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| 1  | UNITED STATES PATENT AND TRADEMARK OFFICE |                             |
| 2  | BEFORE THE PATENT TRIAL AND APPEAL BOARD  |                             |
| 3  | GODBERSEN-SMITH                           | )Case IPR2024-00835         |
| 4  | CONSTRUCTION COMPANY                      | )U.S. Patent No. 11,535,318 |
| 5  | d/b/a GOMACO                              | )                           |
| 6  | CORPORATION,                              | )                           |
| 7  | PETITIONER,                               | )MOBILE VIDEOCONFERENCE     |
| 8  | V.                                        | )DEPOSITION OF              |
| 9  |                                           | )WILLIAM SINGHOSE, Ph.D.    |
| 10 |                                           | )                           |
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| 13 |                                           | )                           |
| 14 | GUNTERT & ZIMMERMAN                       | )                           |
| 15 | CONST. DIV., INC.,                        | )                           |
| 16 |                                           | )                           |
| 17 | PATENT OWNER.                             | )                           |
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| <p>Page 5</p> <p>1 (Whereupon, the following proceedings<br/>2 were had, to-wit:)<br/>3 WILLIAM SINGHOSE, Ph.D.,<br/>4 having been first duly sworn,<br/>5 was examined and testified as follows:<br/>6 DIRECT EXAMINATION<br/>7 BY MR. LAYDEN:<br/>8 Q. Dr. Singhose, nice to meet you today.<br/>9 How are you?<br/>10 A. Oh, Mr. Layden, are you talking?<br/>11 Q. I am, yes.<br/>12 A. You were showing up really small there<br/>13 for a second.<br/>14 Q. Apologies. You submitted a<br/>15 declaration in IPR 2024-00835 against U.S.<br/>16 Patent Number 11,535,318; is that correct?<br/>17 A. Yes.<br/>18 Q. And I believe previously you've also<br/>19 testified in actions between G&amp;Z and GOMACO also<br/>20 at IPR as well; is that also accurate?<br/>21 A. Yes.<br/>22 Q. In preparing for your deposition<br/>23 today, did you review any of your past<br/>24 testimony?<br/>25 A. Yes, I did.</p>                                                                                                                                                       | <p>Page 7</p> <p>1 it looks about right, yeah.<br/>2 Q. How long have you been teaching<br/>3 mechanical design at the --<br/>4 A. Well, I've been at Georgia Tech<br/>5 teaching mechanical design since 1998. Boy,<br/>6 that's what, like 26 years. I actually taught<br/>7 before that, I taught at MIT as a post doc doing<br/>8 some teaching as an undergrad. Over 25 years I<br/>9 think is a fair assessment.<br/>10 Q. And in your classes, what is the<br/>11 designs of the mechanical design that you're<br/>12 mainly focused on?<br/>13 A. That's a good question. I guess I<br/>14 should clarify that I teach more than one class,<br/>15 so briefly not to waste your time, I'll walk<br/>16 through that. I teach the introductory<br/>17 mechanical design class. In fact, I taught it<br/>18 this morning. And in that class we teach them<br/>19 general strategies that they can apply to all<br/>20 kinds of systems. So, for example, today in my<br/>21 class I talked about how you might design<br/>22 cranes, and I also talked about aerial lifts,<br/>23 and coordinate measuring machines.<br/>24 COURT REPORTER: (Requests<br/>25 clarification.)</p>       |
| <p>Page 6</p> <p>1 Q. And did you review your testimony in<br/>2 regards to what you provided for what was<br/>3 referred to as the '749 patent?<br/>4 A. Yes.<br/>5 Q. In your declaration does that provide<br/>6 the whole of your opinions you intend to submit<br/>7 in this action?<br/>8 MR. HIGH: Objection. Form.<br/>9 THE WITNESS: Yeah, as I'm<br/>10 currently sitting here, I wrote down all my<br/>11 opinions at this point.<br/>12 MR. LAYDEN: I'm going to upload<br/>13 what will be marked as Exhibit 1 in the chat.<br/>14 This will be your CV that was attached to your<br/>15 declaration.<br/>16 (Exhibit 1 marked for identification.)<br/>17 BY MR. LAYDEN:<br/>18 Q. Dr. Singhose, is this CV current and<br/>19 up to date?<br/>20 A. I'm just working on downloading it.<br/>21 Sorry. If I go to the desktop -- oh, there it<br/>22 is, okay. By the way, it's actually Singhose,<br/>23 not house. Okay, I found it. This isn't my<br/>24 computer, but I found out where it's at here.<br/>25 Let me just look at this real quick here. Yeah,</p> | <p>Page 8</p> <p>1 THE WITNESS: Coordinate<br/>2 measuring machines.<br/>3 But given the state of the world, a<br/>4 fair amount of what I talk about are machines<br/>5 that have computers in them, in most of them.<br/>6 Most of the machines my students are going to<br/>7 work on after they graduate are going to have a<br/>8 controller or a computer. So in the class we<br/>9 actually give them a small controller with some<br/>10 sensors and actuators and we require them to<br/>11 build an automated machine at the end of the<br/>12 term. So that's the first class.<br/>13 I also teach more advanced design<br/>14 classes at the senior level and also at the<br/>15 graduate level. Those classes would tend to be<br/>16 more sophisticated, a lot of the designs would<br/>17 focus on what I'll call more complicated<br/>18 controllers, more complicated mechatronic<br/>19 systems, like robotic cranes, things like that.<br/>20 So I teach a full spectrum of topics and<br/>21 techniques for design.<br/>22 BY MR. LAYDEN:<br/>23 Q. Would it be fair to say that the focus<br/>24 of your courses is primarily on the control of<br/>25 the systems?</p> |

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| <p style="text-align: right;">Page 9</p> <p>1 A. That would be fair for my graduate<br/>2 classes, because I teach specialized graduate<br/>3 classes. But at the undergraduate level, like<br/>4 the class I taught today, the focus is really<br/>5 more on mechanical parts, like joints and<br/>6 ratchets and levers and things like that. Now,<br/>7 they do try to control those at the end of the<br/>8 term, but it's mostly about the mechanisms of<br/>9 the machines.</p> <p>10 Q. And when you're teaching your<br/>11 students, you know, the proper mechanisms to<br/>12 incorporate into a design, what are the<br/>13 considerations they should take into account?</p> <p>14 MR. HIGH: Objection. Form.</p> <p>15 THE WITNESS: Well, the way I<br/>16 teach it, I say start your design by<br/>17 understanding your customer's needs. So they<br/>18 need to understand what people they're trying to<br/>19 sell this to, who is going to use it. And then<br/>20 from that understanding, that would drive, you<br/>21 know, their selection of components and<br/>22 arrangements and things like that.</p> <p>23 So again, these are very basic<br/>24 fundamental techniques that they could apply to<br/>25 cranes or slipform pavers or smart watches.</p> | <p style="text-align: right;">Page 11</p> <p>1 for example, was on quality, how to design a<br/>2 product so that it has quality during its<br/>3 lifetime.</p> <p>4 Q. When you talk about quality, what do<br/>5 you mean?</p> <p>6 A. I could show my lecture slides, since<br/>7 I just gave it. I won't bore you too much, but<br/>8 quality is a nebulous kind of factor and design,<br/>9 and so I teach the students that quality --<br/>10 there are certain quality considerations of the<br/>11 consumer, and that would be does it last a long<br/>12 time, does it provide good features for the<br/>13 amount of money, can I easily maintain it. And<br/>14 then there's also quality for the producer, like<br/>15 can I make this and I don't have to recall the<br/>16 product. And can I make this without needing<br/>17 specialized materials coming in, like some<br/>18 special plastic. So there's a variety of<br/>19 considerations of quality, but overall, you<br/>20 know, high quality products means that they<br/>21 perform very well in terms of however you want<br/>22 them to perform, and they generally perform for<br/>23 a long time.</p> <p>24 Q. Anything other than safety and quality<br/>25 that you consider?</p> |
| <p style="text-align: right;">Page 10</p> <p>1 That's what we're trying to do at this level is<br/>2 to provide them knowledge and a bit of<br/>3 experience on a wide range of possible products.</p> <p>4 BY MR. LAYDEN:</p> <p>5 Q. Would the design considerations for<br/>6 let's say a smart watch be different from a<br/>7 slipform paver?</p> <p>8 A. Certainly some of them would be, yes.<br/>9 I mean, some of them are universal, for example,<br/>10 safety. So you might not think that smart<br/>11 watches would be unsafe but they have batteries<br/>12 that can burn people. So part of the<br/>13 fundamental process would be keep your eye on<br/>14 safety, take safety into consideration. And<br/>15 there's other fundamental ones like that, for<br/>16 example like cost. But certainly once you get<br/>17 into more detailed customer requirements,<br/>18 they're going to diverge quite a bit.</p> <p>19 Q. Are there any other considerations<br/>20 beyond safety that you would tell your students<br/>21 to consider?</p> <p>22 A. Yes. We teach them a whole list of<br/>23 things to consider. I can go through the list.<br/>24 But I'm just mentioning safety because it's one<br/>25 that I put forward first. But today's lecture,</p>    | <p style="text-align: right;">Page 12</p> <p>1 A. Yeah, cost. Cost is very important.<br/>2 If you can't make a product for a reasonable<br/>3 cost you're never going to make it, your company<br/>4 is not going to produce it. But yeah, just a<br/>5 whole list of them and I could talk about it all<br/>6 day, that's my job, if you want to.</p> <p>7 Q. No, that's fair. Should they consider<br/>8 functional limits of the components?</p> <p>9 A. Yeah, that's generally what we<br/>10 would -- that would be under what we call<br/>11 specifications. So we teach them to develop<br/>12 specifications for their product. Those would<br/>13 be sort of numerical targets, numbers and units.<br/>14 Like it goes 10 miles per hour or it can lift<br/>15 five tons, things like that.</p> <p>16 Q. Looking through your CV, you have, in<br/>17 addition to your teaching credentials,<br/>18 obviously, you have quite a bit of experience in<br/>19 the private sector.</p> <p>20 A. That's true, I think I do, for a<br/>21 professor.</p> <p>22 Q. Yeah, I would say so.</p> <p>23 A. Yeah.</p> <p>24 Q. Within the private sector, what work<br/>25 were you doing in developing your products?</p>                                         |

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| <p>Page 13</p> <p>1 A. I didn't quite hear the last part of<br/>2 that. You're actually a little bit low. I<br/>3 wonder if I can turn the volume up somehow.<br/>4 Q. Well, let me restate it.<br/>5 A. Okay.<br/>6 Q. What type of products in the private<br/>7 sector did you develop?<br/>8 A. Okay. I'll start kind of going<br/>9 through historically. You can feel free to stop<br/>10 me. Some of my first products that I developed<br/>11 were actually in the cement field. I worked<br/>12 with a cement lab and I helped develop new<br/>13 cement products that would solidify faster, like<br/>14 the concrete that you're making from the cement<br/>15 would solidify faster and be stronger. So I<br/>16 would put additives into the cement and then I<br/>17 would test it, right, I would form cement blocks<br/>18 and I would wait like a day and I would bust<br/>19 them and then I'd wait a week and I would bust<br/>20 them and stuff like that, and I would measure<br/>21 how strong they got over time. So that's one of<br/>22 the first products I first worked on.<br/>23 After that I worked at Disney World,<br/>24 and I didn't really develop products from the<br/>25 ground up there, I just modified some of the</p>             | <p>Page 15</p> <p>1 consumer electronic products and also apps like<br/>2 for their phones. So some of that stuff would<br/>3 be -- I did a little bit of work on their smart<br/>4 glasses that you may have heard about.<br/>5 Q. Yep.<br/>6 A. But also their smart watches. They<br/>7 bought Fitbit. So I worked on that kind of<br/>8 stuff for them. Then I also started two of my<br/>9 own companies along the way which had to do with<br/>10 heavy machinery, controlling cranes. And in<br/>11 those companies I developed products that you<br/>12 added, for example, to a crane so that you could<br/>13 move it around and it wouldn't swing as much and<br/>14 it wouldn't run into obstacles.<br/>15 Q. That's the CAMotion Cranes, Inc.?<br/>16 A. Yeah, so CAMotion Cranes was the first<br/>17 company I did that for, and we built that<br/>18 company up and sold it to PaR, which is kind of<br/>19 an old robotics company that makes fancy robot<br/>20 -- big machines like cranes. Like they built<br/>21 the robotic crane that's at Chernobyl, the<br/>22 nuclear reactor, to decommission, take it apart.<br/>23 And then the products that I developed<br/>24 for CAMotion Cranes are kind of expensive. Like<br/>25 if you bought one of my products you'd be paying</p> |
| <p>Page 14</p> <p>1 products that were already at Disney World.<br/>2 After a machine is working like ten years at<br/>3 Disney World, you would often go in and upgrade<br/>4 it or fix it or improve it. So I worked on the<br/>5 big huge simulator rooms there that were driven<br/>6 by hydraulic actuators. I worked on Space<br/>7 Mountain. I did some roller bearing design for<br/>8 Pirates of the Caribbean.<br/>9 And then after that my next sort of<br/>10 big job where I developed a product was at<br/>11 Apple. In that case I shifted over to more<br/>12 consumer electronics, and I did a lot of work<br/>13 helping to develop a monitor that had built-in<br/>14 speakers and microphones, and I'm going to grad<br/>15 school and stuff during this.<br/>16 My next job that evolved, I really<br/>17 focused on developing control systems for<br/>18 robots. That was a big part of what I did<br/>19 there. Then I became a professor and I kept<br/>20 working for various companies along the way and<br/>21 did smaller projects where I'm aiding people<br/>22 developing stuff.<br/>23 I did take about two and a half years<br/>24 off from Georgia Tech and worked for Google.<br/>25 During that time at Google I really focused on</p> | <p>Page 16</p> <p>1 \$50,000 or \$100,000, and so I started a company<br/>2 after that that essentially does a lower cost<br/>3 version of crane controllers. And the company<br/>4 is Invektek, I-N-V-E-K-T-E-K.<br/>5 Q. And while at Invektek and CAMotion<br/>6 Cranes, did you ever develop or modify any of<br/>7 the actual components on the crane or was it<br/>8 focused just on the control system?<br/>9 A. Well, the control system is a<br/>10 component of the crane. So all cranes will have<br/>11 electronics on them because there'll be the<br/>12 person, for example, on the ground pushing a<br/>13 button. That sends an electrical signal up to<br/>14 this computer on the crane and the crane then<br/>15 turns on the drive, or what you might call the<br/>16 amplifier that creates a lot of energy and sends<br/>17 it out to the big motors driving the crane. So<br/>18 that's already on the system. There's already a<br/>19 computer on there and the electronics. We<br/>20 essentially go in and modify or add to that so<br/>21 that the voltages being sent to the motor are<br/>22 shaped in such a way the crane will move around<br/>23 and not swing. So it is a standalone box, but<br/>24 it integrates with the computer that's already<br/>25 there.</p>  |

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| <p style="text-align: right;">Page 17</p> <p>1 Occasionally we would have to tell<br/>2 that company, you need to upgrade your crane<br/>3 motors, they're not good enough, they're like<br/>4 50 years old. So in that case we are really<br/>5 going in, taking off a motor, putting a new<br/>6 motor on so it works better with our controller.<br/>7 Q. You said at Disney World you modified<br/>8 several of their products.<br/>9 A. Yes.<br/>10 Q. When you were trying to modify or<br/>11 improve or fix the products at Disneyland, were<br/>12 you considering working with what they already<br/>13 had, or was it a blank start for you?<br/>14 A. Pretty much everything I did was<br/>15 working with what they had. They're big,<br/>16 expensive machines, so I never recommended or I<br/>17 was never on a project where we completely<br/>18 eliminated everything. The closest thing to<br/>19 that was really Space Mountain. We're not going<br/>20 to change the mountain and the roller coaster<br/>21 that's in there. Space Mountain, just to be<br/>22 clear, is a roller coaster inside a building.<br/>23 It's a special kind of roller coaster in that it<br/>24 has like 16 trains falling all at once. Usually<br/>25 roller coasters have one train that's falling in</p>                                                                     | <p style="text-align: right;">Page 19</p> <p>1 Q. Other than improving or modifying the<br/>2 control system and sensors, did you make any<br/>3 sort of mechanical modifications at all?<br/>4 A. Well, those are mechanical<br/>5 modifications. For example, the sensors, we put<br/>6 new kind of sensors in there, and I had to<br/>7 design sensor brackets so they could mount on --<br/>8 the sensors really need to see the bottom of the<br/>9 train, there's a fin that sticks off the bottom,<br/>10 and you need to have a sensor that sees it<br/>11 whizzing past and counts it and says oh, that's<br/>12 train number 17. So it's a lot of mechanical<br/>13 stuff. In fact, that's what I worked on. I was<br/>14 on the mechanical team.<br/>15 There was another team that focused on<br/>16 the electronics, the control system. Basically<br/>17 it's a PLC, programmable logic controller. I<br/>18 did not at that time work on that system. That<br/>19 was an electrical group focused on that part of<br/>20 the project.<br/>21 Q. And you mentioned quickly, I think,<br/>22 your development of new cement and cement<br/>23 properties; correct?<br/>24 A. Yes.<br/>25 Q. Was that at Riverside Cement Company?</p> |
| <p style="text-align: right;">Page 18</p> <p>1 the gravity field and one that's being loaded<br/>2 with people, so it's kind of inherently safe.<br/>3 The ones at Disney World are small trains, like<br/>4 four people at a time, so there are 16 falling<br/>5 through the gravity field. So if one of them<br/>6 stopped, the other would run into them. So<br/>7 they're actually a sophisticated control system<br/>8 on Space Mountain that has sensors and brakes<br/>9 throughout the mountain, and so if one car<br/>10 derails and stops, you can stop the others from<br/>11 running into it.<br/>12 So consequently, Space Mountain has a<br/>13 pretty sophisticated control system. There's a<br/>14 computer that's reading the whole mountain,<br/>15 determining where these things are, determining<br/>16 whether there's proper separation, and if not,<br/>17 it starts triggering brakes to slow things down.<br/>18 In that case we replaced the entire control<br/>19 system, which is the computer and the sensors<br/>20 and the mounting brackets and stuff. So that<br/>21 was a major like two month taking the mountain<br/>22 down and replacing a lot of stuff. So we<br/>23 essentially gutted a large portion of it but of<br/>24 course we didn't like tear the building down and<br/>25 change the tracks and all of that kind of stuff.</p> | <p style="text-align: right;">Page 20</p> <p>1 A. That's right.<br/>2 Q. Okay. And prior to Riverside Cement<br/>3 Company, I believe you were there summer of<br/>4 1988; is that accurate?<br/>5 A. Yes.<br/>6 Q. You said you worked at Bill's Asphalt<br/>7 Repair. I believe you previously testified that<br/>8 was your family company; is that correct?<br/>9 A. That's correct. It's not me Bill, it<br/>10 was my stepfather, Bill Barton, was how we got<br/>11 that name.<br/>12 Q. And you were there from August 1985 to<br/>13 August 1987?<br/>14 A. Yeah, I think that's officially when I<br/>15 was on the books. I mean, I helped out with the<br/>16 company before that a little bit from time to<br/>17 time. But during that period I worked a lot for<br/>18 the company and essentially was on the payroll<br/>19 getting a paycheck.<br/>20 Q. Okay. And looking at your education,<br/>21 at the top of your CV, you would have been in<br/>22 undergrad during that time at MIT; correct?<br/>23 A. Actually I started when I was a high<br/>24 school student and I was going into college, and<br/>25 during that time I went to the University of</p>                                                              |

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| <p style="text-align: right;">Page 21</p> <p>1 Oregon for two years. I didn't get a degree<br/>2 there so I don't normally put it on my CV. When<br/>3 I quit is when I went to MIT. So the August of<br/>4 '87 quit date was because I was going<br/>5 cross-country and living in Cambridge instead of<br/>6 Oregon.<br/>7 Q. So would you say your time at your<br/>8 family's company, you were a full-time employee<br/>9 or part-time employee?<br/>10 A. I was a full-time employee for parts<br/>11 of the year. Like I worked all the time in the<br/>12 summer and then sometimes during the fall and<br/>13 spring. The truth is construction companies in<br/>14 Oregon don't work much in the winter, too much<br/>15 rain and stuff, especially asphalt. So I was a<br/>16 full-time employee for some of the time and then<br/>17 I would just help out from time to time in the<br/>18 fall and spring.<br/>19 Q. And in your previous testimony you<br/>20 described some of the machines that you operated<br/>21 and worked with while at your family's company.<br/>22 Could you recount those again for me, please?<br/>23 A. I operated all kinds of machines my<br/>24 whole life. I'm trying to make the -- I'm<br/>25 trying to think just about during that time</p>                                             | <p style="text-align: right;">Page 23</p> <p>1 the edges. You would use a backhoe to prepare<br/>2 the site. So that's probably sort of the major<br/>3 pieces of equipment that I used during that<br/>4 time.<br/>5 Q. And I believe you said the spreader<br/>6 that you used, that was hooked up to the rear of<br/>7 the asphalt -- of the dump truck that was<br/>8 dropping the --<br/>9 A. Yeah. You have to -- it's sitting<br/>10 there, it's just a big box kind of; it's really<br/>11 dirty. But it's a big box with some controls<br/>12 that change the angles and the height, and you<br/>13 have to drop the truck up into it and connect it<br/>14 on, and then you raise the dump truck, asphalt<br/>15 starts falling into the box, and you have to<br/>16 start driving forward kind of slowly, and as<br/>17 you're going forward -- there's actually people<br/>18 on the back who are adjusting it and keeping it<br/>19 straight and leveling it and stuff like that.<br/>20 This is before we had computer controllers, like<br/>21 leveling the supports, it was manual, you know,<br/>22 like hey, Joe, raise the right side a half inch<br/>23 or whatever as you're going forward.<br/>24 Q. And typically how thick was the layer<br/>25 of asphalt that you were laying?</p> |
| <p style="text-align: right;">Page 22</p> <p>1 period. That company had a dump truck, and that<br/>2 was one of my main jobs was to go pick out the<br/>3 asphalt and bring it to the job site. But we<br/>4 also -- when we got to the job site I would<br/>5 often hook the dump truck up to a spreader, the<br/>6 spreader box was what we called it, and that's<br/>7 somewhat related to the slipform paver in that<br/>8 you dump hot asphalt into the box and you drive<br/>9 forward. And as you drive forward it's much<br/>10 like the slipform paver in that it forms the<br/>11 asphalt and pushes it down into place, and it<br/>12 takes on the shape of the box. So it's sort of<br/>13 the asphalt equivalent of the cement slipform<br/>14 paver.<br/>15 In addition to that, I would drive the<br/>16 steam roller. Like after you lay asphalt you<br/>17 have to compress it. So I'd get out, I would<br/>18 drive the steam roller sometimes. Around small<br/>19 areas, like around manholes, you have to do that<br/>20 work by hand essentially and I would use a<br/>21 tamper, I would drive a little tamper machine,<br/>22 which is something that bounces up and down and<br/>23 smashes the asphalt down.<br/>24 There's a bunch of auxiliary tools<br/>25 that you use. You use blow torches to clean up</p> | <p style="text-align: right;">Page 24</p> <p>1 A. Two to four inches would be the<br/>2 typical thickness.<br/>3 Q. Can you tell me how that thickness<br/>4 would compare to the depth of concrete that<br/>5 would be laid when paving a road?<br/>6 A. Yeah, and I think that value changes a<br/>7 lot. Like if you're making a runway at an<br/>8 airport, you're going to have thicker stuff.<br/>9 But certainly the kind of cement that we made,<br/>10 we made sidewalks and stuff at that time, that<br/>11 would generally be a little bit thicker, like we<br/>12 would normally be developing sidewalks that were<br/>13 probably four to eight inches thick.<br/>14 Q. How does the thickness of the sidewalk<br/>15 relate to the thickness of a road, or a tarmac,<br/>16 let's say?<br/>17 A. Well, the tarmac would be thicker. I<br/>18 mean, probably. In some cases where you have a<br/>19 lot of loads on these roads or these runways,<br/>20 you know, you wouldn't do it all in one layer.<br/>21 You would do one layer, let it solidify for a<br/>22 couple weeks, and come back and do another layer<br/>23 if you need that much strength.<br/>24 Q. So would it be an accurate assessment<br/>25 that the force needed to lay the concrete or</p>                             |

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| <p style="text-align: right;">Page 25</p> <p>1 push through the concrete to lay a road is</p> <p>2 significantly greater than the force needed to</p> <p>3 spread asphalt?</p> <p>4 MR. HIGH: Objection. Form.</p> <p>5 THE WITNESS: It could be. The</p> <p>6 force to pull a slipform paver and make a curb</p> <p>7 or make a sidewalk is not that great because</p> <p>8 it's smaller. So the amount of force that's</p> <p>9 required to pull those forms over either the</p> <p>10 asphalt or the cement are dominated really by</p> <p>11 how wide and how thick it is. So some of the</p> <p>12 asphalt that we pulled, there's a lot of forces</p> <p>13 there. I mean, I had to use all the power in</p> <p>14 the dump truck to pull forward. But some of the</p> <p>15 forces required to pull that curb certainly</p> <p>16 would be less than that. So it's just a huge</p> <p>17 spectrum, depending on the job that you're</p> <p>18 doing.</p> <p>19 BY MR. LAYDEN:</p> <p>20 Q. When you were doing this asphalt</p> <p>21 repair work, did you ever encounter any large</p> <p>22 slipform pavers?</p> <p>23 A. I did not. Yeah, at that time, we</p> <p>24 were earlier in time and they weren't that</p> <p>25 common. We were also working in a space where</p> | <p style="text-align: right;">Page 27</p> <p>1 Atlanta so just leaving my house, there's lots</p> <p>2 of asphalt repair, but also we have bridges</p> <p>3 nearby where they actually recently resurfaced</p> <p>4 and they used the slipform paver to resurface</p> <p>5 those bridges.</p> <p>6 Q. And when you were going by watching</p> <p>7 the slipform paver operate, what was your</p> <p>8 assessment on how it actually operated?</p> <p>9 MR. HIGH: Object to form.</p> <p>10 THE WITNESS: Yeah, I'm not sure</p> <p>11 that I did that exact thought experiment. I</p> <p>12 mean, I looked at it, I looked at the</p> <p>13 components. One thing that -- one thought I had</p> <p>14 was it's moving slow, like you definitely pick</p> <p>15 up on the fact that these go really, really slow</p> <p>16 when they're in operation. But I'm not sure I</p> <p>17 was trying to gain an overall function. I was</p> <p>18 looking at components, I was looking at how it</p> <p>19 was set up, and just general observations like</p> <p>20 that, like what are the components, how many</p> <p>21 legs are -- is this driving on, how many</p> <p>22 tractors do they have, stuff like that.</p> <p>23 BY MR. LAYDEN:</p> <p>24 Q. Why is it you think slipform pavers</p> <p>25 move slowly?</p>                    |
| <p style="text-align: right;">Page 26</p> <p>1 we were repairing people's driveways, making</p> <p>2 smaller roads, so we would not have been bidding</p> <p>3 on like highway projects where the slipform</p> <p>4 paver makes the most sense.</p> <p>5 Q. Have you ever done any work with the</p> <p>6 slipform paver?</p> <p>7 A. No, not personally, I've never</p> <p>8 operated a slipform paver.</p> <p>9 Q. Have you ever personally seen one?</p> <p>10 A. Many times, yes.</p> <p>11 Q. Have you ever inspected one?</p> <p>12 A. I mean, I haven't gone up and done any</p> <p>13 measurements on them, but I've seen many over</p> <p>14 the course of my life and I have a personal</p> <p>15 interest in it. So if I'm walking by or driving</p> <p>16 by, I'll definitely take a close look at it.</p> <p>17 I'm looking -- as an engineer I'm looking at how</p> <p>18 is this working, how are they doing it, where is</p> <p>19 the rebar, all that kind of stuff. So I'm</p> <p>20 asking myself a lot of questions and using that</p> <p>21 to answer those questions and learn,</p> <p>22 essentially.</p> <p>23 Q. Have you ever seen a slipform paver in</p> <p>24 operation?</p> <p>25 A. Yes. We have a lot of road work in</p>                             | <p style="text-align: right;">Page 28</p> <p>1 A. I've seen them and they go slowly.</p> <p>2 But I mean the reason why is they're pushing a</p> <p>3 lot of force and they're trying to make sure</p> <p>4 there's no gaps in the top. Like if the</p> <p>5 slipform paver went forward and you didn't have</p> <p>6 enough concrete, you would look behind you and</p> <p>7 there would be a ridge.</p> <p>8 Also, when you're dealing with</p> <p>9 concrete, you have to vibrate it. So this is</p> <p>10 part of my job at Riverside Cement is you don't</p> <p>11 just make it and throw it down. Once you throw</p> <p>12 it down in there, you really have to vibrate it</p> <p>13 for a couple reasons. One so it takes on the</p> <p>14 proper shape of your slipform, but also you kind</p> <p>15 of want to get some air bubbles out of it, make</p> <p>16 sure it all settles. That's also why it goes</p> <p>17 really slow is that they're not just pushing,</p> <p>18 they're pushing and vibrating in general.</p> <p>19 Q. How large were the slipform pavers</p> <p>20 that you observed?</p> <p>21 A. I would say large. I mean, they're</p> <p>22 large enough to make a full lane on a freeway.</p> <p>23 Q. So larger than the ones you would use</p> <p>24 to pave a sidewalk?</p> <p>25 A. Pave a what?</p> |

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| <p style="text-align: right;">Page 29</p> <p>1 Q. Pave a sidewalk?</p> <p>2 A. Oh, yeah. I mean, the ones doing the</p> <p>3 freeway are quite wide, and sidewalks are four,</p> <p>4 five feet wide. So the slip forms, the forms</p> <p>5 they're using, certainly would have been much</p> <p>6 bigger, or a fair amount bigger for a freeway</p> <p>7 than a sidewalk.</p> <p>8 Q. Would you be able to estimate the</p> <p>9 weight of the slipform paver you observed?</p> <p>10 A. I would be able to estimate it, yeah.</p> <p>11 Probably I would look up the model number and</p> <p>12 I'd just find out how much it weighed. They</p> <p>13 weigh like tens of thousands of pounds,</p> <p>14 certainly.</p> <p>15 Q. Would that affect the speed at all?</p> <p>16 A. I guess it could, but I would think</p> <p>17 that the speed of operation, again, is dominated</p> <p>18 by the need to level it and vibrate it and have</p> <p>19 it get into the shape that you want. That's</p> <p>20 probably what's limiting the speed more than the</p> <p>21 weight of it.</p> <p>22 Q. And what would happen if the machine,</p> <p>23 the slipform paver, encountered frequent stops?</p> <p>24 What would that do to the quality of the</p> <p>25 concrete it's laying?</p>                                                                                                                | <p style="text-align: right;">Page 31</p> <p>1 you can't shape it. So you want to put your</p> <p>2 concrete down and have it be moldable and</p> <p>3 shapeable, and set up after you're done molding</p> <p>4 it. If it starts setting up before, you can't</p> <p>5 work with it.</p> <p>6 BY MR. LAYDEN:</p> <p>7 Q. Going back to the slipform paver, as</p> <p>8 far as the drive mechanism, what are the key</p> <p>9 components of the drive mechanism on a slipform</p> <p>10 paver?</p> <p>11 A. I think the key, what I would consider</p> <p>12 the key components, the diesel engine driving</p> <p>13 the whole thing, like you've got to have a power</p> <p>14 plant, usually a big diesel engine that can</p> <p>15 generate quite a few horsepower. So you have</p> <p>16 that, and you have to convert that energy into</p> <p>17 at least a couple different forms of energy.</p> <p>18 One has to be the track motion, right, the</p> <p>19 mechanical motion of driving forward. But all</p> <p>20 these are hydraulics. So you have to take that</p> <p>21 diesel engine and you have to drive a hydraulic</p> <p>22 pump and compress fluid and create a source of</p> <p>23 hydraulic oil and pressure. That's what drives</p> <p>24 a lot of the parts of the machines, like the</p> <p>25 cylinders and stuff are driven by the</p> |
| <p style="text-align: right;">Page 30</p> <p>1 A. Depends on how long the stop is. You</p> <p>2 know, concrete is pretty workable for about</p> <p>3 30 minutes, in my experience. So if you stopped</p> <p>4 for 30 seconds or a minute or two, just wouldn't</p> <p>5 matter. But, yeah, if you broke down and the</p> <p>6 concrete that you had just laid behind you</p> <p>7 solidified, then you have a transition problem,</p> <p>8 like it might be a little bit challenging to</p> <p>9 restart and have a nice smooth transition</p> <p>10 because your old cement has set up. If it's</p> <p>11 sitting there too long, I mean, I'm going to</p> <p>12 imagine that you have to sort of back up, cut it</p> <p>13 off, and get a nice edge and start relaying the</p> <p>14 fresh concrete, if you're broken down so long.</p> <p>15 Q. And you would say longer than</p> <p>16 30 minutes would be a problem?</p> <p>17 MR. HIGH: Object to form.</p> <p>18 THE WITNESS: Yeah, depends on</p> <p>19 the concrete that they're using. You can</p> <p>20 actually have concrete set up in different</p> <p>21 lengths of time. You can have quick-set</p> <p>22 concrete you may have seen at Home Depot, so it</p> <p>23 will start to set up -- what I mean by set up,</p> <p>24 to clarify that, is it starts to get hard. If</p> <p>25 it sets up too much you can't mold it anymore,</p> | <p style="text-align: right;">Page 32</p> <p>1 hydraulics.</p> <p>2 Q. And the cylinders on the leg that</p> <p>3 contact the ground necessarily, right, you have</p> <p>4 a jacking column, the slipform pavers have</p> <p>5 jacking columns; that's right?</p> <p>6 A. Yeah, generally they have jacking</p> <p>7 columns, meaning the part that allows them to</p> <p>8 raise and lower their frame and the slipform</p> <p>9 that's attached to the frame.</p> <p>10 Q. Okay. Can you describe for me the</p> <p>11 components of the jacking column?</p> <p>12 A. Certainly. Generic jacking column is</p> <p>13 a telescoping structure. So one part of it</p> <p>14 would be generally some kind of tube, circular</p> <p>15 or rectangular or square. And that would be the</p> <p>16 top part. And then there would be an inside</p> <p>17 tube that would extend out, and that extension</p> <p>18 out, if it's pushing against the ground, would</p> <p>19 cause the frame or the top part of the jacking</p> <p>20 column to go up.</p> <p>21 Now, inside there is going to be a</p> <p>22 hydraulic cylinder that's causing that</p> <p>23 telescoping action. So you've got to have --</p> <p>24 you pretty much have to have the three of those</p> <p>25 components, sort of an outer cylinder structure,</p>                                 |

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| <p style="text-align: right;">Page 33</p> <p>1 an inner one, and some kind of power source<br/>2 inside of there which would often be a hydraulic<br/>3 cylinder.<br/>4 Q. Now, you gave two descriptions of the<br/>5 shape of the cylinder, being either square or<br/>6 round. Is there an advantage or disadvantage to<br/>7 using either of those?<br/>8 MR. HIGH: Object to the form.<br/>9 THE WITNESS: I think there's<br/>10 trade-offs, I think is what you're asking about<br/>11 certainly. Yeah, there's reasons why you would<br/>12 choose circles and why you would choose squares.<br/>13 BY MR. LAYDEN:<br/>14 Q. Why would you choose a square?<br/>15 A. Well, if you have a telescoping<br/>16 structure that's square, then it has a natural<br/>17 resistance to twisting. So when you extend it<br/>18 out the inner one won't twist relative to the<br/>19 outside one very much. There's always a little<br/>20 bit of play in all these things, but you can put<br/>21 shims and bearings in there, and so that<br/>22 structure naturally gives you a lot of<br/>23 resistance to twisting, having the two parts<br/>24 twist relative to each other.<br/>25 Q. Why would someone choose a round</p> | <p style="text-align: right;">Page 35</p> <p>1 column, what forces would you apply?<br/>2 MR. HIGH: Objection. Form.<br/>3 THE WITNESS: Well, if I want to<br/>4 rotate something, we have to generate forces<br/>5 that we'd normally call torques. That's sort of<br/>6 a specialized name for forces that cause things<br/>7 to twist. So whatever object I want to rotate,<br/>8 Newton tells me I have to apply a torque to it.<br/>9 BY MR. LAYDEN:<br/>10 Q. How is torque applied to an object?<br/>11 A. Well, a torque is a force times a<br/>12 distance. So I have to get some distance away<br/>13 from the axis of rotation and then I have to<br/>14 apply a force there. And the combination of<br/>15 that force times the distance gives us a moment<br/>16 or gives us a torque. And then that's how we<br/>17 start to twist things.<br/>18 Q. So the further you're away from the<br/>19 axis of rotation, the more torque you're able to<br/>20 generate?<br/>21 MR. HIGH: Objection. Form.<br/>22 THE WITNESS: Generally speaking,<br/>23 if you're putting the same amount of force in.<br/>24 If I put one pound of force in and my lever<br/>25 arm -- that's what we normally call it -- the</p>            |
| <p style="text-align: right;">Page 34</p> <p>1 configuration for the cylinder?<br/>2 A. I would choose round because it would<br/>3 be cheaper to make and easier to do, like round<br/>4 things are just easier. It's also a little bit<br/>5 smaller, you'd use less material. Like for the<br/>6 same sort of strength, you would use less<br/>7 material with a circular cross section.<br/>8 Q. You said the square had a resistance<br/>9 to twisting, the square-shaped cylinder?<br/>10 A. Yes.<br/>11 Q. Is that opposed to the circular-shaped<br/>12 cylinder?<br/>13 A. That's correct. If you just put one<br/>14 smaller cylinder inside another, there's not a<br/>15 lot of resistance to twisting; there will be<br/>16 frictional. So those kinds of structures you<br/>17 would put a keyway in there.<br/>18 Q. And that keyway would help prevent<br/>19 twisting of the inner cylinder?<br/>20 A. That's right. Well, you need a key<br/>21 and a keyway. A key is something that kind of<br/>22 sticks out, and a keyway would be the slot that<br/>23 it slides up and down in.<br/>24 Q. And if you wanted to rotate, let's<br/>25 say, either the crawler track or the jacking</p>                     | <p style="text-align: right;">Page 36</p> <p>1 lever arm is one foot, that gives me one foot<br/>2 pound. If I move out a foot further, then that<br/>3 same force gives me double the torque. That's<br/>4 why you see plumbers with long wrenches. The<br/>5 longer arm on the wrench, that allows them to<br/>6 apply more torque and break loose like rusted<br/>7 old pipes.<br/>8 BY MR. LAYDEN:<br/>9 Q. Using your example, would the length<br/>10 of the wrench that the plumber is using, is it<br/>11 because it allows them to gain more leverage?<br/>12 A. That's another way to say it, yeah,<br/>13 lever or leverage. So it is a lever and it<br/>14 helps them get more leverage for the same amount<br/>15 of input force.<br/>16 Q. So to input torque then, do you have<br/>17 to increase your leverage?<br/>18 MR. HIGH: Objection. Form.<br/>19 THE WITNESS: Well, you wouldn't<br/>20 always use that term. That's one way of<br/>21 generating torque is to have a lever arm. There<br/>22 are other ways with gears, for example. We<br/>23 wouldn't really call that leverage, we'd call<br/>24 that a mechanical advantage or a gear ratio or<br/>25 something like that. So there are other ways of</p> |

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| <p style="text-align: right;">Page 37</p> <p>1 amplifying forces that aren't just a lever.<br/>2 BY MR. LAYDEN:<br/>3 Q. When designing a device to apply<br/>4 torque -- strike that.<br/>5 With torque then, if you're using what<br/>6 you described as a mechanical advantage, how<br/>7 would you calculate how much torque you're able<br/>8 to gain from that mechanical advantage?<br/>9 A. It's pretty simple. You have a device<br/>10 and it's got a mechanical advantage which is a<br/>11 number, which is how much it multiplies the<br/>12 force. And so you just take that number that's<br/>13 associated with your force amplifier and you<br/>14 multiply it by how much force you're putting in.<br/>15 So force times a multiplier gets you the torque<br/>16 that that device will generate.<br/>17 Q. Going back to your work in the private<br/>18 sector and then at MIT or any of your -- not<br/>19 MIT. Sorry. Strike that.<br/>20 Going back to your work in the private<br/>21 sector and your time teaching in college, what's<br/>22 the largest machine you've helped design?<br/>23 A. I'm thinking the largest one may be a<br/>24 huge crane over in Korea, and I think it was<br/>25 rated for 100 tons. So that means how much it</p>                      | <p style="text-align: right;">Page 39</p> <p>1 mechanical parts, like bearings and support<br/>2 structures and mounting brackets. So those are<br/>3 some examples.<br/>4 Q. Have you ever worked on a design,<br/>5 either starting from new, or improving the<br/>6 steering mechanism of a machine?<br/>7 A. Yes. Not like a steering wheel, but<br/>8 the cranes that I've been talking about, they're<br/>9 driven by -- the steering of them is through<br/>10 buttons and joysticks. And so that's a part of<br/>11 what my company does, or companies did. In<br/>12 fact, I've developed steering systems for cranes<br/>13 that actually operate from an iPhone. We wanted<br/>14 to get rid of the clunky buttons and joysticks,<br/>15 so we actually have an iPhone app, and you can<br/>16 take out your iPhone and you can start it up and<br/>17 you can move around your iPhone and touch its<br/>18 interface, and that's the steering system for a<br/>19 crane.<br/>20 Q. Did you ever work on any of the<br/>21 mechanical components used in steering the<br/>22 crane?<br/>23 A. Well, the joysticks and the button<br/>24 pushes, those are mechanical devices.<br/>25 Q. What about any of the components that</p>                    |
| <p style="text-align: right;">Page 38</p> <p>1 could lift. And it was in a shipyard. So I<br/>2 went over there and helped, again, design part<br/>3 of it, the control system. That's the biggest<br/>4 one that comes to mind. I've actually been on<br/>5 bigger cranes at Boeing, I did a lot of work for<br/>6 Boeing, and I've operated the Boeing cranes,<br/>7 which are even bigger than that because they're<br/>8 moving around fuselages. But that's the biggest<br/>9 one where I would say something I designed, like<br/>10 a component I designed went into the machine and<br/>11 the machine is operating with something I<br/>12 designed and built.<br/>13 Q. Have you ever worked on designs that<br/>14 didn't implement the control system?<br/>15 A. Yes.<br/>16 Q. What were those designs?<br/>17 A. Well, like I said, going back to<br/>18 things we've talked about today, for example,<br/>19 when I worked at Apple, I physically designed<br/>20 the monitor, the speaker enclosure, the mounting<br/>21 for the microphones, the base, the electrical<br/>22 connector. So I was involved in just design of<br/>23 the mechanical parts of the monitor, nothing to<br/>24 do with the electrical control system.<br/>25 At Disney World I designed a lot of</p> | <p style="text-align: right;">Page 40</p> <p>1 are in contact with the ground?<br/>2 A. Are we just talking about cranes?<br/>3 Q. Anywhere across your work.<br/>4 A. Oh, okay. Yeah, that's an interesting<br/>5 question the way you've posed it. For example,<br/>6 when I worked on Pirates of the Caribbean,<br/>7 that's a boat for the most part, it's a vehicle<br/>8 that's carrying a dozen people. But it actually<br/>9 gets elevated up through the ride by roller<br/>10 bearings, and it also comes down roller<br/>11 bearings, and that's exactly what I designed was<br/>12 the rollers that propelled the boats of Pirates<br/>13 of the Caribbean. So that's one example. I<br/>14 would call it the ground, right, that's how the<br/>15 vehicle is being propelled along.<br/>16 Q. But the boat itself is not actually<br/>17 steering itself; is that accurate?<br/>18 A. That's right. We designed the ride so<br/>19 it just bounces around. Like it can't -- it<br/>20 bounces from wall to wall and goes up and down<br/>21 and you can't twist it around. The passageway<br/>22 is too narrow.<br/>23 Q. Have you ever done any work in the<br/>24 past on a jacking column?<br/>25 A. You know, I've used them a lot, and my</p> |

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| <p style="text-align: right;">Page 41</p> <p>1 control systems have been applied to machines<br/>2 that essentially have jacking columns, or<br/>3 something very much like a jacking column, but I<br/>4 didn't design -- can't think of where I designed<br/>5 the physical components. I would generally be<br/>6 designing the control system that operates a<br/>7 jacking column.<br/>8 Q. Have you ever done any work on the<br/>9 design or upgrade of the crawler track?<br/>10 A. No.<br/>11 Q. Is it fair to assume, then, you've<br/>12 never done any work designing or updating a<br/>13 jacking column connected to a crawler track?<br/>14 A. That's correct, I haven't done that,<br/>15 either.<br/>16 Q. And other than your time with your<br/>17 family's company, do you have any other<br/>18 experience in the concrete paving industry?<br/>19 A. Well, yeah, I worked at Riverside<br/>20 Cement Company. That's the other one we talked<br/>21 about. I would say professionally where I got a<br/>22 paycheck, that's most of it. I mean, I've done<br/>23 a lot of concrete work on my house and other<br/>24 projects throughout my life, but those are where<br/>25 I got paychecks for doing that kind of work.</p> | <p style="text-align: right;">Page 43</p> <p>1 Q. How much did that box weigh?<br/>2 A. I never weighed it. It's definitely a<br/>3 couple thousand pounds.<br/>4 Q. And did it have independent tracks or<br/>5 wheels, or was it just placed on the ground and<br/>6 dragged behind the dump truck?<br/>7 A. It basically is placed on the ground<br/>8 and you drag it. It's the shape that you want<br/>9 it to be in. So it doesn't have wheels or<br/>10 anything. It has adjustability. You have to<br/>11 change the height of how much -- you know, you<br/>12 can change the height, like I said, between two<br/>13 and four inches, but you can also put a slope on<br/>14 it. So one side you might set for two inches<br/>15 and one you might set for four. So that's the<br/>16 kind of like knobs and adjustments that you<br/>17 would do when you're riding in the back of it.<br/>18 And you can change the width of it. So it has<br/>19 some width adjustability like the slipform<br/>20 pavers that we're talking about here.<br/>21 Q. How would you change the width of the<br/>22 box used?<br/>23 A. It has a telescoping structure. So<br/>24 you can imagine that you have a box and if it's<br/>25 a rectangle, you can go to the longer side,</p> |
| <p style="text-align: right;">Page 42</p> <p>1 Q. I believe you said you had never<br/>2 operated a slipform paver; is that accurate?<br/>3 A. That's correct.<br/>4 Q. And other than the spreader plow that<br/>5 you used with your family's construction<br/>6 company, what's the next closest machine that<br/>7 you've operated that would be comparable to a<br/>8 slipform paver?<br/>9 A. That would be -- I mean, like I said,<br/>10 that's very similar to a slipform paver, so<br/>11 that's definitely the closest thing that I've<br/>12 personally operated.<br/>13 Q. And the spreader you were describing,<br/>14 I believe it was a box spreader, that's pulled<br/>15 behind a dump truck?<br/>16 A. Yeah. We just call it the box. You<br/>17 use simple names for this. But it's a form, so<br/>18 it has a form to it, and you dump material in<br/>19 front of it. Like the slipform pavers, you dump<br/>20 moist or workable concrete in front of. In<br/>21 these ones you dump hot asphalt, like 300 degree<br/>22 asphalt, so it's multiple, and then you drive<br/>23 forward and you compress it and it takes on the<br/>24 shape of the box that you're dragging behind<br/>25 you.</p>                            | <p style="text-align: right;">Page 44</p> <p>1 generally, and you can essentially turn a<br/>2 ratchet and it telescopes out from -- I think<br/>3 the smallest one was probably six feet wide.<br/>4 Our box did something like six to ten feet, and<br/>5 you would telescope it out and lock it in and<br/>6 say this is the width of this driveway or this<br/>7 road that we want to make.<br/>8 Q. Have you ever used any sort of paving<br/>9 or spreading machine that's wider than 10 feet?<br/>10 A. That's the only one I used. At this<br/>11 point I don't remember exactly how wide I went.<br/>12 But it's the width of a lane of road. That's<br/>13 what the machine does.<br/>14 MR. LAYDEN: I'm putting into the<br/>15 chat what will be marked as Exhibit 2. And<br/>16 Exhibit 2 is a copy of your declaration.<br/>17 (Exhibit 2 marked for identification.)<br/>18 THE WITNESS: Okay, I have that<br/>19 now. I also have a physical copy of that next<br/>20 to me.<br/>21 MR. LAYDEN: Yeah, you can use<br/>22 either.<br/>23 THE WITNESS: If you see me<br/>24 turning pages, it's because it's sitting next to<br/>25 me here.</p>                                                                                                                    |

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| <p>1 MR. LAYDEN: That's fair. Page 45</p> <p>2 BY MR. LAYDEN:</p> <p>3 Q. What other documents do you have there</p> <p>4 next to you?</p> <p>5 A. I have this binder, I'll just show</p> <p>6 you, and it has my declaration and my CV -- I</p> <p>7 think it's the exhibits essentially that go</p> <p>8 along with this. There's like -- they have</p> <p>9 little tabs on them and I think the numbers</p> <p>10 associated with, like, Exhibit 1006 or something</p> <p>11 like that.</p> <p>12 Q. Do you have anything else before you?</p> <p>13 A. No, that's it.</p> <p>14 Q. Do you have any other windows open on</p> <p>15 your screen?</p> <p>16 A. Well, I have the Zoom and I have the</p> <p>17 PDF of what you just sent me. Those are the</p> <p>18 only two windows.</p> <p>19 MR. LAYDEN: We've been going</p> <p>20 about an hour. Let's take a five-minute break.</p> <p>21 (11:25 - Recess taken.)</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>                      | <p>1 discussion of CIII. Can you tell me what CIII Page 47</p> <p>2 is?</p> <p>3 A. CIII is a manual, it's the Commander</p> <p>4 III New Generation Trimmer/Paver</p> <p>5 Operator/Service Manual G21 Controls.</p> <p>6 Q. And have you ever physically seen a</p> <p>7 Commander III machine?</p> <p>8 A. Not in person. I've seen like videos</p> <p>9 of it.</p> <p>10 Q. If I could direct you to Paragraph 41,</p> <p>11 beginning on Page 21 of your report?</p> <p>12 A. Okay.</p> <p>13 Q. In this paragraph you're discussing</p> <p>14 what you have labeled as a smart steer cylinder?</p> <p>15 A. Yes.</p> <p>16 Q. Can you describe for me the operation</p> <p>17 of the smart steer cylinder?</p> <p>18 A. Certainly. The cylinder is a</p> <p>19 hydraulic cylinder. So I don't know how much</p> <p>20 you want me to explain that. But basically a</p> <p>21 hydraulic cylinder has two hoses coming into it</p> <p>22 and you can force hydraulic fluid into either</p> <p>23 one of those and some other fluid comes out the</p> <p>24 other one, and basically that high pressure side</p> <p>25 causes an internal part of the cylinder to</p>                                                                                                                                                                                                           |
| <p>1 (At 11:34 a.m., with parties present Page 46</p> <p>2 as before, the following proceedings were had,</p> <p>3 to-wit:)</p> <p>4 BY MR. LAYDEN:</p> <p>5 Q. Dr. Singhose, in Exhibit 2, this is</p> <p>6 the copy of your declaration; is that correct?</p> <p>7 A. Yes. Exhibit 1002?</p> <p>8 Q. Exhibit 2 of this deposition,</p> <p>9 Exhibit 1002 of the --</p> <p>10 A. Okay, yeah. What you sent me says</p> <p>11 1002. That's what I'm looking at.</p> <p>12 Q. Yes. For purposes of this deposition,</p> <p>13 Exhibit 2?</p> <p>14 A. Okay.</p> <p>15 Q. And if you turn to Page 117 of your</p> <p>16 declaration.</p> <p>17 A. Okay.</p> <p>18 Q. Is that your signature on the bottom</p> <p>19 of the page?</p> <p>20 A. Yes, it is.</p> <p>21 Q. And if I could direct you to</p> <p>22 Paragraph 38, beginning on Page 16. Let me know</p> <p>23 when you're there.</p> <p>24 A. Page 16, Paragraph 38, I'm there.</p> <p>25 Q. And so this paragraph begins your</p> | <p>1 extend outward. So it's an unequal pressure and Page 48</p> <p>2 it causes the cylinder to extend out, or if you</p> <p>3 put the high pressure oil into the other side,</p> <p>4 it causes it to retract. So that's the</p> <p>5 fundamental operation of a hydraulic cylinder,</p> <p>6 it comes in and out.</p> <p>7 A smart cylinder has some sort of a</p> <p>8 sensor associated with it that measures how much</p> <p>9 the cylinder is extended, and sends that</p> <p>10 information back to a computer so the computer</p> <p>11 knows the state, or you can think of it as the</p> <p>12 length of the extension of the cylinder.</p> <p>13 Q. And on CIII, where is the smart steer</p> <p>14 cylinder attached to?</p> <p>15 A. Well, they have a smart steer cylinder</p> <p>16 on their swing leg, and that smart cylinder is</p> <p>17 attached to basically a bracket that extends out</p> <p>18 from the outside of the jacking column, and</p> <p>19 that's sort of the base end. And the other end</p> <p>20 attaches to a linkage, and that linkage is at</p> <p>21 the end of an internal cylinder. That's able to</p> <p>22 rotate relative to the outer tube. So as that</p> <p>23 smart cylinder extends and retracts, it will</p> <p>24 pull on that linkage and create a torque, like</p> <p>25 we talked about before, and that is really the</p> |

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| <p style="text-align: right;">Page 49</p> <p>1 lever arm; right. So the smart cylinder is the<br/>2 thing creating the force, that linkage is the<br/>3 lever arm. Those two working together create a<br/>4 torque that causes the inside to twist, to<br/>5 rotate.<br/>6 Q. According to your statement beginning<br/>7 at the bottom of Page 21, and continuing on to<br/>8 the top of Page 22: When the smart steering<br/>9 cylinder is actuated, it's rotating both the<br/>10 guide tubes and the crawler track in unison. Do<br/>11 you see that statement, Doctor?<br/>12 A. Yes, I do.<br/>13 Q. How would it rotate both the guide<br/>14 tubes and the crawler track?<br/>15 A. Well, it's physically connected to the<br/>16 upper guide tube -- just, I guess, to lay the<br/>17 ground work, inside the jacking column are two<br/>18 tubes. The upper one kind of stays at the same<br/>19 height but there's one inside that telescopes<br/>20 out. And because they have made these<br/>21 structures square or rectangular, when this<br/>22 mechanism twists the upper or outer guide tube,<br/>23 the inside one has no choice but to go along<br/>24 with it, it's being twisted as well through the<br/>25 square shape or the rectangular shape that we</p>                                                          | <p style="text-align: right;">Page 51</p> <p>1 exactly square.<br/>2 Q. Fair enough. Going back to our<br/>3 previous discussion about either the square or<br/>4 the round jacking columns, would this indicate<br/>5 an effort by CIII to eliminate rotation within<br/>6 the crawler track and the jacking column -- or I<br/>7 should say minimize rotation between the roller<br/>8 track and the jacking column?<br/>9 A. Yes. I think it's trying to minimize<br/>10 relative rotation. The flip side of that is<br/>11 it's just trying to get the crawler track to<br/>12 rotate along with the guide tubes.<br/>13 Q. Would there be any other advantage<br/>14 other than minimizing rotation and having the<br/>15 jacking column and the crawler track rotate in<br/>16 unison?<br/>17 A. Can you repeat the question?<br/>18 Q. Would there be any other advantage to<br/>19 having the jacking column and crawler track<br/>20 rotate in unison for CIII?<br/>21 MR. HIGH: Objection. Form.<br/>22 THE WITNESS: You're saying<br/>23 another advantage. What advantage were we<br/>24 talking about before?<br/>25 BY MR. LAYDEN:</p>                                               |
| <p style="text-align: right;">Page 50</p> <p>1 talked about. And then at the bottom of that<br/>2 inner guide tube or lower guide tube, it's<br/>3 directly connected -- basically directly<br/>4 connected to the crawler track, and so the<br/>5 crawler track has to go along with it, too. The<br/>6 crawler track is having a torque applied to it<br/>7 from the rotation as well.<br/>8 Q. What makes the crawler track and the<br/>9 lower guide tube directly connected?<br/>10 A. Well, there's basically what we call a<br/>11 yoke. So at the bottom of the lower guide tube,<br/>12 this C-shaped structure, a yoke, is rigidly<br/>13 connected to the bottom. And then that yoke in<br/>14 turn is connected to the crawler. So because<br/>15 those are rigid connections, they pretty much<br/>16 turn together. There will be some deflexion.<br/>17 But the crawler track is pretty much going to go<br/>18 along with the lower guide tube because the yoke<br/>19 is forcing it to go along with it.<br/>20 Q. And you mentioned that CIII has a<br/>21 square-shaped inner tube. Is that accurate?<br/>22 A. I think it's square or rectangular.<br/>23 It's pretty close to square, but you know, a<br/>24 square is a special kind of rectangle so I think<br/>25 it's safe to call it a rectangle if they're not</p> | <p style="text-align: right;">Page 52</p> <p>1 Q. Well, previously we were talking about<br/>2 the shape of the guide tube itself.<br/>3 A. Okay. So there's an advantage to that<br/>4 shape -- I see what you're saying. There's an<br/>5 advantage to that shape because when the outer<br/>6 one turns, the inner one has to go along with<br/>7 it. There are some other advantages to that<br/>8 shape. For example, square surfaces are very<br/>9 easy to put shims up in there or bearings up in<br/>10 there so that you can get rid of backlash and<br/>11 stuff like that. So it's an easy structure to<br/>12 adjust and get rid of backlash.<br/>13 The circle ones that we talked about<br/>14 before would be tougher to do that. You could<br/>15 do it but it's a little bit harder.<br/>16 Q. Does CIII have any other mechanism<br/>17 within its crawler track that limits its<br/>18 rotational ability?<br/>19 MR. HIGH: Objection. Form.<br/>20 THE WITNESS: Limits its<br/>21 rotational ability, like relative to something,<br/>22 or --<br/>23 BY MR. LAYDEN:<br/>24 Q. Well, are there any pins, any other<br/>25 tie-downs, turnbuckles, anything of that nature</p> |

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| <p style="text-align: right;">Page 53</p> <p>1 that would be used to prevent the track from<br/>2 having any sort of undesired rotation to it.<br/>3 A. Yeah, I mean, in general, one of the<br/>4 main ways of doing that is to make these thick<br/>5 and strong. So if you look at it, you can see<br/>6 they're thick and strong. Because of that, when<br/>7 they hit little obstacles and stuff they tend<br/>8 not to respond much to those forces.<br/>9 But maybe what you're wanting to<br/>10 discuss, let me know, is that when you put this<br/>11 in a certain configuration there are additional<br/>12 pins that pin the structure and help hold it<br/>13 into position as well.<br/>14 Q. And what are those pins? Where would<br/>15 they be located?<br/>16 A. Those pins -- well, there's actually<br/>17 kind of two sets of these pins. One is out near<br/>18 the end where the swing arm connects to the<br/>19 jacking column. And so out there, they're<br/>20 basically pins. When you get it in the<br/>21 configuration you want, you can put a pin in and<br/>22 it will hold it pretty close to that position.<br/>23 There's a corresponding set of pins back near<br/>24 the frame where the swing arm itself can be put<br/>25 into position and pinned down to help hold its</p> | <p style="text-align: right;">Page 55</p> <p>1 operate the machine without putting the pins in.<br/>2 There appears to be no like electronic check on<br/>3 that. So you could operate it. They might tend<br/>4 to drift around a little bit, if you didn't<br/>5 apply those pins.<br/>6 Q. What do you mean by drift around a<br/>7 little bit?<br/>8 A. Well, as you drive forward there's<br/>9 going to be forces put on the machine. Any time<br/>10 you have forces, the machine is going to get<br/>11 pushed, and if those forces get large enough,<br/>12 they might push the arm sort of out of position.<br/>13 But you could certainly drive it without the<br/>14 pins. It just wouldn't drive as straight and<br/>15 reliably as if those pins were in there locking<br/>16 the structure and making it stiffer.<br/>17 Q. Would the steering cylinder be able to<br/>18 maintain the position of the track?<br/>19 MR. HIGH: Object to form.<br/>20 THE WITNESS: Certainly within<br/>21 certain ranges it would be able to do that<br/>22 because it's able to make some compensations. I<br/>23 didn't do the calculations about how far out of<br/>24 whack the swing arm could get and the steering<br/>25 structure could compensate for that. I didn't</p> |
| <p style="text-align: right;">Page 54</p> <p>1 position as well. Both of those angles will be<br/>2 effecting what you're asking me about, which is<br/>3 the rotation of the crawler track. The crawler<br/>4 track can be rotated through either one of those<br/>5 rotations.<br/>6 Q. I'm sorry, the crawler track can be<br/>7 rotated through either one of what rotations?<br/>8 A. So starting back at the frame of the<br/>9 machine, you have the swing arm. That swing<br/>10 arm, it's a swing arm, so you can swing it from<br/>11 left to right through an arc. If you held<br/>12 everything else the same and you just moved that<br/>13 swing arm, well the crawler track is going to<br/>14 rotate. It's going to move left and right and<br/>15 also rotate. So that's one way of changing the<br/>16 rotation of the crawler track.<br/>17 But once you've fixed that, then you<br/>18 can go out to the end of the swing arm that's<br/>19 near the jacking column and you can similarly<br/>20 rotate it out there and then pin that one down<br/>21 as well. Those are the two rotations we were<br/>22 talking about that could be pinned in place.<br/>23 Q. Are those pins in place while the<br/>24 machine is operational?<br/>25 A. I would think so. I mean, you could</p>             | <p style="text-align: right;">Page 56</p> <p>1 do that calculation.<br/>2 BY MR. LAYDEN:<br/>3 Q. What about the control over the<br/>4 crawler track itself, would the steering<br/>5 cylinder be able to maintain its position of the<br/>6 crawler track?<br/>7 MR. HIGH: Objection. Form.<br/>8 THE WITNESS: That's what I<br/>9 thought we were discussing. I'm sorry. So the<br/>10 steering mechanism that we talked about a little<br/>11 while ago, it can change the angle of the<br/>12 crawler track by extending and retracting. So<br/>13 to the extent that you're asking me the question<br/>14 can it control the angular position, that's what<br/>15 I was answering last question about yeah, it can<br/>16 control the angular position.<br/>17 But if the swing arm swings out say<br/>18 one foot, that steering mechanism can't, you<br/>19 know, push it back one foot. It can only<br/>20 control the rotational position, not the<br/>21 translational position.<br/>22 BY MR. LAYDEN:<br/>23 Q. If you could turn to Paragraph 48 on<br/>24 Page 27 of your declaration.<br/>25 A. Okay.</p>                                                                                                                                                          |

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| <p style="text-align: right;">Page 57</p> <p>1 Q. There you're talking about the turn<br/>2 buckles, the two turn buckles that are on each<br/>3 swing leg; right?<br/>4 A. Yes.<br/>5 Q. Now, those turn buckles are in<br/>6 addition to the pins used on the swing leg and<br/>7 the crawler track?<br/>8 MR. HIGH: Objection. Form.<br/>9 THE WITNESS: Those -- I think<br/>10 the ones we're talking about there, those turn<br/>11 buckles are used to hold the swing leg in place.<br/>12 So they don't have a control over the rotation<br/>13 of the crawler track. So, no, they can't do<br/>14 exactly what those pins do, as far as securing<br/>15 the end rotation. They're just controlling the<br/>16 rotation of the arm, not the stuff past the end<br/>17 of the arm.<br/>18 BY MR. LAYDEN:<br/>19 Q. And the rotation of the arm would<br/>20 affect the angle of the crawler track, is --<br/>21 A. Yes, it very well could, and that's<br/>22 why you want to lock it into place.<br/>23 Q. Okay. Is it a fair assessment, then,<br/>24 based on the design, the square design or<br/>25 rectangular design of the jacking column, the</p>                                                                 | <p style="text-align: right;">Page 59</p> <p>1 Q. Correct. So let's say you wanted to<br/>2 operate CIII but you took off the turn buckles,<br/>3 you removed the pins, and you try to go through<br/>4 paving a job. What impact would that have on<br/>5 the concrete that you're trying to mold?<br/>6 MR. HIGH: Objection. Form.<br/>7 THE WITNESS: It depends on the<br/>8 operating conditions. It could actually have<br/>9 potentially no effect for a little while, you<br/>10 just drive forward and the slipform would go<br/>11 forward in the way that you want and you'd be<br/>12 making concrete. But if they swing out a lot,<br/>13 then the machine might start heading a little<br/>14 bit in the wrong direction, the crawler tracks<br/>15 might swing out and hit a curb that you don't<br/>16 want it to. So it really depends on the<br/>17 application. But the machine could work for a<br/>18 while just fine without that, but you would run<br/>19 into conditions where it wouldn't be working<br/>20 that well.<br/>21 BY MR. LAYDEN:<br/>22 Q. If you could turn to Paragraph 42 of<br/>23 Page 22 of your report. Here you're talking<br/>24 about the steering system; is that accurate?<br/>25 A. Yes.</p> |
| <p style="text-align: right;">Page 58</p> <p>1 pins, as well as the turn buckles, to say that<br/>2 CIII puts a high priority on limiting the<br/>3 rotational movement of the swing arm and the<br/>4 crawler track?<br/>5 MR. HIGH: Objection. Form.<br/>6 THE WITNESS: I'm not exactly --<br/>7 I don't exactly know what you mean by high<br/>8 priority, but certainly it's designed to hold<br/>9 those swing arms in place once you've swung them<br/>10 into the place that you want. You're setting up<br/>11 this machine and it's going to experience a lot<br/>12 of forces, so once you get it into the<br/>13 configuration, they've designed it to lock it<br/>14 down and that's what those mechanisms are doing.<br/>15 Q. If those mechanisms weren't able to<br/>16 lock down the swing leg, how would that impact<br/>17 the laying of the concrete as the paver moves<br/>18 forward?<br/>19 MR. HIGH: Objection. Form.<br/>20 THE WITNESS: Just to clarify,<br/>21 not able to lock down, I mean, you're not<br/>22 meaning that they break and fall off; you just<br/>23 mean that they allow the swing leg to swing back<br/>24 and forth a few inches or something like that?<br/>25 BY MR. LAYDEN:</p> | <p style="text-align: right;">Page 60</p> <p>1 Q. And you reference a servo valve and a<br/>2 control loop on an S2X controller. Do you see<br/>3 that?<br/>4 A. Yes.<br/>5 Q. Can you describe for me what a servo<br/>6 valve is?<br/>7 A. A servo is a valve -- I guess I'll<br/>8 start there. A valve is something you can open<br/>9 and close, and the valves we're talking about<br/>10 here are hydraulic valves. So they'll open and<br/>11 they'll allow hydraulic oil, hydraulic fluid to<br/>12 go through them, and then you close it and they<br/>13 can't go through.<br/>14 And so this is -- you would have a<br/>15 valve to control the extension and retraction of<br/>16 the smart steer cylinder, where you'd open one<br/>17 valve and the fluid would flow in the front<br/>18 side, or you'd open a different valve and it<br/>19 would flow in the back side. Opening and<br/>20 closing those valves would control the<br/>21 direction.<br/>22 Now, a servo valve is a special kind<br/>23 of valve that allows you to accurately control<br/>24 it. So you can open it just a little bit and<br/>25 have it go really slow rather than just open the</p>                                                         |

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| <p style="text-align: right;">Page 61</p> <p>1 valve and it comes gushing through.</p> <p>2 So imagine your sink at home, your kid</p> <p>3 might go in there and just lift the handle all</p> <p>4 the way up and all the water comes gushing out.</p> <p>5 Or an adult would probably go in and just lift</p> <p>6 it up a little bit to get the amount of water</p> <p>7 coming out that they want. That's a servo</p> <p>8 valve. It lets you have control over the amount</p> <p>9 of flow per time.</p> <p>10 Q. Then that opening sentence in</p> <p>11 Paragraph 42, you also reference a sensor. What</p> <p>12 are the sensors?</p> <p>13 A. Just so you know, when you turn away,</p> <p>14 I can't really hear you.</p> <p>15 Q. Oh, I'm sorry. On Paragraph 42, the</p> <p>16 opening sentence, you also reference a sensor?</p> <p>17 A. Yes.</p> <p>18 Q. What are the sensors CIII uses for</p> <p>19 steering?</p> <p>20 A. Well, a sensor -- actually I mentioned</p> <p>21 this before, is that this is a smart cylinder so</p> <p>22 it has a sensor that can tell how far it's</p> <p>23 extended. So if it extends out three inches, it</p> <p>24 sends a signal back to the S2X controller, and</p> <p>25 that controller, you know, uses that information</p> | <p style="text-align: right;">Page 63</p> <p>1 particular if you could turn to Page 407.</p> <p>2 A. It's not going to give me 407 because</p> <p>3 it's Part 2. So I only have 218.</p> <p>4 Q. 173 of the PDF.</p> <p>5 A. Okay. So that's also, just to</p> <p>6 verify -- so it does say Page 407 at the bottom</p> <p>7 of that, and it's also 8-105.</p> <p>8 Q. Correct.</p> <p>9 A. Okay. Yeah, I'm at the right spot</p> <p>10 then.</p> <p>11 Q. In this part of the CIII manual, it's</p> <p>12 discussing its network steer electrical. Do you</p> <p>13 see that at the top?</p> <p>14 A. I do.</p> <p>15 Q. And in that first sentence it talks</p> <p>16 about the control systems that are responsible</p> <p>17 for maintaining the distance between the</p> <p>18 finished product and the guideline.</p> <p>19 A. Yes.</p> <p>20 Q. Can you tell me what the guideline is?</p> <p>21 A. Sure. The guideline is one way of</p> <p>22 driving this machine. I mean, you can just</p> <p>23 drive it around like a car, I suppose, if you</p> <p>24 wanted to. But when you're on a large</p> <p>25 construction site, you will go out and you'll</p>                                                                                                                                                                                                                                                  |
| <p style="text-align: right;">Page 62</p> <p>1 to decide what it wants to do next.</p> <p>2 Q. And the feedback pot that you</p> <p>3 reference in Paragraph 42, is that used to</p> <p>4 determine the location of the crawler track?</p> <p>5 A. Yes, it is. It's basically a way of</p> <p>6 setting a desired position. So it's part of the</p> <p>7 feedback controller. So you know where you're</p> <p>8 at, but you also need to know where you want to</p> <p>9 be, and that's helping you decide where -- what</p> <p>10 angle you want the crawler track to be at.</p> <p>11 MR. LAYDEN: If we can mark for</p> <p>12 Exhibit Number 3, as Exhibit Number 3, a CIII</p> <p>13 reference, Exhibit 1005 in this action,</p> <p>14 previously uploaded it to the chat. Two large</p> <p>15 files I've loaded into the chat.</p> <p>16 (Exhibit 3 marked for identification.)</p> <p>17 COURT REPORTER: (Requests</p> <p>18 clarification.)</p> <p>19 MR. LAYDEN: Oh, okay, I'll</p> <p>20 re-upload it. Should be in there now.</p> <p>21 COURT REPORTER: It is.</p> <p>22 THE WITNESS: So I have those, I</p> <p>23 have Part 1 and Part 2.</p> <p>24 BY MR. LAYDEN:</p> <p>25 Q. Let's start with Part 2. In</p>                                                            | <p style="text-align: right;">Page 64</p> <p>1 prep the ground surface and you'll mark where</p> <p>2 you want the road to be. You know, you've</p> <p>3 presumably dug up the old road or something like</p> <p>4 that, and you've got a survey and you mark where</p> <p>5 this road needs to go.</p> <p>6 Generally off to the side of that a</p> <p>7 little bit you would put this guideline, like a</p> <p>8 wire, and you can say this wire is parallel to</p> <p>9 where I want the edge of the road to be, and you</p> <p>10 essentially stake it along there and that guides</p> <p>11 the machine. And how that guides the machine is</p> <p>12 that the machine has a sensor arm that kind of</p> <p>13 sticks out there and touches the guidewire. And</p> <p>14 it drives along, and as long as it's touching</p> <p>15 the wire just a little bit, the machine says</p> <p>16 this must be where I want to be. But if it</p> <p>17 starts to turn left, the machine, that wire will</p> <p>18 trigger the arm and say, hey, you shouldn't be</p> <p>19 turning left, come back towards me. So that's</p> <p>20 how that wire guides the machine, it gives the</p> <p>21 machine feedback on its distance, its location</p> <p>22 laterally.</p> <p>23 Q. So the steering of CIII is determined</p> <p>24 based off of a signal to a controller</p> <p>25 representing the machine's location to the</p> |

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| <p>1 guideline?<br/>2 MR. HIGH: Objection. Form.<br/>3 THE WITNESS: That is one of the<br/>4 ways this machine operates. That's how you set<br/>5 it up, in one of these modes, is that you can<br/>6 have it try to follow that guideline as it<br/>7 drives forward laying this concrete for you.<br/>8 BY MR. LAYDEN:<br/>9 Q. And using this S2X controller, are you<br/>10 capable of controlling all the tracks on the<br/>11 machine?<br/>12 A. Yes, with the caveat is that there's<br/>13 more than one S2X controller. There is a<br/>14 controller associated with each of these swing<br/>15 legs and crawlers that you can control. And<br/>16 each one of those are little controllers that<br/>17 are doing the best job they can to hold that<br/>18 particular controller at the angle that a higher<br/>19 level controller is telling it to do.<br/>20 So there's a higher level of<br/>21 controller that's monitoring all four of these<br/>22 and sending down signals to each of these lower<br/>23 level controllers saying this is your angle,<br/>24 stick to this, buddy. So that's what they do.<br/>25 Q. Looking at Page 407, the third</p>                                                                                                                      | <p>Page 65</p> <p>1 drive one side of it and you'll be holding the<br/>2 line that you want.<br/>3 Q. And how much steering does this S2X<br/>4 controller and its configuration allow for?<br/>5 A. Well, I think it allows enough to keep<br/>6 it going the direction that you want. If you're<br/>7 asking the question, what is the amount of<br/>8 angular change it can make, I don't recall that<br/>9 off the top of my head. It's dependent on the<br/>10 stroke of that cylinder. Basically if you<br/>11 extend that cylinder as far as you can, that's<br/>12 as much as you can turn. And quite frankly it<br/>13 depends on how they've set it up that day.<br/>14 Q. Would it allow for turning in a<br/>15 90-degree opposite direction of travel?<br/>16 A. That I'm not sure. I mean I didn't<br/>17 look for that particular number, sorry. It can<br/>18 turn a lot, but whether it can -- you're saying<br/>19 if it's going straight ahead can it then retract<br/>20 the cylinder all the way and pull it 90 degrees.<br/>21 That I'm not sure of, that it can go exactly<br/>22 that far. I mean, it could, this kind of<br/>23 structure could do that, depending on the length<br/>24 of the cylinder stroke and the kind of mechanism<br/>25 that you're attaching it with.</p> |
| <p>1 sentence in that first paragraph where it says:<br/>2 The side of the machine controlled by the steer<br/>3 sensors is determined by which side the sensors<br/>4 are plugged into and the set-up parameters<br/>5 determined by the machine's operator.<br/>6 Do you see that sentence?<br/>7 A. Yes.<br/>8 Q. Does that mean only one side of the<br/>9 machine is steered using these sensors?<br/>10 A. I don't think so. The whole machine<br/>11 is steered by, what that's indicating is you<br/>12 could put this guide wire on the left side or on<br/>13 the right side. You know, in construction sites<br/>14 sometimes you can't put it on the right because<br/>15 you're going to run into a bridge or a tree or<br/>16 whatever. So you may want to set up this pass<br/>17 with your guideline on the right sometimes and<br/>18 sometimes on the left. So I told you it has a<br/>19 sensor that sticks out to the side and touches<br/>20 the wire. You would -- you know, you have to<br/>21 put that sensor either on the right or the left,<br/>22 and it would -- the machine basically just<br/>23 follows one side, and if it's following one<br/>24 side, you know, the machine is real rigid so the<br/>25 other side is coming along. So you just need to</p> | <p>Page 66</p> <p>1 Q. Are you aware of how far CIII allowed<br/>2 it to operate or to turn while the machine is<br/>3 actually operational and moving forward?<br/>4 A. That's what I'm saying, I don't recall<br/>5 that number or I'm not even sure I exactly<br/>6 looked for it.<br/>7 Q. If you'd turn to Page 408. In that<br/>8 first column, it's talking about the operation<br/>9 of the S2X controller with the steer sensor. If<br/>10 you go towards the bottom, it's discussing<br/>11 examples showing where the turns required are no<br/>12 more than a couple of inches. Do you see that?<br/>13 A. Yeah, I see it. It's essentially<br/>14 working through an example and it says let's<br/>15 consider a case where the crawler track is<br/>16 turned like one inch off. Let's talk about how<br/>17 this controller will get it back to the<br/>18 direction that we want. And it is using this<br/>19 sort of simple example of one inch.<br/>20 Q. Does that inform your opinion at all<br/>21 as to how much degree or steering degrees of<br/>22 freedom the operator has when using CIII?<br/>23 A. I didn't quite understand that<br/>24 question. The operator's degree of freedom?<br/>25 Q. When steering.</p> <p>Page 67</p> <p>Page 68</p>                                |

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| <p style="text-align: right;">Page 69</p> <p>1 A. When steering. So I mean, the machine<br/>2 can steer -- maybe I'm not understanding the<br/>3 question. There's four of these crawler tracks<br/>4 that you can use to steer, so the degrees of<br/>5 freedom in the steering is what we call four,<br/>6 you have four options how to adjust that. Is<br/>7 that the question you're asking?<br/>8 Q. Yes.<br/>9 A. Yeah, so it has four. I'm not sure<br/>10 that informed me of that. I knew that from<br/>11 other stuff like the description of how the<br/>12 machine is set up, it says that you can steer<br/>13 the four crawler tracks.<br/>14 Q. And the rotation of those crawler<br/>15 tracks would be limited to the length of the<br/>16 actuator used to rotate the crawler track?<br/>17 A. Yes. So the cylinders, if you look at<br/>18 the pictures in the manual -- and you can<br/>19 probably find out the numbers -- but the<br/>20 cylinders are a couple of feet, which generally<br/>21 means that the bar inside it, that comes in and<br/>22 out, could go more than a foot. And so those<br/>23 things can extend and retract probably one to<br/>24 two feet, and that one to two feet would be<br/>25 converted into an angular rotation via the</p>     | <p style="text-align: right;">Page 71</p> <p>1 But it could be on a slope, it could<br/>2 be up against some rocks, it could be gravel.<br/>3 So nobody knows the answer to your question<br/>4 until you know what it's pushing up against.<br/>5 But under normal operations the amount of force<br/>6 required is well within the capabilities of the<br/>7 machine.<br/>8 Q. What do you consider normal operating<br/>9 conditions?<br/>10 A. Well, you would be driving down a<br/>11 well-prepared road with the gravel surface on<br/>12 the sides where these crawler tracks are, a hard<br/>13 gravel surface, and there's not a bunch of<br/>14 impediments, you know, there's not a tree there,<br/>15 there's not a curb. That would be sort of<br/>16 normal, well-prepared worksite conditions.<br/>17 Q. And in that operating condition, what<br/>18 would be the force required to rotate the tracks<br/>19 with a CIII in operation?<br/>20 MR. HIGH: Objection to form.<br/>21 THE WITNESS: Again, I don't know<br/>22 the actual value, but it's well within the force<br/>23 that the cylinders can generate, or this<br/>24 wouldn't be a product. I mean, if they went to<br/>25 sell this, it wouldn't work. So I guarantee you</p> |
| <p style="text-align: right;">Page 70</p> <p>1 mechanism that attaches and causes the rotation.<br/>2 So you would have to look at the mechanism -- if<br/>3 you want to get the amount of angle, you have to<br/>4 go to that mechanism and move it back and forth,<br/>5 let's say, one foot and see how much it turns.<br/>6 So it's going to be quite a few degrees, you<br/>7 know, based on the foot extension.<br/>8 Q. How much force would be required to<br/>9 rotate the crawler tracks while the machine is<br/>10 operational?<br/>11 A. Nobody knows that answer because it<br/>12 depends on what the crawler track is up against.<br/>13 So if the crawler track is unimpeded, it's going<br/>14 to require a certain amount of force and that<br/>15 force is going to be well within the<br/>16 capabilities of the hydraulic cylinder or this<br/>17 machine wouldn't work.<br/>18 Now, if that crawler track has --<br/>19 you've driven up right next to a concrete wall<br/>20 and you try to turn it and the toe of that<br/>21 crawler track is hitting the concrete wall,<br/>22 well, the amount of force required is going to<br/>23 go way up because you're going to have to eat<br/>24 into the concrete wall. So that's kind of the<br/>25 two extremes.</p> | <p style="text-align: right;">Page 72</p> <p>1 that it's well within the capabilities of that<br/>2 cylinder.<br/>3 BY MR. LAYDEN:<br/>4 Q. How would you determine what force is<br/>5 needed in your ideal operational environment?<br/>6 A. Oh, how the way I would do it, I would<br/>7 just go and measure. If I'm developing this<br/>8 machine we have a test field or a test track and<br/>9 I go out there and I set it up and I put it<br/>10 under these conditions, it's called the nominal<br/>11 conditions, and I would apply a little bit --<br/>12 the way I would do it is I apply a little bit of<br/>13 the servo valve opening and just try to apply a<br/>14 little bit of force, and then I would wait until<br/>15 it moved and at that point that's when the<br/>16 cylinder is providing enough force, and that's<br/>17 how I would measure it.<br/>18 Q. Have you ever conducted those<br/>19 experiments on a machine weighing 50,000 pounds?<br/>20 A. No.<br/>21 Q. So then you would go through and<br/>22 actually create a prototype to determine this,<br/>23 or use the machine itself and then just measure<br/>24 the amount of force required in that design?<br/>25 A. Yeah, that's the way I would do it.</p>       |

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| <p style="text-align: right;">Page 73</p> <p>1 If I'm working at this company that's the surest<br/>2 way. Before we got that far off course I could<br/>3 sketch out a preliminary calculation of how much<br/>4 that would be. I would just assume -- what I'd<br/>5 have to do is I have to assume a co-efficient of<br/>6 friction between the crawler tracks and the<br/>7 surface, something like .6, and then I would<br/>8 take the downward force on that crawler track,<br/>9 which would be like 10,000 pounds or 20,000<br/>10 pounds, because it would be approximately one<br/>11 fourth of the total forces, and from that then I<br/>12 could get a theoretical estimation of how much<br/>13 force I would need.</p> <p>14 But if I'm making this machine, at the<br/>15 end of the day I'm not letting it go out without<br/>16 me actually testing the actual conditions that I<br/>17 have.</p> <p>18 Q. Okay. Going back to the CIII<br/>19 reference, in terms of this network steer<br/>20 option, when did that become available on CIII?<br/>21 MR. HIGH: Form.</p> <p>22 THE WITNESS: I don't think I did<br/>23 that investigation, but this -- I think this<br/>24 manual is from 2002. I'm not exactly sure, but<br/>25 that's my memory, it's from 2002, so it was</p> | <p style="text-align: right;">Page 75</p> <p>1 A. By rotation, do you mean the -- I<br/>2 think you mean the steering rotation, not the<br/>3 rotation of the track to drive it forward?<br/>4 Q. Correct.</p> <p>5 A. Those are still coming from these S2X<br/>6 controllers. They're the ones driving --<br/>7 there's four of those and they're each<br/>8 controlling one at a time. So ultimately those<br/>9 crawler tracks are being controlled by those<br/>10 four subcontrollers.</p> <p>11 Q. And those subcontrollers, where do<br/>12 they receive that signal telling them to rotate<br/>13 the crawler track in response to --<br/>14 A. Well, they're not really getting a<br/>15 signal to rotate the crawler tracks per se.<br/>16 They're getting a set point from this higher<br/>17 level Pancon controller. The Pancon controller<br/>18 is the overall controller. It's telling the<br/>19 four subcontrollers what angles to shoot for.<br/>20 And then those lower level ones are the ones<br/>21 trying to hold that desired angle.</p> <p>22 Q. And so would the operator interface<br/>23 with the Pancon controller then?<br/>24 A. Yeah, they are, and that's -- part of<br/>25 what they're doing is they're setting that steer</p>                                                                                         |
| <p style="text-align: right;">Page 74</p> <p>1 available as of 2002. Whether this was on the<br/>2 previous versions, I do not know.</p> <p>3 BY MR. LAYDEN:</p> <p>4 Q. Previously you mentioned that this was<br/>5 just one of the steering options CIII provides.<br/>6 Can you tell me what the other steering options<br/>7 are?</p> <p>8 A. Well, essentially you could just have<br/>9 the operator steer it, give it a set point and<br/>10 then have the machine drive and it will drive<br/>11 and steer. So there's no guideline, basically.<br/>12 The operator has to be giving it this desired<br/>13 set point.</p> <p>14 Q. So CIII either has a manual steering<br/>15 option or this network steer option that uses<br/>16 guidelines?</p> <p>17 A. That's right. The manual steer option<br/>18 is just a couple pages later in the manual, on<br/>19 Page 409, you'll see it's labeled Manual Steer<br/>20 Option. And then there's a picture below it<br/>21 that actually shows the interface of how you<br/>22 select the steer mode.</p> <p>23 Q. And when steering is done there, where<br/>24 is the signal originating from that controls the<br/>25 rotation of the crawler tracks?</p>                                                                                 | <p style="text-align: right;">Page 76</p> <p>1 mode switch that we just talked about on<br/>2 Page 409, that's the signal being sent to the<br/>3 Pancon controller, and the Pancon controller is<br/>4 saying, okay, I know that you want me to do<br/>5 manual or I know that you want me to be looking,<br/>6 for example, at the guideline sensor to what to<br/>7 do. So yeah, the operator is interfacing to the<br/>8 controller in that way.</p> <p>9 Q. And in terms of adjusting the swing<br/>10 leg angle on CIII, is that a manual operation?<br/>11 A. Yes. I mean, it's manual in the sense<br/>12 that they push a button that drives the<br/>13 hydraulic actuator; right. You don't have to go<br/>14 and push on that one with your hands. But you<br/>15 do essentially what I'll call jog, you sit there<br/>16 and you hit a button and you moved the hydraulic<br/>17 cylinder and that will move the swing leg.</p> <p>18 Q. And traditionally, is that a job one<br/>19 person can do on their own?<br/>20 A. You could do it by yourself. It would<br/>21 be a bit awkward because you have to get up on<br/>22 the machine, I think, to jog it. They might<br/>23 have a jog button down below sometimes. A lot<br/>24 of times these actuators will have a secondary<br/>25 jog button. But what I know for certain is that</p> |

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| <p style="text-align: right;">Page 77</p> <p>1 you can jog it from up at the controller station<br/>2 and you can jog it over and then you probably<br/>3 want someone on the ground to say that's the<br/>4 position we want to be and stop jogging it and<br/>5 let me put the pin in. So I think it's<br/>6 naturally a two-person job but it could be done<br/>7 with one person.<br/>8 Q. What about the turn buckles, would<br/>9 they need to be reattached?<br/>10 A. Yes, while you're doing that you<br/>11 should disconnect the turn buckles or loosen<br/>12 them as you're going along. If you're just<br/>13 going a little bit, you might be able to just<br/>14 kind of loosen the turn buckles and jog it a<br/>15 little bit. But if you're going a long way, you<br/>16 probably just want to disconnect the turnbuckle,<br/>17 you know, make the move, and then reattach<br/>18 stuff.<br/>19 Q. And in regards to that new angle of<br/>20 the swing leg, does the processor adjust the<br/>21 crawler track at all?<br/>22 A. I mean, it could. While you're doing<br/>23 that, you're very likely to wiggle the crawler<br/>24 track and it's going to be moving around, and if<br/>25 your controller is still on, then it's going to</p>                                   | <p style="text-align: right;">Page 79</p> <p>1 this is straight ahead again, and then they<br/>2 essentially -- there's various words for this,<br/>3 but you zero it out, you hit a reset button.<br/>4 You say, whatever you're seeing right now, let's<br/>5 call this zero and this is now straight ahead.<br/>6 Q. And that process is not done while the<br/>7 machine is actively moving, is it?<br/>8 A. No. The manual operations described<br/>9 in the CIII, you stop the machine.<br/>10 Q. We can go back to Exhibit 2, which is<br/>11 your declaration. You can turn to Paragraph 49,<br/>12 beginning on Page 29 of your report. And if you<br/>13 could let me know once you're there.<br/>14 A. Okay, I'm there.<br/>15 Q. And in this section is where you begin<br/>16 your discussion of the Rio reference.<br/>17 A. Yes.<br/>18 Q. Can you describe for me what Rio is?<br/>19 A. Rio is -- there's lots of names for<br/>20 what Rio is. It's a road milling machine, it's<br/>21 a cold planer. My kids call it an asphalt<br/>22 spitter. It's basically something that grinds<br/>23 off the top surface of a road so that you can<br/>24 put a new surface back on there.<br/>25 Q. And how does a road milling machine</p>                                                             |
| <p style="text-align: right;">Page 78</p> <p>1 keep trying to maintain the angle that you told<br/>2 it to.<br/>3 But once you -- if you make a large<br/>4 motion, like a 10-degree swing of the swing leg,<br/>5 as we talked about before, you lock that into<br/>6 place and then you go out to the other end of<br/>7 the swing leg and you counter-rotate that<br/>8 crawler track and you repin it. And then after<br/>9 you've done that it's probably not going to be<br/>10 perfectly aligned, so it teaches you to<br/>11 recalibrate the sensor and tell it you're now<br/>12 pointing straight ahead because it's hard to<br/>13 make those two pins line up perfectly. So one<br/>14 would rotate you 10.1 degrees and the<br/>15 counter-rotation might only be 9.9 degrees, so<br/>16 you'd be off two tenths of a degree and you have<br/>17 to straighten it out and recalibrate. So that's<br/>18 why it's kind of an arduous process.<br/>19 Q. And when you recalibrate that sensor,<br/>20 what is it using to determine that it is in fact<br/>21 straight ahead?<br/>22 A. Well, my understanding of the manual<br/>23 is that the people decide. They've set it up<br/>24 and they've got it aligned and they take<br/>25 whatever kind of measurements they want to say</p> | <p style="text-align: right;">Page 80</p> <p>1 relate to a slipform paver?<br/>2 A. Well, they're both very big, heavy<br/>3 construction machines. They would actually --<br/>4 you could use them in conjunction in the sense<br/>5 that the road milling machine would help you<br/>6 prepare the road surface to put a new concrete<br/>7 surface on there.<br/>8 So we've already talked about how the<br/>9 slipform pavers would work best if the road was<br/>10 well prepared. That means kind of smooth and<br/>11 flat without a bunch of obstacles. So if you've<br/>12 got a road that's got problems, like potholes<br/>13 and cracks and stuff like that, you wouldn't<br/>14 want to lay a new surface on top of that because<br/>15 those potholes and cracks would propagate up to<br/>16 the new surface.<br/>17 So to make a good road, you want to<br/>18 start with a firm, flat, level surface, to a<br/>19 large extent, and that's what Rio does. It<br/>20 comes through and it grinds off an old surface<br/>21 and makes everything relatively flat. I mean,<br/>22 it's got teeth marks and stuff after it eats up<br/>23 the road, but those are relatively small. So<br/>24 it's a road preparation machine. And then the<br/>25 slipform paver would come back and operate over</p> |

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| <p style="text-align: right;">Page 81</p> <p>1 the top of that.</p> <p>2 Q. And as a road preparation machine,</p> <p>3 it's going over previously-laid road, safe to</p> <p>4 say?</p> <p>5 A. That's really what this is designed</p> <p>6 for. I mean, it has these teeth that can eat</p> <p>7 through asphalt and also concrete. The teeth</p> <p>8 wear out faster if you go through on concrete.</p> <p>9 But you could certainly use this on like a dirt</p> <p>10 road or something like that if there was a bunch</p> <p>11 of rocks on there and you wanted to sort of</p> <p>12 clean up and get a nice surface to start with.</p> <p>13 There's really no limit on what you could use</p> <p>14 Rio on, but it's really designed to tear up an</p> <p>15 old road.</p> <p>16 Q. And in terms of the swing leg utilized</p> <p>17 by Rio, can you describe for me its features?</p> <p>18 A. Sure. Rio has a swing leg on the back</p> <p>19 right that's back near the milling drum. That's</p> <p>20 the part that has the teeth on it that eat up</p> <p>21 the road. And these machines are pretty heavy,</p> <p>22 they're like 30,000 pounds or something like</p> <p>23 that, and they're creating a lot of forces that</p> <p>24 are eating into a road, so they can be sort of</p> <p>25 bouncy while you're sitting on there, they're</p>                                        | <p style="text-align: right;">Page 83</p> <p>1 going to be less stable and then when you've</p> <p>2 passed the obstacle, you can swing the leg back</p> <p>3 out and have your better stability properties.</p> <p>4 Q. Is there a reason why Rio only has one</p> <p>5 swing leg?</p> <p>6 MR. HIGH: Object to form.</p> <p>7 THE WITNESS: I'm not sure. I</p> <p>8 wasn't involved in the design process. I can</p> <p>9 see reasons for having just one, but I don't</p> <p>10 know why they chose just to have one.</p> <p>11 BY MR. LAYDEN:</p> <p>12 Q. Have you ever encountered a road</p> <p>13 milling machine?</p> <p>14 A. Lots of times.</p> <p>15 Q. And what's the typical configuration</p> <p>16 of the road milling machine that you've seen?</p> <p>17 A. I'm not sure what you mean by</p> <p>18 configuration.</p> <p>19 Q. Did they have one swing arm, two,</p> <p>20 four?</p> <p>21 A. Oh, okay. I see what you're saying.</p> <p>22 A lot of the ones I've seen have had swing arms</p> <p>23 on them, and they're deployed sometimes,</p> <p>24 sometimes they're not. If you see these</p> <p>25 operating in a neighborhood, they often -- I've</p>                                                                                                                                                                                                                                       |
| <p style="text-align: right;">Page 82</p> <p>1 kind of bouncing around while you're eating up</p> <p>2 the road. And also roads aren't always flat,</p> <p>3 they're curved, so given you've got a big heavy</p> <p>4 machine that's bouncing around a little bit that</p> <p>5 might be tilting side to side, you want your</p> <p>6 base of support to be as wide as possible so</p> <p>7 they don't tip.</p> <p>8 So they designed this machine so you</p> <p>9 can swing out one of the tracks further outside</p> <p>10 and that makes you more stable. You have a</p> <p>11 wider base of support. So that's really how</p> <p>12 you'd want to operate the machine all the time</p> <p>13 if you could. But given that you're tearing up</p> <p>14 an old road, you're going to be running this</p> <p>15 machine towards obstacles, like a manhole cover</p> <p>16 or a curb or a guard rail or something like</p> <p>17 that. So you need to mill right up next to the</p> <p>18 obstacle sometimes. A curb is a really good</p> <p>19 example.</p> <p>20 So they've recognized the need for</p> <p>21 that and they're like okay, if you've got to get</p> <p>22 right up close to something like a building or a</p> <p>23 curb, we'll let you pull that swing leg back</p> <p>24 inside so we're nearer and you can get your</p> <p>25 milling drum much closer to an obstacle. You're</p> | <p style="text-align: right;">Page 84</p> <p>1 noticed they often don't have the swing arm</p> <p>2 deployed because they're going around curbs and</p> <p>3 they're going to be running into stuff. But if</p> <p>4 you go to the Atlanta freeways here -- and</p> <p>5 you're going to see these operating pretty</p> <p>6 regular -- they have a swing arm out for greater</p> <p>7 stability because there's no obstacles on the</p> <p>8 freeway. So they get their wide stability to</p> <p>9 just go down the road eating up the asphalt.</p> <p>10 Q. And I believe Rio references the</p> <p>11 position of the swing leg as either retracting</p> <p>12 or retracted; do you recall that?</p> <p>13 A. Yes, retracted or projecting is</p> <p>14 probably -- yeah, something like that.</p> <p>15 Q. And if I'm correct in what you just</p> <p>16 stated, the machines are more maneuverable with</p> <p>17 the swing leg in the retracted position than the</p> <p>18 protracted position; is that accurate?</p> <p>19 A. I think that's a good way of</p> <p>20 describing it, more maneuverable in that you</p> <p>21 could go closer to obstacles, if that's what you</p> <p>22 mean by maneuverability, because you don't have</p> <p>23 that arm sticking out there to run into stuff.</p> <p>24 Q. How does Rio handle the rotation of</p> <p>25 its swing leg, or the pivoting of its swing leg?</p> |

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| <p style="text-align: right;">Page 85</p> <p>1 A. Well, it has an actuator that can</p> <p>2 apply forces to the swing leg, really more</p> <p>3 properly, as we talked about, torques, and it</p> <p>4 applies torques around a joint and the joint</p> <p>5 rotates and the leg swings in or out.</p> <p>6 Q. How does Rio handle rotation of its</p> <p>7 crawler track?</p> <p>8 A. Again, with an actuator that applies</p> <p>9 torque and causes the crawler track to rotate.</p> <p>10 Q. If you could turn to Page 31 of your</p> <p>11 declaration, Paragraph 50.</p> <p>12 A. Okay.</p> <p>13 Q. Beginning at Paragraph 50 you're</p> <p>14 describing a pivoting of the swing arm from its</p> <p>15 retracted to projected position. Do you see</p> <p>16 that?</p> <p>17 A. Yes, I do.</p> <p>18 Q. When going from the retracted to the</p> <p>19 projecting position, can you describe for me the</p> <p>20 process Rio discloses?</p> <p>21 MR. HIGH: Object to form.</p> <p>22 THE WITNESS: Okay. Going from</p> <p>23 the retracted to the projected?</p> <p>24 BY MR. LAYDEN:</p> <p>25 Q. Mm-hmm.</p>                                                                                                                                                                                                                                                   | <p style="text-align: right;">Page 87</p> <p>1 BY MR. LAYDEN:</p> <p>2 Q. Now, in the Rio reference you say --</p> <p>3 it describes multiple embodiments of its swing</p> <p>4 leg; is that accurate?</p> <p>5 A. Yes.</p> <p>6 Q. In regards to its swing leg, are there</p> <p>7 any other measures Rio discloses in terms of</p> <p>8 stabilizing or somehow limiting the range of</p> <p>9 motion of that swing leg?</p> <p>10 MR. HIGH: Objection to form.</p> <p>11 THE WITNESS: I think I</p> <p>12 understand your question. Yes, it does. So</p> <p>13 primarily the position is controlled by that</p> <p>14 cylinder we just talked about. So the cylinder</p> <p>15 has an associated sensor so Rio's controller</p> <p>16 knows how far it's extended or retracted. So</p> <p>17 the Rio controller can use that sensor</p> <p>18 information to decide how far it wants to swing</p> <p>19 the swing leg out. In general, it's going to</p> <p>20 swing it out to a projected position. And that</p> <p>21 hydraulic cylinder in and of itself is very</p> <p>22 strong because it's just moved the leg. So that</p> <p>23 hydraulic cylinder is going to act to hold that</p> <p>24 swing arm in that location.</p> <p>25 Now, Rio adds to that another actuator</p>                                                     |
| <p style="text-align: right;">Page 86</p> <p>1 A. Sure. Well, the retracted position,</p> <p>2 just to clarify the starting position, it's when</p> <p>3 the swing arm is swung in towards the frame and</p> <p>4 in fact, the crawler track goes inside the</p> <p>5 frame. So there it's not sticking out at all</p> <p>6 and you can get really close.</p> <p>7 So to swing the arm out, there's an</p> <p>8 actuator described in here, in fact, the</p> <p>9 actuator is shown in figures 3 and 4, or one</p> <p>10 embodiment of the actuator, and it's a hydraulic</p> <p>11 cylinder like the ones we've been talking about,</p> <p>12 and it pulls in, it pulls its rod in, and as</p> <p>13 that's pulling in, that rod applies force to the</p> <p>14 swing arm and pulls it out or pulls it open like</p> <p>15 a door. So that's one of the embodiments.</p> <p>16 Rio also talks about how you could use</p> <p>17 a rotary actuator and also provide the same sort</p> <p>18 of torque that would swing the arm outward from</p> <p>19 the frame.</p> <p>20 MR. LAYDEN: I just uploaded to</p> <p>21 the chat Exhibit 4, and Exhibit 4 is the Rio</p> <p>22 reference used in the petition, labeled 1006.</p> <p>23 Let me know when you have that up, please.</p> <p>24 (Exhibit 4 marked for identification.)</p> <p>25 THE WITNESS: Okay, I have that.</p> | <p style="text-align: right;">Page 88</p> <p>1 that can essentially clamp it or pin it in place</p> <p>2 when it gets to the desired projected position.</p> <p>3 BY MR. LAYDEN:</p> <p>4 Q. Is there any embodiment in Rio that</p> <p>5 doesn't have that other device that clamps its</p> <p>6 swing leg into position?</p> <p>7 A. Yeah, I'm not sure it says there's an</p> <p>8 embodiment where you get rid of that. That's</p> <p>9 not the way that Rio describes its embodiments.</p> <p>10 But I don't think Rio says you have to have</p> <p>11 that. I think it's a good practice. It's</p> <p>12 corollary to the CIII pins that we talked about</p> <p>13 before. Those CIII pins, again, I told you, you</p> <p>14 don't have to have them but it's good practice</p> <p>15 and those are manually operated. Rio is just</p> <p>16 teaching us that you could do the same sort of</p> <p>17 thing in an automated way. Its controller can</p> <p>18 decide to lock it or to not lock it.</p> <p>19 Q. Does Rio describe an embodiment where</p> <p>20 the swing leg can be extended from the retracted</p> <p>21 to the protracted position while the machine is</p> <p>22 operational?</p> <p>23 A. From the retracted to the -- to the</p> <p>24 what position?</p> <p>25 Q. From the retracted to the projecting,</p> |

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| <p style="text-align: right;">Page 89</p> <p>1 sorry. Projecting position while the machine is<br/>2 operational.<br/>3 A. Well, I mean, the machine is operating<br/>4 in the sense that it's turned on, like you have<br/>5 to have it turned on or running to generate<br/>6 these hydraulic forces and stuff. But I think<br/>7 the part of Rio that explains how you could do<br/>8 this, I think it does start with jack it up. In<br/>9 that sense it's not grinding up a road, you<br/>10 know, it's got that arm jacked up so that it's<br/>11 easier to swing and get into the position that<br/>12 you want.<br/>13 Q. So there's no embodiment in Rio that<br/>14 discloses changing the angle of the swing leg<br/>15 while the machine is moving?<br/>16 MR. HIGH: Object to form.<br/>17 THE WITNESS: I don't recall<br/>18 that. I mean, I recall them adjusting the<br/>19 crawler track angle as you're driving, but as I<br/>20 sit here, I think that the description it has<br/>21 where it details the steps on swinging the swing<br/>22 leg, I think it does start with jack this up,<br/>23 jack this corner up, as I recall. But the way<br/>24 you would do it, I think you set the milling<br/>25 drum down on the ground is the other way to do</p> | <p style="text-align: right;">Page 91</p> <p>1 (At 1:20 p.m. with parties present as<br/>2 before, the following proceedings were had,<br/>3 to-wit:)<br/>4 BY MR. LAYDEN:<br/>5 Q. Dr. Singhose, previously we were<br/>6 discussing your evaluation of the Rio reference.<br/>7 Continuing with that line, can you describe for<br/>8 me the configuration Rio teaches in its swing<br/>9 leg, or its jacking column and crawler track?<br/>10 A. Sure. I mean, it teaches various<br/>11 embodiments, but for a start it has the same<br/>12 general structure that we've been talking about<br/>13 earlier today, which is it has sort of an outer<br/>14 cylinder part and then an inner cylinder part<br/>15 that telescopes out, and that telescoping is<br/>16 powered by a linear hydraulic actuator, and at<br/>17 the bottom of the section that telescopes out,<br/>18 it's somehow connected to like a yoke and a<br/>19 crawler track. And then it has a slew actuator,<br/>20 an actuator that turns around in a circle, if<br/>21 you will, to power the turning of the crawler<br/>22 track.<br/>23 Q. And in the embodiments disclosed in<br/>24 Rio, where is the location of that actuator to<br/>25 turn the crawler track?</p> |
| <p style="text-align: right;">Page 90</p> <p>1 it. So you set the milling drum down on the<br/>2 ground and you lift the crawler track up with<br/>3 the jacking column and then you rotate it, I<br/>4 think is how they describe it.<br/>5 MR. LAYDEN: Let's take a<br/>6 10-minute break.<br/>7 (12:39 p.m. - Lunch recess taken.)<br/>8<br/>9<br/>10<br/>11<br/>12<br/>13<br/>14<br/>15<br/>16<br/>17<br/>18<br/>19<br/>20<br/>21<br/>22<br/>23<br/>24<br/>25</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p style="text-align: right;">Page 92</p> <p>1 MR. HIGH: Object to form.<br/>2 THE WITNESS: Yeah, it has<br/>3 various embodiments, and one of the embodiments<br/>4 basically say it can be -- the general<br/>5 disclosure is that actuator can be anywhere<br/>6 along the vertical axis of the jacking column.<br/>7 BY MR. LAYDEN:<br/>8 Q. And I believe looking at Paragraph 50<br/>9 of your declaration, at the bottom of that<br/>10 paragraph you touch on that point and say<br/>11 that -- it's in reference to avoiding problems<br/>12 caused by the accumulation of mechanical devices<br/>13 at a single location. Do you see that?<br/>14 A. Yes, I do. I think it's a general<br/>15 guideline that says you can put your rotary<br/>16 actuator anywhere, probably not a good idea to<br/>17 put it at the same place as some other linkages<br/>18 that you have for this device.<br/>19 Q. What are the other linkages Rio is<br/>20 trying to avoid?<br/>21 A. For example, we talked about this<br/>22 before, the locking actuator, like that's<br/>23 also -- they represent that as it can be like a<br/>24 cylinder that extends out and puts a pin in.<br/>25 You wouldn't want to put your rotary actuator at</p>      |

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| <p style="text-align: right;">Page 93</p> <p>1 the same place because you would be running into<br/>2 each other.<br/>3 Q. For each of the embodiments described<br/>4 in Rio, are you aware of an embodiment that<br/>5 doesn't include rotating inner cylinder of the<br/>6 lifting column in conjunction with the crawler<br/>7 track?<br/>8 A. Yes.<br/>9 Q. What's that embodiment?<br/>10 A. Well, that would be the embodiment<br/>11 when you put the slew drive at the bottom. So<br/>12 if you put the slew drive at the bottom, it<br/>13 wouldn't work, basically, if that inner cylinder<br/>14 could still rotate relative to the outer. You<br/>15 have to connect them together -- lock them<br/>16 together somehow like we talked about earlier<br/>17 with keys or keyways or something to that<br/>18 effect.<br/>19 Q. In your opinion Rio discloses locking<br/>20 the jacking column when putting the rotary<br/>21 actuator at the bottom of the crawler track?<br/>22 MR. HIGH: Objection. Form.<br/>23 THE WITNESS: I'm not sure -- you<br/>24 know, you're using disclosure, disclosing.<br/>25 Maybe that's got a legal term for it, but I</p>                                                                                                       | <p style="text-align: right;">Page 95</p> <p>1 THE WITNESS: I don't think it's<br/>2 that specific using those terms. I mean, Rio<br/>3 discloses you need to lock it, right, it's got<br/>4 these locking actuators. So I think when it's<br/>5 describing those alternate ones it's not<br/>6 describing every feature of the alternate ones.<br/>7 But if it goes at the bottom, you have to lock<br/>8 that inner tube.<br/>9 BY MR. LAYDEN:<br/>10 Q. Previously you described Rio as a<br/>11 heavy machine. Do you recall that?<br/>12 A. Yes.<br/>13 Q. Would you say Rio is heavier or<br/>14 lighter than CIII?<br/>15 A. I don't think there's enough detail in<br/>16 there, I don't think they give weights, but I<br/>17 know these machines and they're both in the tens<br/>18 of thousands of pounds. And they would<br/>19 obviously be -- possible to have various sizes<br/>20 of Rio and also various sizes of slipform<br/>21 pavers.<br/>22 Q. Would there be an advantage when<br/>23 trying to rotate the crawler track of a heavier<br/>24 machine and also rotating the inner column of<br/>25 the jacking column?</p>                                                                                                |
| <p style="text-align: right;">Page 94</p> <p>1 guess it would be obvious to me when I read that<br/>2 and I would put the slew actuator at the bottom,<br/>3 I would know immediately that I need to use a<br/>4 key and a keyway, or I would need to use like a<br/>5 square cross-sectional area, something like<br/>6 that. Because you would know immediately,<br/>7 basically, using Newton's third law of motion<br/>8 that there's every -- if every force is equal to<br/>9 the opposite force, I would realize if I'm<br/>10 putting a force on the crawler track to turn it,<br/>11 I have to have an equal and opposite force from<br/>12 the inner tube, and it can't apply that unless<br/>13 it's locked in place.<br/>14 Q. In that last sentence of Paragraph 50<br/>15 of your declaration you state that the second<br/>16 actuator is at the top of the lifting column in<br/>17 a typical embodiment.<br/>18 A. Yes. I think that's a direct quote<br/>19 from Rio that says here's a typical embodiment,<br/>20 and then as you know, these patents have various<br/>21 alternate embodiments.<br/>22 Q. And the alternate embodiments<br/>23 described discuss locking the inner column of<br/>24 the crawler track?<br/>25 MR. HIGH: Objection. Form.</p> | <p style="text-align: right;">Page 96</p> <p>1 A. I think if I was really, really<br/>2 concerned about rotating the track of a really<br/>3 heavy machine, ultimately I'd just pick the<br/>4 right size of the actuator for that job. But I<br/>5 think it would actually be a little bit easier<br/>6 to rotate the crawler track if in fact I locked<br/>7 the inner tube because it's one less thing I<br/>8 have to move around. So I'm rotating less<br/>9 inertia, so locking the inner part gives you a<br/>10 little bit of an advantage in rotating the<br/>11 crawler track.<br/>12 Q. So the typical embodiment of Rio, as<br/>13 well as CIII that rotate the inner tube, they<br/>14 were designed at a disadvantage from what you're<br/>15 saying now?<br/>16 COURT REPORTER: (Requests<br/>17 clarification.)<br/>18 MR. HIGH: Objection. Form.<br/>19 THE WITNESS: Again, sorry, there<br/>20 was an objection. I'm trying to understand the<br/>21 question. I'm not sure if there is the typical<br/>22 embodiment in Rio. I think there is what it's<br/>23 calling an atypical embodiment. And yeah, any<br/>24 particular embodiment in a machine, probably if<br/>25 I was a good engineer I could find a way to do</p> |

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| <p style="text-align: right;">Page 97</p> <p>1 it a little bit better. The way it's described<br/>2 there, if my primary concern was being able to<br/>3 rotate the crawler track with less energy or<br/>4 less force, then I would choose to put my slew<br/>5 drive at the very bottom. If there were other<br/>6 concerns that I wanted to take into account and<br/>7 that wasn't my primary concern, then I could see<br/>8 moving the actuator of Rio up a little bit or<br/>9 even to the very top, which is what it shows in<br/>10 the pictures. So it's really balancing a bunch<br/>11 of trade-offs. There's not one concern when I<br/>12 think about designing these machines.<br/>13 BY MR. LAYDEN:<br/>14 Q. If an actuator is at the top of a<br/>15 jacking column and it rotates the inner member<br/>16 of the jacking column as well as the crawler<br/>17 track, would that require more or less force to<br/>18 rotate?<br/>19 A. That would require a little bit more<br/>20 force or torque than if the actuator was at the<br/>21 bottom, because you're rotating more inertia.<br/>22 It's probably not a lot more, it's just a little<br/>23 bit more.<br/>24 Q. And the force you're referencing would<br/>25 be torque?</p>                                               | <p style="text-align: right;">Page 99</p> <p>1 mechanism. And if I wanted to get more torque,<br/>2 I would make that linkage mechanism stick out<br/>3 further, and that's how I would make it<br/>4 essentially a longer lever arm.<br/>5 Q. And the way Rio looks, it's just using<br/>6 a rotary actuator somewhere along the lifting<br/>7 column axis to provide a rotational force, would<br/>8 you say that would be kind of similar to using a<br/>9 screwdriver?<br/>10 MR. HIGH: Objection. Form.<br/>11 THE WITNESS: Yeah, I didn't<br/>12 equate it to a screwdriver. These are pretty<br/>13 complicated mechanisms and they're a lot<br/>14 stronger than that. But at the end of the day<br/>15 it is creating the same kind of force, that is,<br/>16 a torque, that a screwdriver does. A<br/>17 screwdriver would just be like a very simple way<br/>18 of doing it and you couldn't ever get a very big<br/>19 force out of a screwdriver.<br/>20 BY MR. LAYDEN:<br/>21 Q. Regardless of whether or not you get a<br/>22 lot of force out of a screwdriver, would you be<br/>23 able to get more torque using a small<br/>24 screwdriver as opposed to one that's longer?<br/>25 A. Well, the length of the screwdriver,</p>                                                             |
| <p style="text-align: right;">Page 98</p> <p>1 A. That's right. We can use force and<br/>2 torques interchangeably. Just more properly<br/>3 it's torque because it's the force that causes a<br/>4 rotation.<br/>5 Q. And earlier when we were discussing<br/>6 torque, you said it's as you get further from<br/>7 the axis of rotation you can produce higher<br/>8 torque; do you recall that?<br/>9 A. Yes. In that case I was talking about<br/>10 a specific way of generating torque, which was<br/>11 just like with a wrench or a lever arm, you<br/>12 know, very simple mechanism that we've used for<br/>13 thousands of years. With that mechanism, the<br/>14 longer your lever arm is, the longer your wrench<br/>15 is, you'll be able to generate more torque for<br/>16 the same amount of input force. But it's not<br/>17 magic. You actually pay for that by having to<br/>18 push a longer distance. So you don't get<br/>19 something for nothing. There's trade-offs.<br/>20 Q. So your earlier example of using a<br/>21 wrench to create the torque, longer wrench,<br/>22 right, longer distance, would that be similar to<br/>23 the steering cylinder of CIII?<br/>24 A. That would be similar to the steering<br/>25 cylinder of CIII, yes, where it connects to that</p> | <p style="text-align: right;">Page 100</p> <p>1 as I'm understanding your use of the word<br/>2 length, wouldn't really matter. What matters<br/>3 with a screwdriver is how big your handle is.<br/>4 So if you try to use a screwdriver with a tiny<br/>5 little handle, it's hard to generate a lot of<br/>6 torque. But if you get a bigger handle, then<br/>7 your distance from the center line of the<br/>8 screwdriver to the edge of the handle is<br/>9 increased, and that's why it's a lot easier for<br/>10 you to use a screwdriver with a big handle than<br/>11 a tiny little handle, in terms of the diameter<br/>12 of the hammer grip.<br/>13 Q. And in terms of relating that to<br/>14 references that we see here, the length of the<br/>15 handle, you said, as that increases, it would be<br/>16 what's important with the jacking column and its<br/>17 inner tubular member be representative of the<br/>18 handle in your scenario?<br/>19 MR. HIGH: Objection. Form.<br/>20 THE WITNESS: No. The jacking<br/>21 column and its tube, that's what's being turned.<br/>22 So the screwdriver is the tool to turn<br/>23 something, presumably a screw. So if there's<br/>24 some kind of analogy here, I would think that<br/>25 the screw that we're, you know, not directly</p> |

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| <p style="text-align: right;">Page 101</p> <p>1 talking about, but we should be talking about,<br/>2 would be the jacking column. That's what you're<br/>3 trying to turn.<br/>4 BY MR. LAYDEN:<br/>5 Q. And the jacking column that's<br/>6 connected to the crawler track in this instance;<br/>7 correct?<br/>8 A. Yeah, that's correct. That's what<br/>9 you're trying to turn.<br/>10 Q. So in what Rio calls a typical<br/>11 embodiment, it's trying to rotate the jacking<br/>12 column and not necessarily the crawler track?<br/>13 MR. HIGH: Objection. Form.<br/>14 THE WITNESS: No. It's trying to<br/>15 rotate the crawler track. That's its goal.<br/>16 It's kind of incidentally rotating the inner<br/>17 part -- I mean, it's rotating the jacking<br/>18 column, it's just rotating the inner part of the<br/>19 jacking column, but its function, its goal is to<br/>20 turn the crawler track.<br/>21 BY MR. LAYDEN:<br/>22 Q. Rio also discloses an anti-rotate<br/>23 device. Are you familiar with that?<br/>24 A. Yes.<br/>25 Q. And if you look at Exhibit 4, on</p>                                                                                                                    | <p style="text-align: right;">Page 103</p> <p>1 A. Yeah, that's right. When the<br/>2 rotary -- so the rotary actuator, physically,<br/>3 it's a rotary joint. It allows rotation. It<br/>4 happens to be a powered joint. So it would be a<br/>5 rotational connection at the bottom of the inner<br/>6 tubular member to the yoke, which is then<br/>7 connected to the crawler track.<br/>8 Q. In your opinion, what's the importance<br/>9 of the anti-rotate device in Rio?<br/>10 A. The anti-rotate device being the<br/>11 Number 90, which is stopping the rotation of the<br/>12 swing leg, is that the one we're talking about?<br/>13 Q. Mm-hmm, the rotation of the crawler<br/>14 track.<br/>15 A. Oh, the rotation of the crawler track.<br/>16 Okay. Yeah, the rotation of the crawler track,<br/>17 it would be important if you want to secure that<br/>18 crawler track at a certain angle and make sure<br/>19 that it doesn't change very much as you're<br/>20 driving this machine. It's essentially a<br/>21 mechanism that adds an additional holding force;<br/>22 right. Whatever actuators we're using to rotate<br/>23 the track, that's going to have some resistive<br/>24 force, some resistive torque. But if you want<br/>25 to add extra resistive torque, then you would</p> |
| <p style="text-align: right;">Page 102</p> <p>1 Column 6, beginning at Line 38, it describes the<br/>2 anti-rotate device as being connected --<br/>3 A. Let me jump over to that. You said<br/>4 Column 6, what lines?<br/>5 Q. Beginning at Line 38.<br/>6 A. Okay, I see that, yeah.<br/>7 Q. It says the anti-rotate device<br/>8 includes a collar that's connected with collar<br/>9 keys to the inner tubular member. So is the<br/>10 anti-rotate device focused on rotation of the<br/>11 jacking column or roller track?<br/>12 A. Well, those are -- in this embodiment<br/>13 it's talking about those are connected. So if<br/>14 you control one, you're controlling the other.<br/>15 Q. Is there an embodiment in Rio where<br/>16 the jacking column, the inner tubular member,<br/>17 and the crawler track are not connected?<br/>18 A. They're all connected. The question<br/>19 is whether there's a stiff, unmovable connection<br/>20 or a rotary connection. Those would be the two<br/>21 kind of different classes of embodiments that<br/>22 Rio teaches.<br/>23 Q. And Rio teaches a rotary connection<br/>24 between the jacking column and crawler track, in<br/>25 your opinion?</p> | <p style="text-align: right;">Page 104</p> <p>1 add this anti-rotating device, which is like a<br/>2 pin in a hole kind of thing.<br/>3 Q. So the anti-rotate device would serve<br/>4 a similar purpose to the pins used in CIII to<br/>5 lock the crawler track?<br/>6 MR. HIGH: Objection. Form.<br/>7 THE WITNESS: So the pins --<br/>8 yeah, it's somewhat similar. The pins in the<br/>9 CIII that we talked about before, just to<br/>10 clarify, those were pins that were holding the<br/>11 swing arm in place to the frame, and then also<br/>12 holding the jacking column in place relative to<br/>13 the swing arm. But yeah, its very similar idea<br/>14 is that you have manual pins that help lock the<br/>15 CIII in place. Rio is using a very similar<br/>16 locking pin device, but it's telling you that<br/>17 you can control it with a computer, you can turn<br/>18 it on and off with a computer and a control<br/>19 system.<br/>20 Q. If you could turn to Exhibit 3, it was<br/>21 the CIII reference.<br/>22 A. Okay.<br/>23 Q. In this case I need you to turn to<br/>24 Part 1, which is Page 80.<br/>25 A. Okay, I'm on Page 80. It's also</p>                                                                                                                                |

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| <p style="text-align: right;">Page 105</p> <p>1 labeled 3-18.</p> <p>2 Q. In the left-hand column at the bottom</p> <p>3 it has a picture of the CIII and it says swing</p> <p>4 leg to left. Do you see that?</p> <p>5 A. Yes.</p> <p>6 Q. Could you read those two paragraphs</p> <p>7 below that picture for me and let me know when</p> <p>8 you're done.</p> <p>9 A. Okay.</p> <p>10 Q. And there it's talking about moving</p> <p>11 the swing leg assembly left from any position,</p> <p>12 and it discusses removing two locking pins, one</p> <p>13 at the frame end and one at the track end. Do</p> <p>14 you see that?</p> <p>15 A. Yes.</p> <p>16 Q. The pin at the track end, what does</p> <p>17 that lock into place?</p> <p>18 A. That's locking sort of the rotational</p> <p>19 degree of freedom of the crawler track out at</p> <p>20 the far end of the arm instead of the end of the</p> <p>21 arm that's near the frame.</p> <p>22 Q. And does that pin aid or hurt the</p> <p>23 rotational ability of the crawler track in CIII?</p> <p>24 A. It aids the ability of the crawler</p> <p>25 track not to be unintentionally turned, but it</p>                                                                                                                          | <p style="text-align: right;">Page 107</p> <p>1 position.</p> <p>2 BY MR. LAYDEN:</p> <p>3 Q. Is that because within CIII the</p> <p>4 steering cylinder is not strong enough to</p> <p>5 maintain and overcome those forces?</p> <p>6 MR. HIGH: Object to the form.</p> <p>7 THE WITNESS: I don't think the</p> <p>8 manual says why they made that choice.</p> <p>9 BY MR. LAYDEN:</p> <p>10 Q. In your opinion, if you were designing</p> <p>11 the machine, would you make that choice?</p> <p>12 MR. HIGH: Objection. Form.</p> <p>13 THE WITNESS: So this is sort of</p> <p>14 a typical design choice where I could see going</p> <p>15 either way, right. There are benefits and</p> <p>16 drawbacks to both sides. If I have the pin,</p> <p>17 it's a pretty rigid connection, but I require my</p> <p>18 operator to go out there and jam the pin in and</p> <p>19 get it aligned and stuff like that. So I don't</p> <p>20 like that part of it. I like the security of</p> <p>21 it.</p> <p>22 If I get rid of the pin, then it's</p> <p>23 much better for my operator to not have to do</p> <p>24 that operation, but then I might need to make my</p> <p>25 steer cylinder a little bit bigger or I might</p>                                      |
| <p style="text-align: right;">Page 106</p> <p>1 doesn't affect the intentional turning of it.</p> <p>2 It's like an extra safety device so it doesn't</p> <p>3 get knocked out of place by what we would call</p> <p>4 disturbance forces.</p> <p>5 Q. And your disturbance forces, as you've</p> <p>6 described, they would be considered in the</p> <p>7 design of these swing leg assemblies, would they</p> <p>8 not?</p> <p>9 A. Yes.</p> <p>10 Q. And maintaining the position of the</p> <p>11 crawler track while the machine is moving</p> <p>12 forward is necessary to prevent the variations</p> <p>13 in the track position that you were describing;</p> <p>14 is that also correct?</p> <p>15 MR. HIGH: Objection. Form.</p> <p>16 THE WITNESS: Yeah. We talked</p> <p>17 about this, how the machine would function for a</p> <p>18 while if it wasn't -- if it didn't have this</p> <p>19 extra restraint force. But they've decided</p> <p>20 that -- or they've anticipated that the</p> <p>21 disturbance forces might get large enough at</p> <p>22 some point and push the crawler track out of the</p> <p>23 alignment that they want to maintain, and so</p> <p>24 they've added to their design this extra</p> <p>25 constraint force to help hold it in the desired</p> | <p style="text-align: right;">Page 108</p> <p>1 have to make my feedback controller on my steer</p> <p>2 cylinder a little more aggressive to compensate</p> <p>3 for that. So there's reasons to do it either</p> <p>4 way.</p> <p>5 BY MR. LAYDEN:</p> <p>6 Q. The way CIII chose to do it was to</p> <p>7 manually lock its track in place to try to</p> <p>8 overcome those obstructional forces; is that</p> <p>9 accurate?</p> <p>10 A. That's correct. That's the design</p> <p>11 choice that they've made for this particular</p> <p>12 model.</p> <p>13 Q. Turning back to Rio, how does Rio</p> <p>14 disclose overcoming those obstructional forces</p> <p>15 to maintain the travel direction of its crawler</p> <p>16 track?</p> <p>17 A. Rio has made a similar choice in that</p> <p>18 it's got a rotary axle that can rotate its</p> <p>19 track, its crawler track back and forth while</p> <p>20 it's driving around. So it can steer it, but</p> <p>21 it's also giving the use or the opportunity to</p> <p>22 apply some extra force. And if you just want to</p> <p>23 go straight ahead, you can block this pin in</p> <p>24 here and you'll just keep going straight ahead,</p> <p>25 and if you want to turn, you'll have to unlock</p> |

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| <p style="text-align: right;">Page 109</p> <p>1 it and turn. So it's just basically a different<br/>2 operating mode that they've chosen and there is<br/>3 some similarities there.<br/>4 Q. In your opinion would the decision to<br/>5 use some sort of locking mechanism on the<br/>6 crawler track be impacted at all by a rotary<br/>7 actuator or steering cylinder that's not strong<br/>8 enough to maintain the track in the direction as<br/>9 it's traveling?<br/>10 MR. HIGH: Objection. Form.<br/>11 THE WITNESS: Yes. If you<br/>12 designed a machine and you had, for whatever<br/>13 reason, used an underpowered actuator that<br/>14 rotates the crawler track, then it would be<br/>15 beneficial to have a backup locking pin to help<br/>16 your underdesigned actuator.<br/>17 BY MR. LAYDEN:<br/>18 Q. In the Rio reference, would that<br/>19 anti-rotate device be that extra mechanism you<br/>20 described?<br/>21 A. Yes. I think the -- just to refresh,<br/>22 I think Rio is -- it has two anti-rotation<br/>23 devices, but I think one is called anti-swing<br/>24 for the swing leg, and then anti-rotate for the<br/>25 crawler track. And given that understanding,</p>                                                           | <p style="text-align: right;">Page 111</p> <p>1 or not have your feedback so active so it's<br/>2 always correcting. It's a way of basically<br/>3 doing like a cruise control, if you will.<br/>4 Q. The controller that Rio uses to send<br/>5 its signals to the rotary actuators and the<br/>6 actuators of the swing leg and the crawler<br/>7 track, does it control the operation of the<br/>8 swing leg and crawler track in the same manner<br/>9 when steering?<br/>10 A. I'm not exactly sure what you mean by<br/>11 in the same manner, so I'll just clarify my<br/>12 answer to some extent. Yeah, it reads a sensor<br/>13 signal -- it reads two sensor signals, one, the<br/>14 position of the swing leg and, one, the angular<br/>15 position of the crawler track. And it uses<br/>16 those two signals to make a decision about how<br/>17 much to turn the swing leg and the crawler<br/>18 track. So in that global sense it's operating<br/>19 the same kind of way, getting a signal, deciding<br/>20 what to do, and sending out a command to the<br/>21 actuators.<br/>22 Q. What modifications to the control<br/>23 system, if any, would be necessary to change the<br/>24 angle of the swing leg while the machine is<br/>25 moving forward?</p> |
| <p style="text-align: right;">Page 110</p> <p>1 yeah, the anti-rotate one is a device that adds<br/>2 extra torque, extra restraining torque to keep<br/>3 the crawler track in the desired position.<br/>4 Q. In your opinion, is that the<br/>5 suggestive -- strike that.<br/>6 In your opinion, does that suggest<br/>7 that Rio's rotary actuator is not strong enough<br/>8 to maintain the track while traveling?<br/>9 MR. HIGH: Objection. Form.<br/>10 THE WITNESS: I don't see that<br/>11 suggestion there because it tells me that it can<br/>12 drive along and while it's driving, it can turn<br/>13 the track. So if it can turn the track, it's<br/>14 certainly able to hold the track at a certain<br/>15 angle. You know, it's turning it -- if you<br/>16 will, turning it back and forth to hold the<br/>17 straight ahead position. So it's not indicating<br/>18 that it can't hold the track in place while<br/>19 driving. That's not what it's indicating.<br/>20 BY MR. LAYDEN:<br/>21 Q. What does it indicate, then?<br/>22 A. Well, it indicates that they feel the<br/>23 need to have some extra controlling torque on<br/>24 this when you're not steering, and you maybe<br/>25 want to turn off your feedback control actuator</p> | <p style="text-align: right;">Page 112</p> <p>1 MR. HIGH: Objection. Form.<br/>2 THE WITNESS: Which machine are<br/>3 we talking about, the Rio?<br/>4 BY MR. LAYDEN:<br/>5 Q. Rio.<br/>6 A. I really don't think you need to<br/>7 change it at all. I mean, it discloses that you<br/>8 can swing the leg, and in coordination with that<br/>9 you can control the crawler track. So the<br/>10 control system knows how to do that. If you<br/>11 were driving on the ground and you wanted the<br/>12 swing leg to go in or out, you could do that<br/>13 with the same controller. You may want to use a<br/>14 somewhat bigger actuator. Rio doesn't tell us<br/>15 exactly what that is. You would just want to<br/>16 use an actuator that's big enough to create the<br/>17 appropriate torque to swing the leg out while<br/>18 you're driving forward. It already discloses,<br/>19 as we know, that you can steer the crawler<br/>20 track, the crawler itself back and forth while<br/>21 you're driving. It just doesn't specifically<br/>22 say -- I don't think it specifically says that<br/>23 you can also swing the arm. But the controller<br/>24 is sitting there ready to do it. If you give it<br/>25 the command, it will try to do it.</p>            |

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| <p style="text-align: right;">Page 113</p> <p>1 Q. Does the controller also dictate how<br/>2 much force the actuator puts out?<br/>3 A. We don't know that level of detail.<br/>4 That's sort of an implementation detail. We<br/>5 know that it keeps putting out some force until<br/>6 it gets to the desired angle. That's what we<br/>7 know about the control system. So we don't know<br/>8 exactly the formula in the feedback controller.<br/>9 The truth is there could be any number of<br/>10 formulas that would do it. But we do know that<br/>11 it keeps applying a force until it gets to the<br/>12 angle that it wants to get to.<br/>13 Q. Would the force necessary to rotate<br/>14 the swing leg from retracted to the projecting<br/>15 position be reduced if it's raised off the<br/>16 ground?<br/>17 MR. HIGH: Objection. Form.<br/>18 THE WITNESS: I would say<br/>19 probably the forces are less if you're raised<br/>20 off the ground. It kind of depends on how you<br/>21 would be driving it. If you were driving it<br/>22 in -- for example, if you're driving it slightly<br/>23 downhill and you wanted to go from the retracted<br/>24 position to the projecting position, it would<br/>25 actually be forces kind of helping you do that</p> | <p style="text-align: right;">Page 115</p> <p>1 Q. Can you think of an operating<br/>2 condition that would require less force in<br/>3 rotating the swing leg as opposed to picking it<br/>4 up off the ground and rotating --<br/>5 A. Yes. As I just described to you, if<br/>6 you're going down a hill, if you're going down<br/>7 an incline and you're going from the retracted<br/>8 position to the projected, you basically have to<br/>9 move the leg backward. You have to move it out<br/>10 and backward. But because you're going down the<br/>11 hill, the forces are going to be pushing<br/>12 backward on the crawler track and the swing leg.<br/>13 So in that case those operating conditions are<br/>14 going to help you swing the leg out.<br/>15 Q. Again, in your opinion, though, would<br/>16 that force, even in that scenario going<br/>17 downhill, be greater than or less than the force<br/>18 required when the track is not engaged with the<br/>19 ground?<br/>20 MR. HIGH: Objection. Form.<br/>21 THE WITNESS: The force required<br/>22 to swing the leg when it's up in the air, let's<br/>23 call that 1, so we have a number. If I'm going<br/>24 down the hill and the ground is pushing backward<br/>25 on the track trying to swing the leg out, then</p> |
| <p style="text-align: right;">Page 114</p> <p>1 from the ground. The ground would be pushing<br/>2 the leg backwards because you're going down a<br/>3 hill.<br/>4 And then conversely, if you're going<br/>5 the other direction backwards, then there would<br/>6 be some forces from the ground helping you push<br/>7 the swing leg back into place. So it really<br/>8 depends on the operating conditions.<br/>9 BY MR. LAYDEN:<br/>10 Q. Whether or not the track is bearing<br/>11 some of the weight of the machine wouldn't<br/>12 impact the force required to rotate the swing<br/>13 leg?<br/>14 MR. HIGH: Objection. Form.<br/>15 THE WITNESS: It would impact the<br/>16 amount of force required. I'm just pointing out<br/>17 sometimes the impact would actually be<br/>18 beneficial. It would help you move the swing<br/>19 leg and then sometimes it will clearly go<br/>20 against you as well. So it depends on the<br/>21 operating conditions whether or not the ground<br/>22 forces are acting in the direction you want to<br/>23 go, or against the direction that you want to<br/>24 go.<br/>25 BY MR. LAYDEN:</p>                                                                                                                                        | <p style="text-align: right;">Page 116</p> <p>1 I'm going to be able to swing the leg out with a<br/>2 force less than 1 because the force is acting in<br/>3 the direction that I want the leg to go. So it<br/>4 could be, let's say, .8 because the ground force<br/>5 is contributing a portion of the force required<br/>6 to swing the leg out and back.<br/>7 BY MR. LAYDEN:<br/>8 Q. What about if the machine was being<br/>9 operated on level ground, would that force from<br/>10 the elevated position and swinging it out be<br/>11 greater or less than the force required when the<br/>12 track is engaged with the ground and moving<br/>13 forward?<br/>14 A. If you're in a level condition, it's<br/>15 probably going to be less force required to<br/>16 swing the leg if you jack it off the ground.<br/>17 Q. Why would you have -- strike that.<br/>18 How would you get a rotary actuator to<br/>19 produce more force?<br/>20 A. There's a couple of ways. It really<br/>21 depends on the design of the rotary actuator.<br/>22 Let's use a worm drive, since that comes up a<br/>23 lot here. To get more torque out of a worm<br/>24 drive, you can get a bigger, stronger actuator<br/>25 that's driving the worm. You could use a</p>                                    |

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| <p style="text-align: right;">Page 117</p> <p>1 greater number of worm teeth per inch. And you<br/>2 could use a larger worm diameter. Those are<br/>3 probably the three main ways of increasing the<br/>4 torque out of a -- say you're starting with sort<br/>5 of a default design of a worm gear, worm gear<br/>6 drive.<br/>7 Q. Would changes need to be made to the<br/>8 hydraulic system powering those gears?<br/>9 A. Nothing. So you won't have to change<br/>10 the hydraulic system for those changes. But you<br/>11 do bring up a good point. You could increase<br/>12 the pressure within your hydraulic system so you<br/>13 can get a bigger hydraulic pump and run it like<br/>14 7,000 PSI instead of 5,000 PSI, and then you<br/>15 would also get additional torque out of a worm<br/>16 drive.<br/>17 Q. Can you explain for me how more<br/>18 hydraulic pressure produces more force on the<br/>19 rotary drive?<br/>20 A. Sure. Well, hydraulic pressure, you<br/>21 know, that's the amount of force per area that<br/>22 the hydraulic oil has. So holding everything<br/>23 else the same and you're having this hydraulic<br/>24 oil push to turn your worm drive, if everything<br/>25 stays the same, then it's like the same area</p> | <p style="text-align: right;">Page 119</p> <p>1 rotate about a second axis to a second angular<br/>2 orientation relative to the jacking column;<br/>3 right?<br/>4 A. Yes.<br/>5 Q. That element in the '318 you're<br/>6 contending is similar to element 17D, 17E, 17F<br/>7 of the '749 patent?<br/>8 A. Yes.<br/>9 Q. Looking at element 17E of the '749<br/>10 patent, it states: A rotary connection between<br/>11 a jacking column and a crawler track permitting<br/>12 relative rotational movement of the crawler<br/>13 track and jacking column about a first upright<br/>14 axis. Do you see that?<br/>15 A. Yes.<br/>16 Q. Can you provide for me your<br/>17 interpretation of what it means to permit<br/>18 relative rotational movement of the crawler<br/>19 track and jacking column about a first upright<br/>20 axis?<br/>21 MR. HIGH: Objection. Form.<br/>22 Scope.<br/>23 THE WITNESS: Sure. So I think I<br/>24 followed your question. I mean, there's stuff<br/>25 that goes before this, obviously, to lay the</p>                                                                                                                                                                                                                                                    |
| <p style="text-align: right;">Page 118</p> <p>1 that you're pushing on, you would just have a<br/>2 larger force because your pressure goes up, so<br/>3 your force goes up, because your area is the<br/>4 same.<br/>5 Q. Can you turn to Page 35 of your<br/>6 declaration for me.<br/>7 A. Okay.<br/>8 Q. Here you compare the claim language of<br/>9 the '318 patent, which is at issue here, to the<br/>10 '749 patent, which was part of an earlier<br/>11 action. Do you see that?<br/>12 A. Yes.<br/>13 Q. If you turn to Page 36, there you have<br/>14 what looks like your analysis for -- on 1C of<br/>15 the '318 in the left-hand column?<br/>16 A. Yes.<br/>17 Q. And Claim 17 of the '749?<br/>18 A. Yes.<br/>19 Q. Is it your opinion that the claims of<br/>20 the '318 are similar to that of the '749?<br/>21 A. Yes.<br/>22 Q. And in particular, the limitation 1C<br/>23 of the '318 patent, you claim that a crawler<br/>24 track rotatably coupled to the jacking column<br/>25 wherein the crawler track is configured to</p>                                                                                                                                                                                                                  | <p style="text-align: right;">Page 120</p> <p>1 ground work. But when we get to this part of<br/>2 the claim, what it's claiming is that a jacking<br/>3 column, obviously, and a crawler track on that,<br/>4 and they're permitted to have rotational<br/>5 movements, that is, the crawler track can rotate<br/>6 when the jacking column stays in one place. And<br/>7 in this case the first upright axis is a<br/>8 vertical axis that's nominally running through<br/>9 the jacking column.<br/>10 BY MR. LAYDEN:<br/>11 Q. This same claim, 17E of the '749<br/>12 patent that you have here on Page 36, permitting<br/>13 relative rotational movements of the crawler<br/>14 track and the jacking column, do you interpret<br/>15 that to be -- to mean that the jacking column<br/>16 and the crawler track can rotate?<br/>17 MR. HIGH: Objection. Form.<br/>18 THE WITNESS: I think that they<br/>19 can because I know the stuff before this in the<br/>20 claim. But this one is speaking just to the<br/>21 relative rotational movement. So the relative<br/>22 rotational movement is easily thought about when<br/>23 you, in your mind, assume one is fixed and the<br/>24 other one rotates and it's able to do that. So<br/>25 that's what permitting relative rotational</p> |

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| <p style="text-align: right;">Page 121</p> <p>1 motion can be.</p> <p>2 That's contrasted to a case where they</p> <p>3 were all locked together and they couldn't</p> <p>4 rotate relative together, but like maybe the</p> <p>5 whole contraption could rotate. So that's all</p> <p>6 it's speaking to is that there is what we call a</p> <p>7 degree of freedom between the jacking column and</p> <p>8 the crawler track. They can be pointed in</p> <p>9 different directions.</p> <p>10 BY MR. LAYDEN:</p> <p>11 Q. Do you see in Claim 17E, though, it</p> <p>12 says movements, not movement though?</p> <p>13 A. I didn't hear the last part.</p> <p>14 Q. In Claim 17 it says movements, not</p> <p>15 movement, relative rotational movements of the</p> <p>16 crawler track and the jacking column.</p> <p>17 A. I see movements, yes.</p> <p>18 Q. Is that suggestive of rotational</p> <p>19 movements of the crawler track and rotational</p> <p>20 movements of the jacking column?</p> <p>21 A. Yes, it is. So I mean, if you're</p> <p>22 holding the crawler track fixed, you could</p> <p>23 rotate the jacking column, or you could hold the</p> <p>24 jacking column and rotate the crawler tracks.</p> <p>25 Those are movements. And they're relative, that</p> | <p style="text-align: right;">Page 123</p> <p>1 THE WITNESS: I don't think so.</p> <p>2 But can you ask your question again? I didn't</p> <p>3 quite fully understand your question.</p> <p>4 BY MR. LAYDEN:</p> <p>5 Q. Is limitation 1C of the '318 patent,</p> <p>6 in your opinion, limited to only rotational</p> <p>7 movements occurring in the crawler track?</p> <p>8 MR. HIGH: Same objection.</p> <p>9 THE WITNESS: I don't think so.</p> <p>10 The problem with rotational motions is that to</p> <p>11 understand them you have to define a reference</p> <p>12 frame, if you will. Like you have to establish</p> <p>13 like a zero position. So it's not that</p> <p>14 specific, I think. It's not that limiting to</p> <p>15 what you're suggesting there. I think, for</p> <p>16 example, the swing leg could be moving and the</p> <p>17 crawler track could keep pointing straight</p> <p>18 ahead, and that motion combined would read on</p> <p>19 this because the crawler track is rotatably</p> <p>20 coupled to the jacking column, but in some sense</p> <p>21 the crawler track isn't rotating, it's still</p> <p>22 pointing straight ahead. But what it's attached</p> <p>23 to, the jacking column is rotating. So again,</p> <p>24 it's not that specific. Either one of those</p> <p>25 motions lead to the rotatable coupling that is</p> |
| <p style="text-align: right;">Page 122</p> <p>1 is, the two objects are rotating relative to</p> <p>2 each other.</p> <p>3 Q. So is it then under your</p> <p>4 interpretation that either the crawler track or</p> <p>5 the jacking column can rotate in satisfaction of</p> <p>6 Claim 17E of the '749 patent?</p> <p>7 MR. HIGH: Objection. Form.</p> <p>8 Scope.</p> <p>9 THE WITNESS: Yeah, to achieve</p> <p>10 relative rotation, there's actually no -- you</p> <p>11 know, just looking at that portion of it there's</p> <p>12 no requirement that one has to be fixed. Either</p> <p>13 one could do it to satisfy that limitation.</p> <p>14 BY MR. LAYDEN:</p> <p>15 Q. In looking at the limitation of the</p> <p>16 '318 1C it says, a crawler track rotatably</p> <p>17 coupled to the jacking column and it continues</p> <p>18 to say wherein the crawler track is configured</p> <p>19 to rotate about the second axis to a second</p> <p>20 angular orientation relative to the jacking</p> <p>21 column.</p> <p>22 A. Yes.</p> <p>23 Q. Is 1C in the '318 patent limited to</p> <p>24 only rotational movements of the crawler track?</p> <p>25 MR. HIGH: Objection. Form.</p>                                                                                       | <p style="text-align: right;">Page 124</p> <p>1 claimed there.</p> <p>2 BY MR. LAYDEN:</p> <p>3 Q. In looking at the claims of the '318</p> <p>4 patent, is it your opinion, then, that pivoting</p> <p>5 the swing arm equates to rotating the jacking</p> <p>6 column?</p> <p>7 MR. HIGH: Objection. Form.</p> <p>8 THE WITNESS: It's not equating</p> <p>9 to it, but it could lead to it.</p> <p>10 BY MR. LAYDEN:</p> <p>11 Q. So if I pivot the swing leg as taught</p> <p>12 in the '318 patent, does that rotate any part of</p> <p>13 the jacking column?</p> <p>14 A. It could, if the jacking column was</p> <p>15 rigidly attached to the end of the swing arm.</p> <p>16 If it's rigidly attached out there and not</p> <p>17 moving, then when the swing arm swings, the</p> <p>18 jacking column is going to swing with it.</p> <p>19 Q. Is swinging different than rotation?</p> <p>20 A. It could be, but they both involve</p> <p>21 rotation.</p> <p>22 Q. Does the '318 patent use both swing</p> <p>23 and rotation in its claims?</p> <p>24 A. That I'm not sure about. But</p> <p>25 certainly the swing arm is rotating -- the thing</p>                                                                                                                                                                                                            |

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| <p style="text-align: right;">Page 125</p> <p>1 about rotation is again, I mentioned this<br/>2 before, to understand it clearly, you want to<br/>3 define like a reference frame or a point. So<br/>4 the swing arm is swinging, as you can imagine,<br/>5 back and forth, and it's clearly rotating about<br/>6 an axis that is through its hinge point. Now,<br/>7 it also rotates through other axes if you want<br/>8 to get fancy and do dynamic analysis.<br/>9 So I think there would be an<br/>10 interpretation that swinging might be referring<br/>11 to the overall motion, like a playground swing,<br/>12 but some analysis would clearly indicate that<br/>13 that swing is rotating, and you just have to<br/>14 choose which axis you want to talk about when<br/>15 you say it's rotating to make it kind of clear.<br/>16 Q. If I understand you correctly, then,<br/>17 the swing arm in the '318 patent lets you pivot<br/>18 about an axis through its hinge bracket?<br/>19 A. Yes, and that's another word --<br/>20 pivoting could also be another word for<br/>21 rotating.<br/>22 Q. And in the '318 patent rotation is<br/>23 discussed in relation to the crawler track about<br/>24 the axis of jacking column; is that also<br/>25 correct?</p> | <p style="text-align: right;">Page 127</p> <p>1 possibility if you chose not to -- if you chose<br/>2 not to counter-rotate the crawler track while<br/>3 you're pivoting the swing leg, then yes, the<br/>4 crawler track will rotate and in fact, that's<br/>5 kind of one of the claims is that I don't want<br/>6 that a lot of the time. As I swing out, I want<br/>7 to counter-rotate and keep the crawler track<br/>8 pointed straight ahead. That's one of the<br/>9 things it's claiming. But it's not, I don't<br/>10 think, disclaiming the other one. It's just<br/>11 saying -- it's saying my invention can't do the<br/>12 other; it could do the other.<br/>13 Q. So Claim 1C then discusses that the --<br/>14 states that the crawler track is configured to<br/>15 rotate relative to the jacking column. Does<br/>16 that mean parts of the jacking column are also<br/>17 rotating?<br/>18 A. It's not speaking to that. It's just<br/>19 saying that the -- this limitation isn't<br/>20 describing the whole machine. It's really just<br/>21 describing one part of the machine, which is<br/>22 that the crawler track is connected to the<br/>23 jacking column in such a way that it can rotate<br/>24 relative to the jacking column.<br/>25 Q. In the claims of the '318 how is the</p> |
| <p style="text-align: right;">Page 126</p> <p>1 A. Yes. It tends to use the word<br/>2 rotation when it's talking about the crawler<br/>3 track rotation. And when it talks about the<br/>4 swing leg rotation, it often calls that<br/>5 pivoting, I've noticed.<br/>6 Q. So in the claims of the '318 patent,<br/>7 then, when the swing arm is pivoted about the<br/>8 axis to its hinge bracket, is the jacking column<br/>9 also rotating about its axis?<br/>10 A. Yes, if it's rigidly attached to the<br/>11 end of the swing arm.<br/>12 Q. What do you mean by rigidly attached?<br/>13 A. Well, that it's not being allowed to<br/>14 counter-rotate. But some portion of the jacking<br/>15 column can counter-rotate, right, if the swing<br/>16 arm swings out 5 degrees and the, say, inner<br/>17 part of the jacking column and the crawler track<br/>18 are designed in such a way that it<br/>19 counter-rotates, then that part of the jacking<br/>20 column is not rotating, it's counter-rotating<br/>21 and adding up to zero.<br/>22 Q. So then is it your opinion that the<br/>23 '318 patent discloses rotating the jacking<br/>24 column and crawler track together?<br/>25 A. I mean it discloses that's a</p>                                      | <p style="text-align: right;">Page 128</p> <p>1 crawler track connected to the jacking column in<br/>2 such a way that it allows it to rotate?<br/>3 A. It's rotatably coupled.<br/>4 Q. Is that a direct coupling, or indirect<br/>5 coupling?<br/>6 MR. HIGH: Objection. Form.<br/>7 THE WITNESS: I'm not sure that<br/>8 terminology is used in this patent. Is it used<br/>9 somewhere in here?<br/>10 BY MR. LAYDEN:<br/>11 Q. I'm asking you.<br/>12 A. Oh, I don't know. I'm not aware of<br/>13 that being in the claim, so I don't think I<br/>14 addressed that issue because it's not part of<br/>15 the claim language.<br/>16 Q. If you go to limitation 1D it<br/>17 discusses a slew drive coupled to the jacking<br/>18 column and the crawler track. Do you see?<br/>19 A. Yes.<br/>20 Q. Does that inform your opinion as to<br/>21 whether this coupling is direct or indirect?<br/>22 A. Again, I'm not sure what you mean by<br/>23 direct and indirect. We never answered that<br/>24 question. I just think it is what it is. It's<br/>25 just coupled to it.</p>                                                                                                                                                                                                                              |

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| <p style="text-align: right;">Page 129</p> <p>1 Q. What do you understand direct coupling<br/>2 to mean?<br/>3 A. That's what I'm saying, I don't<br/>4 understand it -- I mean, I understand it in a<br/>5 general sense, but you're -- we're talking about<br/>6 me interpreting claims, and I need to be careful<br/>7 about that. So I could see a situation where a<br/>8 specification defines directly coupled. It<br/>9 could say directly coupled as in two surfaces<br/>10 bolted together and touching. And the<br/>11 specification could also say we are going to use<br/>12 the term indirect coupling, and that allows<br/>13 there to be a piece of intervening metal between<br/>14 these parts. I don't remember any of that kind<br/>15 of stuff in the specification. So that's why it<br/>16 doesn't have a clear specific meaning to me in<br/>17 the context of these claims.<br/>18 Q. In your work in the private sector and<br/>19 as a professor, have you ever used the term<br/>20 coupled?<br/>21 A. Yes.<br/>22 Q. When you use the term coupled, how do<br/>23 you mean it?<br/>24 MR. HIGH: Objection. Form.<br/>25 THE WITNESS: It would really</p> | <p style="text-align: right;">Page 131</p> <p>1 that when you want to pave in a certain<br/>2 direction, let's say north, you set up the<br/>3 machine, and it's got various parts in there and<br/>4 you can move in that direction that you want to<br/>5 pave instead of like sideways.<br/>6 Q. Does the '318 patent indicate to you,<br/>7 then, in its preamble of Claim 1 that the<br/>8 machine is moving while undergoing the claim<br/>9 elements shown in Claim 1?<br/>10 MR. HIGH: Objection. Form.<br/>11 THE WITNESS: I think just the<br/>12 preamble alone is not requiring that, it's not<br/>13 requiring movement. It's just saying being<br/>14 configured to move.<br/>15 BY MR. LAYDEN:<br/>16 Q. So it doesn't have to move, in your<br/>17 opinion, then?<br/>18 A. Yeah, I think just the preamble alone<br/>19 is not requiring that.<br/>20 MR. LAYDEN: Let's take a<br/>21 five-minute break.<br/>22 (1:34 p.m. - Recess taken.)<br/>23<br/>24<br/>25</p>                                                                                                                                                                                                         |
| <p style="text-align: right;">Page 130</p> <p>1 depend on the situation that I was using it in<br/>2 and what had been said before leading up to it.<br/>3 But in a very general sense we mean that two<br/>4 parts -- we need to say like two parts are<br/>5 coupled together. We usually indicate there's<br/>6 some sort of connection between them. But<br/>7 coupling is not that clear of a term. If you<br/>8 want to get a real clear definition of coupling,<br/>9 you have to make assumptions and clarify what<br/>10 you're talking about.<br/>11 BY MR. LAYDEN:<br/>12 Q. I'd have you turn back to Page 35,<br/>13 please.<br/>14 A. Okay.<br/>15 Q. At the very top of your chart you<br/>16 compare the preambles of the two claims between<br/>17 the '318 and the '749 patent. Do you see that?<br/>18 A. Yes.<br/>19 Q. In the preamble of the '318 patent it<br/>20 discusses a paving machine configured to move in<br/>21 a paving direction. Do you see that?<br/>22 A. Yes.<br/>23 Q. What does configured to move in a<br/>24 paving direction mean?<br/>25 A. That means the machine is set up so</p>                                                      | <p style="text-align: right;">Page 132</p> <p>1 (At 2:45 p.m. with parties present as<br/>2 before, the following proceedings were had,<br/>3 to-wit:)<br/>4 BY MR. LAYDEN:<br/>5 Q. Dr. Singhose, if you can turn to<br/>6 Page 45 of your declaration for me.<br/>7 A. Okay.<br/>8 Q. On Page 45 you begin explaining your<br/>9 rationale for combining CIII in Rio, and it<br/>10 starts in Paragraph 56. At the bottom of that<br/>11 paragraph, essentially the last half of that one<br/>12 sentence, you explain a list of what you believe<br/>13 are motivations for why a person of skill would<br/>14 make this combination. Do you see that?<br/>15 A. Yes.<br/>16 Q. Within that list you have improving<br/>17 maneuverability of the paver. Why would a<br/>18 POSITA be motivated to improve the<br/>19 maneuverability of the paver?<br/>20 A. Well, these are fundamentally sort of<br/>21 big, clunky machines, and they are kind of hard<br/>22 to move around. So you would just want it to be<br/>23 easier to move around, both setting it up, like<br/>24 trying to get it into position -- you're trying<br/>25 to remember to align it in the desired position</p> |

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| <p style="text-align: right;">Page 133</p> <p>1 to make the road, there might even be that<br/>2 guideline over there, so you're going to have to<br/>3 move it into position to kind of wiggle it<br/>4 around or jog it back and forth, get it to its<br/>5 starting position. That would be aided a lot if<br/>6 you had a more maneuverable machine as opposed<br/>7 to one that took forever to turn.<br/>8 You'd also want a little bit more<br/>9 maneuverability while you're operating it, but<br/>10 mainly I was thinking about moving it around the<br/>11 job site and getting it into position, that this<br/>12 combination would really help in that regard.<br/>13 Q. Earlier you said these machines move<br/>14 very slowly. Do you recall that?<br/>15 A. Yes.<br/>16 Q. If they're already moving slow, where<br/>17 would the need for improved mobility,<br/>18 maneuverability come from?<br/>19 A. Well, the moving slow is the primary<br/>20 reason why you would need it. If you're not in<br/>21 position, say you're one foot too far to the<br/>22 west, then if it moves really slow and you have<br/>23 to go forward and backward and forward and<br/>24 backward and kind of like parallel park the<br/>25 thing, get it closer to the curb, if you will,</p> | <p style="text-align: right;">Page 135</p> <p>1 Q. And in the projected position, I<br/>2 believe if you turn back to exhibit -- the Rio<br/>3 exhibit on column -- where is it -- Column 4,<br/>4 beginning at Line 8 and going down to 37, it's<br/>5 discussing steering. Do you see that?<br/>6 A. Yes, I do.<br/>7 Q. Beginning on Column 35, it talks about<br/>8 steering the rear ground engaging units in a<br/>9 more complicated manner. Right?<br/>10 A. Yes.<br/>11 Q. Does that indicate to you that Rio is<br/>12 improving the maneuverability of the machine<br/>13 through its ability to project and retract its<br/>14 swing arm?<br/>15 MR. HIGH: Objection. Form.<br/>16 THE WITNESS: I don't think that<br/>17 sentence is speaking directly to the issue we're<br/>18 talking about, right. That part of it is not<br/>19 saying therefore, you're more or less<br/>20 maneuverable. It's just saying when you have<br/>21 that swing leg it's got this extra degree of<br/>22 freedom so if you're going to steer it, the<br/>23 steering mechanism is going to be a little bit<br/>24 more complicated. But that's not speaking to<br/>25 maneuverability per se.</p> |
| <p style="text-align: right;">Page 134</p> <p>1 the fact you're going slow makes that take a<br/>2 long time. But if you could, for example, turn<br/>3 all your tracks 90 degrees and just drive<br/>4 straight sideways and then turn your tracks<br/>5 back, that's going to save you a lot of time.<br/>6 That's what I mean by maneuverability. You<br/>7 could make sort of different directions of<br/>8 motion.<br/>9 Q. Does Rio disclose improving<br/>10 maneuverability in its design?<br/>11 A. Well, yeah, fundamentally Rio is --<br/>12 its kind of whole point is to be more<br/>13 maneuverable in the sense that you can maneuver<br/>14 around and closer to obstacles. That's -- like<br/>15 the fundamental purpose of Rio is to pull that<br/>16 arm in and let me maneuver or get close to the<br/>17 curb. So yeah, it's an inherent part or a<br/>18 really important part of Rio.<br/>19 Q. Would the important part of Rio also<br/>20 be allowing for stability?<br/>21 A. Yes. We talked about that. So this<br/>22 maneuverability that you get, you get it at the<br/>23 sacrificing of a little bit of stability with<br/>24 the Rio design when you go from the projecting<br/>25 to the retracted position.</p>                                               | <p style="text-align: right;">Page 136</p> <p>1 BY MR. LAYDEN:<br/>2 Q. How would that give you increased<br/>3 maneuverability?<br/>4 A. How would what give you increased<br/>5 maneuverability?<br/>6 Q. Having the leg in either the<br/>7 projecting or retracted position?<br/>8 A. Oh, okay. So suppose that you're in<br/>9 the projecting position, and you're milling your<br/>10 road and you're coming up to an obstacle. To go<br/>11 around that obstacle you would have to swing out<br/>12 and around it far enough so that you're<br/>13 projecting the leg to clear the obstacle. But<br/>14 if you're able to retract that leg, then you<br/>15 don't have to swing out as far. You can go<br/>16 right up against the obstacle much closer.<br/>17 That's an example of being more maneuverable.<br/>18 You can get closer to an obstacle and save time.<br/>19 Q. So would Rio be better served just<br/>20 keeping its leg in the retracted position the<br/>21 entire time?<br/>22 MR. HIGH: Objection. Form.<br/>23 THE WITNESS: I don't think so,<br/>24 because then you would have a less stable<br/>25 machine. And it's telling me -- Rio is teaching</p>          |

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| <p style="text-align: right;">Page 137</p> <p>1 me I need a wider base of support and so I'm<br/>2 going to swing this leg out and get a wider<br/>3 base.<br/>4 BY MR. LAYDEN:<br/>5 Q. And the swing legs is what provides<br/>6 that wider base; is that accurate?<br/>7 A. Yes, fundamentally, sure.<br/>8 Q. And how would the combination of CIII<br/>9 and Rio increase maneuverability of the paver by<br/>10 use of Rio's swing leg?<br/>11 MR. HIGH: Objection. Form.<br/>12 THE WITNESS: Well, if Rio's<br/>13 swing leg and controller were on the CIII, then<br/>14 when you wanted to move the swing legs say<br/>15 outward to get more stability, or inward to go<br/>16 around an obstacle, you would not have to go<br/>17 through the whole complicated process of<br/>18 stopping the machine and loosening the turn<br/>19 buckles or moving the turn buckles and swinging<br/>20 the legs and reattaching that.<br/>21 So the fact is if you just wanted to<br/>22 go around an obstacle or swerve out a little<br/>23 bit, it would be much easier with the Rio swing<br/>24 arms and controller installed, and that's what I<br/>25 mean by maneuverability in that case.</p> | <p style="text-align: right;">Page 139</p> <p>1 more compact?<br/>2 A. The swing legs?<br/>3 Q. The swing leg of Rio, how would that<br/>4 make CIII a more compact apparatus?<br/>5 MR. HIGH: Objection. Form.<br/>6 THE WITNESS: Well, I'm not<br/>7 saying the swing leg of Rio here, I'm saying the<br/>8 rotary actuator. So the rotary actuator is more<br/>9 compact than a long cylinder attached to a<br/>10 linkage which would be sticking off the side.<br/>11 That's what I'm talking about here.<br/>12 BY MR. LAYDEN:<br/>13 Q. And what do you mean by high torque in<br/>14 that sentence?<br/>15 A. High torque is a device that can<br/>16 create a large amount of torque, rotational<br/>17 force, in a compact apparatus. And these worm<br/>18 drives are well known to be devices that create<br/>19 a lot of torque and they're relatively compact<br/>20 in their design.<br/>21 Q. Can you provide an estimation of how<br/>22 long worm drives have been around for?<br/>23 A. Thousands of years. I mean, there are<br/>24 sketches of them, related devices, back in Greek<br/>25 times.</p>                                            |
| <p style="text-align: right;">Page 138</p> <p>1 BY MR. LAYDEN:<br/>2 Q. And you would agree that Rio doesn't<br/>3 disclose changing the angle of its swing arm<br/>4 while the machine is engaged with the ground and<br/>5 moving?<br/>6 MR. HIGH: Objection. Form.<br/>7 THE WITNESS: We talked about<br/>8 that before. I don't think there's an explicit<br/>9 sentence in there that says you can do it but I<br/>10 think a person of ordinary skill in the art<br/>11 would understand you could do it.<br/>12 BY MR. LAYDEN:<br/>13 Q. If you could turn to Paragraph 59 on<br/>14 Page 47 for me, please.<br/>15 A. Okay.<br/>16 Q. And in that beginning sentence you<br/>17 state that a POSITA would have further been<br/>18 motivated to implement Rio's rotary actuator to<br/>19 provide a compact apparatus with high torque<br/>20 that achieves fine rotary steering control and<br/>21 provides rotary motion without the need for<br/>22 complicated and bulky linkages. Do you see<br/>23 that?<br/>24 A. Yes.<br/>25 Q. How would the swing legs make CIII</p>                                                                                                                | <p style="text-align: right;">Page 140</p> <p>1 Q. Would it be fair to say you reviewed a<br/>2 lot of references in preparation of your<br/>3 declaration?<br/>4 A. Yes.<br/>5 Q. And in any of those references, have<br/>6 you ever come across a paving machine using a<br/>7 slew drive?<br/>8 MR. HIGH: Objection. Form.<br/>9 THE WITNESS: Again, I think so.<br/>10 I pointed out several slew drives, and I think<br/>11 some of those references could have been paving<br/>12 machines. I think some of them are a little bit<br/>13 general as this is a construction machine that<br/>14 could have various things on the bottom, one of<br/>15 which could have been a paving machine.<br/>16 BY MR. LAYDEN:<br/>17 Q. But those references aren't actually<br/>18 disclosing paving machines, are they?<br/>19 MR. HIGH: Objection. Form.<br/>20 THE WITNESS: I'm not sure<br/>21 without reviewing them all whether or not it<br/>22 says this could be used for a paving machine.<br/>23 There are generally references that are sort of<br/>24 large rectilinear frames that could have<br/>25 anything on there, like Miller, for example, its</p> |

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| <p style="text-align: right;">Page 141</p> <p>1 frame, it has four crawler tracks that look just<br/>2 like a slipform paver, but what's in the middle<br/>3 there isn't specified, for example, in Miller.<br/>4 I think it happens to some of the<br/>5 other references, too, like Whitaker, for<br/>6 example. It's basically trying to claim a<br/>7 device that probably could be used for not just<br/>8 slipform paving, but certainly it could be used<br/>9 for slipform paving.<br/>10 BY MR. LAYDEN:<br/>11 Q. If you look at Paragraph 54 in your<br/>12 declaration, you state that CIII and Rio are<br/>13 analogous because they're road construction<br/>14 machines.<br/>15 A. That 54 on page --<br/>16 Q. 44.<br/>17 A. Okay, let me get back to that. Okay,<br/>18 I'm there.<br/>19 Q. You state that CIII and Rio are<br/>20 analogous art because they're road construction<br/>21 machines. Do you see that?<br/>22 MR. HIGH: Objection. Form.<br/>23 THE WITNESS: I see here they're<br/>24 in the same field of endeavor and the reason<br/>25 would be pertinent. I don't think I'm using the</p>        | <p style="text-align: right;">Page 143</p> <p>1 referenced in the IPR petition as Exhibit 1010<br/>2 GT-3200 Trimmer/Slipform Paver.<br/>3 (Exhibit 5 marked for identification.)<br/>4 THE WITNESS: I have that.<br/>5 BY MR. LAYDEN:<br/>6 Q. If you can go down to the last page,<br/>7 Page 8 for me, please.<br/>8 A. Okay.<br/>9 Q. On the right-hand side of the column<br/>10 it specifies the weight of the 3200. Can you<br/>11 tell me what that is, please?<br/>12 A. Up to 16,000 pounds.<br/>13 Q. And would the design considerations<br/>14 built into the machine of 16,000 pounds be<br/>15 different from one, let's say, anywhere from 30<br/>16 to 50,000 pounds?<br/>17 MR. HIGH: Objection to form.<br/>18 THE WITNESS: I mean, the design<br/>19 considerations for any machine is different from<br/>20 another machine that's different than it. But a<br/>21 lot of the design considerations would be the<br/>22 same. Especially if you're talking about a<br/>23 30,000 pound slipform paver, they would have a<br/>24 lot of the same concerns. Being able to load up<br/>25 onto a truck, being able to make it</p>                                                                                                 |
| <p style="text-align: right;">Page 142</p> <p>1 words that you're using.<br/>2 BY MR. LAYDEN:<br/>3 Q. Go down to, I believe, the third<br/>4 sentence.<br/>5 A. Okay. Down there, yeah, I say CIII<br/>6 and Rio are in the same field of endeavor as<br/>7 '318 patent because they each describe swing leg<br/>8 assemblies for road construction machines.<br/>9 Q. Now turning back to your paragraph on<br/>10 59, on Page 47.<br/>11 A. Okay.<br/>12 Q. Which of those references there are<br/>13 road construction machines?<br/>14 MR. HIGH: Objection. Form.<br/>15 THE WITNESS: I don't have them<br/>16 all in front of me, but I would say a lot of<br/>17 them -- for example, GT-3200 says<br/>18 trimmer/slipform paver. So that one is clearly<br/>19 it. But without pulling them out and knowing<br/>20 what they say, I know for a fact they're<br/>21 construction machines. But exactly what kind, I<br/>22 don't know from looking at this list. I would<br/>23 want to see each of the references themselves.<br/>24 MR. LAYDEN: I'm dropping into<br/>25 the chat what will be Exhibit 5. Exhibit 5 is</p> | <p style="text-align: right;">Page 144</p> <p>1 maneuverable, being able to run off diesel.<br/>2 Just all kinds of stuff that would be the same.<br/>3 Being able to vibrate the concrete. So there<br/>4 would be just a whole bunch the same but<br/>5 certainly there would be some differences.<br/>6 BY MR. LAYDEN:<br/>7 Q. What application would the 3200 be<br/>8 used for?<br/>9 A. This machine is designed to be a<br/>10 slipform paver for relatively smaller -- smaller<br/>11 widths of concrete like curbs and sidewalks.<br/>12 I'm not sure exactly how wide it can go. You<br/>13 could use it for roads probably if you did like<br/>14 two strips, maybe two five-foot strips you could<br/>15 make a road. So it's definitely set up to be a<br/>16 little bit more narrow than one of the huge<br/>17 slipform pavers.<br/>18 Q. What effect would the reduced weight<br/>19 have on the force required to rotate the crawler<br/>20 track?<br/>21 A. Well, I mean, holding everything else<br/>22 the same, if you have less weight, you have less<br/>23 friction and so you can turn things easier.<br/>24 This one only has three crawler tracks, so -- it<br/>25 doesn't have four, so in that sense, three means</p> |

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| <p style="text-align: right;">Page 145</p> <p>1 that they're holding more weight than the<br/>2 comparable-sized one with four. And also really<br/>3 depends on the -- a lot of this would depend on<br/>4 the shape of the crawlers themselves, like the<br/>5 teeth and the feet and how long it was. If<br/>6 those get longer, like from toe to heel, heel to<br/>7 toe, that's when you get a lot more difficulty<br/>8 in turning, because you're grabbing a lot more<br/>9 of the ground when you go to do the turn. So<br/>10 there's a number of factors that go into that<br/>11 answer.</p> <p>12 MR. LAYDEN: I just dropped into<br/>13 the chat what will be marked as Exhibit 6.<br/>14 (Exhibit 6 marked for identification.)<br/>15 BY MR. LAYDEN:<br/>16 Q. Exhibit 6 is the Commander III<br/>17 Trimmer/Slipform Paver marketing brochure.<br/>18 A. Okay, I have that.<br/>19 Q. Go to Page 23 of the document for me,<br/>20 please.<br/>21 A. You said Page 23?<br/>22 Q. Yes.<br/>23 A. Okay. Almost at the end, okay. I see<br/>24 that. The Commander III specifications.<br/>25 Q. Correct. In the right-hand column it</p> | <p style="text-align: right;">Page 147</p> <p>1 has to be a lot bigger and wider. The<br/>2 dimensions of the crawler might be different.<br/>3 So there's no real good answer to your question<br/>4 except that there will be -- there could be much<br/>5 of the stuff the same, but there will be some<br/>6 stuff that's different.<br/>7 BY MR. LAYDEN:<br/>8 Q. What about the mechanical components<br/>9 used to rotate the crawler track, would they be<br/>10 the same or different?<br/>11 MR. HIGH: Objection. Form.<br/>12 THE WITNESS: Well, they could be<br/>13 the same if on the -- again, we were trying to<br/>14 answer the question of how much torque would be<br/>15 required to turn these, and we need to<br/>16 understand like how big the crawlers were and<br/>17 how much weight was on each one. But you, in<br/>18 fact, could use the same slew drive for both of<br/>19 these if the slew drive was like overdesigned<br/>20 for the smaller one, and appropriately designed<br/>21 for the bigger one. And a lot of companies<br/>22 actually do that so they don't have a bunch of<br/>23 different kind of parts on their machines;<br/>24 they'll pick one that works for their whole<br/>25 product line. So it could be the same one,</p> |
| <p style="text-align: right;">Page 146</p> <p>1 specifies the weight of the Commander III in the<br/>2 standard three-track and four-track modes. Do<br/>3 you see that?<br/>4 A. Yes, I do.<br/>5 Q. What's the weight of the standard<br/>6 three-track curb and gutter machine?<br/>7 A. The approximate weight it says is<br/>8 29,500 pounds.<br/>9 Q. What about the weight of the standard<br/>10 four-track machine?<br/>11 A. That is approximately 49,500 pounds.<br/>12 Q. So would one be able to just simply<br/>13 implement the design used on the GT-3200 into<br/>14 these machines of CIII, given the weight<br/>15 disparity?<br/>16 MR. HIGH: Objection. Form.<br/>17 THE WITNESS: Yeah, the design is<br/>18 not very specific. There's a bunch of stuff<br/>19 that would be in the design. Some of the things<br/>20 you could probably implement directly, such as<br/>21 water systems and probably the control system<br/>22 could be exactly the same sort of computer and<br/>23 sensors and stuff like that.<br/>24 But yeah, there's going to be a lot of<br/>25 stuff that could be different, like the frame</p>       | <p style="text-align: right;">Page 148</p> <p>1 actually.<br/>2 BY MR. LAYDEN:<br/>3 Q. Who made the 3200 machine?<br/>4 MR. HIGH: Objection. Form.<br/>5 THE WITNESS: Who made it?<br/>6 GOMACO, yeah.<br/>7 BY MR. LAYDEN:<br/>8 Q. Are you aware of any other machines<br/>9 that implemented the design of the 3200?<br/>10 MR. HIGH: Objection. Form.<br/>11 THE WITNESS: I didn't do that<br/>12 investigation.<br/>13 BY MR. LAYDEN:<br/>14 Q. Are you aware of any other GOMACO<br/>15 machines prior to its GP-3 that used a rotary<br/>16 actuator to rotate the crawler track?<br/>17 MR. HIGH: Objection. Form.<br/>18 THE WITNESS: I did not do that<br/>19 investigation.<br/>20 BY MR. LAYDEN:<br/>21 Q. Turning back to your declaration,<br/>22 Paragraph 59. You had mentioned Miller; is that<br/>23 correct?<br/>24 A. Yes, I think Miller is in there.<br/>25 MR. LAYDEN: Just uploaded what</p>                                                                                                                                                                                                                                                                                                                                                               |

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| <p style="text-align: right;">Page 149</p> <p>1 would be Exhibit 7, that is the Miller<br/>2 reference, labeled in the petition as<br/>3 Exhibit 1008.<br/>4 (Exhibit 7 marked for identification.)<br/>5 THE WITNESS: Okay, I have that.<br/>6 BY MR. LAYDEN:<br/>7 Q. Dr. Singhose, looking at Miller, it<br/>8 just refers to a construction machine, doesn't<br/>9 it, and not a paving machine?<br/>10 MR. HIGH: Objection. Form.<br/>11 THE WITNESS: It does call it a<br/>12 construction machine but it also calls it<br/>13 essentially a paving machine as well. For<br/>14 example, in the caption of Figure 19 it says<br/>15 it's showing a picture for laying pavement.<br/>16 That's a paving machine.<br/>17 BY MR. LAYDEN:<br/>18 Q. You contend that Miller's use of a<br/>19 rotary actuator was common prior to the '318<br/>20 patent; is that correct?<br/>21 MR. HIGH: Objection.<br/>22 THE WITNESS: I don't think I<br/>23 said it was common. I'm just pointing this out,<br/>24 it was well known. People knew to do this. I<br/>25 didn't do a marketing survey and come up with a</p> | <p style="text-align: right;">Page 151</p> <p>1 MR. HIGH: Same objections.<br/>2 THE WITNESS: Yeah, we were just<br/>3 looking at some, right, the 3200, for example.<br/>4 BY MR. LAYDEN:<br/>5 Q. What about the ones used to actually<br/>6 pave roads and highways, have you ever seen any<br/>7 of those use rotary actuators?<br/>8 MR. HIGH: Same objections.<br/>9 THE WITNESS: I don't think I did<br/>10 that analysis. So yeah, I didn't go out and<br/>11 find one paving the road around here to see how<br/>12 it turned its crawler tracks. I mean, all the<br/>13 crawler tracks are being turned to steer it, but<br/>14 I didn't do that investigation.<br/>15 MR. LAYDEN: I've uploaded into<br/>16 the chat what will be marked as Exhibit 8, and<br/>17 that is the Littman reference, disclosed as<br/>18 Exhibit 1007 in the petition.<br/>19 (Exhibit 8 marked for identification.)<br/>20 THE WITNESS: Okay, I have that.<br/>21 BY MR. LAYDEN:<br/>22 Q. Dr. Singhose, looking at Littman, in<br/>23 the abstract discusses a prime mover having a<br/>24 central body. Do you see that?<br/>25 A. Yes, I do.</p>                                                                       |
| <p style="text-align: right;">Page 150</p> <p>1 certain percentage and then say that's common or<br/>2 not. I didn't use that kind of evaluation.<br/>3 BY MR. LAYDEN:<br/>4 Q. Was the design and the disclosures in<br/>5 Miller ever developed commercially?<br/>6 MR. HIGH: Objection. Scope.<br/>7 Form.<br/>8 THE WITNESS: That, again, I<br/>9 didn't investigate. It's a pretty old patent,<br/>10 back into the '70s, so that would take a little<br/>11 bit of a historian to track the answer down to<br/>12 that question.<br/>13 BY MR. LAYDEN:<br/>14 Q. Well, when you were working with your<br/>15 asphalt company in the late '80s, did you ever<br/>16 encounter a slipform paver using rotary<br/>17 actuators to turn its tracks?<br/>18 MR. HIGH: Objection. Form.<br/>19 Scope.<br/>20 THE WITNESS: No, I did not at<br/>21 that time.<br/>22 BY MR. LAYDEN:<br/>23 Q. What about after that time? Have you<br/>24 ever encountered or seen a slipform paver using<br/>25 rotary actuators to turn its tracks?</p>                                                                          | <p style="text-align: right;">Page 152</p> <p>1 Q. Is Littman a road paving machine?<br/>2 A. I don't think so. I mean, this is a<br/>3 construction machine. It's showing the figures<br/>4 clearly as basically like an aerial lift is one<br/>5 of the uses of this Littman invention. I don't<br/>6 remember this one saying that it was a paving<br/>7 machine per se.<br/>8 Q. Would Littman be used in road<br/>9 construction?<br/>10 A. Yeah, I mean, it's -- you know, it has<br/>11 a lot of different functionality, and so you<br/>12 could use it -- it's shown clearly as an aerial<br/>13 lift. You could put -- instead of an aerial<br/>14 basket on there you could put forks on there and<br/>15 it could be like a fork truck and it could be<br/>16 used to, like, lift off parts of the frame or<br/>17 lift off a swing leg that you'd attached and put<br/>18 it on. So it could be that kind of a helper<br/>19 device on a construction site.<br/>20 Q. So it would function as a forklift,<br/>21 then?<br/>22 MR. HIGH: Objection. Form.<br/>23 THE WITNESS: Yeah, I think that<br/>24 it could. These machines that are aerial<br/>25 lifts -- we call this an aerial lift. The</p> |

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| <p style="text-align: right;">Page 153</p> <p>1 figure that's shown in Figure 1 is clearly<br/>2 designed to have a basket hanging off it with<br/>3 people in it. So there could be people in there<br/>4 and you lift them up to work on something.<br/>5 These often have the ability to detach that<br/>6 basket and to put on forks. So instead of<br/>7 lifting people, you would lift up and down,<br/>8 like, boxes and supplies. You see this at<br/>9 construction sites a lot, lifting up like<br/>10 building supplies up onto a roof. But you could<br/>11 also use these to, like I said, lift heavy<br/>12 materials around a construction site.<br/>13 BY MR. LAYDEN:<br/>14 Q. Then would Littman not be used in the<br/>15 direct construction of the road?<br/>16 MR. HIGH: Objection. Form.<br/>17 THE WITNESS: I mean, I think<br/>18 that is the direct construction of the road, but<br/>19 I don't think it's in the part that's laying the<br/>20 concrete. Like this seems like a little bit of<br/>21 a weird structure to use for the actual laying<br/>22 of the concrete.<br/>23 MR. LAYDEN: In the chat is what<br/>24 will be marked as Exhibit 9. Exhibit 9 is the<br/>25 Johns reference, which is indicated in the</p> | <p style="text-align: right;">Page 155</p> <p>1 THE WITNESS: What was the<br/>2 question?<br/>3 BY MR. LAYDEN:<br/>4 Q. What is the machine in Whitaker<br/>5 intended for use in?<br/>6 MR. HIGH: Same objection.<br/>7 THE WITNESS: Well, I don't think<br/>8 it has a single use, to be honest, when I looked<br/>9 over this. I think it's suggesting that you<br/>10 could use this as a frame for a machine that<br/>11 could do a variety of things. It's more of an<br/>12 invention of the frame and the driving structure<br/>13 rather than this sort of specific equipment that<br/>14 it's carrying. But it definitely says, for<br/>15 example, it's for railroad repair. That's one<br/>16 of the things that you could use it for.<br/>17 BY MR. LAYDEN:<br/>18 Q. How would railroad repair relate to<br/>19 road construction?<br/>20 A. Well, it's road construction but the<br/>21 road is for trains. And so these rails have to<br/>22 be repaired and updated just like roads have to<br/>23 be. And I've actually watched this happen. I<br/>24 live near railroad tracks. It's a pretty cool<br/>25 operation where you have to go and instead of a</p>                                                                                                                                                                |
| <p style="text-align: right;">Page 154</p> <p>1 petition as Exhibit 1009.<br/>2 (Exhibit 9 marked for identification.)<br/>3 THE WITNESS: Yes, I see that. I<br/>4 have it.<br/>5 BY MR. LAYDEN:<br/>6 Q. Dr. Singhose, is the Johns reference a<br/>7 road construction machine?<br/>8 A. Again, I don't think the road<br/>9 construction machine that lays the cement down.<br/>10 It's essentially related to the last one we were<br/>11 talking about, it's a mobile work platform,<br/>12 which is an aerial lift. So it's primarily<br/>13 designed to lift people and boxes and tools up<br/>14 to more elevated heights.<br/>15 MR. LAYDEN: Uploaded is what<br/>16 we've marked as Exhibit 10, the Whitaker<br/>17 reference, what we've referenced as<br/>18 Exhibit 1011.<br/>19 (Exhibit 10 marked for<br/>20 identification.)<br/>21 THE WITNESS: Okay, I have that.<br/>22 BY MR. LAYDEN:<br/>23 Q. Dr. Singhose, what is the machine in<br/>24 Whitaker intended for use in?<br/>25 MR. HIGH: Objection. Form.</p>                                                                                                                                                                                                                       | <p style="text-align: right;">Page 156</p> <p>1 grinding off with a road milling machine, you<br/>2 have to like pull the wood planks. There are<br/>3 these huge wood planks, you know, railroad ties<br/>4 you call them, you have to pull those out and<br/>5 then push another one in. Like that's one of<br/>6 the operations when the wood gets old.<br/>7 And it's pretty cool. They have these<br/>8 attachments where it actually digs out the rock,<br/>9 there's like an arm that goes in there and just<br/>10 conveys out the rock and spits it out sideways<br/>11 and you kind of clear it out, and you've got<br/>12 like a pincher -- a pincher device on there and<br/>13 you pull -- and you kind of pull it out<br/>14 sideways, and then you kind of do the reverse<br/>15 operation, push the other one back in.<br/>16 So that's a lot of what this is<br/>17 talking about is repairing the road of a train,<br/>18 which is the railroad.<br/>19 Q. And in repairing the railroad and what<br/>20 you witnessed, is the machine moving while the<br/>21 repair is taking place or is it stationary?<br/>22 A. I'm not sure it requires motion or<br/>23 inhibits motion. I mean, obviously you've got<br/>24 to drive to where you want to work. Probably a<br/>25 lot of the operations you're then stopping. But</p> |

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| <p style="text-align: right;">Page 157</p> <p>1 when you move to the next location down the<br/>2 railroad track to dig your next operation,<br/>3 that's when you would want to move these legs in<br/>4 and out and rotate the tracks so you could go<br/>5 around. There's often a lot of debris and crap<br/>6 around railroad tracks. So you're driving this<br/>7 down, you might want to pull it in and down<br/>8 around some old abandoned 55-gallon drum, and<br/>9 then put your leg back out again.<br/>10 So it's clearly made to operate during<br/>11 motion, but some of the operations certainly are<br/>12 done while it gets to a position, puts its arm<br/>13 out and stabilizes itself, and then starts<br/>14 pulling the railroad ties out. So there's<br/>15 motion operation and nonmotion operation with<br/>16 this machine.<br/>17 Q. By motion operation, do you mean the<br/>18 tracks moving forward as the machine is<br/>19 performing, either pulling the railroad ties<br/>20 out, putting them back in?<br/>21 A. I was basically speaking about when it<br/>22 was driving to the next location, right. So you<br/>23 drive up, you fix a few railroad ties -- like<br/>24 sometimes they go out and they spray, like an<br/>25 inspector goes out and spray these with paint,</p> | <p style="text-align: right;">Page 159</p> <p>1 its collar tracks.<br/>2 BY MR. LAYDEN:<br/>3 Q. As it's driving down the track, is it<br/>4 having to push any material, grind up any<br/>5 material, change any material, anything of that<br/>6 nature, or is it free to move on its own?<br/>7 A. I don't think I -- I didn't read the<br/>8 reference for that. I think I'd have to go back<br/>9 and reread it to see whether or not it discloses<br/>10 that it might use a greater -- or it might be<br/>11 dropping rocks along the way. I don't know all<br/>12 of the things, off the top of my head, what this<br/>13 is disclosed as doing.<br/>14 MR. LAYDEN: Also dropping into<br/>15 the chat Exhibit 11. Exhibit 11 is the<br/>16 Smolders, reference is 1012.<br/>17 THE WITNESS: Okay, I have<br/>18 Smolders. It's a slipform paver.<br/>19 (Exhibit 11 marked for<br/>20 identification.)<br/>21 BY MR. LAYDEN:<br/>22 Q. Does Smolders disclose a rotary<br/>23 actuator used to rotate its crawler tracks?<br/>24 MR. HIGH: Objection. Form.<br/>25 THE WITNESS: In Figure 5 it's</p>                                                                                                     |
| <p style="text-align: right;">Page 158</p> <p>1 like you've got to take these three railroad<br/>2 ties out here, and he keeps walking down the<br/>3 track and he spray paints the ones you've got to<br/>4 take out.<br/>5 So they put this machine on there and<br/>6 it drives down there and it pulls out the first<br/>7 three, and then it drives 50 meters down to the<br/>8 next ones. That's the way I've seen these kind<br/>9 of things operate.<br/>10 Q. So the only movement that it's<br/>11 engaging in then is when it's not actually<br/>12 performing any operational function of replacing<br/>13 the tracks?<br/>14 A. Do you mean there's no operation --<br/>15 are you trying to talk about the swing legs?<br/>16 Q. The swing legs and crawler tracks.<br/>17 When the machine is operating as it's intended,<br/>18 the machine is not moving; is that correct?<br/>19 MR. HIGH: Objection. Form.<br/>20 THE WITNESS: Well, I don't<br/>21 understand that because it's intended to drive<br/>22 down the tracks. So that's part of its intended<br/>23 operation is to drive down the tracks. And<br/>24 while it's driving down the tracks it's free to<br/>25 use the swing legs to go in and out and rotate</p>                                                                          | <p style="text-align: right;">Page 160</p> <p>1 disclosing an actuator that steers it, but it's<br/>2 more akin to the CIII design where it's a<br/>3 cylinder going in and out and it's connected to<br/>4 a linkage, and the combination of that linear<br/>5 rotation of the piston and the design of the<br/>6 mechanism leads to a rotation of the tracks.<br/>7 BY MR. LAYDEN:<br/>8 Q. If you turn to Column 6 of Smolders,<br/>9 beginning at Line 15 and ending at Line 35.<br/>10 A. I'm there.<br/>11 Q. Where it's talking about the steering<br/>12 gear mechanism?<br/>13 A. Yeah, I'm there.<br/>14 Q. Does Smolders disclose a design where<br/>15 in order to rotate the crawler track, parts of<br/>16 the lifting column are also rotating as well?<br/>17 A. I didn't follow the question. I'm<br/>18 sorry.<br/>19 Q. Does Smolders disclose a design where<br/>20 in order to rotate the crawler track, components<br/>21 of the jacking column are rotating as well?<br/>22 A. Oh, okay. Without rereading the whole<br/>23 document here to save us time, I'm looking at<br/>24 figure -- let's see, what figure is this? Top<br/>25 of the screen here -- Figure 3 shows a side view</p> |

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| <p style="text-align: right;">Page 161</p> <p>1 and it shows that steering -- I believe it shows<br/>2 the steering mechanism we were just talking<br/>3 about, and that cylinder goes out and attaches<br/>4 to that mechanism, and that mechanism is not at<br/>5 the very bottom of the lifting column, so that<br/>6 teaching there indicates, I think, that some<br/>7 portion of the lifting column like the inner<br/>8 part of it, is being rotated by the steering<br/>9 mechanism.<br/>10 Q. Why do you think the designs used on<br/>11 large slip -- strike that. Sorry.<br/>12 Why do you think that the design of<br/>13 large slipform pavers prior to 2010 included<br/>14 rotation of the jacking column and crawler track<br/>15 together?<br/>16 MR. HIGH: Objection. Form. Go<br/>17 ahead.<br/>18 THE WITNESS: I guess first of<br/>19 all I don't know that's the case. So given that<br/>20 I don't agree with the setup, I don't have an<br/>21 answer to the question because I don't know that<br/>22 for a fact. You're assuming the fact that<br/>23 that's the situation. I don't know that.<br/>24 Doesn't sound quite right to me.<br/>25 BY MR. LAYDEN:</p> | <p style="text-align: right;">Page 163</p> <p>1 THE WITNESS: Yeah, I mean, to<br/>2 the extent I'm understanding your interpretation<br/>3 of jacking column, the rotary actuator is at the<br/>4 bottom of the jacking column, between the bottom<br/>5 and the crawler track.<br/>6 BY MR. LAYDEN:<br/>7 Q. So then are you implying that the<br/>8 jacking column would be fixed in that situation?<br/>9 MR. HIGH: Objection. Form.<br/>10 THE WITNESS: Well, again, to the<br/>11 extent that I understand you, what being fixed<br/>12 means, yeah, I think that the telescoping part<br/>13 going in and out is fixed or probably keyed to<br/>14 the outer part because the rotary actuator is<br/>15 showing at the very bottom of that. So<br/>16 basically when you have the rotary actuators, to<br/>17 get their crawler track to rotate, the other<br/>18 side has to be fixed; you have to push off<br/>19 something.<br/>20 BY MR. LAYDEN:<br/>21 Q. Does Miller disclose swing legs?<br/>22 A. Let me see. I'm not sure I have a<br/>23 searchable version of it to be honest, and I<br/>24 don't seem to be able to search for that, and<br/>25 I'm not sure I did that investigation. That's</p> |
| <p style="text-align: right;">Page 162</p> <p>1 Q. Have you shown a reference of a large<br/>2 slipform paver actually using a rotary actuator<br/>3 to control the rotation of just the crawler<br/>4 track and not some part of the jacking column as<br/>5 well?<br/>6 MR. HIGH: Objection. Form.<br/>7 THE WITNESS: Yeah, remember that<br/>8 one that was -- what was the one I was talking<br/>9 about that was Figure 19 that was a paving<br/>10 machine? Do you remember that reference? We've<br/>11 gone through a lot. I'm sorry.<br/>12 BY MR. LAYDEN:<br/>13 Q. Figure 19, I do not.<br/>14 A. Remember I read that caption for<br/>15 Figure 19 on one of these. I think I can find<br/>16 it for you pretty quick here.<br/>17 Q. Are you thinking about Miller?<br/>18 A. Yeah. Let me pull that up and see.<br/>19 Yes, Miller. So remember, Miller can be a<br/>20 paving machine. We talked about that. That<br/>21 seems large to me, the way it's described and<br/>22 stuff, that's a large paving machine.<br/>23 Q. Does Miller disclose fixing the<br/>24 jacking column to the rotary actuator?<br/>25 MR. HIGH: Objection. Form.</p>                            | <p style="text-align: right;">Page 164</p> <p>1 not what I'm using it for.<br/>2 Q. Does Miller allow independent rotation<br/>3 of its crawler tracks?<br/>4 MR. HIGH: Objection. Form.<br/>5 THE WITNESS: Yes. I don't see<br/>6 anything that indicates they're all hooked<br/>7 together.<br/>8 BY MR. LAYDEN:<br/>9 Q. In Miller, though, at least two are<br/>10 hooked together by that cross beam, 64; is that<br/>11 correct?<br/>12 MR. HIGH: Object to form.<br/>13 THE WITNESS: Well, the 64 --<br/>14 yeah, 64 goes across and connects the -- I would<br/>15 say the outer housing of the fixed part of that.<br/>16 But there's an internal part that rotates. So<br/>17 theoretically, the right one, or let's say a<br/>18 front one could rotate five degrees, and let's<br/>19 say a back one could rotate six degrees.<br/>20 There's no teaching to me that those are all<br/>21 hooked together.<br/>22 BY MR. LAYDEN:<br/>23 Q. Can you turn to Page 72 of your<br/>24 declaration -- I'm sorry, Page 56, Paragraph 72.<br/>25 In your combination of --</p>                                                                                                                                 |

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| <p style="text-align: right;">Page 165</p> <p>1 A. I just got there. Sorry.</p> <p>2 Q. Okay. In your combination of CIII and</p> <p>3 Rio, are you replacing CIII's jacking column</p> <p>4 with Rio's?</p> <p>5 MR. HIGH: Objection to form.</p> <p>6 THE WITNESS: No.</p> <p>7 BY MR. LAYDEN:</p> <p>8 Q. So you're relying on the jacking</p> <p>9 column of CIII and modifying it based off the</p> <p>10 teaching of Rio; is that correct?</p> <p>11 MR. HIGH: Objection. Form.</p> <p>12 THE WITNESS: Yeah, again, the</p> <p>13 way I'm doing this is I'm using the combined</p> <p>14 teachings. So I don't think that I am just</p> <p>15 stuck with CIIIs or Rios. I am using the</p> <p>16 combined teachings to set up a jacking column</p> <p>17 that a person of ordinary skill in the art would</p> <p>18 do and would want to do and feel successful in</p> <p>19 their ability to set it up. That's what's going</p> <p>20 on here.</p> <p>21 BY MR. LAYDEN:</p> <p>22 Q. And so in those combined teachings</p> <p>23 would the inner tubular member of the jacking</p> <p>24 column be round or square?</p> <p>25 MR. HIGH: Objection. Form.</p> | <p style="text-align: right;">Page 167</p> <p>1 wheel; is that accurate?</p> <p>2 A. Yes, it does show some wheels.</p> <p>3 Q. In terms of rotating a component while</p> <p>4 it's contacting with the ground, is less force</p> <p>5 required to rotate a wheel than there is a</p> <p>6 crawler track?</p> <p>7 A. It would depend on the design of</p> <p>8 those, and the co-efficient of frictions and</p> <p>9 that sort of stuff. So crawler tracks are made</p> <p>10 out of metal, normally, and so metal has a lower</p> <p>11 co-efficient of friction than rubber, which is</p> <p>12 what tires would normally be made out of. Tires</p> <p>13 are designed not to slip. So without making a</p> <p>14 whole bunch of assumptions, we just don't know</p> <p>15 the answer to that. Like the rubber causes a</p> <p>16 lot of grip, and it would be hard to twist,</p> <p>17 whereas the tracks being metal would be easier</p> <p>18 to slide relative to a lot of surfaces. So it</p> <p>19 would depend on the specifics of the design and</p> <p>20 the surfaces that it's operating on.</p> <p>21 MR. LAYDEN: I've uploaded what</p> <p>22 will be marked as Exhibit 11 -- Exhibit 12, my</p> <p>23 apologies, that's the Tax reference, reference</p> <p>24 in the petition as Exhibit 1016.</p> <p>25 THE WITNESS: Okay, I have that</p> |
| <p style="text-align: right;">Page 166</p> <p>1 THE WITNESS: It could be either</p> <p>2 one. If you had the squared one, then you sort</p> <p>3 of have the built-in anti-rotation twisting that</p> <p>4 we talked about before. But if you want to use</p> <p>5 round members for your telescope, you could</p> <p>6 certainly do that. You just have to use the key</p> <p>7 and keyway feature that's commonly known.</p> <p>8 BY MR. LAYDEN:</p> <p>9 Q. If you could turn to Paragraph 80 for</p> <p>10 me, please, on Page 62.</p> <p>11 A. Okay, I'm there.</p> <p>12 Q. And there you're talking about how the</p> <p>13 combination of CIII and Rio would allow for</p> <p>14 adjustment of the swing legs and crawler tracks</p> <p>15 while moving underload. Do you see that?</p> <p>16 A. Yes.</p> <p>17 Q. And support for that, you cite to</p> <p>18 Littman and this other reference, Tax; is that</p> <p>19 correct?</p> <p>20 A. Yes.</p> <p>21 Q. And Littman we had discussed</p> <p>22 previously in Exhibit 8, if you can pull that</p> <p>23 up.</p> <p>24 A. Okay.</p> <p>25 Q. Littman, in its figures, shows a</p>                      | <p style="text-align: right;">Page 168</p> <p>1 open.</p> <p>2 (Exhibit 12 marked for</p> <p>3 identification.)</p> <p>4 BY MR. LAYDEN:</p> <p>5 Q. Dr. Singhose, looking at the abstract</p> <p>6 of Tax, that first sentence, does that indicate</p> <p>7 to you that Tax is using wheels or crawler</p> <p>8 tracks?</p> <p>9 MR. HIGH: Objection. Form.</p> <p>10 THE WITNESS: Well, that sentence</p> <p>11 specifically says it's using wheels.</p> <p>12 BY MR. LAYDEN:</p> <p>13 Q. Is there any disclosure that you're</p> <p>14 aware of in Tax using crawler tracks?</p> <p>15 A. There's certainly not a track coming</p> <p>16 up when I search for it. It looks like the use</p> <p>17 of track there, though, is the use of track</p> <p>18 where you're talking about the separation</p> <p>19 between your ground engaging members, if you</p> <p>20 will. So I'm not seeing anything that</p> <p>21 specifically says crawler tracks.</p> <p>22 Q. Are you aware of any reference that</p> <p>23 discloses rotating crawler tracks while the</p> <p>24 paving machine is moving and under load?</p> <p>25 A. I think -- weren't we just talking</p>                                                                                                                                                                                          |

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| <p style="text-align: right;">Page 169</p> <p>1 about that with the Miller one?</p> <p>2 Q. Yes.</p> <p>3 A. So I think that one does, yeah.</p> <p>4 Q. And turning back to Miller, does</p> <p>5 Miller rotate its crawler tracks in response to</p> <p>6 the pivot changes of its swing leg?</p> <p>7 MR. HIGH: Objection. Form.</p> <p>8 THE WITNESS: As we said before,</p> <p>9 I don't know that it discloses swing legs.</p> <p>10 BY MR. LAYDEN:</p> <p>11 Q. Is there any other reference you can</p> <p>12 think of aside from Miller that shows a machine</p> <p>13 rotating its crawler tracks in response to the</p> <p>14 changes to the pivot angle of its swing leg</p> <p>15 while moving and under load?</p> <p>16 MR. HIGH: Objection. Form.</p> <p>17 THE WITNESS: I think the Rio</p> <p>18 does that, the Rio reference. It's teaching us</p> <p>19 that I can swing my leg and I can rotate my</p> <p>20 crawler track at the same time.</p> <p>21 BY MR. LAYDEN:</p> <p>22 Q. Can you show me where in Rio that</p> <p>23 disclosure is made?</p> <p>24 MR. HIGH: Objection. Form.</p> <p>25 THE WITNESS: Sure. That's one</p>                                                                                                                                                                                                               | <p style="text-align: right;">Page 171</p> <p>1 there -- does not use those words, but a person</p> <p>2 of ordinary skill in the art looking at this</p> <p>3 would say oh, they've got a system, they're</p> <p>4 claiming a system here which has a pivot sensor</p> <p>5 and a rotate sensor, so it's sensing where those</p> <p>6 angles are. It goes into a controller and out</p> <p>7 of the controller is the ability to turn the</p> <p>8 first actuator and the second actuator, which is</p> <p>9 what turns the swing leg and the crawler track.</p> <p>10 So looking at this diagram, a person</p> <p>11 of ordinary skill in the art would view the</p> <p>12 machine capable of turning the swinging leg and</p> <p>13 at the same time rotating the crawler track, and</p> <p>14 that's a teaching that says the machine is</p> <p>15 capable of doing that.</p> <p>16 Q. Is there any other disclosure other</p> <p>17 than Figure 5 that provides --</p> <p>18 A. Yeah, there's lots of textual</p> <p>19 descriptions. I'm just kind of going through it</p> <p>20 there. If I had a good searchable version, I</p> <p>21 think it -- probably the disclosures are</p> <p>22 counter-rotate is what it talks about a lot. So</p> <p>23 if you search through there and you found the</p> <p>24 counter-rotation, usually those are descriptions</p> <p>25 of -- the machine is capable of swinging the leg</p> |
| <p style="text-align: right;">Page 170</p> <p>1 of the points of Rio is that it teaches a method</p> <p>2 that can swing the leg and counter-rotate the</p> <p>3 crawler track. So it's kind of throughout. But</p> <p>4 if you want to bring up a few sentences, let me</p> <p>5 try to find Rio again. What reference was that,</p> <p>6 again?</p> <p>7 Q. Rio was Exhibit 4. And it's in the</p> <p>8 deposition as Exhibit 1006.</p> <p>9 A. Sure. Well, we can start going</p> <p>10 through it. So, for example, Figure 5 is a</p> <p>11 diagram of the controller and the sensors and</p> <p>12 the actuators. So if you look at that diagram,</p> <p>13 you'll see -- on the left side you'll see a</p> <p>14 pivot sensor and a rotate sensor, and that's</p> <p>15 going into the controller, and then out the</p> <p>16 other side of the controller it's driving the</p> <p>17 first and second actuators, which would be the</p> <p>18 actuators that swing and ro -- swing the leg and</p> <p>19 rotate the crawler. So that's a disclosure that</p> <p>20 the machine is capable of doing that.</p> <p>21 Q. Figure 5 describes changing the</p> <p>22 rotational orientation of the crawler track in</p> <p>23 response to the swing leg while the machine is</p> <p>24 moving and under load?</p> <p>25 A. Well, it doesn't have all of that in</p> | <p style="text-align: right;">Page 172</p> <p>1 and at the same time counter-rotate the crawler</p> <p>2 track so that it can stay in a desired</p> <p>3 direction.</p> <p>4 A lot of it talks about keeping the</p> <p>5 crawler track pointed forward, but it actually</p> <p>6 goes beyond that and says that you can -- while</p> <p>7 you're doing this coordinated motion, the</p> <p>8 crawler track can be pointed in sort of whatever</p> <p>9 way that you want and -- one thing it actually</p> <p>10 points out is that you can tow in the crawler</p> <p>11 track as you're bending the frame to sort of</p> <p>12 dive into the frame at a better angle. So it's</p> <p>13 a clear teaching that you're able to control</p> <p>14 these different swing angles in a coordinated</p> <p>15 way to reach actually a variety of objectives.</p> <p>16 Q. So looking at the Rio reference, your</p> <p>17 counter-rotation, it comes up in the background</p> <p>18 of the invention?</p> <p>19 A. Yeah, if you want to -- I've got some</p> <p>20 highlighted if you want me to just walk it</p> <p>21 through. So if we go to Column 8 and we go to</p> <p>22 Line 34.</p> <p>23 Q. Mm-hmm.</p> <p>24 A. It says: The controller 32</p> <p>25 responsively actuates the second actuator 44 to</p>                                                                                                                      |

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| <p style="text-align: right;">Page 173</p> <p>1 counter-rotate the one ground engaging unit 20<br/>2 to maintain it in the same running direction as<br/>3 it moves towards the retracted position. So<br/>4 that's a teaching of what you're asking about.<br/>5 Q. And that teaching ties into the<br/>6 previous application in Column 7 where it<br/>7 states: First the operator stops the machine,<br/>8 engages the parking brake and sends the brake<br/>9 signal to the controller, beginning at Line 62<br/>10 of Column 7. Is that accurate?<br/>11 MR. HIGH: Objection. Form.<br/>12 THE WITNESS: Can you give me<br/>13 line numbers again? I was trying to jump over<br/>14 and catch you. You got ahead of me.<br/>15 BY MR. LAYDEN:<br/>16 Q. Line 62 of Column 7.<br/>17 A. Yeah, so this is the -- the title of<br/>18 this whole section is Industrial Applicability,<br/>19 so it's going through an example of how this<br/>20 machine can be used. But it's not like an<br/>21 exclusive description. It's not saying this is<br/>22 the only way it can be used. It's walking you<br/>23 through a way that this could be used. But in<br/>24 that example is a clear teaching that the<br/>25 machine is able to swing the leg and</p>                             | <p style="text-align: right;">Page 175</p> <p>1 are locking you in place, because now I want to<br/>2 move, so obviously I'm going to disengage the<br/>3 locking mechanisms, I'm going to swing the leg,<br/>4 and I'm going to counter-rotate the<br/>5 ground-engaging unit.<br/>6 BY MR. LAYDEN:<br/>7 Q. So to be clear, Columns 7, 8 and 9 of<br/>8 Rio go through an industrial application of how<br/>9 to use the Rio machine, start to finish; is that<br/>10 accurate?<br/>11 MR. HIGH: Objection. Form.<br/>12 THE WITNESS: I don't really like<br/>13 the start to finish part of that because you'd<br/>14 probably not be finished. You know, you could<br/>15 keep doing it for other things. But it's<br/>16 clearly one example of how this technology can<br/>17 be used. That's what that section is<br/>18 describing.<br/>19 BY MR. LAYDEN:<br/>20 Q. And is there any disclosure of Rio<br/>21 being used to change the pivot orientation of<br/>22 its swing leg and counter-rotate its crawler<br/>23 track while engaged on the ground and moving?<br/>24 A. So I don't think it goes through that<br/>25 specific example; right. It's walking us</p> |
| <p style="text-align: right;">Page 174</p> <p>1 counter-rotate the crawler track.<br/>2 Q. And within Rio at Column 8, beginning<br/>3 just above where you were in that paragraph<br/>4 above it at Line 21, it states: In response to<br/>5 receiving permissive signals indicating that the<br/>6 machine is safely stopped, the recess cover is<br/>7 open, and the one ground unit is suitably<br/>8 elevated, the controller activates the<br/>9 anti-swing actuator and anti-rotate actuator to<br/>10 release the corresponding protrusions from<br/>11 engagement with the receptacles.<br/>12 So before anything happens, right,<br/>13 that actuates the swing leg in the response, Rio<br/>14 is pretty clear that machine has to be stopped,<br/>15 is it not?<br/>16 MR. HIGH: Objection. Form.<br/>17 THE WITNESS: Well, that<br/>18 particular part isn't talking about stopping.<br/>19 That's talking about disengaging the anti-swing<br/>20 and anti-rotate devices that we talked about<br/>21 quite a bit before. So, yeah, this example is<br/>22 going through how you could do it and it's<br/>23 pretty clear this didn't even have to be said,<br/>24 honestly, to a person of ordinary skill in the<br/>25 art that you have to disengage the devices that</p> | <p style="text-align: right;">Page 176</p> <p>1 through an example here -- it does talk about<br/>2 other uses. For example, when it's on the<br/>3 ground you can clearly rotate and counter-rotate<br/>4 the crawler track. But I don't think it<br/>5 specifically calls out an example use that<br/>6 you're asking for. But it would be obvious that<br/>7 you could do it.<br/>8 MR. LAYDEN: Dr. Singhose, I<br/>9 appreciate your time. I have no further<br/>10 questions.<br/>11 MR. HIGH: Can we take a<br/>12 15-minute break?<br/>13 (3:52 p.m. - Recess taken.)<br/>14<br/>15<br/>16<br/>17<br/>18<br/>19<br/>20<br/>21<br/>22<br/>23<br/>24<br/>25</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

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| <p style="text-align: right;">Page 177</p> <p>1 (At 4:11 p.m. with parties present as<br/>2 before, the following proceedings were had,<br/>3 to-wit:)<br/>4 CROSS-EXAMINATION<br/>5 BY MR. HIGH:<br/>6 Q. Dr. Singhose, can you turn to<br/>7 Paragraph 80 of your declaration?<br/>8 A. Okay.<br/>9 Q. Do you recall being asked about your<br/>10 discussion of Littman in this paragraph?<br/>11 A. Yes.<br/>12 Q. Can you pull up Littman, which I<br/>13 believe was premarked as Exhibit 1007?<br/>14 A. I have that up.<br/>15 Q. Do you recall counsel asking you about<br/>16 Littman depicting wheels in one of its figures?<br/>17 A. Yes.<br/>18 Q. Does Littman teach any other type of<br/>19 ground-engaging unit besides wheels?<br/>20 A. Yeah, actually it does. In Column 4,<br/>21 starting at Line 21, it says: If desired tracks<br/>22 may be used in place of the wheels. The term<br/>23 "wheel means" therefore is intended to include<br/>24 both forms of ground-engaging and supporting<br/>25 devices.</p>              | <p style="text-align: right;">Page 179</p> <p>1 A. No.<br/>2 MR. HIGH: Pass the witness.<br/>3 MR. LAYDEN: Nothing further.<br/>4 MR. HIGH: Okay. I think that<br/>5 wraps it up.<br/>6 COURT REPORTER: (Requests orders<br/>7 for the record.)<br/>8 MR. LAYDEN: You've got our<br/>9 order.<br/>10 MR. HIGH: We'll take a rough,<br/>11 but I don't think we need any expedited<br/>12 delivery. Standard delivery for the transcript<br/>13 is fine.<br/>14 (4:16 p.m. - Adjournment.)<br/>15 ** ** ** **<br/>16<br/>17<br/>18<br/>19<br/>20<br/>21<br/>22<br/>23<br/>24<br/>25</p> |
| <p style="text-align: right;">Page 178</p> <p>1 Q. What does the term tracks in that<br/>2 section mean to you?<br/>3 A. Crawler tracks.<br/>4 Q. So does Littman disclose rotating a<br/>5 crawler track in pivoting a swing leg while<br/>6 under load?<br/>7 A. Yes, it does.<br/>8 Q. Can you pull up Whitaker, which is<br/>9 Exhibit 1011. I don't remember the deposition<br/>10 designation.<br/>11 MR. LAYDEN: Exhibit 10.<br/>12 THE WITNESS: Exhibit 10, okay.<br/>13 Okay, I have that open.<br/>14 BY MR. HIGH:<br/>15 Q. I want you to turn to the background<br/>16 of the invention section, which starts on --<br/>17 A. Okay, I'm there.<br/>18 Q. Does this section mention any type of<br/>19 slipform paver or other paving machine?<br/>20 A. Yes. Above the Column 1, starting<br/>21 Line 65, it actually starts talking about the<br/>22 GOMACO GP-3500 four-track and it talks about how<br/>23 it's a road paving machine.<br/>24 Q. Do you understand Whitaker to be<br/>25 limited to railroad construction machines?</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|    |                                                  |
|----|--------------------------------------------------|
| 1  | C E R T I F I C A T E                            |
| 2  | STATE OF NEBRASKA )                              |
| 3  | COUNTY OF DOUGLAS ) Ss.                          |
| 4  | I, Cheryl A. Rooney, Registered                  |
| 5  | Professional Reporter, General Notary Public     |
| 6  | within and for the State of Nebraska, do hereby  |
| 7  | certify that the foregoing testimony of WILLIAM  |
| 8  | SINGHOSE, Ph.D., was taken by me in shorthand    |
| 9  | and thereafter reduced to typewriting by use of  |
| 10 | Computer-Aided Transcription, and the foregoing  |
| 11 | one hundred seventy-nine (179) pages contain a   |
| 12 | full, true and correct transcription of all the  |
| 13 | testimony of said witness, to the best of my     |
| 14 | ability;                                         |
| 15 | That I am not a kin or in any way                |
| 16 | associated with any of the parties to said cause |
| 17 | of action, or their counsel, and that I am not   |
| 18 | interested in the event thereof.                 |
| 19 | IN WITNESS WHEREOF, I hereunto affix             |
| 20 | my signature and seal this 19th of February,     |
| 21 | 2025.                                            |
| 22 |                                                  |
| 23 | CHERYL A. ROONEY, RPR                            |
| 24 | GENERAL NOTARY PUBLIC                            |
| 25 | Registered Professional Reporter                 |
|    | My Commission Expires: November 24, 2026         |

| <u><b>WORD INDEX</b></u> |                     |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| < \$ >                   | <b>\$100,000</b>    | 16:1                                                                            | <b>12</b> 1:18 4:18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                          | <b>\$50,000</b>     | 16:1                                                                            | 167:22 168:2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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|                          | <b>20001</b>        | 2:8                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| < 7 >                    | <b>2002</b>         | 73:24, 25<br>74:1                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| < 8 >                    | <b>202.408.4329</b> | 2:9                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                          | <b>2024-00835</b>   | 5:15                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| < 9 >                    | <b>2025</b>         | 1:18 180:21                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                          | <b>2026</b>         | 180:25                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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