second state in which the process chamber is fluidically isolated from said central chamber; and which is in fluidic communication with said plurality of process chambers. However, Laessle teaches wherein (b) a central chamber (para[0082]...As seen in Fig 5., incompressible actuating fluid is stored in the central chamber or cavity 207 of the actuation mechanism...) and which transforms the process chamber from a first state in which the process chamber is in fluidic communication with said central chamber (para[0026]...Actuating fluid flows only into the pumping chambers having at least one outlet valve opened, resulting in displacement of process fluid from the associated pumping chamber...) , to a second state in which the process chamber is fluidically isolated from said central chamber (para[0106]...Assuming that each system is completely primed and full of process fluid, all valves are closed and a unit is ready to process a first wafer...); and which is in fluidic communication with said plurality of process chambers (para[0026]...Actuating fluid flows only into the pumping chambers having at least one outlet valve opened, resulting in displacement of process fluid from the associated pumping chamber...).Therefore it would have been obvious to someone skilled in the art to combine these references in an attempt to provide a more efficient transfer between process chambers.

As the shared technical features were known in the art at the time of the invention, they cannot be considered common technical features that would otherwise unify the groups. Therefore, Groups I-III lack unity under PCT Rule 13.