UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE, INC., Petitioner,	)	
VS.	)	Case Nos. IPR2024-00806 IPR2024-00807
RESONANT SYSTEMS, INC., Patent Owner.	)	

REMOTE DEPOSITION OF
DR. BLAKE HANNAFORD
TUESDAY, JUNE 24, 2025

STENOGRAPHIC REPORTER: CHRISTA YAN, CSR NO. 14316, RPR

APPEARANCES:

FOR PETITIONER:
FISH & RICHARDSON
BY: THOMAS ROZYLOWICZ, ATTORNEY-AT-LAW
1000 Maine Avenue SW, Suite 1000
Washington, D.C. 20024
(202) 783-5070
rozylowicz@fr.com

FOR PATENT OWNER
RUSS AUGUST & KABAT
BY: NEIL RUBIN, ATTORNEY-AT-LAW
12424 Wilshire Boulevard, 12th Floor
Los Angeles, California 90025
(310) 826-7474
nrubin@raklaw.com

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No Exhibits Marked.		

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BE IT REMEMBERED that on TUESDAY, the 24TH DAY OF JUNE, 2025, at the hour of 9:33 a.m., of said day, before me remotely, CHRISTA YAN, a Certified Shorthand Reporter, State of California, REMOTELY appeared DR. BLAKE HANNAFORD, who was examined as a witness in said cause; that said transcript format was prepared in accordance with California Code of Regulations Section 2473.

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DR. BLAKE HANNAFORD,

the Witness, called on behalf of the Patent Owner, being duly sworn to state the truth, the whole truth, and nothing but the truth, testified on oath as follows:

EXAMINATION

BY MR. RUBIN:

Q Good morning again, Dr. Hannaford.

A Good morning, Mr. Rubin.

Q So you and I had a deposition yesterday in some related matters; is that right?

A That's correct.

Q And you're familiar with the deposition process?

A Yes.

Q Do you have any questions about the deposition process or... what we'll be doing today?

A No.

Q Are you currently experiencing any illness or

taking any medication that would affect your ability to answer questions today or to remember facts?

A No.

Q Is there any other reason that you cannot give complete and accurate testimony here today?

A No.

Q We're here today in connection with two IPRs filed against Resonant Systems, Inc., patents by Apple, IPR2024-00806 and IPR2024-00807. Is that your understanding?

A Yes.

Q And in each of those two IPRs I just listed, you submitted supplemental expert declarations dated May 29, 2025; is that right?

A Yes, if I recall the date correctly.

Q And I will share these in the chat function in Zoom PDF copies of those declarations as they were filed with the PTAB. Are you able to download those?

A Yeah, that sounds great. That process seemed to work very smoothly yesterday. I am downloading them right now. And I was successful.

Q All right. Do you have any printed materials here with you today for use in the deposition?

A No.

Q Okay. So you didn't -- withdrawn.

Yesterday, you had printed copies of your declarations, but it sounds like today, you don't have printed copies of the declarations; is that right?

A That's correct.

Q Okay. Do you have electronic copies of any materials that you'll be consulting today during the deposition, with the exception of items that I share in the chat?

A No. Only the items. I made a special folder for these downloads from this chat, and that's what I'm going to be limited to.

Q Okay. Sitting here right now are you aware of any errors or things that you would wish to correct in either of the two declarations we're here to address today?

A No.

Q I've just uploaded in the Zoom chat function Exhibit 2009 from the 00807 IPR, which is titled, Expert Declaration of the Keith W. Goossen, PhD?

A And I have that.

Q And I take it that you reviewed Dr. Goossen's declaration in preparing your supplemental declarations in these IPRs?

A Yes.

Q You should see now on your screen Exhibit 2009,

Dr. Goossen's declaration, which I'm sharing via Zoom.

A Yeah, I see the title page right now.

Q So I'd like to call your attention to the section that starts in paragraph 128 of Dr. Goossen's declaration addressing the limitation flux paths comprising of paramagnetic material. Do you see that?

A I... yes, I do see that.

Q Now going down to paragraph 144, Dr. Goossen calculates the relative permeability of aluminum as approximately 1.000022. Do you see that?

A I see that.

Q And you don't dispute that that's approximately the correct value for the relative permeability of aluminum?

A I can't vouch for all the decimal places, but that value doesn't surprise me.

Q Now on paragraph 143, Dr. Goossen refers to a permeability, quote, In the thousands. Would you agree that a paramagnetic material would typically have a permeability in the thousands, that is a relative permeability in the thousands?

A Sitting here, to answer that precisely, I feel I would have to look it up. But that number is not -- does seem reasonable to me.

Q Turning to paragraph 137 of Dr. Goossen's

declaration, there, he reproduces an annotated Wakuda Figure 1B which I believe appeared in your earlier declaration in this IPR. Do you recognize this annotated figure?

A I do recognize the figure.

Q And so there are these -- withdrawn.

There are these red rectangles which are labeled, Magnetic flux. Do you see that?

A I see that.

Q And the red highlights are on top of rectangles in the original Wakuda reference that are made up of black lines with arrows on them. Do you see that?

A Yes, I see that as well.

Q And so the figure from Wakuda as annotated with the red lines shows that magnetic flux lines run inside and parallel to the casing which is highlighted in blue, correct?

A It shows magnetic flux lines inside the casing, yes.

Q Dr. Goossen offers the opinion that one would see magnetic field lines -- withdrawn.

Dr. Goossen offers the opinion that one would see lines of magnetic flux confined within the casing like as shown in this Wakuda figure if the casing were made out of material with a relative permeability in the thousands,

but that one would not see the field lines, the flux lines, confined within the casing if it were made of a material with a permeability of 1.000022 such as aluminum.

Do you dispute that opinion of Dr. Goossen's?

A The -- I think neither the figure -- neither Wakuda's figure or that description describe all the flux. So some flux lines are not shown.

Q Focusing on the flux lines that are shown, Wakuda's figure shows that flux lines that enter the casing, annotated here in blue, bend by approximately 90 degrees, travel through the casing and then again at approximately 90 degrees when they exit the casing. Do you see that?

A I see those rectangular shapes with 90-degree angles, yes.

Q And do you agree that for magnetic flux lines to bend in that dramatic fashion upon entering a material, that that material would have to have a high magnetic permeability?

MR. ROZYLOWICZ: Objection. Scope.

THE WITNESS: I interpret these lines in this diagram as a schematic illustration of an approximate flux path, but I think any POSITA would recognize that essentially, no -- in fact, no physical magnetic field would have right-angle bends in it, that this is not, for example, a

computational analysis of the magnetic flux. It's not obtained by solving flux equations. It's a schematic pathway.

BY MR. RUBIN:

Q Do you agree that the magnetic field line passes from one material into a second material that has the same relative permeability as the first, that there will be no abrupt bend in the direction of the magnetic field line as you pass from the first material into the second?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: Yeah, I'd have to form another opinion about that, I think. I'm not sure if you're referring to any specific pair of materials in this diagram or how your -- what your context is for that question. Maybe you can nail that down a little bit more for me.

BY MR. RUBIN:

Q Okay. So let's focus on the upper one of the two red rectangles in this figure.

A Okay.

Q Let's focus on the upper left-hand corner of that rectangle.

A Okay.

Q There we have flux lines that are traveling through the casing and then exit the material of the casing in a downward direction. Do you see that?

A To the extent that that rectangle represents flux lines, yes. I repeat my previous answer that that's a schematic representation of a flux path. But no POSITA would ever recognize a rectangle as a physically realistic flux diagram in my opinion.

Q The flux lines exit the casing material at that corner of the rectangle. They're traveling from the casing material into air; is that right?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: Yeah, I'm sorry. There was a little audio glitch in the beginning of your question. So... probably should repeat it.

BY MR. RUBIN:

Q One second.

When the magnetic flux lines in this -- in the vicinity of the upper left-hand corner of the top rectangle exit the casing, they enter the air, correct?

A I don't believe those dashed lines with arrows forming a rectangle actually represent magnetic field lines. I believe they're a schematic representation of a path.

THE STENOGRAPHIC REPORTER: I'm sorry, Counsel. Are you saying enter the air, a-i-r, air?

MR. RUBIN: That's right.

THE STENOGRAPHIC REPORTER: Thank you.

BY MR. RUBIN:

Q Okay. Now, Wakuda labels those paths in Figure 1B with the Greek letter phi, correct?

A Yes, I see that.

Q And you or whoever prepared this, the annotations in this figure, added an annotation with an arrow pointing to the phi labeled magnetic flux, correct?

A Yes.

Q And that's because the Greek letter phi is commonly used to represent a magnetic flux; is that right?

A Yes.

Q Okay. So whether it's in a schematic sense or not, those rectangles are representing magnetic flux, correct?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: I believe that rectangle represents a schematic flux path.

BY MR. RUBIN:

Q And so in particular, represents magnetic flux that travels from the casing material into the air, in the vicinity of the upper left-hand corner of that rectangle, right?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: I'm not sure that characterizes what I said. A schematic is a conceptual and approximate

representation of anything. And in this case, it's a conceptual and approximate representation of a set of magnetic field lines which are not shown.

BY MR. RUBIN:

Q So -- withdrawn.

So is it your testimony that you can't tell from Wakuda Figure 1B anything at all about the actual path that the magnetic field lines travel on?

MR. ROZYLOWICZ: Objection. Form.

BY MR. RUBIN:

Q The Wakuda device?

MR. ROZYLOWICZ: Sorry.

THE WITNESS: I believe this diagram illustrates a magnetic flux path at a schematic level. So it -- in that sense, I do not say that you can't tell anything.

BY MR. RUBIN:

Q Okay. Can you tell from this figure whether any portion of the magnetic flux path travels through air?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: I believe in converting -- in attempting to convert this schematic representation to actual magnetic field lines, a POSITA would know that in some combination, flux goes in the casing and in the outside air or in all the air.

BY MR. RUBIN:

Q I'm sorry. What was that?

THE STENOGRAPHIC REPORTER: That was not me. I'm not sure what that was.

BY MR. RUBIN:

Q Would a POSITA looking at the schematic flux paths in Wakuda Figure 1B know whether magnetic field lines travel from the casing material into air?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: The schematic flux path that's shown by the rectangle goes through air, in part. So yes.

BY MR. RUBIN:

Q So suppose that someone skilled in the art -- well, withdrawn.

So you've said a number of times that you think this is -- withdrawn.

You said a number of times that you think the rectangles of magnetic flux in Wakuda Figure 1B are a schematic representation of the magnetic field lines; is that right?

A Yes.

Q And I think you referred earlier to the possibility of someone doing a numerical simulation of what the magnetic field lines would actually look like for a system like what's depicted in Wakuda Figure 1B. You

agree that it would be possible to do such a numerical simulation?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: I agree it would be possible.

BY MR. RUBIN:

Q Suppose that you looked at the magnetic field lines in such a numerical simulation and you looked at all the direction of those magnetic field lines bent that the interface between the casing material and the air, would you agree that if the casing material was made of the same -- would you agree that if the casing material had the same relative permeability as the air, that there would be no bend in the direction of the magnetic field lines at that interface?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: Yeah, I don't want to speculate on the results of a numerical simulation. But if I do agree that if the casing and the air were identical, then there would be no difference.

BY MR. RUBIN:

Q So would you agree that in that numerical simulation of the magnetic field lines, that you would expect that if the relative permeability of the casing material were increased, that the amount by which the magnetic field lines bent that the interface between that

material and the air would also increase?
MR. ROZYLOWICZ: Objection. Form.
THE WITNESS: Sitting here right now without diving into it more, I would agree with that.
BY MR. RUBIN:
Q All right. Now I'm sharing on my screen your supplemental declaration concerning the '830 patent which is Exhibit 1049 in the IPR ending in 806. Do you see that?
A Yes. And I have just -- using those two numbers, 1049 and 806, I have also opened that document.
Q Actually -- actually, let's switch to the other declaration. My apologies.
So now, you should see shared on the screen your supplemental declaration concerning the -- withdrawn. You should now see on your screen your second declaration concerning the '337 patent, which is Exhibit 1049 in the IPR ending in 00807. Do you see that?
A Yeah, I have now opened the one that's 1049, 00807, contains both of those numbers in the title.
Q So here, you offer some opinions concerning the drive signal S1 in the Wakuda prior reference. Do you recall that? Sorry, did you hear my question?
A I did not. I did not hear a question. I apologize.

Q Okay. So in your second declaration concerning the '337 patent, you offer some opinions concerning the drive signal S1 in Wakuda. Do you recall that?

A Yes. Assuming by second declaration, you mean the one that we're looking at right now.

Q That's what I mean, yeah.

And turning to paragraph 6 of this declaration, you refer to an argument by patent owner that that drive signal S1 only corresponds to the directional output D of the '337 patent. Do you see that?

A I see that sentence. Yes.

Q I'm going to share, using the chat function, the '337 patent. You should be able to download now Exhibit 1001 and the IPR ending in 00807, which is a copy update, '337 copy.

A I have the '337 now, yes, thanks to your download. Thanks to your -- I mean, I downloaded it from your chat.

Q Okay. And so you'll recall that the '337 patent includes Figures 7A, 7B, and 7C, which describe certain steps of an algorithm.

A Yes, I recall and see those figures.

Q And so there have been -- well, withdrawn.

So in particular, in Figure 7A the step identified as 708 includes outputting of a signal D. Do

you see that?
A Yes.
THE STENOGRAPHIC REPORTER: I'm sorry, Counsel. Did you say signal date or signal D?
MR. RUBIN: Signal D, as in the fourth letter of the alphabet.
THE STENOGRAPHIC REPORTER: Thank you.
BY MR. RUBIN:
Q And then turning to Figure 7C of the '337 patent, the step labeled 762 includes outputting a signal P to the power supply. Do you see that?
A I see that.
Q So in your opinion, does Wakuda perform both of those steps outputting signal D and outputting signal P?
MR. ROZYLOWICZ: Objection. Form.
THE WITNESS: My opinion is the drive means of Wakuda outputs both a direction and a magnitude. Which are an output and a direction.
BY MR. RUBIN:
Q And what, in your opinion, in Wakuda is the power supply?
A The composite figure we've reproduced that you're showing right now at the bottom of page 3, which, you know, it combines Figures 3 and 4 of Wakuda, designates that the drive means is what supplies power to the

vibrating device. It's the power supply.
Q So in your opinion, the drive means 13 of Wakuda is what corresponds to the power supply in the '337 patent?
MR. ROZYLOWICZ: Objection. Form.
THE WITNESS: Yes.
BY MR. RUBIN:
Q So Step 762 of the '337 patent includes outputting P to the power supply. So in your opinion does Wakuda perform both the step of outputting the signal D and the step of outputting the signal P to the power supply?
A Yes.
Q So where in Wakuda is the signal D of the '337 patent?
A It comes from the sign of the waveform applied by the drive means, the drive current, for example.
Q Where in Wakuda is the step of outputting the signal P to the power supply performed?
MR. ROZYLOWICZ: Objection. Form.
THE WITNESS: If I may, I'd like to refresh my memory with my declaration on this. So I'm going to look a little bit on that.
Okay. I've looked. I've refreshed my memory. So I'm sorry to take a while. Could you please repeat the

question?
BY MR. RUBIN:
Q So where in Wakuda is the step of outputting the signal P to the power supply performed?
A It's out -- it's out -- it's -- the signal is generated by signal generation means. And that's where the step is performed. Also, we rely extensively on a combination with Gregorio for more details about generating the waveform or the drive signal or the drive signals, the components of the drive signal.
Q You report to relying on Gregorio. Do you agree that for grounds 1 and 2 in the '337 IPR, you argue that claims of the '337 patent are obvious without relying on Gregorio, correct?
A Yes.
Q So in the grounds 1 and 2 -- withdrawn.
So in the combinations in grounds 1 and 2 of the '337 IPR, it's your opinion that the outputting of the drive signal S1 to the drive mains in Wakuda satisfies the '337 patent step of outputting signal P to the power supply?
A Well, I don't think we rely on combinations. So I think Wakuda alone discloses that the drive signals S1, and we quote it right here on this same page. For example, it has a plurality of patterns, the patterns are

selected, and that, you know, if you look at the example of patterns, they have different magnitudes, frequencies and directions.

So to do that, I believe Wakuda is disclosing in terms that a POSITA would understand, that the signal S1 has both direction and position information in it or P, power information.

Q Do you have an opinion on the drive signal S1 of Wakuda corresponds to both signal D and signal P in the '337 patent?

MR. ROZYLOWICZ: Objection. Form.

THE WITNESS: I believe -- my opinion is it carries that, both of those pieces of information, the drive signal S1.

MR. RUBIN: All right. I have no further questions for this morning. Done for today.

THE STENOGRAPHIC REPORTER: Okay. Tom, do you have any line of questioning?

MR. ROZYLOWICZ: Can we -- I don't know that we do. Can we take a -- if I can respectfully request a short break and then I'll kind of confirm kind of whether there's any further questions. If we can -- can we jump back on here at -- oh, gosh, you're California. It's 10:35 now. If we can jump back on at 10:50 to confirm.

Counsel, does that work for you?

MR. RUBIN: That's fine.
MR. ROZYLOWICZ: Thanks, Counsel.
THE WITNESS: It's okay with me. See you at 10:50.
(Recess taken.)
MR. ROZYLOWICZ: I'd just like to confirm that Apple has no further questions.
MR. RUBIN: Okay. I guess we can go back off the record then.
THE STENOGRAPHIC REPORTER: All right. Perfect. Thank you so much.
(WHEREUPON THE DEPOSITION WAS CONCLUDED AT 10:52 A.M.)

Please be advised I have read the foregoing deposition, pages 1 through 25, inclusive.

I hereby state there are:

(Check one)_____ no corrections

_____ corrections per attached

_____

DR. BLAKE HANNAFORD

--oOo--

WITNESS'S CHANGES OR CORRECTIONS

NOTE: If you are adding to your testimony, print the exact words you want to add. If you are deleting from your testimony, print the exact words you want to delete. Specify with "Add" or "Delete" and sign this form.

Deposition of: DR. BLAKE HANNAFORD
Case Title: APPLE V. RESONANT
Date of Deposition: JUNE 24, 2025

I,_____have

the following corrections to make to my deposition:

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CERTIFICATE OF SHORTHAND REPORTER/STENOGRAPHER

I, Christa Yan, Certified Shorthand/Stenographic Reporter within and for the State of California do hereby certify:

That Dr. Blake Hannaford, the Witness whose deposition is hereinbefore set forth, was duly sworn by me before the commencement of such deposition and that such deposition was taken before me and is a true record of the testimony given by such witness.

I further certify that both parties were represented by counsel at the deposition.

I further certify that the deposition of Dr. Blake Hannaford, occurred remotely on June 24, 2025, commencing at 9:33 a.m. to 10:52 a.m.

I further certify that I am not related to any of the parties to this action by blood or marriage, I am not employed by or an attorney to any of the parties to this action, and that I am in no way interested, financially or otherwise, in the outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my hand this 27th day of June 2025.



_____
CERTIFIED SHORTHAND/STENOGRAPHIC REPORTER
IN AND FOR THE STATE OF CALIFORNIA

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