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Harness, Dickey & Pierce, P.L.C. (Lam)
P.O. Box 828
Bloomfield Hills, MI 48303

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte HAOQUAN YAN,[1]
ROBERT GRIFFITH O'NEILL, RAPHAEL CASAES,
JON MCCHESNEY, and ALEX PATERSON

Appeal 2018-006228
Application 14/705,430
Technology Center 1700

Before MARK NAGUMO, LILAN REN and SHELDON M. MCGEE, *Administrative Patent Judges*.

NAGUMO, *Administrative Patent Judge*.

DECISION ON APPEAL

Lam Research Corporation ("Yan") timely appeals under 35 U.S.C. § 134(a) from a non-final rejection[2] of all pending claims 1–18. We have jurisdiction. 35 U.S.C. § 6. We reverse.

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[1] The applicant under 37 C.F.R. § 1.46 (Application Data Sheet, filed 6 May 2015), and hence the appellant under 35 U.S.C. § 134, is the real party in interest, identified as Lam Research Corporation. (Appeal Brief, filed 15 January 2018 ("Br."), 3.)

[2] Office Action mailed 25 July 2017 ("Office Action"; cited as "OA"), entered in response to a request for continued examination filed 10 April 2017, under 37 C.F.R. § 1.114.

OPINION

A. Introduction[3]

The subject matter on appeal relates to edge coupling rings ("ECR") used in plasma substrate processing systems. (Spec. 1 [0002].) Typically, a substrate wafer is held on a central pedestal in a processing chamber, where it is exposed to a plasma for etching, reactive deposition, etc.
The ′430 Specification explains that, "[e]dge coupling rings have been used to adjust an etch rate and/or etch profile of the plasma near a radially outer edge of the substrate." (*Id.* at 2 [0005].) The Specification explains that process conditions can be modified by changing the position, shape, profile, height of the ECR relative to the upper surface of the substrate, etc. (*Id.*)

As shown in Figures 1 and 2, reproduced on the next page, during plasma processing, exposed portion **32**[4] of ECR **30** may be eroded, resulting in distortion of the etching plasma, especially at the periphery of the substrate wafer (see converging arrows at **48** in Figure 2). Adjusting or changing the ECR generally has required that the processing chamber be opened, which is said to be undesirable. (Spec. 2 [0006].) Yan seeks patent protection for a substrate processing system that is said to allow the position of the ECR to be adjusted with an actuator without opening the processing chamber, as shown in Figure 5, on the next page.

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[3] Application 14/705,430, *Moveable edge coupling ring for edge process control during semiconductor wafer processing*, filed 6 May 2015 as a continuation-in-part of 14/598,943, filed 16 January 2015. We refer to the "′430 Specification," which we cite as "Spec."

[4] Throughout this Opinion, for clarity, labels to elements are presented in bold font, regardless of their presentation in the original document.

{Figure 1 is shown below}

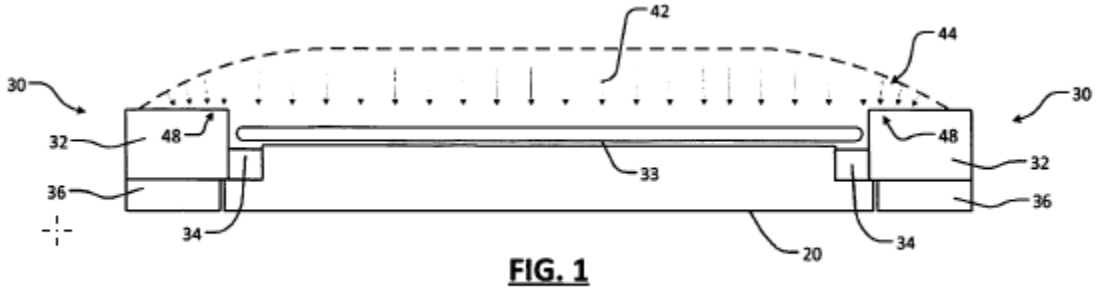


FIG. 1
Prior Art

{Figure 1 shows prior art plasma etching with new annular edge coupling ring portion **32** (annular portions **34** and **36** form other parts of ECR **30**)}

{Figure 2 is shown below}

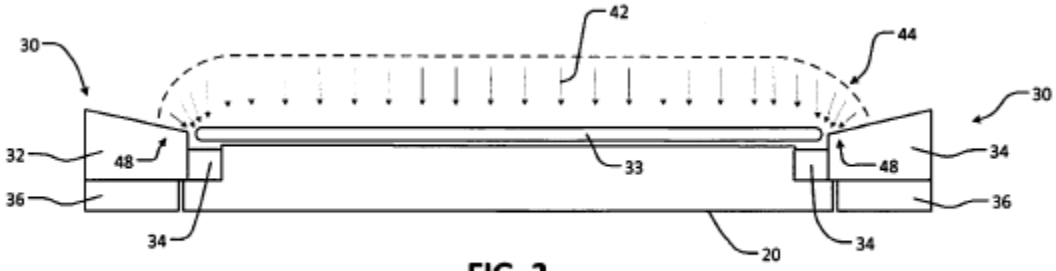


FIG. 2
Prior Art

{Figure 2 shows prior art plasma etching with eroded ECR portion **32**}

{Figure 5 is shown below}

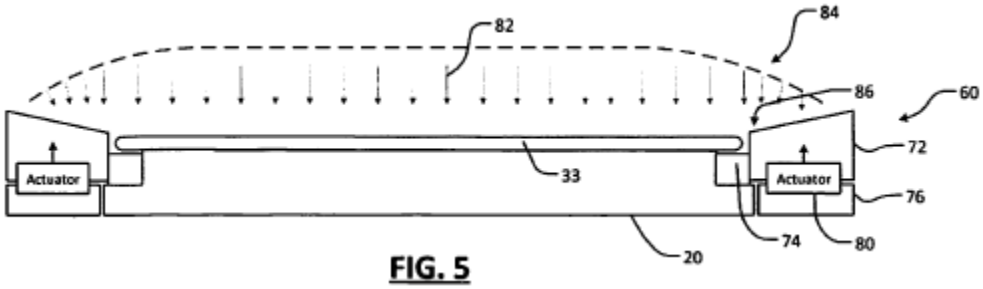


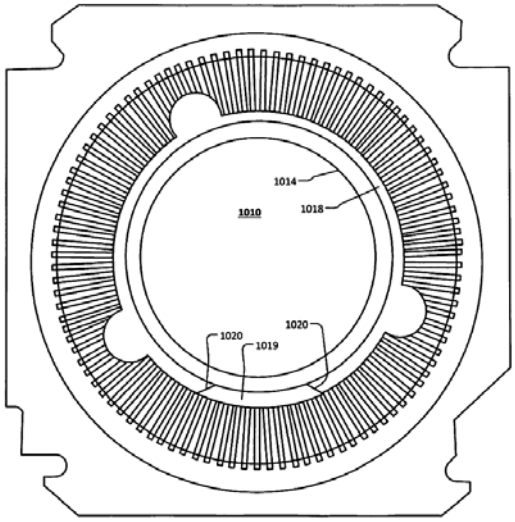
FIG. 5

{Figure 5 shows eroded ECR **72** moved vertically by actuator **80** reduce distortion of the plasma at the edge of substrate wafer **33**}

In a further embodiment, shown in Figures 15 and 17, reproduced on the next page, lifting ring **1018** ("LR"), which engages edge coupling ring **1014**, is biased by pillar **1060** that is moved vertically by actuator **1064**. (*Id.* at 18 [0080].) Thus, as shown in Figure 17, eroded ECR **1014** can be

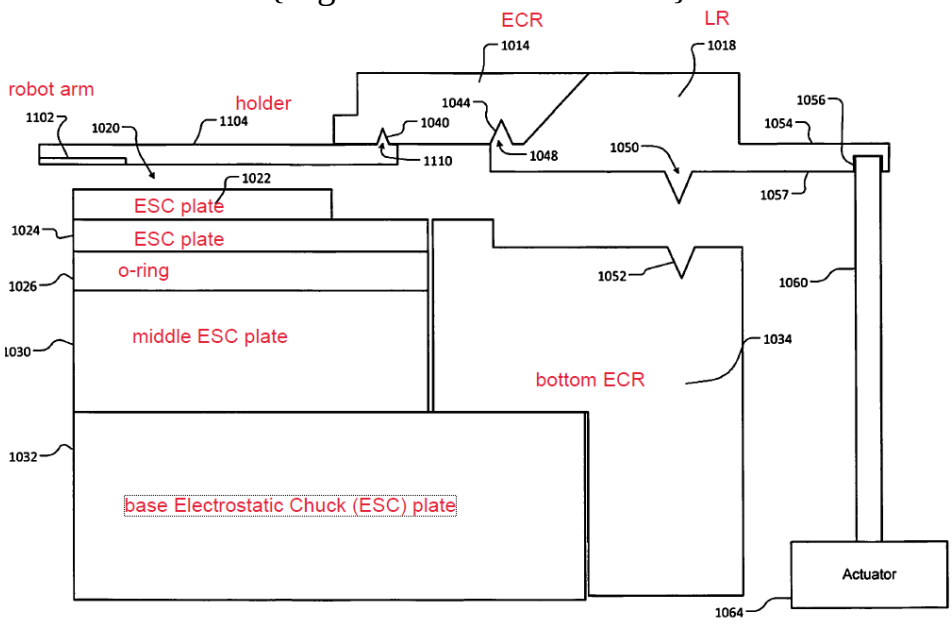
raised above pedestal **1010** (which comprises electrostatic chuck **1021** comprised of multiple plates) to provide clearance for robot arm **1102**, fitted with holder **1104** for ECR **1014**, to replace the old ECR with a new ECR.

{Figure 15 is shown below}



{Figure 15 shows a top plan view of the processing chamber with (from the center outwards) pedestal **1010**, ECR **1014**, and LR **1018**}

{Figure 17 is shown below}



{Figure 17 shows a cross section of the pedestal (electrostatic chuck, "ESC") with ECR **1014**, LR **1018**, lifting actuator **1064**, and robot arm **1102** and holder **1104** (annotations added)}

As shown in Figure 16, below, after robot arm **1102** and holder **1104** have been moved from the processing region, actuator **1064** is lowered, and the bottom surface of ECR **1014** is supported by the upper surface of at least one plate of the pedestal—here, ESC plate **1024**.

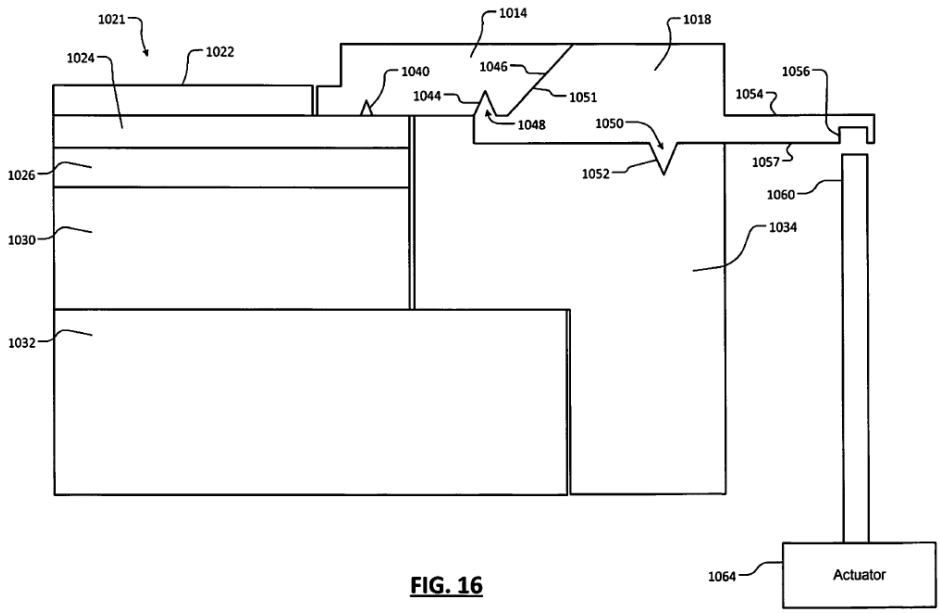


FIG. 16

{Figure 16 shows the ECR and LR in the lowered position of actuator **1064**}

Sole independent claim 1 is representative and reads:

> A substrate processing system [**500**], comprising:
>
> a processing chamber [**502**];
>
> a pedestal [**1010**] arranged in the processing chamber, the pedestal including
>
> a baseplate [**1032**] and
>
> at least one plate [**1030**, **1024**, **1022**[5]] arranged on the baseplate;

[5] Yan identifies only element **1022** as an example of the "at least one plate arranged on the baseplate" recited in claim 1. (Br. 5, ll. 7–8.)

an *edge coupling ring* [**1014**] *arranged*
*adjacent to a radially outer edge of the pede*stal,
wherein an inner portion of the edge coupling ring overlaps the at least one plate [**1024**];

a lifting ring [**1018**], *wherein*
an outer portion of the edge coupling ring [**1014**] *overlaps the lifting ring* [**1018**]; and

a first actuator [**1064**] configured to selectively move the edge coupling ring [**1014**] to a raised position and a lowered position relative to the pedestal, wherein,

when the edge coupling ring is in the raised position [Fig. 17],

a bottom surface of the edge coupling ring [**1014**] is above an uppermost surface of the pedestal [**1022**]

to define a clearance gap between the bottom surface of the edge coupling ring [**1014**] and the uppermost surface of the pedestal [**1022**],

wherein the gap is

directly below the bottom surface of the edge coupling ring [**1014**] and

above an upper surface of the at least one plate [**1022 (1024)**], and wherein,

when the edge coupling ring [**1014**] *is in the lowered position* [Fig. 16],

the bottom surface of the edge coupling ring [**1014**] i*s supported by the upper surface of the at least one plate* [**1024**].

(Claims App., Br. 17; some formatting, emphasis, and bracketed labels to the Figures and to elements shown in the Figures added.)

The Examiner maintains the following grounds of rejection:[6, 7]

A. Claims 1–3 and 7 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson[8] and Yamamoto.[9]

A1. Claims 4, 9, and 10 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson, Yamamoto, and Lanee.[10]

A2. Claims 6 and 8 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson, Yamamoto, and Yudovsky.[11]

A3 Claim 5 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson, Yamamoto, Lanee, and Yudovsky.

A4. Claims 11 and 12 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson, Yamamoto, and Seo.[12]

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[6] Examiner's Answer mailed 4 May 2018 ("Ans.").

[7] Because this application was filed after 16 March 2013, the effective date of the America Invents Act, we refer to the AIA version of the statute.

[8] Wayne L. Johnson, *Tunable focus ring for plasma processing*, U.S. Patent Application Publication 2003/0201069 A1 (2003).

[9] Takashi Yamamoto, *Plasma processing apparatus and method of manufacturing semiconductor device*, U.S. Patent Application Publication 2011/0287631 A1 (2011).

[10] Khamsidi Lanee and Gerry Moore, *Automated systems and methods for adapting semiconductor fabrication tools to process wafers of differen.tr diameters*, U.S. Patent Application Publication 2009/0067954 A1 (2009).

[11] Joseph Yudovsky et al., *Self aligning non contact shadow ring process kit*, U.S. Patent No. 5,869,352 B1 (2003).

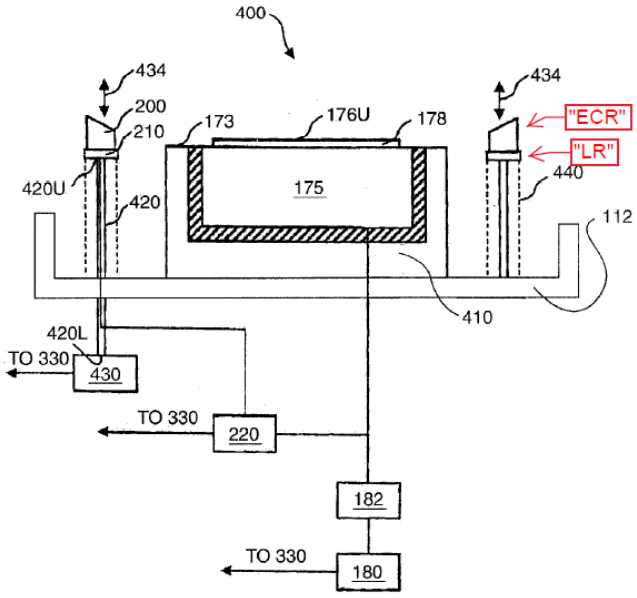
[12] Hirofumi Seo and Shinichi Hiramatsu, *Semiconductor device manufacturing machine and method for manufacturing a semiconductor device by using the same manufacturing machine*, U.S. Patent No. 6,044,534 (2000).

A5. Claims 13–18 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Johnson, Yamamoto, and Seo, and Steger. [13]

B. Discussion

The Board's findings of fact throughout this Opinion are supported by a preponderance of the evidence of record.

The Examiner finds that Johnson describes plasma processing system **400**, a close-up of a portion of which is shown in Figure 5A, below.



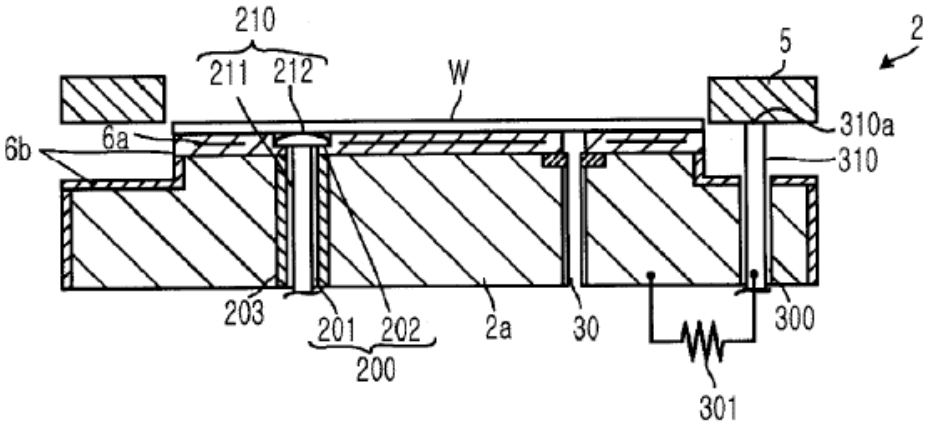
{Johnson Figure 5A shows a close up of plasma reactor system **400** (annotations added)}

System **400** comprises work-piece support member **410**, which has upper annular support surface **173** surrounding lower electrode **175**, which supports work-piece wafer **176**. System **400** further comprises adjustable

[13] Robert J. Steger, *Method and apparatus for the compensation of edge ring wear in a plasma processing chamber*, U.S. Patent Application Publication 2004/0053428 A1 (2004).

focus ring **200** (which the Examiner identifies as the edge control ring recited in claim 1), ring electrode **210** (which the Examiner identifies as the recited lift ring) and actuator **430** to raise and lower the focus ring. (OA 2, ¶ 3.) Johnson discloses that ring electrode **210** and focus ring **200** are not supported by work-piece support member **410**, but are supported by "separate adjustable shafts **420** each having an upper end **420U** serving as a focus ring support surface." (Johnson 4 [0043].) The Examiner finds that "Johnson fails to teach the plate in the pedestal," and that Johnson "fails to explicitly teach that when the edge coupling ring is raised a bottom of the ring is above an upper surface of the pedestal to provide a gap directly below the bottom surface of the edge coupling ring and above the upper surface of the pedestal." (OA sentence bridging 2–3.)

The Examiner finds that Yamamoto describes a plasma processing apparatus in Figure 3(a), shown below, comprising (insulating) plate **6b**, which, with electrode **6a**, forms electrostatic chuck **6** on (conductive) pedestal **2a**. Edge ring **5** [elevated by lifter pins **310**] is provided, such that there may be "a gap directly below the ring (**5**) and the upper surface of the pedestal (**2a**)." (OA 3, ll. 7–8.) The Examiner finds further that when ring **5**



{Yamamoto Figure 3(a) shows holding stage **2** with lifter pins **310** for focus ring **5**}

is lowered, it is supported on plate **6b**, as shown in Figure 3b (not reproduced here). (OA 4, l.4.)

The Examiner concludes that it would have been obvious to modify the system shown in Johnson, Figure 5A, by substituting the vertically adjustable edge ring arrangement described by Yamamoto, which overlaps the outer peripheral region of the pedestal. The Examiner points out that Johnson describes an alternative embodiment, shown in Figure 1A, "in which the edge ring is above the outer peripheral region of the pedestal." (OA 3, ll. 16–17.)

Yan argues, inter alia, that because "the entire focus ring **200** of Johnson is arranged on the element **210**", the Examiner errs harmfully in concluding that the combined teachings of Johnson and Yamamoto would have taught or suggested an edge coupling ring that meets the limitations, "wherein an inner portion of the edge coupling ring overlaps the at least one plate," and "wherein an outer portion of the edge coupling ring overlaps the lifting ring." (Br. 9, ll. 8–10; 11, ll. 4–12.)

Yan argues further (Br., para. bridging 8–9 (discussing Johnson); para. bridging 11–12 (discussing Yamamoto)) that the combined teachings of the references do not teach or suggest the relations between the edge coupling ring and the pedestal in either the raised position, "wherein the gap is directly below the bottom surface of the edge coupling ring and above an upper surface of the at least one plate"; or, in the lowered position, that "the bottom surface of the edge coupling ring is supported by the upper surface of the at least one plate," as required by claim 1.

Resolution of this appeal depends on the interpretation of the relations required by the claim between three elements, namely, the "edge coupling ring," the "lifting ring," and the "at least one plate," recited in the claim. In conducting this inquiry, we are guided by the principles that, during examination, claims are to be read broadly, consistent with the disclosure in the Specification, as understood by persons having ordinary skill in the art. *In re Morris*, 127 F.3d 1048, 1054 (Fed. Cir. 1997) ("the PTO applies to the verbiage of the proposed claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in the applicant's specification."). Limitations from preferred embodiments must not be read into the claims. *In re Am. Acad. Sci. Tech Ctr.*, 367 F.3d 1359, 1369 (Fed. Cir. 2004) ("[w]e have cautioned against reading limitations into a claim from the preferred embodiment described in the specification.").

Claim 1 is not a model of clarity and precision.

The pedestal comprises a baseplate and at least one plate arranged on the baseplate. The claim subsequently refers three times to "*the* at least one plate" (emphasis added), once generally, once to "*an* upper surface of the at least one plate," and once to "*the* upper surface of the at least one plate" (emphasis added). Yan describes plate **1022** as depicted in Figure 16 as an example of such a plate (Br. 5, ll. 7–8), but plate **1022** in Figure 16 cannot be "the at least one plate" referred to subsequently in claim 1 because it is not overlapped by the edge coupling ring **1014**. Rather, plate **1022** and edge coupling ring **1014** are adjacent to one another in this Figure.

In any event, the edge coupling ring is "arranged adjacent to a radially outer edge of the pedestal," and "an inner portion of the edge coupling ring overlaps the at least one plate." This recitation accommodates, but does not require, that an outer portion of the edge coupling ring project beyond each plate in the pedestal as depicted in Figure 16. Although the claim requires that "an outer portion of the edge coupling ring overlaps the lifting ring," no other express constraint is placed on the lifting ring, the relation of the lifting ring to any other component of the claimed substrate processing system, or the function of the lifting ring. In particular, the plain language of the claim does not exclude expressly the possibility, pointed out by the Examiner, that the "the entirety of ring **200** and ring **210** overlap the one plate (**6b**) of Yamamoto which means the inner portion of the ring **200** overlaps the one plate and the outer portion overlaps the lifting ring (**210** of Johnson)." (Ans. 11, l. 20–12, l. 1.) In the Examiner's words, "[n]ote the claim does not require only an outer portion to overlap the lifting ring or an inner portion of the edge ring to be radially inward of the lifting ring." (*Id.* at 12, ll. 1–2.)

The final limitation of claim 1 recites, "when the edge coupling ring is in the lowered position, the bottom surface of the edge coupling ring is supported by the upper surface of the at least one plate." The Examiner maintains that "in the combination the bottom surface of the edge ring can be considered to be supported by the upper surface of the at least one plate (note the claim does not require them to be contacting)." (OA 4, ll. 4–7.) The Examiner's interpretation has a certain appeal of audacity, bearing in mind that the foundation of a house can reasonably be considered to "support" every part of the house above it, including the roof. The Examiner's interpretation, however, does not, in our view, consider

adequately the import of the words "bottom surface" (of the edge coupling ring) and "upper surface" (of the at least one plate). In one sense they might be considered redundant, because any two hard (i.e., under ordinary conditions of use, essentially impenetrable) bodies necessarily have intact surfaces when one supports the other, even indirectly. It is preferred, however, to give meaning to every claim term. *See*, *e.g.*, *Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1372, (Fed. Cir. 2005) ("A claim construction that gives meaning to all the terms of the claim is preferred over one that does not do so.") Here, the express recitations that the "bottom surface of the edge coupling ring" "is supported by" "the upper surface of the at least one plate" serve to emphasize that one surface directly supports the other. This appears to be the only embodiment described in the Specification or illustrated in the drawings. The Examiner does not direct our attention to any disclosure in the Specification that indicates a broader interpretation was intended by Yan, or would have been perceived by a person having ordinary skill in the art.

We conclude that the Examiner has not shown, by a preponderance of the evidence, that every limitation of claim 1 is met or suggested by the combined teachings of Johnson and Yamamoto. The Examiner makes no findings regarding further limitations recited in the dependent claims or further disclosures in the other cited prior art that cure this defect. We therefore reverse all the appealed rejections for obviousness.

C. Conclusion

In summary:

Claims Rejected	Basis	Affirmed	Reversed
1–3, 7	§ 103: Johnson and Yamamoto		1–3, 7
4, 9, 10	§ 103: Johnson, Yamamoto, and Lanee		4, 9, 10
6, 8	§ 103: Johnson, Yamamoto, and Yudovsky		6, 8
5	§ 103: Johnson, Yamamoto, Lanee, and Yudovsky		5
11, 12	§ 103: Johnson, Yamamoto, and Seo		11, 12
13–18	§ 103: Johnson, Yamamoto, Seo, and Steger		13–18
Overall Outcome	1–18		1–18

REVERSED