PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: RONALD GRAF
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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	01 SEP 2009
Applicant's or agent's file reference	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2009/002910	11 May 2009	15 May 2008

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - F02G 1/04 (2009.01)
USPC - 60/517

Applicant GRAF, Ronald

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 43*bis*.1(a)(i) 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

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 66.1*bis*(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.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	17 August 2009	Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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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(a))

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. type of material

      ☐ a sequence listing

      ☐ table(s) related to the sequence listing

   b. format of material

      ☐ on paper

      ☐ in electronic form

   c. time of filing/furnishing

      ☐ contained in the international application as filed

      ☐ filed together with the international application in electronic form

      ☐ furnished subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in 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. 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 appicable 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 1-10 are drawn to a device comprising a first substantially centrifugal compressor and a second substantially centrifugal compressor.

Group II, claims 11-12 is drawn to a pump.

The inventions listed as Groups I-II 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: the special technical features of Group I, a first fluid connedtion, a first substantially centrifugal compressor, a second fluid connection, a second substantially centrifugal compressor, means to add heat, means to remove heat, are not present in Group II; the special technical features of Group II, a set of blades, a casing, the velocity vector of each point within the blades, are not present in Group I.

Since none of the special technical features of the Group I-II inventions is found in more than one of the inventions, unity is lacking.

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. 1-10

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

1. Statement

Novelty (N)	Claims	2, 5-10	YES
	Claims	1, 3, 4	NO
Inventive step (IS)	Claims	2, 7	YES
	Claims	1, 3-6, 8-10	NO
Industrial applicability (IA)	Claims	1-10	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1, 3, 4 lack novelty under PCT Article 33(2) as being anticipated by Silver et al. (US 2006/0075752 A1).

Regarding claims 1, 3, 4, and as far as these claims are understood, Silver et al. ('752) disclose [Cl. 1] a device (fig. 2) comprising: a first substantially centrifugal compressor (at 103b, 107b), a second substantially centrifugal compressor (at 103a, 107a) to be used as an expander to produce power, a first fluid connection (102), which communicates between the conventional output of the first substantially centrifugal compressor (at 103b, 107b) and the conventional output of the second substantially centrifugal compressor (at 103a, 107a), a second fluid connection (104), which communicates between the conventional input of the first substantially centrifugal compressor (at 103b, 107b) and the conventional input of the second substantially centrifugal compressor (at 103a, 107a), the fluid connections being such that normally during constant device speed when a substantial conventional flow (from 107b to 107a) is taking place in the first compressor (at 103b, 107b) a reverse flow (from 107a to 107b) is taking place in the second compressor (at 103a, 107a) thus making the second compressor's (at 103a, 107a) conventional flow output an actual input and making its conventional flow input an actual output, a means located along the first fluid connection to add heat (abstract, lines 2-4; [0032], lines 10-11) to the fluid while it is flowing in the first fluid connection, the heat coming from some system (abstract, lines 2-4) outside of the fluid, a means located along the second fluid connection to remove heat from the fluid ([0025], lines 33-37) while it is flowing in the second fluid connection, the heat going to a system outside of the fluid, the fluid being contained in the device ([0005], lines 3-7), so that, except for minor leaks, none of the fluid escapes from the device during power production (intended use); [Cl. 3] the device being an external heat engine (abstract, lines 1-4) wherein the first substantially centrifugal compressor (at 103b, 107b) is such that the first compressor's blades (103b) and the first compressor's blade casing (115) both rotate at substantially the same rate; and [Cl. 4] the device being an external heat engine (abstract, lines 1-4) wherein the first substantially centrifugal compressor (at 103b, 107b) is such that at least some of the first compressor's rotating blades (103b) are firmly attached to the first compressor's blade casing (115).

Claim 5 lacks an inventive step under PCT Article 33(3) as being obvious over Silver et al. (US 2006/0075752 A1).

Regarding claim 5, Silver et al. ('752) disclose the device of claim 1, including that the device is an external heat engine (abstract, lines 1-4), and that a fluid other than air may be used as the working fluid (abstract, lines 5-6; [0025], last two lines), but fail to specifically disclose [Cl. 5] that the working fluid of the flow is heavier than air, as for example Argon and Krypton, thus making compression using centrifugal force easier than for air. However, modifications regarding materials are generally considered to be modifications that are obvious to and well within the purview of one with ordinary skill in the art. Further, it is known in the course of ordinary research and discovery by a skilled artisan to optimize the dimensions, materials, etc. of a device to have it perform under the conditions for which a consumer will use. Therefore, it would have been obvious to one with ordinary skill in this art at the time of the invention to modify the device of Silver et al. ('752) by using a working fluid that is heavier than air, as a matter of preference based on application needs for the purpose of improved efficiency by making the fluid compression easier to achieve.

Continued in Supplemental Box

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 1-10 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6. Claims 1-10 are indefinite for the following reasons.

Claim 1: In claim 1, lines 5-6, "the conventional output of said first substantially centrifugal compressor" has no antecedent; lines 6-7, "the conventional output of said second substantially centrifugal compressor" has no antecedent; lines 8-9, the conventional input of said first substantially centrifugal compressor" has no antecedent; lines 9-10, "the conventional input of said second substantially centrifugal compressor" has no antecedent; lines 13-14, "the second compressor's conventional flow output" has no antecedent", and; lines 14-15, "its conventional flow input" has no antecedent.

Claim 2: This claim depends from claim 1 and recites various elements, e.g. "a fluid container", "said fluid", "a means located far from the rotation axis and used to heat", "a means to extract energy", "a means located near to the rotation axis and used to remove heat", however it is unclear whether they are the same elements as some of the elements recited in claim 1, or how they interrelate with the elements recited in claim 1.

Claim 3: In claim 3, lines 2-3, "said first compressor's blades" has no antecedent, and; line 3, "said first compressor's blade casing" has no antecedent.

Claim 4: In claim 4, lines 2-3, "said first compressor's rotating blades" has no antecedent, and; lines 3-4, "said first compressor's blade casing" has no antecedent.

Claim 5; In claim 5, line 2, "the working fluid" has no antecedent.

Claim 6: In claim 6, lines 5-6, "the conventional output of said first substantially centrifugal compressor" has no antecedent; lines 6-7, "the conventional output of said second substantially centrifugal compressor" has no antecedent; lines 8-9, the conventional input of said first substantially centrifugal compressor" has no antecedent; lines 9-10, "the conventional input of said second substantially centrifugal compressor" has no antecedent; lines 13-14, "the second compressor's conventional flow output" has no antecedent", and; lines 14-15, "its conventional flow input" has no antecedent.

Claim 7: This claim depends from claim 6 and recites various elements, e.g. "a fluid container", "said fluid", "a means located far from the rotation axis and used to extract heat", "a means to extract energy", "a means located near to the rotation axis and used to add heat", however it is unclear whether they are the same elements as some of the elements recited in claim 1, or how they interrelate with the elements recited in claim 1.

Claim 8: In claim 8, lines 2-3, "said first compressor's blades" has no antecedent, and; line 3, "its blade casing" has no antecedent.

Claim 9: In claim 9, lines 2-3, "said first compressor's rotating blades" has no antecedent, and; lines 3-4, "said first compressor's blade casing" has no antecedent.

Claim 10: In claim 10, line 2, "the working fluid" has no antecedent.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V

Claims 6, 8-10 lack an inventive step under PCT Article 33(3) as being obvious over Silver et al. (US 2006/0075752 A1) in view of Crow.

Regarding claims 6, 8, 9, and as far as these claims are understood, Silver et al. ('752) disclose [Cl. 6] a device (fig. 2) comprising: a first substantially centrifugal compressor (at 103b, 107b), a second substantially centrifugal compressor (at 103a, 107a) to be used as an expander to produce power, a first fluid connection (102), which communicates between the conventional output of the first substantially centrifugal compressor (at 103b, 107b) and the conventional output of the second substantially centrifugal compressor (at 103a, 107a), a second fluid connection (104), which communicates between the conventional input of the first substantially centrifugal compressor (at 103b, 107b) and the conventional input of the second substantially centrifugal compressor (at 103a, 107a), the fluid connections being such that normally during constant device speed when a substantial conventional flow (from 107b to 107a) is taking place in the first compressor (at 103b, 107b) a reverse flow (from 107a to 107b) is taking place in the second compressor (at 103a, 107a) thus making the second compressor's (at 103a, 107a) conventional flow output an actual input and making its conventional flow input an actual output, a means located along the first fluid connection to add heat (abstract, lines 2-4; [0032], lines 10-11) to the fluid while it is flowing in the first fluid connection, the heat coming from some system (abstract, lines 2-4) outside of the fluid, a means located along the second fluid connection to remove heat from the fluid ([0025], lines 33-37) while it is flowing in the second fluid connection, the heat going to a system outside of the fluid, the fluid being contained in the device ([0005], lines 3-7), so that, except for minor leaks, none of the fluid escapes from the device during power production (intended use); [Cl. 8] the device being an external heat engine (abstract, lines 1-4) wherein the first substantially centrifugal compressor (at 103b, 107b) is such that the first compressor's blades (103b) and the first compressor's blade casing (115) both rotate at substantially the same rate; and [Cl. 9] the device being an external heat engine (abstract, lines 1-4) wherein the first substantially centrifugal compressor (at 103b, 107b) is such that at least some of the first compressor's rotating blades (103b) are firmly attached to the first compressor's blade casing (115). Silver et al. ('752) fail to disclose the device being a heat pump, a means located along the first fluid connection to remove heat from the fluid while it is flowing in the first fluid connection, the heat going to some system outside of the fluid, and a means located along the second fluid connection to add heat to the fluid while it is flowing in the second fluid connection, the heat coming from a system outside of the fluid. However, Crow discloses a similar device and system (title; abstract; [0002]), comprising a heat engine ([0002]) that converts thermal energy to mechanical energy ([0002]). Crow also teaches the concept of reversing the configuration of the heat engine, the device can be run as a heat pump (abstract, lines 20-22; [0141]). Therefore, it would have been obvious to one with ordinary skill in this art at the time of the invention to reverse the configuration of the means to add heat and the means to remove heat of Silver et al. ('752), wherein the device would run as a heat pump, as taught by Crow, for the purpose of providing a more versatile device that may be used in a variety of applications and environments.

Regarding claim 10, the modified Silver et al. ('752) disclose the heat pump of claim 6, including that a fluid other than air may be used as the working fluid (abstract, lines 5-6; [0025], last two lines), but fail to specifically disclose [Cl. 5] that the working fluid of the flow is heavier than air, as for example Argon and Krypton, thus making compression using centrifugal force easier than for air. However, modifications regarding materials are generally considered to be modifications that are obvious to and well within the purview of one with ordinary skill in the art. Further, it is known in the course of ordinary research and discovery by a skilled artisan to optimize the dimensions, materials, etc. of a device to have it perform under the conditions for which a consumer will use. Therefore, it would have been obvious to one with ordinary skill in this art at the time of the invention to further modify the device of Silver et al. ('752) by using a working fluid that is heavier than air, as a matter of preference based on application needs for the purpose of improved efficiency by making the fluid compression easier to achieve.

Claims 1-10 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Claims 2, 7 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest the device of claim 1, and [Cl. 2] the device being an external heat engine comprising: a fluid container containing a compressible fluid, a means to rotate the fluid container around a rotation axis, a means to cause a part of the fluid to flow from a first position, called position one, in the container close to the rotation axis to a second position, called position two, in the container far from the rotation axis thus causing a compression of the part of the fluid, near and far being relative to a scale having a minimum distance being the distance from the axis of a point in the container closest to the rotation axis and a maximum distance being the distance from the axis of a point in the container farthest from the rotation axis, a means located far from the rotation axis and used to heat the part of the fluid by heat exchange with a heat sink external to the fluid while the part of the fluid travels from position two to another position, called position three, also far from the axis, a means to extract energy as the part of the fluid moves from the position three, far from the axis, to a position, called position four, close to the rotation axis, with accompanying expansion of the part of the fluid, a means located near to the rotation axis and used to remove heat from the part of the fluid by heat exchange with another heat sink external to the fluid while the part of the fluid travels from position four, near to the rotation axis, to position five also near to the rotation axis; or the device of claim 6, and [Cl. 7] the device being a heat pump comprising: a fluid container containing a compressible fluid, a means to rotate the fluid container around a rotation axis, a means to cause a part of the fluid to flow from a first position, called position one, in the container close to the rotation axis to a second position, called position two, in the container far from the rotation axis thus causing a compression of the part of the fluid, near and far being relative to a scale having a minimum distance being the distance from the axis of a point in the container closest to the rotation axis and a maximum distance being the distance from the axis of a point in the container farthest from the rotation axis, a means located far from the rotation axis and used to extract heat from the part of the fluid by heat exchange with an external sink while the part of the fluid travels from position two to another position, called position three, also far from the rotation axis, a means to extract energy as the part of the fluid moves from the position three, far from the axis, to a position, called position four, close to the rotation axis, with accompanying expansion of the part of the fluid, a means located near to the rotation axis and used to add heat to the part of the fluid by heat exchange with another external heat sink while the part of the fluid travels from position four, near to the rotation axis, to position five also near to the rotation axis. None of the cited prior art references taken alone or in combination disclose or suggest the specific device as recited above, and none of the cited references cure the deficiencies of Silver et al. (US 2006/0075752 A1) and Crow discussed in this written opinion.