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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ROBERT W. BUSSARD

Appeal 2010-002746
Application 11/527,906
Technology Center 3600

Before: PHILLIP J. KAUFFMAN, MICHAEL C. ASTORINO, and HYUN J. JUNG, *Administrative Patent Judges*.

JUNG, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Robert W. Bussard (Appellant) appeals under 35 U.S.C. § 134 from a rejection of claims 1-9, 11-16, and 18. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

THE CLAIMED SUBJECT MATTER

The claims are directed to a method and an apparatus for controlling charged particles. Spec. 1:6. Claim 2, reproduced below, is illustrative of the claimed subject matter:

> 2. An apparatus for controlling positively charged particles comprising:
>
> means for generating a magnetic field within a region, all the cusps of said magnetic field being point cusps;
>
> means for injecting electrons into the center of said region for forming a negative potential well within said region;
>
> means for performing at least one of injecting positively charged particles into said region or creating positively charged particles within said region, and using said negative potential well to confine said positively charged particles within said region; and
>
> means for maintaining the number of electrons greater than the number of positively charged particles;
>
> wherein said magnetic field generating means includes current carrying means for carrying an electric current, said current carrying means so arranged as to lie on at least some faces of a polyhedron and spaced from and adjacent to edges of said polyhedron and spaced apart at each vertex of said polyhedron, said polyhedron having an even number of faces about each vertex;
>
> wherein said magnetic field generating means generates only point cusps at positions corresponding to the centers of faces of said polyhedron; and

wherein said electron injecting means is arranged to inject said electrons through one of said point cusps along a first line corresponding to an axis of said polyhedron.

THE REFERENCES

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Bussard '646 US 4,826,646 May 2, 1989

A.I. Morozov et al., *On Galateas-magnetic traps with plasma-embedded conductors*, 41 Physics-Uspekhi, 1049-56 (1988) (hereinafter "Morozov").

O. Lavrent'ev, *Electrostatic and Electromagnetic High-Temperature Plasma Traps*, 251 Annals of the New York Acad. of Sci., 152-78 (1975) (hereinafter "Lavrent'ev").

Ronald Allen Knief, *Nuclear Engineering : Theory and Technology of Commercial Nuclear Power*, 641 (1992) (hereinafter "Knief").

James Riordon, *ALTERNATIVES: Fusion Power From a Floating Magnet?*, 285 Science 6, 821-23 (Aug. 1999) (hereinafter "Riordon").

Dolan, *Magnetic Electrostatic Plasma Confinement*, 36 Plasma Physics, Controlled Fusion, 1539-93 (1994) (hereinafter "Dolan").

Robert W. Bussard, *The Advent of Clean Nuclear Fusion: Superperformance Space Power and Propulsion*," Int'l Astronautic Congress, 1-29 (2006) (hereinafter "Bussard IAC2006").

B. D. Bondarenko, *Role played by O A Lavrent'ev in the formulation of the problem and the initiation of research into controlled nuclear fusion in the USSR*, 44 Physics-Uspekhi, 844 (2001) (hereinafter "Bondarenko").

Todd H. Rider, *Fundamental limitations on plasma fusion systems not in thermodynamic equilibrium*, 4 Phys. Plasmas, 1039-46 (Apr. 1997) (hereinafter "Rider").

V.D. Shafranov et al., *FROM THE HISTORY OF PHYSICS : On the history of the research into controlled thermonuclear fusion*, 44 Physics–Uspekhi, 835-65 (2001) (hereinafter "Shafranov").

THE REJECTIONS

The Appellant seeks our review of the following rejections:

Claims 1-8 stand rejected under 35 U.S.C. § 101 because the claimed invention as disclosed is inoperative and therefore lacks utility. Ans. 7-8.

Claims 1-9, 11-16, and 18 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Ans. 8-9.

Claims 1, 5-9[1], 11-16, and 18 stand rejected under 35 U.S.C. § 112, second paragraph, as indefinite. Ans. 9-10.

Claims 1-9, 11-16, and 18 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Bussard '646 and Morozov. Ans. 10-21.

ANALYSIS

Inoperability

The Examiner finds that the subject matter of claims 1-4 as disclosed is inoperative because the possible fusion rate and positive particle lifetime achieved by the method of claim 1 and the apparatus of claim 2 is below the break-even point for exceeding energy used to generate nuclear reactions. Ans. 7-8. The Examiner also finds that the subject matter of claims 5-8 as

[1] The Answer erroneously includes claim 10 as being rejected under 35 U.S.C. § 112, second paragraph. However, claim 10 is canceled. Br. 2, 12, Claims App'x.

disclosed is inoperative because the possible fusion rate in the device of claim 5 is also below the break-even point. Ans. 8.

The Appellant argues that the claimed invention has the specific and substantial utility of obtaining fusion reactions and that there is no requirement to achieve "break even." Br. 14. The Appellant also notes that the Specification describes applications that do not require "break even," such as tritium production, fissionable fuel production, and nuclear waste burn up. *Id*. (referencing Spec. 40:4 *et seq*.).

The Examiner responds that there is no credible confirmation that the claimed invention provides a well-defined and particular benefit to the public or has a significantly and presently available benefit to the public. Ans. 32. The Examiner states that the apparatus cannot operate as disclosed and cannot produce the claimed results through the disclosed principle of operation. *Id*. (referring to Ans. 21-31). The Examiner also states that the disclosed principle of operation does not support fusion plasma production in any scalable device. *Id*. The Examiner further states that an upgraded version of the claimed apparatus would need to demonstrably exceed break-even or have net energy production, but the disclosed apparatus and method are incapable of producing such results. *Id*. at 33. The Examiner cites drifting plasma collected by coil supports, plasma loss, Rider, unreliable neutron radiation readings, inability to confine plasma due to plasma-wall interaction, and Lavrent'ev as indicating inoperability of the disclosed invention. *Id*. at 34-36, 38-41. The Examiner also cites Shafranov for the many claims of efficient controlled fusion production which were neither confirmed nor reproduced. *Id*. at 36. The Examiner also finds that undue experimentation would be required for the claimed invention to produce the claimed results. *Id.* at 37-38.

To question the objective truth of the Appellant's statement of utility, evidence must be presented that establishes a reason for one of ordinary skill in the art to question that statement. *In re Cortright*, 165 F.3d 1353, 1357 (Fed. Cir. 1999) (*quoting In re Brana*, 51 F.3d 1560, 1566 (Fed. Cir. 1995)). The record amply establishes that the Examiner doubts the disclosed invention can exceed "break even." However, the Specification describes embodiments that "achieve large ion densities in stably-confined plasmas, held in negative electric potential wells formed by magnetically-confined electrons." Spec. 24:22-23. Thus, the disclosed embodiments could achieve ion densities that do not have to provide more energy than it consumes. The Examiner provides no evidence that shows some amount of fusion reactions below "break even" cannot occur in the disclosed embodiments or that shows such a device cannot be useful in applications where "break even" is not a concern. The drifting plasma collected by coil supports, plasma loss, unreliable neutron radiation readings, and inability to confine plasma due to plasma-wall interaction cited by the Examiner are not enough for one skilled in the art to question whether the disclosed invention can magnetically confine electrons to produce a potential well that holds plasma with a fusion rate below "break even." Rider and Shafranov put into doubt whether the disclosed invention can be scaled up to for a power plant, but these references alone are not enough for one skilled in the art to question whether the disclosed invention can achieve an ion density in a plasma held in a potential well formed by magnetically confined electrons, wherein the ion density is higher than that previously obtainable but below "break even."

Accordingly, on the record before us, we cannot sustain the Examiner's rejection of claims 1-8 under 35 U.S.C. § 101 because the claimed invention as disclosed is inoperative and thus lacks utility.

Enablement

The Examiner rejects claims 1-9, 11-16, and 18 as containing subject matter which was not described in such a way as to enable a skilled artisan to make or use the inventions for the reasons set forth in an objection to the Specification in the Final Office Action. Ans. 8-9. In particular, the Examiner finds no credible basis for scaling of fusion reaction rate. Final Office Action 15 (mailed Jan. 25, 2008). The Examiner cites Dolan for describing the many issues to be resolved before magnetic electrostatic plasma confinement devices can become fusion reactors. *Id.* at 15-16. The Examiner notes that the Specification has no indication of how the claimed invention overcomes the deficiencies described by Dolan. *Id.* at 16. The Examiner finds that the Specification lacks experimental data and stability analysis for positive energy balance. Ans. 23.

The Appellant cites Bussard IAC2006 as having experimental results that indicate a fusion reaction rate of 1 billion per second in a 15 cm radius device with a 10 kV electron driver and a 1 kG magnetic field. Br. 9-10. The Appellant also argues that Morozov has lower ion densities than the claimed invention and its plasma is in local thermodynamic equilibrium, unlike the claimed invention. Br. 9 and 11. The Appellant further notes that Dolan was written and published before an experimental program that led to the claimed invention. Br. 11.

In order to comply with the enablement requirement of 35 U.S.C. § 112, first paragraph, the specification must provide sufficient teaching such that one skilled in the art could make and use the full scope of the invention without undue experimentation. *CFMT, Inc. v. Yieldup Int'l Corp.*, 349 F.3d 1333, 1338 (Fed. Cir. 2003); *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1365 (Fed. Cir. 1997); *In re Wands*, 858 F.2d 731, 736-37

(Fed. Cir. 1988). The key word is "undue," not experimentation. *Wands*, 858 F.2d at 737. That is, the specification need only teach those aspects of the invention that one skilled in the art could not figure out without undue experimentation. *See, e.g., Nat'l Recovery Techs., Inc., v. Magnetic Separation Sys., Inc.*, 166 F.3d 1190, 1196 (Fed. Cir. 1999) ("The scope of enablement . . . is that which is disclosed in the specification plus the scope of what would be known to one of ordinary skill in the art without undue experimentation.").

Factors to be considered in determining whether a disclosure would require undue experimentation include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims. *Wands*, 858 F.2d at 737.

The record before us indicates that the Examiner has considered the breadth of the claims and found that the scope of the claims include embodiments that can be used in a power plant. *See* Final Office Action 15-16; *see also* Spec. 32:1-33:27 (describing a truncated cube system as a heat-generating element in a power plant). The record also indicates that the Examiner found no direction, guidance, or working examples of the claimed invention that can be used in a power plant. *See* Final Office Action 15 (stating that "there is no credible basis for the optimistic scaling of fusion reaction rate") and Ans. 27. The record further indicates that the Examiner has considered the state of the prior art and that Dolan reveals challenges associated with scaling toward power plant applications. Final Office Action 14-16 (stating that the "art of the present invention . . . is not new,

but cannot be considered by itself as having a real feasibility for producing sufficient nuclear fusion (collision) reactions, "[a]lthough some recent confinement results appear promising, there are still many issues to be resolved before [magnetic electrostatic plasma confinement] devices can become fusion reactors," and "no indication in the Specification how the invention of the present application has overcome these well-known deficiencies . . . "). Thus, the Examiner has considered factors to evaluate whether a disclosure would require undue experimentation. The Appellant's arguments do not address the Examiner's findings regarding embodiments that can be used in a power plant and do not indicate where the disclosure enables such embodiments. Br. 9-12.

Accordingly, we sustain the Examiner's rejection of claims 1-9, 11-16, and 18 as failing to comply with the enablement requirement.

Indefiniteness

Independent claim 1 recites that "each of said plurality of containers having a cross sectional shape conformal to the B field produced by said coils, except at portions that connect said containers to each other"; independent claim 5 recites that "wherein said field coils are contained within a housing having parts having cross sectional shapes conformal to the B field produced by said field coils, except where said parts connect to each other"; and independent claim 11 recites that "wherein said plurality of field coils are contained within a corresponding plurality of containers, each of which has a cross sectional shape conformal to the B field produced by said plurality of field coils, except where said containers connect to each other." Br., Claims App'x. The Examiner finds that these limitations are not statements of structure but instead express functions without a means to carry them out. Ans. 9-10 (citing Spec. 13:3-8). The Examiner finds that

the Specification does not disclose a design or embodiment that satisfies the above limitations. Ans. 10.

The Appellant argues that the limitations are written in structural terms that describe the shape of the containers relative to the shape of the produced magnetic field and that the Specification contains examples, such as Figures 9A, 9B, 10A, 10B, 11, and their accompanying description. Br. 13. The Examiner responds that no relationship between coil shape and magnetic field line shape is shown in Figures 9A, 9B, 10A, 10B, and 11. Ans. 31.

The Appellant's arguments are persuasive. Figures 9A and 9B show a truncated cube system's set of coils, using coils of circular plan form, with B field conforming containers of circular cross-section. *See* Spec. 24:3-6. The accompanying description at page 27, line 22, through page 28, line 10 of the Specification explains the coil structures 101 and the connecting tubes or structures 112 shown in Figures 9A and 9B. The description also refers to Figure 9C. Spec. 27:23-24 ("Note the spacing 105 between coils, and their conformal circular cross sections (FIG. 9C)"). The description for Figure 9C states that "the cross sectional shape of the housing 50 is seen to be conformal to the B field surrounding the coil" and that "[t]he shape of the B field is shown in dotted line in FIG. 9C." Spec. 28:17-19. Thus, in view of Figures 9A-9C and their description, a person skilled in the art would reasonably understand the limitations regarding containers having a cross sectional shape conforming to a B field produced by coils except at portions that connect the containers to each other, when such limitations are read in the context of the Specification.

Accordingly, we cannot sustain the Examiner's rejection of claims 1, 5, and 11 or claims 6-9, 12-16, and 18, which depend therefrom, under 35 U.S.C. § 112, second paragraph, as indefinite.

Obviousness

The Examiner concludes that Bussard '646 and Morozov render obvious the subject matter of claims 1-9, 11-16, and 18. Ans. 10-21.

The Appellant argues that Morozov is based on lower ion densities than the claimed invention, higher confinement times than the claimed invention, and plasma in local thermodynamic equilibrium. Br. 17. The Appellant also argues that Morozov describes a device that requires complex external supporting coils in addition to internal coils. Br. 18. The Appellant further argues that teachings related to the longer time, lower confinement density device of Morozov would not be applicable to a shorter time, higher confinement density device of the claimed invention. *Id*.

The Examiner responds that the Appellant's arguments are not related to claim language. Ans. 41-42. We agree with the Examiner as the Appellant's arguments regarding lower ion densities, higher confinement times, plasma in local thermodynamic equilibrium, and external supporting coils are not related to any recitation in the claims that would distinguish the claims from Bussard '646 and Morozov. *See* Br., Claims App'x.

Also, the Appellant's argument that a person having ordinary skill in the art would recognize the inapplicability of Morozov's teachings to Polywell fusion devices is unpersuasive because it is not supported by evidence. The Examiner cites Morozov for teaching features of the independent claims that are not necessarily taught by Bussard '646. Ans. 11-12, 14, 16-17, and 19-20 (citing Morozov 1050 and figs. 1-3). However, Appellant does not provide any evidence to show that Morozov's particular

teaching of detaching conductors, which induce a magnetic configuration, from their base does not or cannot apply when a skilled artisan considers designs for coils of Polywell devices. Moreover to the extent that Appellant is arguing that Morozov is non-analogous, the Appellant's argument fails to persuade us because both the claimed invention and Morozov appear to be in the same field of endeavor and Morozov appears to be reasonably pertinent to the problem faced by the inventor. *See* Spec. 11:24-26 (stating "it appears that useful confinement of plasmas can be achieved by improvement on all prior concepts, by the new and unique uses and combinations of magnetic and electric fields . . . and by use of inertial forces") and Morozov, Abs. (describing that the "introduction of plasma-embedded magnetically insulated current-carrying conductors into a plasma trap magnetic system radically increases the number of possible trap designs").

The Appellant does not provide separate arguments regarding the patentability of claims 3, 4, 6-9, 12-16, and 18, which depend from claims 2, 5, or 11, over the cited references. Br. 17-18. Accordingly, we sustain the rejection of claims 1-9, 11-16, and 18 as unpatentable over Bussard '646 and Morozov.

DECISION

The Examiner's rejection of claims 1-8 under 35 U.S.C. § 101 because the claimed invention as disclosed is inoperative and therefore lacks utility is reversed.

The Examiner's rejection of claims 1-9, 11-16, and 18 under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement is affirmed.

The Examiner's rejection of claims 1, 5-9, 11-16, and 18 under 35 U.S.C. § 112, second paragraph, as indefinite is reversed.

The Examiner's rejection of claims 1-9, 11-16, and 18 under 35 U.S.C. § 103(a) as unpatentable over Bussard and Morozov is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2011).

AFFIRMED

hh