UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

_____

APPLE, INC.,

Petitioner,

v.

RESONANT SYSTEMS, INC.,

Patent Owner.

_____

Case No. IPR2024-00806

U.S. Patent No. 9,941,830

***

Case No. IPR2024-2024-00807

U.S. Patent No. 8,860,337

DEPOSITION OF BLAKE HANNAFORD, Ph.D.

CONDUCTED REMOTELY

Tuesday, January 28, 2025

9:09 a.m. Pacific Time

Stenographically Reported By:

Lorie Rhyne, CSR, RPR, CRR

Job No. 108130

1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 _____
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD
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5 APPLE, INC.,
6 Petitioner,
7 v.
8 RESONANT SYSTEMS, INC.,
9 Patent Owner.
10 _____
11 Case No. IPR2024-00806
12 U.S. Patent No. 9,941,830
13 ***
14 Case No. IPR2024-2024-00807
15 U.S. Patent No. 8,860,337
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20 REMOTE DEPOSITION OF BLAKE HANNAFORD, Ph.D., taken
21 by Patent Owner Resonant Systems, Inc., held remotely
22 via Zoom, taken before Lorie Rhyne, CRR, RPR, CSR No.
23 12905, a Certified Shorthand Reporter for the
24 State of California, commencing on Tuesday,
25 January 28, 2025, 9:09 a.m. Pacific Time.

Resonant Systems, Inc., Ex. 2012
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

(All Appearances via Videoconference)

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I N D E X

WITNESS: BLAKE HANNAFORD, Ph.D.

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E X H I B I T S

(None Offered.)

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P R O C E E D I N G S

THE STENOGRAPHER: Good morning. My name is Lorie Rhyne. I am a California Certified Shorthand Reporter and the deposition officer for today's deposition. My CSR license number is 12905.

Can I have the attorneys state their appearances on the record, and then I will swear in the witness.

MR. RUBIN: This is Neil Rubin of Russ August & Kabat representing the patent owner, Resonant Systems.

MR. DEUTSCH: This is Craig Deutsch -- okay.

All right. This is Craig Deutsch with Fish & Richardson representing Petitioner, Apple.

THE STENOGRAPHER: Okay. And I'll go ahead and swear the witness in.

MR. ROZYLOWICZ: Sorry. This is also --

THE STENOGRAPHER: Oh, I'm sorry.

MR. ROZYLOWICZ: Yeah, this is also Tom Rozylowicz from Fish & Richardson representing Apple.

BLAKE HANNAFORD, Ph.D.,

having been duly sworn, testified as follows:

THE STENOGRAPHER: Thank you.

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You can proceed.

EXAMINATION

BY MR. RUBIN:

Q. Good morning, Dr. Hannaford.

A. Good morning, Mr. Rubin.

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

A. Yes.

Q. And today I'm here to ask you some questions about declarations that you submitted on behalf of Apple in two other IPR cases different from the cases that we discussed yesterday.

Do you understand that?

A. Yes, I understand that.

Q. And one of those IPRs that we're here to address is IPR2024-00806 concerning the U.S. Patent 9,941,830.

Do you understand that?

A. Looking at my copy, I can't confirm the IPR proceeding number, but I agree with the patent number.

Is that good enough? Are we -- like yesterday, we could work with the attorney docket numbers if -- if that's acceptable.

Q. Well, so the attorney docket number that's

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1 listed on your declaration that was submitted in that
2 IPR, the one concerning the '830 patent, is
3 50093-01791P1.
4 Would you agree?
5 **A. Actually, I have a different one -- I'm**
6 **sorry -- 50095-0179IP1.**
7 Q. I stand corrected. That is an I, not a 1.
8 So the -- the attorney docket number ends in IP1.
9 **A. Right. I -- I thought I heard you say**
10 **"50093," so that's what I thought I was correcting. I**
11 **think --**
12 Q. Okay.
13 **A. -- we're pretty close to the same number**
14 **here.**
15 Q. All right. Well, it's possible that I
16 misspoke in more than one way. So the attorney docket
17 number, just so we're on the same page, is
18 50095-0179IP1. And --
19 **A. That's what I have.**
20 Q. All right. And so I may refer to that as
21 the -- as your '830 patent declaration.
22 Is that fair?
23 **A. Yes. That's good for me.**
24 Q. And -- and that was a declaration of this --
25 MR. RUBIN: I'll say again for the record,

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that was filed in the 00- -- the IPR -- with IPR number ending in 00806.

BY MR. RUBIN:

Q. All right. And then the other IPR that we're addressing here today is an IPR that was filed challenging U.S. Patent Number 8,860,337, and your declaration filed in that IPR has an attorney docket number of 50095-0178IP1; is that right?

A. That agrees with mine as well, yes.

Q. All right. And so you have a copy of that declaration with you today?

A. I have it right here in front of me, yes.

MR. RUBIN: All right. And for the record, that is the declaration that was filed in support of IPR2024-00807.

BY MR. RUBIN:

Q. All right?

A. Again, I don't have that number in front of me, but as long as counsel agrees on that number, I'm happy.

Q. Yesterday we went through some of the ground rules that pertain to these depositions, so I won't repeat any of those unless you have questions.

Do you have any questions about the -- the process or rules that govern today's deposition?

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A. No. Unless they've changed from yesterday, but --

Q. Not that I know of.

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

A. No.

Q. Are you sick today?

A. No.

Q. Are you on any medications that would affect your memory or ability to testify?

A. No, I'm not.

Q. Okay. What printed documents do you have available to you for today's deposition?

A. I have the two declarations that we just identified, and I have the two patents: one of them ending in '337 and one of them ending in '830.

Q. No other printed documents besides those four?

A. No other printed documents or anything else.

Q. And then yesterday --

A. No other printed document, sorry.

Q. Okay. Yesterday you testified that you had available to you a laptop that had certain documents loaded on it.

Is the same true today?

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A. I -- yes. I have a folder of documents and -- actually, I have one folder related to '830 and a second folder related to '337.

Q. And I'll ask counsel.

MR. RUBIN: Are -- are the documents in those folders solely unmodified versions of documents that have been filed with the PTAB in these cases?

MR. DEUTSCH: That's correct.

BY MR. RUBIN:

Q. And like yesterday, I'll be asking you questions about specific documents following these IPRs and asking you to look at specific documents. If you want to look at any documents other than documents that I've specifically asked you about, you can do so. But I would ask that if you look at anything on the laptop other than what I've specifically asked you about, please let me know that you're looking at another document.

Okay?

A. I will do that.

Q. If I recall correctly, you testified yesterday that prior to yesterday, you had been deposed seven times; is that right?

A. With -- that's my memory pretty precisely. You know, maybe -- maybe it's six, maybe it's eight,

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but that's about right.
Q. All right.
A. And there's one more now from yesterday.
Q. All right. And I guess by the end of tomorrow, there will be a total of three more.
All right. So if I could ask you to look at your declaration from the IPR concerning the '830 patent. I'd like you -- to direct you to the last page of that document, page 256.
A. Okay.
Q. So I -- I had asked you now about how many times you had been deposed.
Have you testified at trial?
A. Yes.
Q. How many times is that?
A. I'm -- I think, as I recall, about three.
Q. All right. So on this page 256 of your '830 IPR declaration, there's a heading, Consulting.
Do you see that?
A. Yes.
Q. And then there are a number of consulting matters, some of which identify law firms and some of which refer to you being an expert witness.
Do you see those?
A. Yes, I do.

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Q. All right. Are the seven cases where you've been deposed prior to this week all listed somewhere in this Consulting section?

A. Well, again, some of them go back quite a few years, so I -- my memory isn't perfect, but I believe so.

Q. And which seven cases were those?

A. Well, let's call -- the one working with McKool Smith, the one working with Orrick in -- in the ITC, the one working with Steptoe in the ITC, the one working with Dorsey Whitney [sic] and DLA Piper. I -- I didn't count if that equals seven, but I wasn't asked to, you know, put those details on my CV for this.

Q. Okay. And which cases did you testify at trial?

A. Well, I know I testified with Orrick in the ITC in 2011. That was memorable.

I tested -- I testified -- I testified in one which is -- oh, the -- the Dorsey Whitney case -- no, the second bullet. I know I testified in this copyright case, Kumar versus IEEE, so that's two.

And I can't remember exactly which is the third one.

Q. The first bullet point that refers to an ITC case, IMMR versus Apple, which party were you an expert

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1 witness for?
2 **A. Apple.**
3 Q. Were you working for Apple in any of the
4 other cases listed in -- on this page?
5 **A. If it doesn't say it, then I don't believe**
6 **so. Again, I have a more complete record, but I don't**
7 **have it in my head.**
8 Q. So there are some engagements on this list
9 that don't identify any parties.
10 Is it your testimony that none of those
11 matters involved working for Apple or on Apple's
12 behalf?
13 **A. I told you that -- that my recollection**
14 **isn't sufficient to give you an exact answer to that**
15 **question. I -- I -- because this is my academic CV, I**
16 **wrote it in a way that academic CV readers would care**
17 **about.**
18 Q. So aside from the first bullet point here,
19 IMMR versus Apple, do you believe that you served as an
20 expert witness or a consultant for Apple in any other
21 litigation-related matters?
22 **A. I believe there was one which was very**
23 **brief. The case did not continue very far. But that's**
24 **a -- that's -- again, that's just a recollection. I**
25 **have all my records of those cases, and they're just**

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1 **not in my head.**
2 Q. If you could please look at your declaration
3 relating to the '830 patent and turn to page 81. Let
4 me know when you're there.
5 **A. I'm sorry. You said 81; is that correct?**
6 Q. Yeah. That's right.
7 **A. Okay.**
8 **Okay. I'm on page 81 of the '830**
9 **declaration.**
10 Q. And this is part of your discussion of
11 alleged invalidity of claims based on the Gregorio
12 reference.
13 Do you see that?
14 **A. Yes. Based on the table of contents, that's**
15 **right.**
16 Q. So let's actually turn to the Gregorio
17 reference itself. If you can open Exhibit 1004.
18 **A. Okay. I have it on the screen. That's the**
19 **'277 patent to Gregorio.**
20 Q. All right. And so that's U.S. Patent
21 Number 7,843,277; is that right?
22 **A. That's correct.**
23 Q. And if you could turn in Gregorio to page 9,
24 which has Columns 3 and 4 on it.
25 **A. I'm there.**

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Q. And in your declaration, you quote portions of a paragraph that begins at the bottom of Column 3 and continues on to Column 4.

And I'd like to direct you to the second sentence of that paragraph. So at the very bottom of Column 1, it says, quote --

A. You mean Column 3?

Q. Column 3. I -- yes.

Column 3 is the word "A" -- and then it continues on to Column 4 -- "drive signal cycle includes a drive period where the -- where drive signal pulses are applied to LRA 18 and a monitoring period where the back electromagnetic field ('EMF') of the moving mass 27 is received and used to determine the resonant frequency of the LRA."

MR. RUBIN: And I just realized that I did not upload this for the benefit of the court reporter. I'll get that now.

BY MR. RUBIN:

Q. So you would agree, based on what I just read, that at least in this embodiment in Gregorio, there are distinct drive periods where a current is supplied to the LRA and monitoring periods when the EMF is measured -- I should say the back EMF is measured?

A. I certainly see the terms "drive period" and

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1 "monitoring period" used in -- in those sentences, yes.
2 Q. So do you understand the term -- what is a
3 back electromagnetic field, or back EMF?
4 A. It's a -- a voltage. "Voltage" is a very
5 well-known equivalent term to "EMF," even into basic
6 electricity. And it's a voltage that's specifically
7 generi- -- generated by a magnet moving through a coil,
8 or more precisely, a magnetic field moving through a
9 coil.
10 Q. And in the linear resonant actuator of
11 Gregorio, there's a magnet that's moving through the
12 coil; is that right?
13 MR. DEUTSCH: Objection. Form.
14 THE WITNESS: The mass of Gregorio is
15 driven -- is a magnet and has -- let me find where I
16 completely more accurately describe that.
17 Yeah, for example, you know, Gregorio --
18 I -- I have a description of -- you know, a
19 correspondence of that in paragraph 102: "Gregorio's
20 system includes the electric coil, which corresponds to
21 a driving component, because when curl -- when current
22 flows through the coil, a magnetic field forms around
23 Coil 28, which causes movement" --
24 THE STENOGRAPHER: Wait. Wait.
25 Can you slow down a little bit? That's too

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fast.

THE WITNESS: I'm sorry. I'm just reading from a segment of the -- "when current flows through Coil 28, a magnetic field forms around Coil 28, which causes movement oscillation, in quotes, of Magnet 27."

So referring to Gregorio's figure of -- of -- I guess it's Figure 2 in Gregorio, that movable component is a magnet. So Gregorio describes clearly a magnet which moves in a coil.

And so getting back to the original -- sorry, I got diverted. We were talking about back EMF, and that is voltage induced in the coil by the magnet moving.

BY MR. RUBIN:

Q. And you agree that that back EMF voltage will be proportional to the velocity at which the magnet is moving?

MR. DEUTSCH: Objection. Form.

THE WITNESS: In general, the velo- -- the voltage induced in a coil by a magnet moving through it is proportional to velocity.

BY MR. RUBIN:

Q. If I could ask you to turn to Figure 4, please, of Gregorio.

A. I am looking at Figure 4 of Exhibit 1000- --

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Apple 1004, which is Gregorio, I believe.
I am now on that figure, yes.
Q. So in Figure 4, there's a Block 18 which is labeled LRA.
Do you see that?
A. I see that.
Q. So would you agree that the line to the left of that block is depicting the electrical connection to the coil within the linear resonant actuator?
MR. DEUTSCH: Objection. Form.
THE WITNESS: I think that's fair.
BY MR. RUBIN:
Q. To the left of that block, there's another block that's numbered 422.
Do you see that?
A. Yes, I see Block 422.
Q. And inside Block 422 is the text V-I EN.
Do you see that?
A. Yes, I see that.
Q. Do you have an understanding of what that text means?
A. Sitting here, I don't recall "EN." "V-I," I think any POSITA would assume that a power stage -- in the context of a power stage, which is the label on Block 422, "Volt" would refer to volts and current.

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"I" is the universal symbol for current. So V and I are always used -- or let's just say extremely commonly used to represent volts and current, which are very important parameters of a power stage.

Q. And so would you agree that during the drive period, the power stage 422 generates a current which then flows through the electromagnetic coil of the actuator 18?

A. Yes.

Q. During the monitoring period, would you agree that the power stage 422 does not output current?

MR. DEUTSCH: Objection. Form.

THE WITNESS: I am not sure that my opinion really clearly addresses that question either way. So I'd have to look into it more.

BY MR. RUBIN:

Q. Would you agree that it's -- well, withdrawn.

If you could turn to Column 5, please, paragraph starting at line 12.

A. Okay. I'm -- I'm there. I -- I assume you mean Column 5 of Gregorio, Apple 1004?

Q. That's right. The first sentence I'll -- I'll quote, "During a drive cycle, the drive pulse has a duration of approximately 2.2 milliseconds generated

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by pulse duration 408, and it is then followed by an approximately 100 microsecond delay generated by drive extension 409 that allows the drive pulse to go back to zero."

Do you see that?

A. I see that.

Q. And then it says, "During this 100 microsecond monitoring period, the LRA back EMF is transmitted along monitoring branch 430 to Zero Crossing with Offset Null circuit 405."

Do you see that?

A. I see that text, yes.

Q. So when it says that the drive pulse goes back to zero during the monitoring period, would you agree that that's saying that there's no current being generated by the power stage during that monitoring period?

MR. DEUTSCH: Objection. Form.

THE WITNESS: I think this embodiment or description here that we've just looked at describes two separate time intervals for drive and monitoring.

BY MR. RUBIN:

Q. And during the monitoring period, the actuator is not being driven by the power stage; is that right?

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A. I think that's implied in this sequential presentation here.

Q. And it would be easier to measure the back EMF when the actuator is not being driven because the process of driving the actuator is going to alter the voltage across the coil; is that right?

MR. DEUTSCH: Objection. Scope.

THE WITNESS: I didn't form any opinion or study the question of whether it's easier to do them in -- at the same time or at different times that I -- at least that I can recall. I don't recall forming an opinion about that question.

BY MR. RUBIN:

Q. All right. Do you have any understanding of why Gregorio has, at least in the embodiment we've been discussing, a separate drive period and monitoring period?

MR. DEUTSCH: Same objection.

THE WITNESS: And I think it's -- I have the same answer, which is I -- I would want a -- time to study the reference more carefully to make an opinion on that, to look for it in Gregorio.

BY MR. RUBIN:

Q. Turning back to Figure 4 of Gregorio.

Do you see that there's a line near the top

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of the figure labeled Monitoring Branch?

A. Yes, I -- I see the monitoring branch line in Figure 4.

Q. And would you agree that the monitoring branch line at all times has a voltage that's equal to the -- well, withdrawn.

Do you agree that the monitoring branch line is connected to one end of the electromagnetic coil of the actuator 18?

MR. DEUTSCH: Objection. Form.

THE WITNESS: I -- no, I don't think that's depicted in Figure 4, actually, which end or whether it's one end or two ends.

BY MR. RUBIN:

Q. The monitoring branch line is shown as connecting to Block 405, labeled Zero Crossing with Offset Null.

Do you see that?

A. Yes, I see that.

Q. Now, turning to Column 5, starting at line 16, Gregorio says, quote, "During this 100 microsecond monitoring period, the LRA back EMF is transmitted along monitoring branch 430 to Zero Crossing with Offset Null circuit 405."

Do you see that?

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A. I do.

Q. Okay. And so would you agree that that's saying that a voltage equal to the back EMF is transmitted along that monitoring branch to the zero crossing with offset null?

A. I think that's a likely interpretation of this -- this quoted sentence in line 12, yes.

Q. All right. Bear with me.

So earlier you said you weren't sure if monitoring branch was connected -- if the monitoring branch was connected to one end of the electromagnetic coil or two ends; is that right?

MR. DEUTSCH: Objection. Form.

THE WITNESS: This Figure 4 -- are we still talking about Figure 4 of this patent -- of Gregorio?

BY MR. RUBIN:

Q. Sure.

A. Yeah, so Figure 4 is highly schematic. There's one line which connects the power stage 422 to the LRA 18. So we know this is not a circuit diagram because you cannot apply a current through just one wire. It -- the line indicates a connection. It could be -- and in -- it must be a two-wire connection in order to apply a current into an LRA coil. That's basic electricity.

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1 So we know that that line is -- has to be
2 interpreted at a schematic level. And if you're
3 sensing a voltage off of a coil, you could connect a --
4 what's called a single-ended sensing to one line of the
5 coil or you could do differential sensing of the coil
6 voltage and you could connect two wires, one to each
7 end of the coil, and subtract them with circuitry to
8 get the voltage across the coil. Both of those are
9 well-known techniques.
10 So, you know, I -- I don't interpret these
11 lines as wires because, if you did, it wouldn't even
12 vibrate. It could be a differential measurement. It
13 could be a single-ended measurement.
14 Q. So turning back to Column 5 -- starting at
15 line 33 is the discussion of the box labeled 402 --
16 I'll quote, "Amplitude sampling with offset null
17 circuit 402 includes an operational amplifier and three
18 analog switches. Circuit 402 measures the difference
19 in -- of amplitude between the time the zero crossing
20 is detected until the end of the sampling period, which
21 lasts approximately 200 microseconds. Circuit 402 also
22 nulls the amplifier offset. Offsets increase amplitude
23 errors and decrease the performance at braking."
24 Do you see that?
25 A. I do see that.

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Q. So turning to Figure 4, box labeled 402 appears to have connections labeled In, Out and S/H.
Do you see that?
A. Yes.
Q. Would "S/H" mean sample and hold?
A. Just sitting here, that would be my interpretation of it, most likely.
Q. So there's no line shown connecting to the In connection of 402.
Do you see that?
A. I do.
Q. Do you have an understanding of what the input would be to this box in Figure 4?
MR. DEUTSCH: Objection. Form.
THE WITNESS: That's something I haven't studied or formed an opinion on.
BY MR. RUBIN:
Q. Do you know if that input could be the back EMF voltage?
A. As I said, it's not something I studied, and I don't know. At least to the best of my recollection, I don't recall studying why there's no input to that box.
Q. In Figure 4, is there anything that you would consider to be a sensor?

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MR. DEUTSCH: Objection. Form. And scope.

THE WITNESS: I think considering Figure 4 by itself and -- and our discussion of the monitoring branch, sensing -- measuring velocity by sensing back EMF is a sensor.

BY MR. RUBIN:

Q. So what specifically in this Figure 4 is a sensor?

MR. DEUTSCH: Objection. Scope.

THE WITNESS: The monitoring branch generates a signal sensing velocity.

BY MR. RUBIN:

Q. So if you could please turn in your '830 declaration to page 103. Let me know when you're there.

A. Okay. I'm at page 103 of the -- of my '830 declaration.

Q. Starting at the end of the fourth line from the bottom, you cite to Apple Exhibit 1032. And in parentheses, you say, quote, "Describing paramedics [sic] as one -- paramagnets" -- let me start over.

At the end of the fourth line from the bottom of page 103, you cite to Apple Exhibit 1032, and in parentheses, you say, quote, "Describing paramagnets as one of four types of magnetic material."

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Do you see that?

A. I see that.

Q. Could you open up Exhibit 1032, please?

A. I have that.

Q. And so would you agree that this appears to be a capture of a web page from the Internet Archive Wayback Machine titled Phys 251?

A. I -- I agree on the title. I'm not sure that it's a Wayback Machine capture, but there's this sort of familiar bar graph at the top. I -- I'm looking at the thing titled -- it's from a -- there's a Jaguars logo on the left and Phys -- Phys 251 and a NSF logo on the right header.

So I'm not sure its provenance, but that's what I'm seeing.

Q. So looking at the third paragraph, which begins with the word "first," the third sentence -- I'm sorry -- the fourth sentence of that paragraph says, quote, "There are three categories that describe how a material is affected by a magnetic field."

Do you see that?

A. I see that.

Q. And then it says, "There are others, but these are the most basic."

Do you see that?

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A. I see it.

Q. So in your -- well, withdrawn.

Exhibit 1032 goes on to list diamagnetism, paramagnetism and ferromagnetic materials as types of materials.

Do you see that?

A. Yes.

Q. So in your declaration, in parentheses, you said that the document describes paramagnets as one of four types of materials.

What's the fourth material, or is that a typo?

A. This -- this same reference says there are other types, but sitting here now, I can't remember the fourth one I was referring to.

Q. Let's step back for a minute.

A. Also we cite another reference there, which may describe it, but -- in that same sentence.

Q. So let's step back for a minute.

Sitting here right now, are you aware of any errors or things that you'd like to correct from either of the two declarations we're here to discuss today: the declaration concerning the '830 patent or the declaration concerning the '337 patent?

A. Not specifically right now.

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Q. You offer opinions in your declarations that aluminum could be used as a material within the Wakuda prior art reference; is that right?

A. Well, right -- right near the location that we are pointed to, I have -- I state that -- I state, "Wakuda requires the Casing 2 and the yoke members 8a and 8b to be 'made of a magnetic substance' or 'formed from a magnetic material.'"

That's on page 102.

Q. And you offer opinions that those portions of Wakuda could have been made out of aluminum; is that right?

MR. DEUTSCH: Objection. Form.

THE WITNESS: I'm not sure it's -- I offer an opinion that the casing is part of the flux path and could be made of a magnetic material.

BY MR. RUBIN:

Q. Okay. If you could turn to page 105 of your declaration, paragraph 157.

A. Okay.

Q. So in the first sentence, I'll quote, "A POSITA would have been motivated to use a paramagnetic material (e.g., aluminum) for the casing of the Gregorio-Wakuda actuator for several reasons."

Do you see that?

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1 **A. I see it.**
2 Q. So here you -- you refer to a paramagnetic
3 material, e.g., aluminum.
4 Is aluminum always paramagnetic? Well, let
5 me withdraw the question.
6 Is aluminum at -- let's say at room
7 temperature and standard pressure always paramagnetic?
8 **A. That's my understanding.**
9 Q. If you could turn to Exhibit 1031, please,
10 and specifically -- well, let's start with just the
11 Exhibit 1031.
12 **A. Okay. I've pulled it up.**
13 Q. And this is a patent to Elliot Brooks with
14 Patent Number 8,134,437; is that right?
15 **A. Yes. That's what I see.**
16 MR. RUBIN: And I forgot to upload
17 Exhibit 1032 earlier, but I've uploaded that and
18 Exhibit 1031.
19 Are there any other exhibits that I've
20 referred to but forgot to upload?
21 THE STENOGRAPHER: No. I have them all.
22 Thank you.
23 MR. RUBIN: Okay.
24 BY MR. RUBIN:
25 Q. Do you recognize this as a -- withdrawn.

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Do you recognize Exhibit 1031 as a reference that you cite in your expert declarations in these cases?

A. This one is -- I'm less familiar with. It's been a long time. So I kind of need to refamiliarize myself with it.

Q. You can take a minute to do that if you'd like.

A. Okay. I've -- I've brushed up on it. Thank you.

Q. No problem.

I'd like you to look at page 33 of this document, Column 21. Let me know when you're there.

A. Okay. Page 33.

Q. So in Column 21, starting at line 61 of Brooks' patent, it says, quote, "In applications where it is desired to ensure actuation times are as low as possible, the piston 92 is made of material having a suitably high ratio that is also nonmagnetic, nonferrous and, if desired, can be paramagnetic."

Do you see that?

A. Yes.

Q. So here it refers to using a material that is nonmagnetic and, if desired, can be paramagnetic.

Would you agree that here -- the Brooks

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patent, at least, is referring to paramagnetic materials as nonmagnetic?

MR. DEUTSCH: Objection. Form.

THE WITNESS: No. I don't think that's what this sentence means.

BY MR. RUBIN:

Q. The sentence after that says, quote, "Aluminum, copper and magnesium and alloys thereof are examples of suitable materials meeting these requirements."

Do you see that?

A. Sorry. Was there a question there? I -- I heard the quote that you read.

Q. I just asked if you saw what I --

A. And I see --

Q. -- read.

A. -- that quote that you read.

Q. All right. So would you agree that that sentence is identifying aluminum as an example of a nonmagnetic and nonferrous material?

A. Actually, I would say it's -- it's -- it's an example that can be paramedic -- paramagnetic because it's -- aluminum is known to be paramagnetic.

Q. So when the first sentence that I read says that a material is nonmagnetic and can be paramagnetic,

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you interpret that sentence to be describing two distinct alternatives?

MR. DEUTSCH: Objection. Form.

BY MR. RUBIN:

Q. Not two properties that are simultaneously satisfied?

MR. DEUTSCH: Same objection.

THE WITNESS: Sorry. You said, "Not two properties that are simultaneously satisfied?" I -- because it says "if desired," I think they could -- they're alternatives.

For -- you know, a paramagnetic material has less -- it's less magnetic than, say, ferromagnetic material, and that's what they're saying. But it has some magnetism, and that's what they're saying. And aluminum is classified as paramagnetic.

BY MR. RUBIN:

Q. If you could turn back to Exhibit 1032, please.

A. Okay. I have 1032 up there.

Q. So the third paragraph, first sentence, reads, quote, "First, a technical point" -- paragraph continues, quote -- "All materials are magnetic in the sense that they are affected by magnetic fields in some way," closed quote.

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Do you see that?

A. Yes.

Q. Do you think that that's an accurate statement, that all materials should be considered to be magnetic materials?

MR. DEUTSCH: Objection. Scope.

THE WITNESS: To the best of my recollection, I didn't offer an opinion about whether all materials are magnetic in any sense. This gives a very specific sense in which they state all materials are magnetic and not -- I'm not sure.

I would have to study that and form an opinion if I agree with it or not because there only has to be one material in the entire universe that is completely unaffected by magnetism, and that would make this statement false, and that would take research.

BY MR. RUBIN:

Q. Yeah, I have some thoughts about that, but it would take us pretty far afield from your opinions in this case, so save that for another day.

If you could turn back to your declaration -- actually, withdrawn.

MR. RUBIN: How about we take a break?

THE WITNESS: That's okay with me.

MR. RUBIN: All right. Can we start again

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at 10:40?

THE WITNESS: 10:40.

MR. RUBIN: Sounds good.

MR. DEUTSCH: Okay.

(A brief recess was taken from 10:26 to 10:41 a.m.)

BY MR. RUBIN:

Q. Let's go back to your '830 declaration, page 105.

And so --

A. Okay.

Q. -- I think we looked earlier today at paragraph 157 where you offer the opinion that a POSITA would have been motivated to use aluminum for the casing of the actuator in the combination of Gregorio with Wakuda; is that right?

MR. DEUTSCH: Objection. Form.

THE WITNESS: The -- the first sentence is that, "A POSITA would have been motivated to use a paramagnetic material like aluminum for the casing of the Gregorio-Wakuda actuator." I think that answers your question. And then we cover several reasons.

BY MR. RUBIN:

Q. In the next paragraph, paragraph 158, the first sentence reads, quote, "As a second reason, it

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was well-known that at least one well-known paramagnetic material, such as aluminum, is lighter than other popular paramagnetic" -- I'm sorry -- "other popular magnetic materials, like iron and steel, making it a superior choice for applications where weight matters, such as Gregorio-Wakuda's portable handheld device."

Do you see that?

A. I see that.

Q. So you would agree that iron and steel are popular magnetic materials?

A. Yes.

Q. So when Wakuda refers to its casing as being made of a magnetic substance, would a POSITA understand that a ferromagnetic material such as iron or steel could be used as the casing in Wakuda?

MR. DEUTSCH: Objection. Form.

THE STENOGRAPHER: I just want to make sure. Was that Mr. Deutsch objecting?

MR. DEUTSCH: Yes.

THE STENOGRAPHER: Okay. Thank you.

THE WITNESS: I think a POSITA would consider many materials and that iron and steel could be used.

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BY MR. RUBIN:

Q. And are both iron and steel ferromagnets at ordinary temperatures and pressures?

A. That's my understanding, yes.

Q. And would you agree that iron and steel are not paramagnets at ordinary temperatures and pressures?

A. Yes.

Q. If you could please turn in your '830 declaration to page 117.

A. Okay. I am on page 19 -- 117 of the -- my declaration about '830.

Q. And here you show, with annotations, Figure 9 from the Tierling reference.

Do you see that?

A. Yes.

Q. And I think it's a little hard to make out the numbers in the annotated figure here, but I think it might be a little bit easier to make out those numbers if you look at the original document. But if you could please turn to Figure 9 in Exhibit 1008.

A. I have to be in the right folder to find that exhibit, and there it is.

Tierling Patent Office Publication [sic] 2005/0134561 A1; correct?

Q. Yes.

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A. Okay.
Q. So if you could please turn to Figure 9.
A. Okay. I can even rotate it to see --
Q. All right.
A. -- if -- the way it's -- similar to what's sampled there --
Q. All right. Very good.
A. -- in the declar- -- yeah.
Q. Okay. So would you agree that Figure 9 shows two sinusoidal waves?
A. Yes.
Q. And in your annotations, you label one of those sinusoidal wades -- waves, quote, Desired Output Frequency (Lower Frequency); is that right?
A. Yes.
Q. And then in your annotations, you label the other wave, which has a shorter wavelength, the, quote, Resonant Frequency (Higher Frequency); is that right?
A. I see that, yes.
Q. So along the horizontal axis, which is labeled Time, in seconds, do you see a -- at the far left a 0?
A. Yes. Partially. I mean, it's half of a 0, yeah.
Q. And the far right, do you see the number 12

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on that?

A. I see the number 12, yes.

Q. And although it's a -- perhaps a little bit hard to make out, would you agree that the -- there are numbers corresponding to the vertical lines along that axis of 02, 04, 08 -- I'm sorry -- 06, 08 and presumably a 10?

A. Well, I don't see a 10. I -- you know, they're pretty obscured here, but maybe 02 is the clearest and 12 is the clearest and -- yeah. That's what I see.

08 appears to be clear, but O- -- the -- the thing to the left of 08 looks like 08 as well, so there's some -- definitely difficulty reading those numbers.

Q. All right. Now, if you turn in this document to paragraph 110, which is on page 23, please.

A. Sorry. In which document?

Q. Fair enough. The Tierling patent, Exhibit --

A. Okay.

Q. -- 1008.

A. Okay. Now I have to unrotate it.

Q. I'll upload it to the chat.

A. Sorry. Now I -- I'm going to have to rotate

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1 it three times to get it back to straight up.
2 Okay. I'm straight up.
3 So now -- paragraph 110 you asked, I think?
4 Q. That's right.
5 A. All right. I see "Figure 9" -- I'm sorry --
6 paragraph 110, which starts "Figure 9."
7 Q. All right. So the second sentence reads,
8 quote, "More specifically, Figure 9 illustrates a
9 desired output sinusoidal response having a frequency
10 of approximately 1 hertz superimposed on a higher
11 frequency resonant mode of a harmonic haptic device,
12 124."
13 Do you see that?
14 A. Yes.
15 Q. So turning back to Figure 9.
16 If the lower frequency sinusoid there has a
17 period -- I'm sorry -- has a frequency of 1 hertz,
18 would you agree that it would have a period of
19 1 second?
20 A. Yes.
21 Q. And so based on that, would it be your
22 understanding that the markings that we were talking
23 about earlier that looked like they say 02, 04, 06,
24 08 -- that those are indicating times of 0.2 seconds,
25 0.4 seconds, 0.6 seconds and 0.8 seconds?

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A. Yes. I think that's a reasonable way to disambiguate the fuzzy numbers in Figure 9.

Q. So I'd like to take a look at the higher frequency sinusoidal in Figure 9 and look at the time interval between 0 and 0.2 seconds.

Would you agree that there are four periods of that sinusoid shown in that time period?

A. Yes.

Q. So would that make the period of the higher frequency sinusoid 1/20 of a second?

A. If my math in my head is right, I would agree with that, yes.

Q. Or put another way, the period would be .05 seconds?

A. Doing the math in my head is sometimes unreliable, but it seems to agree with that right now.

Q. And so that would indicate that the frequency of that higher frequency sinusoid is 20 hertz; is that right?

A. Yes.

Q. And so a 20-hertz sinusoid is going to be periodic -- well, withdrawn.

The 1-hertz sinusoid will have the same value at a given point in time as it had 1 second earlier in time; correct?

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A. Yes.

Q. And the 20-hertz sinusoid will also have the same value at a given point in time as it had 1 second earlier in time; correct?

MR. DEUTSCH: Objection. Form.

THE WITNESS: That would be -- that's correct if the 20 hertz is exact and it's an exact multiple of 1.0. If it was 20.01 hertz or something, it would not be correct.

BY MR. RUBIN:

Q. Figure 10 -- withdrawn.

Figure 10 of Tierling shows a waveform that's produced by multiplying the two sinusoids in Figure 9; is that right?

A. Yes, I believe that's right.

Q. And so assuming that the sinusoids in Figure 9 are as depicted with the frequency of the higher frequency waveform being a multiple of the frequency of the lower frequency waveform, their product will be periodic; correct?

A. Yes.

Q. And so in particular, the value of the product of those two waveforms at any given point in time will be the same as its value was 1 second earlier; correct?

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MR. DEUTSCH: Objection. Form. Scope.

THE WITNESS: Yeah, as -- as I clarified before, that depends on the two frequencies being the -- the high frequency being an exact multiple of the low frequency, in that in this example, 20 hertz is an exact multiple of 1 hertz, but 21 hertz is not. It's not an inter- -- actually, it is of 1 hertz. Okay. But 20.5 is not.

So I think that -- I would have to really, you know, work out the math a little bit to make sure I had the answer right. But sitting here right now, I think that if, and only if, the two frequencies are related by a integer, like 20X or 5X or 50X, then your statement is correct.

BY MR. RUBIN:

Q. So you said if, and only if, they're related by an integer.

Would you agree they could also be related by a rational number, for example, three halves, and the result would be periodic?

MR. DEUTSCH: Objection. Form.

THE WITNESS: Eventually, the result would be periodic, but it would not be the same period as the envelope, which in this example, is 1 hertz.

I believe that's what you asked me, if I

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recall it right.

MR. RUBIN: I'll pass the witness.

MR. DEUTSCH: Let's take a short break.

MR. RUBIN: Okay. Short break.

(A recess is taken.)

MR. DEUTSCH: Thank you again for your time today, Dr. Hannaford.

No further questions.

THE STENOGRAPHER: Would counsel like a copy of the transcript?

MR. RUBIN: We would, yeah. So we'll take the rough, and I think we had requested three-day delivery.

THE STENOGRAPHER: Okay. Any counsel from Fish & Richardson?

MR. DEUTSCH: Yeah. The rough, and just the regular time frame is fine.

THE STENOGRAPHER: Thank you.

(Time noted: 11:11 a.m.)

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ACKNOWLEDGEMENT OF DEPONENT

I, BLAKE HANNAFORD, Ph.D., do hereby acknowledge that I have read and examined the foregoing testimony and the same is a true, correct, and complete transcription of the testimony given by me and any corrections appear on the attached errata sheet signed by me.

_____ _____

(BLAKE HANNAFORD, Ph.D.) (DATE)

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REPORTER'S CERTIFICATE

I, LORIE RHYNE, CSR No. 12905, RPR, CRR, DO HEREBY CERTIFY THAT THE FOREGOING DEPOSITION OF BLAKE HANNAFORD, PH.D., WAS TAKEN ON 1/28/25 VIA ZOOM BEFORE ME AT 9:09 A.M. FOR THE PURPOSE IN THE CAPTION STATED; THAT THE WITNESS WAS FIRST DULY SWORN TO TELL THE TRUTH, THE WHOLE TRUTH, AND NOTHING BUT THE TRUTH; THAT THE DEPOSITION WAS TAKEN BEFORE ME STENOGRAPHICALLY AND AFTERWARDS TRANSCRIBED UNDER MY DIRECTION; THAT THE FOREGOING IS A FULL, TRUE, AND CORRECT TRANSCRIPT OF THE SAID DEPOSITION SO GIVEN; THAT COUNSEL FOR ALL PARTIES WERE PRESENT AT THE TIME OF THE DEPOSITION; THAT THERE WAS A REQUEST THAT THE WITNESS READ AND SIGN THE TRANSCRIPT.

I FURTHER CERTIFY THAT I AM NEITHER OF COUNSEL NOR OF KIN TO ANY OF THE PARTIES TO THIS ACTION, AND AM IN NO WAY INTERESTED IN THE OUTCOME OF SAID ACTION.

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Lorie Rhyne

LORIE RHYNE, CSR No. 12905, RPR, CRR

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