

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		)
11		)
12		)
13		)
14	GUNTERT & ZIMMERMAN	)
15	CONST. DIV., INC.,	)
16		)
17	PATENT OWNER.	)
18		)
19		)
20		)
21		)
22		)
23		)
24		)
25		)

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

1	I N D E X		
2	CASE CAPTION.....	PAGE	1
3	APPEARANCES.....	PAGE	2
4	INDEX.....	PAGE	3-4
5	TESTIMONY.....	PAGE	5
6	REPORTER CERTIFICATE.....	PAGE	180
7	E X A M I N A T I O N		
8	DIRECT EXAMINATION:		
9	BY MR. LAYDEN.....	PAGE	4
10	CROSS-EXAMINATION:		
11	BY MR. HIGH.....	PAGE	176
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

1	E X H I B I T S		
2	EXHIBIT NO.		MARKED
3	Exhibit 1	Curriculum Vitae	6
4	Exhibit 2	Singhose Declaration	44
5	Exhibit 3	Commander Ill New Generation	
6	(Part 1)	Trimmer/Paver Operator/Service	
		Manuel G21 Controls	62
7	Exhibit 3	Commander Ill New Generation	
8	(Part 2)	Trimmer/Paver Operator/Service	
		Manuel G21 Controls	62
9	Exhibit 4	Rio Patent	86
10	Exhibit 5	GT-3200 Slipform/Paver	
11		Marketing Brochure	143
12	Exhibit 6	Commander III Trimmer/Slipform	
		Paver Marketing Brochure	145
13	Exhibit 7	Miller Patent	149
14	Exhibit 8	Littman Patent	151
15	Exhibit 9	Johns Patent	153
16	Exhibit 10	Whitaker Patent	154
17	Exhibit 11	Smolders Patent	159
18	Exhibit 12	Tax Patent	167
19			
20			
21			
22			
23			
24			
25			

Page 5 1 (Whereupon, the following proceedings 2 were had, to-wit:) 3 WILLIAM SINGHOSE, Ph.D., 4 having been first duly sworn, 5 was examined and testified as follows: 6 DIRECT EXAMINATION 7 BY MR. LAYDEN: 8 Q. Dr. Singhose, nice to meet you today. 9 How are you? 10 A. Oh, Mr. Layden, are you talking? 11 Q. I am, yes. 12 A. You were showing up really small there 13 for a second. 14 Q. Apologies. You submitted a 15 declaration in IPR 2024-00835 against U.S. 16 Patent Number 11,535,318; is that correct? 17 A. Yes. 18 Q. And I believe previously you've also 19 testified in actions between G&Z and GOMACO also 20 at IPR as well; is that also accurate? 21 A. Yes. 22 Q. In preparing for your deposition 23 today, did you review any of your past 24 testimony? 25 A. Yes, I did.	Page 7 1 it looks about right, yeah. 2 Q. How long have you been teaching 3 mechanical design at the -- 4 A. Well, I've been at Georgia Tech 5 teaching mechanical design since 1998. Boy, 6 that's what, like 26 years. I actually taught 7 before that, I taught at MIT as a post doc doing 8 some teaching as an undergrad. Over 25 years I 9 think is a fair assessment. 10 Q. And in your classes, what is the 11 designs of the mechanical design that you're 12 mainly focused on? 13 A. That's a good question. I guess I 14 should clarify that I teach more than one class, 15 so briefly not to waste your time, I'll walk 16 through that. I teach the introductory 17 mechanical design class. In fact, I taught it 18 this morning. And in that class we teach them 19 general strategies that they can apply to all 20 kinds of systems. So, for example, today in my 21 class I talked about how you might design 22 cranes, and I also talked about aerial lifts, 23 and coordinate measuring machines. 24 COURT REPORTER: (Requests 25 clarification.)
Page 6 1 Q. And did you review your testimony in 2 regards to what you provided for what was 3 referred to as the '749 patent? 4 A. Yes. 5 Q. In your declaration does that provide 6 the whole of your opinions you intend to submit 7 in this action? 8 MR. HIGH: Objection. Form. 9 THE WITNESS: Yeah, as I'm 10 currently sitting here, I wrote down all my 11 opinions at this point. 12 MR. LAYDEN: I'm going to upload 13 what will be marked as Exhibit 1 in the chat. 14 This will be your CV that was attached to your 15 declaration. 16 (Exhibit 1 marked for identification.) 17 BY MR. LAYDEN: 18 Q. Dr. Singhose, is this CV current and 19 up to date? 20 A. I'm just working on downloading it. 21 Sorry. If I go to the desktop -- oh, there it 22 is, okay. By the way, it's actually Singhose, 23 not house. Okay, I found it. This isn't my 24 computer, but I found out where it's at here. 25 Let me just look at this real quick here. Yeah,	Page 8 1 THE WITNESS: Coordinate 2 measuring machines. 3 But given the state of the world, a 4 fair amount of what I talk about are machines 5 that have computers in them, in most of them. 6 Most of the machines my students are going to 7 work on after they graduate are going to have a 8 controller or a computer. So in the class we 9 actually give them a small controller with some 10 sensors and actuators and we require them to 11 build an automated machine at the end of the 12 term. So that's the first class. 13 I also teach more advanced design 14 classes at the senior level and also at the 15 graduate level. Those classes would tend to be 16 more sophisticated, a lot of the designs would 17 focus on what I'll call more complicated 18 controllers, more complicated mechatronic 19 systems, like robotic cranes, things like that. 20 So I teach a full spectrum of topics and 21 techniques for design. 22 BY MR. LAYDEN: 23 Q. Would it be fair to say that the focus 24 of your courses is primarily on the control of 25 the systems?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 guideline? 2 MR. HIGH: Objection. Form. 3 THE WITNESS: That is one of the 4 ways this machine operates. That's how you set 5 it up, in one of these modes, is that you can 6 have it try to follow that guideline as it 7 drives forward laying this concrete for you. 8 BY MR. LAYDEN: 9 Q. And using this S2X controller, are you 10 capable of controlling all the tracks on the 11 machine? 12 A. Yes, with the caveat is that there's 13 more than one S2X controller. There is a 14 controller associated with each of these swing 15 legs and crawlers that you can control. And 16 each one of those are little controllers that 17 are doing the best job they can to hold that 18 particular controller at the angle that a higher 19 level controller is telling it to do. 20 So there's a higher level of 21 controller that's monitoring all four of these 22 and sending down signals to each of these lower 23 level controllers saying this is your angle, 24 stick to this, buddy. So that's what they do. 25 Q. Looking at Page 407, the third	Page 65 1 drive one side of it and you'll be holding the 2 line that you want. 3 Q. And how much steering does this S2X 4 controller and its configuration allow for? 5 A. Well, I think it allows enough to keep 6 it going the direction that you want. If you're 7 asking the question, what is the amount of 8 angular change it can make, I don't recall that 9 off the top of my head. It's dependent on the 10 stroke of that cylinder. Basically if you 11 extend that cylinder as far as you can, that's 12 as much as you can turn. And quite frankly it 13 depends on how they've set it up that day. 14 Q. Would it allow for turning in a 15 90-degree opposite direction of travel? 16 A. That I'm not sure. I mean I didn't 17 look for that particular number, sorry. It can 18 turn a lot, but whether it can -- you're saying 19 if it's going straight ahead can it then retract 20 the cylinder all the way and pull it 90 degrees. 21 That I'm not sure of, that it can go exactly 22 that far. I mean, it could, this kind of 23 structure could do that, depending on the length 24 of the cylinder stroke and the kind of mechanism 25 that you're attaching it with.
1 sentence in that first paragraph where it says: 2 The side of the machine controlled by the steer 3 sensors is determined by which side the sensors 4 are plugged into and the set-up parameters 5 determined by the machine's operator. 6 Do you see that sentence? 7 A. Yes. 8 Q. Does that mean only one side of the 9 machine is steered using these sensors? 10 A. I don't think so. The whole machine 11 is steered by, what that's indicating is you 12 could put this guide wire on the left side or on 13 the right side. You know, in construction sites 14 sometimes you can't put it on the right because 15 you're going to run into a bridge or a tree or 16 whatever. So you may want to set up this pass 17 with your guideline on the right sometimes and 18 sometimes on the left. So I told you it has a 19 sensor that sticks out to the side and touches 20 the wire. You would -- you know, you have to 21 put that sensor either on the right or the left, 22 and it would -- the machine basically just 23 follows one side, and if it's following one 24 side, you know, the machine is real rigid so the 25 other side is coming along. So you just need to	Page 66 1 Q. Are you aware of how far CIII allowed 2 it to operate or to turn while the machine is 3 actually operational and moving forward? 4 A. That's what I'm saying, I don't recall 5 that number or I'm not even sure I exactly 6 looked for it. 7 Q. If you'd turn to Page 408. In that 8 first column, it's talking about the operation 9 of the S2X controller with the steer sensor. If 10 you go towards the bottom, it's discussing 11 examples showing where the turns required are no 12 more than a couple of inches. Do you see that? 13 A. Yeah, I see it. It's essentially 14 working through an example and it says let's 15 consider a case where the crawler track is 16 turned like one inch off. Let's talk about how 17 this controller will get it back to the 18 direction that we want. And it is using this 19 sort of simple example of one inch. 20 Q. Does that inform your opinion at all 21 as to how much degree or steering degrees of 22 freedom the operator has when using CIII? 23 A. I didn't quite understand that 24 question. The operator's degree of freedom? 25 Q. When steering.
Thomas & Thomas Court Reporters Court Reporting Videography Trial Support	Page 67 Page 68 Tel: (402) 556-5000 Fax: (402) 556-2037 www.ttcrrs.com

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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>WORD INDEX</u>			
< \$ >		12 1:18 4:18 167:22 168:2	20 173:1
\$100,000 16:1		12:39 90:7	20,000 73:9
\$50,000 16:1		143 4:10	20001 2:8
		145 4:12	2002 73:24, 25 74:1
< 1 >		149 4:13	2010 161:13
1 3:2 4:3, 5 6:13, 16 62:23 104:24 115:23 116:2 131:7, 9 153:1 178:20		15 160:9	202.408.4329 2:9
1:20 91:1		151 4:14	2024-00835 5:15
1:34 131:22		153 4:15	2025 1:18 180:21
10 4:16 12:14 44:9 154:16, 19 178:11, 12		154 4:16	2026 180:25
10,000 73:9		159 4:17	21 47:11 49:7 174:4 177:21
10.1 78:14		15-minute 176:12	212.715.9000 2:19
10:30 1:17		16 17:24 18:4 46:22, 24	218 63:3
100 37:25		16,000 143:12, 14	22 49:8 59:23
1002 46:7, 9, 11		167 4:18	23 145:19, 21
10036 2:19		17 19:12 118:17 121:14	24 180:25
1005 62:13		173 63:4	25 7:8
1006 45:10 86:22 170:8		176 3:4	26 7:6
1007 151:18 177:13		179 180:11	27 56:24
1008 149:3		17D 119:6	29 79:12
1009 154:1		17E 119:6, 9 120:11 121:11 122:6	29,500 146:8
1010 143:1		17F 119:6	< 3 >
1011 154:18 178:9		180 3:4	3 4:5, 7 62:12, 16 86:9 104:20 160:25
1012 159:16		19 149:14 162:9, 13, 15	3:52 176:13
1016 167:24		1985 20:12	30 30:3, 4, 16 143:15
10-degree 78:4		1987 20:13	30,000 81:22 143:23
10-minute 90:6		1988 20:4	300 42:21
11 4:17 159:15, 19 167:22		1998 7:5	31 85:10
11,535,318 1:3 5:16		19th 180:20	318 118:9, 15, 20, 23 119:5 122:16, 23 123:5 124:3, 12, 22 125:17, 22 126:6, 23 127:25 130:17, 19 131:6 142:7 149:19
11:25 45:21		1C 118:14, 22 122:16, 23 123:5 127:13	3-18 105:1
11:34 46:1		1D 128:16	32 172:24
117 46:15		< 2 >	3200 143:10 144:7 148:3, 9
1177 2:18		2 3:2 4:4, 7 44:15, 16, 17 46:5, 8, 13 62:23, 25 63:3 79:10	
		2:45 132:1	
			151:3
			333 2:14
			34 172:22
			3-4 3:3
			35 118:5 130:12 135:7 160:9
			36 118:13 120:12
			37 135:4
			38 46:22, 24 102:1, 5
			< 4 >
			4 3:4 4:9 86:9, 21, 24 101:25 135:3 170:7 177:20
			4:11 177:1
			4:16 179:14
			407 63:1, 2, 6 65:25
			408 68:7
			409 74:19 76:2
			41 47:10
			42 59:22 61:11, 15 62:3
			44 4:4 141:16 172:25
			45 132:6, 8
			47 138:14 142:10
			48 56:23
			49 79:11
			49,500 146:11
			< 5 >
			5 3:3 4:10 126:16 142:25 143:3 159:25 170:10, 21 171:17
			5,000 117:14
			50 17:4 85:11, 13 92:8 94:14 158:7
			50,000 72:19 143:16
			54 141:11, 15
			55-gallon 157:8
			56 132:10 164:24

59 138:13 142:10 148:22 < 6 > 6 4:3, 10 73:7 102:1, 4 145:13, 14, 16 160:8 62 4:6, 8 166:10 173:9, 16 64 164:10, 13, 14 65 178:21 650.752.1700 2:15 < 7 > 7 4:13 149:1, 4 173:6, 10, 16 175:7 7,000 117:14 700 2:14 70s 150:10 72 164:23, 24 749 6:3 118:10, 17, 20 119:7, 9 120:11 122:6 130:17 < 8 > 8 4:14 116:4 135:4 143:7 151:16, 19 166:22 172:21 174:2 175:7 80 104:24, 25 166:9 177:7 80s 150:15 8-105 63:7 86 4:9 87 21:4 < 9 > 9 4:15 153:24 154:2 175:7 9.9 78:15 90 67:20 103:11 134:3	901 2:8 90-degree 67:15 94065 2:14 < A > a.m 1:17 46:1 abandoned 157:8 ability 52:18, 21 105:23, 24 135:13 153:5 165:19 171:7 180:14 able 29:8, 10 35:19 37:7 48:21 55:17, 21, 22 56:5 58:15, 21 77:13 97:2 98:15 99:23 110:14 116:1 120:24 136:14 143:24, 25 144:1, 3 146:12 163:24 172:13 173:25 about 7:1, 21, 22 8:4 9:8 11:4 12:5 14:23 15:4 21:25 30:2 33:10 38:18 39:8, 25 40:2 41:21 43:20 45:20 48:25 50:1 51:3, 24 52:1, 13 54:2, 22 55:23 56:3, 10, 15 57:1, 10 59:24 60:9 63:16 68:8, 16 76:1 77:8 78:5 80:8 85:3 86:11, 16 87:14 88:12 91:12 92:21 93:16 96:2 97:12 98:9 101:1 102:13 103:12 104:9 105:10 106:17 111:16 112:3 113:7 116:8 119:1, 13, 19 120:22 122:19 124:24 125:1, 5,	14, 18, 23 126:2, 3, 7, 9 129:5, 7 130:10 133:10 134:21 135:7, 18 138:7 139:11 143:22 146:9 147:8 150:23 151:5 154:11 156:17 157:21 158:15 160:11 161:3 162:9, 17, 20 166:4, 12 168:18 169:1 171:22 172:4 173:4 174:18, 19, 20 176:1 177:9, 15 178:21, 22 above 174:3, 4 178:20 abstract 151:23 168:5 According 49:6 account 9:13 97:6 accumulation 92:12 accurate 5:20 20:4 24:24 40:17 42:2 50:21 59:24 84:18 87:4 108:9 137:6 167:1 173:10 175:10 accurately 60:23 achieve 122:9 achieves 138:20 act 87:23 acting 114:22 116:2 action 6:7 32:23 62:13 118:11 180:17 actions 5:19 activates 174:8 active 111:1 actively 79:7	actual 16:7 71:22 73:16 153:21 actuated 49:9 actuates 172:25 174:13 actuator 69:16 76:13 85:1, 8 86:8, 9, 10, 17 87:25 91:16, 19, 20, 24 92:5, 16, 22, 25 93:21 94:2, 16 96:4 97:8, 14, 20 99:6 103:2 109:7, 13, 16 110:7, 25 112:14, 16 113:2 116:18, 21, 24 138:18 139:8 148:16 149:19 159:23 160:1 162:2, 24 163:3, 14 171:8 172:25 174:9 actuators 8:10 14:6 76:24 95:4 103:22 111:5, 6, 21 150:17, 25 151:7 163:16 170:12, 17, 18 add 16:20 103:25 104:1 added 15:12 106:24 adding 126:21 addition 12:17 22:15 57:6 additional 53:11 103:21 117:15 additives 13:16 addressed 128:14 adds 87:25 103:21 110:1 Adjournment 179:14 adjust 52:12 69:6 77:20
---	--	---	---

adjustability 43:10, 19 adjusting 23:18 76:9 89:18 adjustment 166:14 adjustments 43:16 adult 61:5 advanced 8:13 advantage 33:6 36:24 37:6, 8, 10 51:13, 18, 23 52:3, 5 95:22 96:10 advantages 52:7 aerial 7:22 152:4, 12, 13, 24, 25 154:12 affect 29:15 57:20 106:1 affix 180:19 after 8:7 13:23 14:2, 9 16:2 22:16 31:3 78:8 80:22 150:23 again 9:23 21:22 29:17 38:2 71:21 79:1 85:8 88:13 96:19 115:15 123:2, 23 125:1 128:22 140:9 147:13 150:8 154:8 157:9 163:10 165:12 170:5, 6 173:13 against 5:15 32:18 70:12 71:2, 4 114:20, 23 136:16 aggressive 108:2 ago 56:11 agree 138:2 161:20 ahead 67:19 78:12, 21 79:1, 5 108:23, 24 110:17 123:18, 22 127:8	161:17 173:14 aid 105:22 aided 133:5 aiding 14:21 aids 105:24 air 28:15 115:22 airport 24:8 akin 160:2 align 132:25 aligned 78:10, 24 107:19 alignment 106:23 allow 58:23 60:11 67:4, 14 164:2 166:13 allowed 68:1 126:13 allowing 134:20 allows 32:7 36:5, 11 60:23 67:5 103:3 128:2 129:12 Almost 145:23 alone 131:12, 18 along 14:20 15:9 40:15 45:8 49:23 50:5, 18, 19 51:12 52:6 64:10, 14 66:25 77:12 92:6 99:6 110:12 159:11 already 14:1 16:18, 24 17:12 80:8 112:18 133:16 alternate 94:21, 22 95:5, 6 always 33:19 36:20 82:2 111:2 Americas 2:18 amount 8:4 11:13 25:8 29:6 35:23 36:14 61:6, 8 67:7 70:3, 14, 22 71:5 72:24	98:16 114:16 117:21 139:16 amplifier 16:16 37:13 amplifying 37:1 analogous 141:13, 20 analogy 100:24 analysis 118:14 125:8, 12 151:10 angle 56:11 57:20 62:10 65:18, 23 70:3 75:21 76:10 77:19 78:1 89:14, 19 103:18 110:15 111:24 113:6, 12 138:3 169:14 172:12 angles 23:12 54:1 75:19 171:6 172:14 angular 56:14, 16 67:8 69:25 111:14 119:1 122:20 another 19:15 24:22 34:14 36:12 51:23 87:25 125:19, 20 143:20 156:5 answer 26:21 70:11 71:3 111:12 145:11 147:3, 14 150:11 161:21 167:15 answered 128:23 answering 56:15 anticipated 106:20 anti-rotate 101:22 102:2, 7, 10 103:9, 10 104:3 109:19, 24 110:1 174:9, 20 anti-rotating 104:1	anti-rotation 109:22 166:3 anti-swing 109:23 174:9, 19 any 5:23 10:19 16:6 19:2 25:21 26:5, 12 37:18 39:20, 25 40:23 41:8, 12, 17 44:8 45:14 51:13, 18 52:16, 24 53:2 55:9 87:7 88:4 96:23 105:11 111:23 113:9 124:12 129:14 140:5 143:19 148:8, 14 151:6 158:12 159:4, 5 168:13, 22 169:11 171:16 175:20 177:18 178:18 179:11 180:15, 16 anymore 30:25 Anything 11:24 43:10 45:12 52:25 140:25 159:5 164:6 168:20 174:12 Anywhere 40:3 92:5, 16 143:15 apart 15:22 Apologies 5:14 167:23 app 39:15 apparatus 138:19 139:4, 17 APPEAL 1:1 APPEARANCES 3:2 Appearing 2:2, 3, 10 appears 55:2 Apple 14:11 38:19 Applicability 173:18
--	--	--	--

application 59:17 144:7 173:6 175:8 applied 35:10 41:1 50:6 applies 85:4, 8 86:13 apply 7:19 9:24 35:1, 8, 14 36:6 37:3 55:5 72:11, 12, 13 85:2 94:12 108:22 applying 113:11 appreciate 176:9 appropriate 112:17 appropriately 147:20 approximate 146:7 approximately 73:10 146:11 apps 15:1 arc 54:11 arduous 78:18 are 5:9, 10 8:4, 6, 7 9:12, 23 10:9, 19 11:10 15:24 16:21 17:4 18:3, 4, 15 19:4 23:18 25:10 26:18 27:20, 21 29:3 31:8, 20, 25 34:4 36:22, 25 38:7 39:2, 24 40:1, 2 41:24 45:17 49:17 50:15 52:7, 8, 24 53:11, 14 54:21, 23 57:2, 5, 11 58:14 60:10 61:12, 18 63:16 65:9, 16, 17 66:4 68:1, 11 69:20 71:12 74:7 75:5, 9, 20, 24 80:23 81:21, 24 84:16	87:6 88:15 92:19 93:4 99:12 101:23 102:12, 13, 17 107:15 112:2 113:19 114:22 115:11, 13 117:2 118:20 121:25 122:1 126:18 127:16 129:11 130:4 132:13, 20, 21 139:18, 23 140:12, 18, 23 141:12, 19 142:6, 12 148:8, 14 151:13 152:24 156:2 157:11 158:15 160:16, 21 162:17 163:7 164:9, 20 165:3 167:9, 13 168:22 171:6, 21, 24 175:1 area 94:5 117:21, 25 118:3 areas 22:19 aren't 37:1 82:2 140:17 arm 35:25 36:1, 5, 21 49:1, 3 53:18, 24 54:9, 10, 13, 18 55:12, 24 56:17 57:16, 17, 19 58:3 64:12, 18 83:19 84:1, 6, 23 85:14 86:3, 7, 14, 18 87:24 89:10 98:11, 14 99:4 104:11, 13 105:20, 21 112:23 124:5, 15, 17, 25 125:4, 17 126:7, 11, 16 134:16 135:14 138:3 156:9 157:12 arms 58:9 83:22 137:24	arrangements 9:22 art 138:10 141:20 165:17 171:2, 11 174:25 aside 169:12 asked 177:9 asking 26:20 33:10 54:2 56:13 67:7 69:7 128:11 173:4 176:6 177:15 Asphalt 20:6 21:15 22:3, 8, 11, 13, 16, 23 23:7, 14, 25 25:3, 10, 12, 20 27:2 42:21, 22 79:21 81:7 84:9 150:15 assemblies 106:7 142:8 assembly 105:11 assessment 7:9 24:24 27:8 57:23 associated 37:13 45:10 48:8 65:14 87:15 180:16 assume 41:11 73:4, 5 120:23 assuming 161:22 assumptions 130:9 167:14 Atlanta 27:1 84:4 attached 6:14 32:9 48:14, 17 123:22 124:15, 16 126:10, 12 139:9 152:17 attaches 48:20 70:1 161:3 attaching 67:25 attachments 156:8 atypical 96:23 August 20:12, 13 21:3	automated 8:11 88:17 auxiliary 22:24 available 73:20 74:1 Avenue 2:8, 18 avoid 92:20 avoiding 92:11 aware 68:1 93:4 128:12 148:8, 14 168:14, 22 awkward 76:21 axes 125:7 axis 35:13, 19 92:6 98:7 99:7 119:1, 14, 20 120:7, 8 122:19 125:6, 14, 18, 24 126:8, 9 axle 108:18 < B > back 23:18 24:22 30:12 31:7 37:17, 20 38:17 43:17 48:10 51:2 53:23 54:8 56:19 58:23 60:19 61:24 64:19 68:17 70:4 73:18 79:10, 24 80:25 81:18, 19 82:23 83:2 108:13, 19 110:16 112:20 114:7 116:6 125:5 130:12 133:4 134:5 135:2 139:24 141:17 142:9 148:21 150:10 156:15 157:9, 20 159:8 164:19 169:4 background 172:17 178:15 backhoe 23:1
--	--	---	---

backlash 52:10, 12 backup 109:15 backward 115:9, 10, 12, 24 133:23, 24 backwards 114:2, 5 balancing 97:10 bar 69:21 Barton 20:10 base 38:21 48:19 82:6, 11 137:1, 3, 6 based 57:24 64:24 70:7 165:9 basic 9:23 Basically 19:16 43:7 47:20, 24 48:17 50:3, 10 53:20 62:5 66:22 67:10 74:11 79:22 92:4 93:13 94:7 109:1 111:2 115:8 141:6 152:4 157:21 163:16 basket 152:14 153:2, 6 batteries 10:11 beam 164:10 bearing 14:7 114:10 bearings 33:21 39:1 40:10, 11 52:9 beginning 1:17 46:22 47:11 49:6 79:12 85:13 102:1, 5 135:4, 7 138:16 160:9 173:9 174:2 begins 46:25 believe 5:18 20:3, 7 23:5 42:1, 14 84:10 92:8 132:12 135:2	142:3 161:1 177:13 bending 172:11 beneficial 109:15 114:18 benefits 107:15 best 65:17 80:9 180:13 better 17:6 83:3 97:1 107:23 136:19 172:12 beyond 10:20 172:6 bidding 26:2 big 14:5, 10, 18 15:20 16:17 17:15 23:10, 11 31:14 80:2 82:3 99:18 100:3, 10 112:16 132:21 147:16 bigger 29:6 38:5, 7 100:6 107:25 112:14 116:24 117:13 147:1, 21 biggest 38:3, 8 Bill 20:9, 10 Bill's 20:6 binder 45:5 bit 10:2, 18 12:18 13:2 15:3 20:16 24:11 30:8 33:20 34:4 52:15 55:4, 7 59:14 60:24 61:6 64:7, 15 72:11, 12, 14 76:21 77:13, 15 82:4 96:5, 10 97:1, 8, 19, 23 107:25 133:8 134:23 135:23 137:23 140:12 144:16 150:11 153:20 174:21 blank 17:13	block 108:23 blocks 13:17 blow 22:25 BOARD 1:1 boat 40:7, 16 boats 40:12 body 151:24 Boeing 38:5, 6 bolted 129:10 books 20:15 bore 11:7 bottom 19:8, 9 46:18 49:7 50:1, 11, 13 63:6 68:10 91:17 92:9 93:11, 12, 21 94:2 95:7 97:5, 21 103:5 105:2 132:10 140:14 161:5 163:4, 15 bought 15:7, 25 bounces 22:22 40:19, 20 bouncing 82:1, 4 bouncy 81:25 box 16:23 22:6, 8, 12 23:10, 11, 15 42:14, 16, 24 43:1, 22, 24 44:4 boxes 153:8 154:13 Boy 7:5 bracket 48:17 125:18 126:8 brackets 18:20 19:7 39:2 brake 173:8 brakes 18:8, 17 break 36:6 45:20 58:22 90:6 131:21 176:12 bridge 66:15 bridges 27:2, 5 briefly 7:15 bring 22:3 117:11 170:4	Brochure 4:10, 12 145:17 broke 30:5 broken 30:14 bubbles 28:15 buckles 57:2, 5, 11 58:1 59:2 77:8, 11, 14 137:19 buddy 65:24 build 8:11 building 17:22 18:24 82:22 153:10 built 15:17, 20 38:12 143:14 built-in 14:13 166:3 bulky 138:22 bunch 22:24 71:13 80:11 81:10 97:10 144:4 146:18 147:22 167:14 burn 10:12 bust 13:18, 19 button 16:13 39:23 76:12, 16, 23, 25 79:3 buttons 39:10, 14 < C > CA 2:14 calculate 37:7 calculation 56:1 73:3 calculations 55:23 call 8:17 12:10 16:15 35:5, 25 36:23 40:14 42:16 50:10, 25 69:5 76:15 79:5, 21 106:3 115:23 121:6 149:11 152:25 156:4
--	---	--	---

called 22:6 72:10 109:23 calling 96:23 calls 101:10 126:4 149:12 176:5 Cambridge 21:5 CAMotion 15:15, 16, 24 16:5 can 7:19 10:12, 23 11:13, 15, 16 12:14 13:3, 9 18:10 24:3 30:19, 21 31:14 32:10 33:20 39:15, 16, 17 43:12, 13, 18, 24, 25 44:1, 21 47:1, 16, 22 48:11 51:17 52:10 53:5, 21, 24 54:4, 6, 10, 18, 19 56:11, 14, 15, 19 60:5, 8, 24 61:22 62:11 63:20, 22 64:8 65:5, 15, 17 67:8, 11, 12, 17, 18, 19, 21 69:2, 4, 12, 18, 23 71:23 74:6 76:19 77:1, 2 79:10, 11, 18, 23 81:6, 17, 24 82:9, 24 83:2, 8 85:1, 19 86:6 87:17 88:1, 17, 20 91:7 92:4, 5, 15, 23 98:1, 7 104:17 108:18, 20, 23 110:11, 12, 13 112:8, 9, 19, 23 115:1 116:24 117:13, 17 118:5 119:16 120:5, 16, 19 121:1, 8 122:5 123:2 125:4 126:15 127:23 131:4 132:5	134:13 136:15, 18 138:9 139:15, 21 143:6, 10 144:12, 23 162:15, 19 164:23 166:22 169:11, 19, 22 170:2, 9 172:2, 6, 8, 10 173:12, 20, 22 175:16 176:3, 11 177:6, 12 178:8 can't 12:2 30:25 31:1, 4 40:19, 21 41:4 56:18 57:13 60:13 61:14 66:14 94:12 110:18 127:11 capabilities 70:16 71:6 72:1 capable 65:10 170:20 171:12, 15, 25 CAPTION 3:2 149:14 162:14 car 18:9 63:23 careful 129:6 Caribbean 14:8 40:6, 13 carrying 40:8 155:14 Case 1:1 3:2 14:11 17:4 18:18 68:15 98:9 104:23 115:13 120:7 121:2 137:25 161:19 cases 24:18 catch 173:14 cause 32:19 35:6 180:16 caused 92:12 causes 47:25 48:2, 4 49:4 70:1 85:9 98:3 167:15 causing 32:22 caveat 65:12	cement 13:11, 12, 13, 14, 16, 17 19:22, 25 20:2 22:13 24:9 25:10 28:10 30:10 41:20 154:9 center 100:7 central 151:24 certain 11:10 53:11 55:21 70:14 76:25 103:18 110:14 131:1 150:1 Certainly 10:8, 16 24:9 25:15 29:5, 14 32:12 33:11 47:18 55:13, 20 58:8 81:9 110:14 124:25 141:8 144:5 157:11 166:6 168:15 CERTIFICATE 3:4 certify 180:7 challenging 30:8 change 17:20 18:25 23:12 43:11, 12, 18, 21 56:11 67:8 103:19 111:23 112:7 117:9 159:5 175:21 changes 24:6 117:7, 10 169:6, 14 changing 54:15 89:14 138:3 170:21 chart 130:15 chat 6:13 44:15 62:14, 15 86:21 142:25 145:13 151:16 153:23 159:15 cheaper 34:3	check 55:2 Chernobyl 15:21 Cheryl 1:15 180:4, 23 choice 49:23 107:8, 11, 14 108:11, 17 choose 33:12, 14, 25 34:2 97:4 125:14 chose 83:10 108:6 127:1 chosen 109:2 CIII 47:1, 3 48:13 50:20 51:5, 20 52:16 58:2 59:2 61:18 62:12 63:11 64:23 68:1, 22 71:19 73:18, 20 74:5, 14 76:10 79:9 88:12, 13 95:14 96:13 98:23, 25 104:4, 9, 15, 21 105:3, 23 107:3 108:6 132:9 137:8, 13 138:25 139:4 141:12, 19 142:5 146:14 160:2 165:2, 9 166:13 CIIs 165:15 CII's 165:3 circle 52:13 91:20 circles 33:12 circular 32:14 34:7 circular-shaped 34:11 cite 166:17 claim 118:8, 17, 23 120:2, 11, 20 121:11, 14 122:6 127:13 128:13, 15 131:7, 8, 9 141:6 claimed 124:1
---	--	--	--

claiming 120:2 127:9 171:4 claims 118:19 124:3, 23 126:6 127:5, 25 129:6, 17 130:16 clamp 88:1 clamps 88:5 clarification 7:25 62:18 96:17 clarify 7:14 30:24 58:20 86:2 104:10 111:11 130:9 class 7:14, 17, 18, 21 8:8, 12 9:4 classes 7:10 8:14, 15 9:2, 3 102:21 clean 22:25 81:12 clear 17:22 125:15 129:16 130:7, 8 136:13 156:11 172:13 173:24 174:14, 23 175:7 clearly 114:19 125:2, 5, 12 142:18 152:4, 12 153:1 157:10 175:16 176:3 close 26:16 50:23 53:22 60:9, 12 82:22 86:6 134:16 closer 82:25 84:21 133:25 134:14 136:16, 18 closest 17:18 42:6, 11 closing 60:20 clunky 39:14 132:21 coaster 17:20, 22, 23 coasters 17:25	co-efficient 73:5 167:8, 11 cold 79:21 collar 102:8 159:1 college 20:24 37:21 column 32:4, 11, 12, 20 35:1 40:24 41:3, 7, 13 48:18 49:17 51:6, 8, 15, 19 53:19 54:19 57:25 68:8 90:3 91:9 92:6 93:6, 20 94:16, 23 95:24, 25 97:15, 16 99:7 100:16, 21 101:2, 5, 12, 18, 19 102:1, 4, 11, 16, 24 104:12 105:2 118:15, 24 119:2, 11, 13, 19 120:3, 6, 9, 14, 15 121:7, 16, 20, 23, 24 122:5, 17, 21 123:20, 23 124:6, 13, 14, 18 125:24 126:8, 15, 17, 20, 24 127:15, 16, 23, 24 128:1, 18 135:3, 7 143:9 145:25 160:8, 16, 21 161:5, 7, 14 162:4, 24 163:3, 4, 8 165:3, 9, 16, 24 172:21 173:6, 10, 16 174:2 177:20 178:20 columns 32:5, 7 41:2 51:4 175:7 combination 35:14 132:14 133:12 137:8 160:4 164:25 165:2 166:13 combined 123:18	165:13, 16, 22 combining 132:9 come 24:22 64:19 80:25 133:18 140:6 149:25 comes 38:4 40:10 47:23 48:6 61:1, 4 69:21 80:20 116:22 172:17 coming 11:17 47:21 61:7 66:25 75:5 136:10 168:15 command 111:20 112:25 Commander 4:5, 7, 10 47:3, 7 145:16, 24 146:1 commercially 150:5 Commission 180:25 common 25:25 149:19, 23 150:1 commonly 166:7 compact 138:19 139:1, 4, 9, 17, 19 companies 14:20 15:9, 11 21:13 39:11 147:21 COMPANY 1:3 12:3 15:17, 18, 19 16:1, 3 17:2 19:25 20:3, 8, 16, 18 21:8, 21 22:1 39:11 41:17, 20 42:6 73:1 150:15 comparable 42:7 comparable-sized 145:2 compare 24:4 118:8 130:16 compensate 55:25 108:2	compensations 55:22 completely 17:17 complicated 8:17, 18 99:13 135:9, 24 137:17 138:22 component 16:10 38:10 167:3 components 9:21 12:8 16:7 27:13, 18, 20 31:9, 12 32:11, 25 39:21, 25 41:5 147:8 160:20 compress 22:17 31:22 42:23 computer 6:24 8:8 16:14, 19, 24 18:14, 19 23:20 48:10 104:17, 18 146:22 Computer-Aided 180:10 computers 8:5 concern 97:2, 7, 11 concerned 96:2 concerns 97:6 143:24 concrete 13:14 24:4, 25 25:1 28:6, 9 29:25 30:2, 6, 14, 19, 20, 22 31:2 41:18, 23 42:20 58:17 59:5, 12 65:7 70:19, 21, 24 80:6 81:7, 8 144:3, 11 153:20, 22 condition 71:17 115:2 116:14 conditions 59:8, 19 71:9, 16 72:10, 11 73:16 114:8, 21 115:13 conducted 72:18
---	--	--	---

configuration 34:1 53:11, 21 58:13 67:4 83:15, 18 91:8 configured 118:25 122:18 127:14 130:20, 23 131:14 conjunction 80:4 93:6 connect 23:13 93:15 connected 41:13 49:15 50:3, 4, 9, 13, 14 91:18 101:6 102:2, 8, 13, 17, 18 103:7 127:22 128:1 160:3 connection 102:19, 20, 23 103:5 107:17 119:10 130:6 connections 50:15 connector 38:22 connects 53:18 98:25 164:14 consequently 18:12 consider 10:21, 23 11:25 12:7 31:11 68:15 71:8 consideration 10:14 considerations 9:13 10:5, 19 11:10, 19 143:13, 19, 21 considered 106:6 considering 17:12 CONST 1:7 constraint 106:25 CONSTRUCTION 1:3 21:13 42:5 63:25 66:13 80:3 140:13 141:13, 20	142:8, 13, 21 149:8, 12 152:3, 9, 19 153:9, 12, 15, 18 154:7, 9 155:19, 20 178:25 consumer 11:11 14:12 15:1 contact 32:3 40:1 contacting 167:4 contain 180:11 contend 149:18 contending 119:6 context 129:17 continues 122:17 continuing 49:7 91:7 contraption 121:5 contrasted 121:2 contributing 116:5 control 8:24 9:7 14:17 16:8, 9 18:7, 13, 18 19:2, 16 38:3, 14, 24 41:1, 6 56:3, 14, 16, 20 57:12 60:2, 15, 20, 23 61:8 63:16 65:15 102:14 104:17, 18 110:25 111:3, 7, 22 112:9, 10 113:7 138:20 146:21 162:3 172:13 controlled 66:2 75:9 87:13 controller 8:8, 9 17:6 19:17 60:2 61:24, 25 62:7 64:24 65:9, 13, 14, 18, 19, 21 67:4 68:9, 17 75:17, 18, 23 76:3, 8 77:1, 25 87:15, 17 88:17 108:1 111:4 112:13, 23 113:1, 8 137:13,	24 170:11, 15, 16 171:6, 7 172:24 173:9 174:8 controllers 8:18 16:3 23:20 65:16, 23 75:6 controlling 15:10 57:15 65:10 75:8 102:14 110:23 Controls 4:6, 8 23:11 47:5 74:24 conversely 114:4 convert 31:16 converted 69:25 conveys 156:10 cool 155:24 156:7 coordinate 7:23 8:1 coordinated 172:7, 14 coordination 112:8 copy 44:16, 19 46:6 corner 89:23 corollary 88:12 CORPORATION 1:4 correct 5:16 19:23 20:8, 9, 22 34:13 41:14 42:3 46:6 59:1 63:8 75:4 84:15 101:7, 8 106:14 108:10 125:25 145:25 148:23 149:20 158:18 164:11 165:10 166:19 180:12 correcting 111:2 correctly 125:16 corresponding 53:23 174:10 cost 10:16 12:1, 3 16:2	could 9:24 11:6 12:5 15:12 19:7 21:22 25:5 29:16 38:1 46:21 47:10 52:14 54:22, 25 55:3, 13, 24, 25 56:23 57:21 59:8, 17, 22 63:1 66:12 67:22, 23 69:22 71:1, 2 73:2, 12 74:8 76:20 77:6, 22 79:13 80:4 81:9, 13 82:13 84:21 85:10 86:16 88:16 89:7 93:14 96:25 97:7 104:20 105:6 107:14 112:12 113:9 116:4, 25 117:2, 11 121:5, 22, 23 122:13 123:16, 17 124:9, 14, 20 125:20 127:12 129:7, 9, 11 134:2, 7 138:11, 13 140:11, 14, 15, 22, 24 141:7, 8 144:13, 14 146:20, 22, 25 147:4, 12, 18, 25 152:12, 13, 14, 15, 18, 24 153:3, 10 155:10, 11, 16 157:4 164:18, 19 166:1, 5, 9 173:23 174:22 175:14 176:7 couldn't 99:18 121:3 counsel 177:15 180:17 counter-rotate 78:7 126:14, 15 127:2, 7 170:2 171:22 172:1
---	--	--	--

173:1 174:1 175:4, 22 176:3 counter-rotates 126:19 counter-rotating 126:20 counter-rotation 78:15 171:24 172:17 counts 19:11 COUNTY 180:3 couple 24:22 28:13 31:17 43:3 68:12 69:20 74:18 116:20 coupled 118:24 122:17 123:20 128:3, 17, 25 129:8, 9, 20, 22 130:5 coupling 123:25 128:4, 5, 21 129:1, 12 130:7, 8 course 18:24 26:14 73:2 courses 8:24 COURT 7:24 62:17, 21 96:16 179:6 cover 82:15 174:6 cracks 80:13, 15 crane 15:12, 21 16:3, 7, 10, 14, 17, 22 17:2 37:24 39:19, 22 cranes 7:22 8:19 9:25 15:10, 15, 16, 20, 24 16:6, 10 38:5, 6 39:8, 12 40:2 crap 157:5 crawler 34:25 41:9, 13 49:10, 14 50:4, 5, 6, 8, 14, 17 51:6, 11, 15, 19 52:17 54:3, 6, 13,	16 56:4, 6, 12 57:7, 13, 20 58:4 59:14 62:4, 10 68:15 69:3, 13, 14, 16 70:9, 12, 13, 18, 21 71:12 73:6, 8 74:25 75:9, 13, 15 77:21, 23 78:8 85:7, 9 86:4 89:19 90:2 91:9, 19, 21, 25 93:6, 21 94:10, 24 95:23 96:6, 11 97:3, 16 101:6, 12, 15, 20 102:17, 24 103:7, 13, 15, 16, 18 104:5 105:19, 23, 24 106:11, 22 108:15, 19 109:6, 14, 25 110:3 111:6, 8, 15, 17 112:9, 19, 20 115:12 118:23, 25 119:11, 12, 18 120:3, 5, 13, 16 121:8, 16, 19, 22, 24 122:4, 16, 18, 24 123:7, 17, 19, 21 125:23 126:2, 17, 24 127:2, 4, 7, 14, 22 128:1, 18 141:1 144:19, 24 147:2, 9 148:16 151:12, 13 158:16 159:23 160:15, 20 161:14 162:3 163:5, 17 164:3 166:14 167:6, 9 168:7, 14, 21, 23 169:5, 13, 20 170:3, 19, 22 171:9, 13 172:1, 5, 8, 10 174:1 175:22 176:4 178:3, 5	crawlers 65:15 145:4 147:16 create 31:22 48:24 49:3 72:22 98:21 112:16 139:16, 18 creates 16:16 creating 49:2 81:23 99:15 credentials 12:17 cross 34:7 164:10 cross-country 21:5 CROSS- EXAMINATION 3:4 177:4 cross-sectional 94:5 CRR 1:16 cruise 111:3 C-shaped 50:12 curb 25:6, 15 59:15 71:15 82:16, 18, 23 133:25 134:17 146:6 curbs 84:2 144:11 current 6:18 currently 6:10 Curriculum 4:3 curved 82:3 customer 10:17 customer's 9:17 cut 30:12 CV 6:14, 18 12:16 20:21 21:2 45:6 cylinder 32:22, 25 33:3, 5 34:1, 9, 12, 14, 19 47:14, 17, 18, 19, 21, 25 48:2, 5, 7, 9, 12, 14, 15, 16, 21, 23 49:1, 9 55:17 56:5 60:16 61:21 67:10, 11, 20, 24 70:16 72:2,	16 76:17 86:11 87:14, 21, 23 91:14 92:24 93:5, 13 98:23, 25 107:4, 25 108:2 109:7 139:9 160:3 161:3 cylinders 31:25 32:2 69:17, 20 71:23 < D > d/b/a 1:3 date 6:19 21:4 DAVID 2:7 david.mroz@finne gan.com 2:10 day 12:6 13:18 67:13 73:15 99:14 DC 2:8 dealing 28:8 debris 157:5 decide 62:1, 9 78:23 87:18 88:18 decided 106:19 deciding 111:19 decision 109:4 111:16 Declaration 4:4 5:15 6:5, 15 44:16 45:6 46:6, 16 56:24 79:11 85:11 92:9 94:15 118:6 132:6 140:3 141:12 148:21 164:24 177:7 decommission 15:22 default 117:5 define 123:11 125:3 defines 129:8
---	---	--	---

definitely 26:16 27:14 42:11 43:2 144:15 155:14 definition 130:8 deflexion 50:16 degree 21:1 42:21 68:21, 24 78:16 105:19 121:7 135:21 degrees 67:20 68:21 69:4 70:6 78:14, 15 126:16 134:3 164:18, 19 delivery 179:12 depend 130:1 145:3 167:7, 19 dependent 67:9 depending 25:17 67:23 Depends 30:1, 18 59:7, 16 67:13 70:12 113:20 114:8, 20 116:21 145:3 depicting 177:16 deployed 83:23 84:2 DEPOSITION 1:5, 14 5:22 46:8, 12 170:8 178:9 Depot 30:22 depth 24:4 derails 18:10 describe 32:10 47:16 60:5 79:18 81:17 85:19 88:19 90:4 91:7 142:7 described 21:20 37:6 79:8 86:8 93:3 94:23 95:10 97:1 106:6 109:20 115:5 162:21	describes 87:3 88:9 102:1 170:21 describing 42:13 84:20 85:14 95:5, 6 106:13 127:20, 21 175:18 description 69:11 89:20 173:21 descriptions 33:4 171:19, 24 design 7:3, 5, 11, 17, 21 8:13, 21 9:12, 16 10:5 11:1, 8 14:7 19:7 37:22 38:2, 22 39:4 41:4, 9 57:24, 25 72:24 83:8 106:7, 24 107:14 108:10 116:21 117:5 134:10, 24 139:20 143:13, 18, 21 146:13, 17, 19 148:9 150:4 160:2, 5, 14, 19 161:12 167:7, 19 designation 178:10 designed 38:9, 10, 12, 19, 25 40:11, 18 41:4 58:8, 13 81:5, 14 82:8 96:14 109:12 126:18 144:9 147:20 153:2 154:13 167:13 designing 37:3 41:6, 12 97:12 107:10 designs 7:11 8:16 38:13, 16 161:10 desired 62:6 74:12 75:21 88:2 106:25 110:3	113:6 132:25 172:2 177:21 desktop 6:21 detach 153:5 detail 95:15 113:3, 4 detailed 10:17 details 89:21 determine 62:4 72:4, 22 78:20 determined 64:23 66:3, 5 determining 18:15 develop 12:11 13:7, 12, 24 14:13 16:6 developed 13:10 14:10 15:11, 23 39:12 150:5 developing 12:25 14:17, 22 24:12 72:7 development 19:22 device 37:3, 9, 16 88:5 92:18 101:23 102:2, 7, 10 103:9, 10 104:1, 3, 16 106:2 109:19 110:1 139:15 141:7 152:19 156:12 devices 39:24 92:12 109:23 139:18, 24 174:20, 25 177:25 diagram 170:11, 12 171:10 diameter 100:11 117:2 dictate 113:1 did 5:23, 25 6:1 13:7 14:7, 12, 18, 21, 23 15:3, 17 16:6 17:14 19:2, 18 25:21, 23	27:11 38:5 39:11, 20 43:1, 4 44:4 73:20, 22 83:19 144:13 148:18 150:15, 20 151:9 163:25 didn't 13:1, 24 18:24 21:1 28:5 38:14 41:4 55:4, 23, 25 67:16 68:23 99:11 106:18 121:13 123:2 148:11 149:25 150:2, 9 151:10, 14 159:7 160:17 174:23 diesel 31:12, 14, 21 144:1 differences 144:5 different 10:6 30:20 31:17 60:18 102:21 109:1 121:9 124:19 134:7 143:15, 19, 20 146:25 147:2, 6, 10, 23 152:11 172:14 difficulty 145:7 dig 157:2 digs 156:8 dimensions 147:2 DIRECT 3:4 5:6 46:21 47:10 94:18 128:4, 21, 23 129:1 153:15, 18 direction 59:14 60:21 67:6, 15 68:18 108:15 109:8 114:5, 22, 23 116:3 130:21, 24 131:2, 4 172:3 173:2 directions 121:9 134:7
---	---	---	--

directly 50:3, 9 100:25 129:8, 9 135:17 146:20	disengage 174:25 175:2	135:5, 6 138:9, 11, 22 139:13 141:21	doing 7:7 12:25 25:18, 20 26:18
dirt 81:9	disengaging 174:19	145:9 146:2, 4 147:22 148:11, 18	29:2 41:25 53:4 58:14 65:17
dirty 23:11	Disney 13:23	149:24, 25 151:14, 24, 25 155:11	75:25 77:10, 22 99:18 111:3
disadvantage 33:6 96:14	14:1, 3 17:7 18:3 38:25	156:14 157:17 158:14 161:10, 12	159:13 165:13 170:20 171:15
disclaiming 127:10	Disneyland 17:11	162:10, 13 165:18 166:6, 15 174:22	172:7 175:15
disclose 108:14 134:9 138:3	disparity 146:15	176:7 177:9, 15 178:24 180:6	Dolphin 2:14
159:22 160:14, 19 162:23 163:21 178:4	distance 35:12, 15 63:17 64:21	doc 7:7	dominated 25:10 29:17
disclosed 91:23 151:17 159:13	98:18, 22 100:7	Doctor 49:11	done 26:5, 12 31:3 40:23 41:8,
discloses 85:20 87:7 89:14 93:19	disturbance 106:4, 5, 21	document 145:19 160:23	12, 14, 22 74:23 77:6 78:9 79:6
95:3 101:22 112:7, 18 126:23, 25 159:9 168:23 169:9	DIV 1:7	documents 45:3	105:8 157:12
disclosing 93:24 140:18 160:1	dive 172:12	does 6:5 11:11, 12 16:2 24:14	don't 11:15 21:2, 14 28:10 44:11
disclosure 92:5 93:24 168:13	diverge 10:18	39:11 44:13 52:16 63:6 66:8	47:19 57:12 58:7 59:15 66:10 67:8
169:23 170:19 171:16 175:20	do 9:7 10:1 11:4 12:20 15:9 22:19	67:3 68:20 77:20 79:25 80:19	68:4 71:21 73:22 76:13 82:7 83:9
disclosures 150:4 171:21	24:20, 21, 22 27:22 29:24 34:3 36:16 38:24	84:24 85:6 87:12 88:19 89:8, 22	84:1, 22 88:10, 14 89:17 95:1, 15, 16
disconnect 77:11, 16	41:17 43:17 45:3, 12, 14 49:10, 12	99:16 105:16, 22 108:13 110:6, 21	98:18 107:7, 19 110:10 112:6, 22
discuss 53:10 94:23	52:14, 15 55:6, 21, 23 56:1 57:13, 14	111:7 113:1 124:12, 22 127:15	113:3, 7 123:1, 9 127:5, 9 128:12,
discussed 125:23 166:21	60:2 62:1 63:12, 14 65:19, 24 66:6	128:20 130:23 131:6 134:9	13 129:3, 14 135:16 136:15, 23
discusses 105:12 127:13 128:17	67:23 68:12 71:8 72:6, 12, 25 73:5	135:11 149:11 159:22 160:14, 19	138:8 141:25 142:15, 22 147:22
130:20 151:23	74:2 75:1, 11 76:4, 7, 15, 19, 20	162:23 163:21 164:2 167:2	149:22 151:9 152:2, 5 153:19
discussing 47:13 56:9 63:12 68:10	84:12 85:15, 17 88:16 89:7, 24, 25	168:6 169:3, 4, 18 171:1 176:1	154:8 155:7 158:20 159:7, 11
91:6 98:5 135:5	92:13, 14 95:11 96:25 98:8 105:4,	177:18, 20 178:1, 4, 7, 18	161:19, 20, 21, 23 163:24 164:5
discussion 47:1 51:3 79:16	13 107:23 108:3, 6 111:20 112:10,	doesn't 43:9 88:5 93:5 103:19	165:14 167:14 169:9 175:12, 24
177:10	12, 24, 25 113:10, 25 117:11 118:11	106:1, 2 112:14, 21 129:16 131:16	176:4 178:9 179:11
	119:14 120:14, 24 121:11 122:13	138:2 144:25 149:8 161:24	door 86:15 double 36:3
	125:8 126:12 127:11, 12 128:18	170:25	DOUGLAS 180:3
	129:1, 22 130:17, 21 132:14 133:14		

down 6:10 18:17, 22, 24 22:11, 22, 23 28:11, 12 30:5, 14 31:2 34:23 40:10, 20 53:25 54:20 58:14, 16, 21 65:22 71:10 76:23 84:9 89:25 90:1 114:2 115:6, 10, 24 135:4 142:3, 5 143:6 150:11 153:7 154:9 157:1, 7 158:2, 6, 7, 22, 23, 24 159:3 downhill 113:23 115:17 downloading 6:20 downward 73:8 dozen 40:8 Dr 5:8 6:18 46:5 91:5 132:5 149:7 151:22 154:6, 23 168:5 176:8 177:6 drag 43:8 dragged 43:6 dragging 42:24 drawbacks 107:16 drift 55:4, 6 Drive 2:14 9:20 16:15 22:8, 9, 15, 18, 21 31:8, 9, 21 42:22 55:8, 13, 14 59:10 63:23 67:1 74:10 75:3 93:11, 12 97:5 110:12 116:22, 24 117:6, 16, 19, 24 128:17 134:3 140:7 147:18, 19 156:24 157:23 158:21, 23 driven 14:5 31:25 39:9 70:19 drives 31:23 64:14 65:7 76:12	139:18, 22 140:10 158:6, 7 driveway 44:6 driveways 26:1 driving 16:17 23:16 26:15 27:21 31:12, 19 63:22 71:10 75:6 89:19 103:20 108:20 110:12, 19 112:11, 18, 21 113:21, 22 116:25 155:12 157:6, 22 158:24 159:3 170:16 drop 23:13 dropped 145:12 dropping 23:8 142:24 159:11, 14 drum 81:19 82:25 89:25 90:1 157:8 dug 64:3 duly 5:4 dump 22:1, 5, 8 23:7, 14 25:14 42:15, 18, 19, 21 43:6 DUNNER 2:6 during 11:2 14:15, 25 20:17, 22, 25 21:12, 25 23:3 157:10 dynamic 125:8 < E > earlier 25:24 91:13 93:16 98:5, 20 118:10 133:13 easier 34:3, 4 89:11 96:5 100:9 132:23 137:23 144:23 167:17 easily 11:13 120:22	easy 52:9, 11 eat 70:23 81:6, 20 eating 81:24 82:1 84:9 eats 80:22 edge 30:13 64:9 100:8 edges 23:1 education 20:20 effect 59:9 93:18 144:18 effecting 54:2 effort 51:5 eight 24:13 either 25:9 33:5, 7 34:25 39:5 41:15 44:22 47:22 51:3 54:4, 7 66:21 74:14 84:11 107:15 108:3 122:4, 12 123:24 136:6 157:19 166:1 electrical 16:13 19:19 38:21, 24 63:12 electronic 15:1 55:2 electronics 14:12 16:11, 19 19:16 element 119:5, 6, 9 elements 131:9 elevated 40:9 116:10 154:14 174:8 eliminate 51:5 eliminated 17:18 embodiment 86:10 88:4, 8, 19 89:13 93:4, 9, 10 94:17, 19 96:12, 22, 23, 24 101:11 102:12, 15 embodiments 86:15 87:3 88:9 91:11, 23 92:3	93:3 94:21, 22 102:21 employee 21:8, 9, 10, 16 enclosure 38:20 encounter 25:21 150:16 encountered 29:23 83:12 150:24 endeavor 141:24 142:6 energy 16:16 31:16, 17 97:3 engaged 115:18 116:12 138:4 175:23 engagement 174:11 engages 173:8 engaging 135:8 158:11 168:19 173:1 engine 31:12, 14, 21 engineer 26:17 96:25 entire 18:18 136:21 environment 72:5 equal 94:8, 11 equate 99:12 equates 124:5 equating 124:8 equipment 23:3 155:13 equivalent 22:13 especially 21:15 143:22 essentially 16:2, 20 18:23 20:18 22:20 26:22 41:2 44:1 45:7 64:10 68:13 74:8 76:15 79:2 88:1 99:4
---	---	---	--

103:20 132:11 149:13 154:10 establish 123:12 estimate 29:8, 10 estimation 73:12 139:21 ET 1:18 evaluation 91:6 150:2 event 180:18 ever 16:6 25:21 26:5, 9, 11, 23 38:13 39:4, 20 40:23 41:8 44:8 47:6 72:18 83:12 99:18 129:19 140:6 150:5, 15, 24 151:6 every 94:8 95:6 everything 17:14, 18 54:12 80:21 117:22, 24 144:21 evolved 14:16 exact 27:11 exactly 40:11 44:11 51:1 57:14 58:6, 7 67:21 68:5 73:24 111:10 112:15 113:8 142:21 144:12 146:22 EXAMINATION 3:4 5:6 examined 5:5 example 7:20 10:9, 16 11:1 15:12 16:12 19:5 36:9, 22 38:18 40:5, 13 52:8 68:14, 19 76:6 82:19 92:21 98:20 113:22 123:16 134:2 136:17 140:25 141:3, 6 142:17 149:14 151:3	155:15 170:10 173:19, 24 174:21 175:16, 25 176:1, 2, 5 examples 39:3 68:11 except 147:4 exclusive 173:21 EXHIBIT 4:2, 3, 4, 5, 7, 9, 10, 13, 14, 15, 16, 17, 18 6:13, 16 44:15, 16, 17 45:10 46:5, 7, 8, 9, 13 62:12, 13, 16 79:10 86:21, 24 101:25 104:20 135:2, 3 142:25 143:1, 3 145:13, 14, 16 149:1, 3, 4 151:16, 18, 19 153:24 154:1, 2, 16, 18, 19 159:15, 19 166:22 167:22, 24 168:2 170:7, 8 177:13 178:9, 11, 12 exhibits 45:7 expedited 179:11 expensive 15:24 17:16 experience 10:3 12:18 30:3 41:18 58:11 experiment 27:11 experiments 72:19 Expires 180:25 explain 47:20 117:17 132:12 explaining 132:8 explains 89:7 explicit 138:8 extend 32:17 33:17 48:1, 2 67:11 69:23	extended 48:9 61:23 87:16 88:20 extending 56:12 extends 48:17, 23 61:23 92:24 extension 32:17 48:12 60:15 70:7 extent 56:13 80:19 111:12 163:2, 11 extra 103:25 106:2, 19, 24 108:22 109:19 110:2, 23 135:21 extremes 70:25 eye 10:13 < F > fact 7:17 19:13 27:15 39:12 78:20 86:4, 8 96:6 127:4 134:1 137:21 142:20 147:18 161:22 factor 11:8 factors 145:10 fair 7:9 8:4, 23 9:1 12:7 29:6 41:11 45:1 51:2 57:23 140:1 fall 21:12, 18 58:22 falling 17:24, 25 18:4 23:15 familiar 101:23 family 20:8 family's 21:8, 21 41:17 42:5 fancy 15:19 125:8 far 31:8 55:23 57:14 61:22 67:11, 22 68:1 73:2 87:16, 18 105:20 133:21	136:12, 15 FARABOW 2:6 faster 13:13, 15 81:8 feature 95:6 166:7 features 11:12 81:17 February 1:18 180:20 feedback 62:2, 7 64:21 108:1 110:25 111:1 113:8 feel 13:9 110:22 165:18 feet 29:4 44:3, 4, 9 69:20, 24 145:5 field 13:11 18:1, 5 72:8 141:24 142:6 Figure 149:14 153:1 159:25 160:24, 25 162:9, 13, 15 170:10, 21 171:17 figures 86:9 152:3 166:25 177:16 files 62:15 fin 19:9 find 29:12 69:19 96:25 151:11 162:15 170:5 fine 59:18 138:20 179:13 finish 175:9, 13 finished 63:18 175:14 FINNEGAN 2:6 firm 80:18 first 5:4 8:12 10:25 13:10, 22 15:16 63:15 66:1 68:8 119:13, 19 120:7 158:6
--	--	---	--

161:18 168:6 170:17 171:8 173:7 Fitbit 15:7 five 12:15 29:4 164:18 five-foot 144:14 five-minute 45:20 131:21 fix 14:4 17:11 157:23 fixed 54:17 120:23 121:22 122:12 163:8, 11, 13, 18 164:15 fixing 162:23 flat 80:11, 18, 21 82:2 flip 51:10 flow 60:17, 19 61:9 fluid 31:22 47:22, 23 60:11, 17 focus 8:17, 23 9:4 focused 7:12 14:17, 25 16:8 19:15, 19 102:10 follow 65:6 160:17 followed 119:24 following 5:1 46:2 66:23 91:2 132:2 177:2 follows 5:5 66:23 foot 36:1, 2 56:18, 19 69:22 70:5, 7 133:21 force 24:25 25:2, 6, 8 28:3 35:11, 14, 15, 23, 24 36:3, 15 37:12, 13, 14, 15 47:22 49:2 70:8, 14, 15, 22 71:5, 18, 22 72:4, 14, 16, 24 73:8, 13 86:13 94:8, 9, 10,	11 97:4, 17, 20, 24 98:1, 3, 16 99:7, 15, 19, 22 103:21, 24 106:19, 25 108:22 113:2, 5, 11, 13 114:12, 16 115:2, 16, 17, 21 116:2, 4, 5, 9, 11, 15, 19 117:18, 21 118:2, 3 139:17 144:19 167:4 forces 25:12, 15 35:1, 4, 6 37:1 53:8 55:9, 10, 11 58:12 73:11 81:23 85:2 89:6 106:4, 5, 21 107:5 108:8, 14 113:19, 25 114:6, 22 115:11 forcing 50:19 foregoing 180:7, 10 forever 133:7 fork 152:15 forklift 152:20 forks 152:14 153:6 Form 6:8 9:14 13:17 25:4 27:9 30:17 33:8 35:2, 21 36:18 42:17, 18 51:21 52:19 55:19 56:7 57:8 58:5, 19 59:6 65:2 71:20 73:21 83:6 85:21 87:10 89:16 92:1 93:22 94:25 96:18 99:10 100:19 101:13 104:6 106:15 107:6, 12 109:10 110:9 112:1 113:17 114:14 115:20 119:21 120:17	122:7, 25 124:7 128:6 129:24 131:10 135:15 136:22 137:11 138:6 139:5 140:8, 19 141:22 142:14 143:17 146:16 147:11 148:4, 10, 17 149:10 150:7, 18 152:22 153:16 154:25 158:19 159:24 161:16 162:6, 25 163:9 164:4, 12 165:5, 11, 25 168:9 169:7, 16, 24 173:11 174:16 175:11 forms 22:10 25:9 29:4 31:17 177:24 formula 113:8 formulas 113:10 forth 58:24 70:4 108:19 110:16 112:20 125:5 133:4 forward 10:25 22:9 23:16, 17, 23 25:14 28:5 31:19 42:23 55:8 58:18 59:10, 11 65:7 68:3 75:3 106:12 111:25 112:18 116:13 133:23 157:18 172:5 found 6:23, 24 171:23 four 18:4 24:1, 13 29:3 43:13, 15 65:21 69:3, 5, 6, 9, 13 75:7, 10, 19 83:20 141:1 144:25 145:2 fourth 73:11	four-track 146:2, 10 178:22 frame 32:8, 9, 19 53:24 54:8 86:3, 5, 19 104:11 105:13, 21 123:12 125:3 141:1 146:25 152:16 155:10, 12 172:11, 12 frames 140:24 FRANKEL 2:13, 15 frankly 67:12 free 13:9 158:24 159:6 freedom 68:22, 24 69:5 105:19 121:7 135:22 freeway 28:22 29:3, 6 84:8 freeways 84:4 frequent 29:23 fresh 30:14 friction 73:6 144:23 167:11 frictional 34:16 frictions 167:8 front 42:19, 20 60:17 142:16 164:18 full 8:20 28:22 180:12 full-time 21:8, 10, 16 fully 123:3 function 27:17 101:19 106:17 152:20 158:12 functional 12:8 functionality 152:11 fundamental 9:24 10:13, 15 48:5 134:15
---	--	--	--

fundamentally 132:20 134:11 137:7 further 35:18 36:2 82:9 98:6 99:3 138:17 176:9 179:3 fuselages 38:8 < G > G&Z 5:19 G21 4:6, 8 47:5 gain 27:17 36:11 37:8 gaps 28:4 GARRETT 2:6 gear 36:24 117:5 160:12 gears 36:22 117:8 General 1:16 7:19 27:19 28:18 53:3 87:19 91:12 92:4, 14 129:5 130:3 140:13 180:5, 23 generally 11:22 12:9 24:11 32:6, 14 35:22 41:5 44:1 64:6 69:20 140:23 generate 31:15 35:4, 20 37:16 71:23 89:5 98:15 100:5 generating 36:21 98:10 Generation 4:5, 7 47:4 Generic 32:12 Georgia 7:4 14:24 getting 20:19 75:14, 16 111:19 133:11 give 8:9 63:2 74:9 95:16	112:24 136:2, 4 173:12 given 8:3 82:3, 13 109:25 146:14 161:19 gives 33:22 35:15, 16 36:1, 3 64:20 96:9 giving 74:12 108:21 glasses 15:4 global 111:18 go 6:21 10:23 14:3 16:20 22:2 27:15 28:1 32:20 43:25 45:7 49:23 50:5, 17, 19 52:6 54:18 59:3, 10 60:12, 13, 25 61:3, 5 63:25 64:5 67:21 68:10 69:22 70:4, 23 72:7, 9, 21 73:15 76:13 78:6 79:10 81:8 84:4, 9, 21 107:18 108:23 112:12 113:23 114:19, 23, 24 116:3 128:16 133:23 134:24 136:10, 15 137:15, 16, 22 142:3 143:6 144:12 145:9, 10, 19 151:10 155:25 157:4, 24 158:25 159:8 161:16 172:21 175:8 goal 101:15, 19 GODBERSEN- SMITH 1:1 goes 12:14 28:16 40:20 86:4 95:7 118:2, 3 119:25 156:9 157:25 161:3 164:14	171:6 172:6 175:24 going 6:12 8:6, 7 9:19 10:18 12:3, 4 13:8 14:14 17:5, 19 20:24 21:4 23:17, 23 24:8 27:6 30:11 31:7 32:21 37:17, 20 38:17 45:19 50:17 51:2 54:13, 14 55:9, 10 58:11 63:2 66:15 67:6, 19 70:6, 13, 15, 22, 23 73:18 77:12, 13, 15, 24, 25 78:9 81:3 82:14 83:1 84:2, 3, 5 85:18, 22 87:19, 23 103:23 107:14 108:24 114:2, 4 115:6, 7, 10, 11, 14, 16, 23 116:1, 15 124:18 129:11 133:2 134:1, 5 135:4, 22, 23 137:2 146:24 160:3 163:13 165:19 170:9, 15 171:19 173:19 174:22 175:2, 3, 4 GOMACO 1:3 5:19 148:6, 14 178:22 good 7:13 11:12 17:3 80:17 82:18 84:19 88:11, 14 92:16 96:25 117:11 147:3 171:20 Google 14:24, 25 GP-3 148:15 GP-3500 178:22 grabbing 145:8 grad 14:14	graduate 8:7, 15 9:1, 2 gravel 71:2, 11, 13 gravity 18:1, 5 great 25:7 greater 25:2 84:6 115:17 116:11 117:1 159:10 Greek 139:24 grind 159:4 grinding 89:9 156:1 grinds 79:22 80:20 grip 100:12 167:16 ground 13:25 16:12 32:3, 18 40:1, 14 43:5, 7 49:17 64:1 77:3 89:25 90:2 112:11 113:16, 20 114:1, 6, 21 115:4, 19, 24 116:4, 9, 12, 16 120:1 135:8 138:4 145:9 167:4 168:19 173:1 174:7 175:23 176:3 ground-engaging 175:5 177:19, 24 group 19:19 GT-3200 4:10 142:17 143:2 146:13 guarantee 71:25 guard 82:16 guess 7:13 29:16 49:16 60:7 94:1 161:18 guide 49:10, 13, 16, 22 50:2, 9, 11, 18 51:12 52:2 66:12 guideline 63:18, 20, 21 64:7 65:1,
--	--	---	--

6 66:17 74:11 76:6 92:15 133:2 guidelines 74:16 guides 64:10, 11, 20 guidewire 64:13 GUNTERT 1:7 gushing 61:1, 4 gutted 18:23 gutter 146:6 < H > had 5:2 14:13 15:9 17:13, 15 19:6 22:1 23:20 25:13 27:13 30:6 34:8 42:1 46:2 83:22 91:2 109:12 130:2 132:2 133:6 148:22 166:2, 21 171:20 177:2 half 14:23 23:22 132:11 hammer 100:12 hand 22:20 handle 61:3 84:24 85:6 100:3, 5, 6, 8, 10, 11, 15, 18 hands 76:14 hanging 153:2 happen 29:22 155:23 happens 103:4 141:4 174:12 hard 30:24 71:12 78:12 100:5 132:21 167:16 harder 52:15 has 11:2 17:24 18:8, 12 30:10 31:18 33:16 42:18 43:10, 18, 23 45:6 47:21 48:7 49:23 50:5,	20 52:6 61:22 64:12 66:18 68:22 69:9 70:18 74:12, 14 81:6, 18, 20 83:4 85:1 87:15 89:20 91:11, 13, 19 92:2 105:3 108:17 109:22 117:22 122:12 141:1 144:24 147:1 152:10 155:8 163:18 167:10 171:4 174:14 have 7:2 8:5, 7 10:11 11:15 12:16, 18 15:4 16:10 17:1, 25 19:10 20:21 22:17, 19 23:9, 13, 15 24:8, 18 26:2, 5, 9, 11, 14, 23, 25 27:2, 22 28:5, 9, 12 29:5, 18 30:7, 9, 12, 20, 21, 22 31:2, 13, 15, 16, 20, 21 32:3, 4, 6, 23, 24 33:15 35:4, 8, 12, 13 36:16, 21 37:9 38:13 39:4, 15 40:23 41:1, 2, 8, 17 43:4, 9, 10, 24 44:8, 18, 19 45:3, 5, 8, 12, 14, 16 47:6, 14 48:15 49:20 52:16 54:9 55:10 57:12 59:4, 8 60:14, 25 61:8 62:22, 23 63:3 65:6 66:20 69:6 70:2, 3, 23 72:8, 18 73:5, 17 74:8, 10 76:13, 21, 23, 24 78:16 82:10 83:3, 10, 12, 19, 22 84:1, 6, 22 86:23,	25 88:5, 10, 14 89:4, 5 92:18 93:15 94:11, 20 95:7, 19 96:8 103:23 104:14 106:18 107:16, 23 108:1, 25 109:15 110:23 111:1 115:8, 9, 23 116:17 117:9 118:1, 13 120:4, 12 123:11, 12 125:13 129:16, 19 130:9, 12 131:16 132:16 133:2, 22 135:20 136:11, 15, 24 137:16 138:17 139:22 140:5, 11, 14, 15, 24 142:15 143:4, 23 144:19, 22, 25 145:18 147:22 149:5 150:23 151:6, 20 153:2, 5 154:4, 21 155:21, 22, 25 156:2, 4, 7 159:8, 17 161:20 162:1 163:16, 18, 22 166:3, 6 167:25 170:25 174:23, 25 176:9 177:14 178:13 haven't 26:12 41:14 he 158:2, 3 head 67:9 159:12 heading 59:13 hear 13:1 61:14 121:13 heard 15:4 heavier 95:13, 23 heavy 15:10 80:2 81:21 82:3 95:11 96:3 153:11 heel 145:6	height 23:12 43:11, 12 49:19 heights 154:14 held 54:11 help 21:17 34:18 53:12, 25 80:5 104:14 106:25 109:15 114:18 115:14 133:12 helped 13:12 20:15 37:22 38:2 helper 152:18 helping 14:13 62:9 113:25 114:6 helps 36:14 HENDERSON 2:6 hereunto 180:19 hey 23:22 64:18 HIGH 2:7 3:4 6:8 9:14 11:20 20:23 25:4 27:9 30:17 33:8 35:2, 21 36:18 47:24 48:3 51:21 52:19 55:19 56:7 57:8 58:2, 5, 7, 19 59:6 65:2 71:20 73:21 83:6 85:21 87:10 89:16 92:1 93:22 94:25 96:18 99:10 100:19 101:13 104:6 106:15 107:6, 12 109:10 110:9 112:1 113:17 114:14 115:20 119:21 120:17 122:7, 25 123:8 124:7 128:6 129:24 131:10 135:15 136:22 137:11 138:6, 19 139:5, 13, 15 140:8, 19 141:22 142:14 143:17
--	--	---	--

146:16 147:11 148:4, 10, 17 149:10, 21 150:6, 18 151:1, 8 152:22 153:16 154:25 155:6 158:19 159:24 161:16 162:6, 25 163:9 164:4, 12 165:5, 11, 25 168:9 169:7, 16, 24 173:11 174:16 175:11 176:11 177:5 178:14 179:2, 4, 10 higher 65:18, 20 75:16 98:7 highlighted 172:20 highway 26:3 highways 151:6 hill 114:3 115:6, 11, 24 hinge 125:6, 18 126:8 historian 150:11 historically 13:9 hit 53:7 59:15 76:16 79:3 hitting 70:21 hold 53:12, 22, 25 57:11 58:8 65:17 75:21 87:23 106:25 110:14, 16, 18 121:23 holding 67:1 103:21 104:10, 12 117:22 121:22 144:21 145:1 hole 104:2 Home 30:22 61:2 honest 155:8 163:23 honestly 174:24 hook 22:5 hooked 23:6	164:6, 10, 21 horsepower 31:15 hoses 47:21 hot 22:8 42:21 hour 12:14 45:20 house 6:23 27:1 41:23 housing 164:15 huge 14:5 25:16 37:24 144:16 156:3 hundred 180:11 hurt 105:22 hydraulic 14:6 31:21, 23 32:22 33:2 47:19, 21, 22 48:5 60:10, 11 70:16 76:13, 16 86:10 87:21, 23 89:6 91:16 117:8, 10, 12, 13, 18, 20, 22, 23 hydraulics 31:20 32:1 < I > idea 92:16 104:13 ideal 72:5 identification 6:16 44:17 62:16 86:24 143:3 145:14 149:4 151:19 154:2, 20 159:20 168:3 If 6:21 12:2, 6 13:3 15:25 18:5, 9, 16 24:7, 23 26:15 28:4 29:22 30:3, 5, 10, 14, 24 31:4 32:18 33:15 34:13, 24 35:3, 23, 24 36:2 37:5 43:24 44:23 46:15, 21 47:10 48:2 50:25 53:5 54:11 55:4, 11, 15	56:17, 23 58:15 59:12, 22 61:23 62:11 63:1, 23 64:16 66:23 67:6, 10, 19 68:7, 9 69:17 70:2, 13, 18 71:24 72:7 73:1, 14 77:12, 15, 24 78:3 79:12 80:9, 11 81:8, 10 82:13, 21 83:24 84:3, 15, 21 85:10 91:20 93:12, 13 94:8, 9 95:7 96:1, 6, 21, 24 97:2, 5, 14, 20 99:1 100:4, 6, 23 101:25 102:13 103:17, 24 104:20 106:18 107:10, 16, 22 108:22, 25 109:11 110:13, 15 111:3, 23 112:10, 24 113:15, 19, 21, 22 114:4 115:5, 6, 23 116:8, 14, 16 117:24 118:13 121:21 123:12 124:11, 14, 16 125:7, 16 126:10, 15 127:1 128:16 130:7 132:5 133:5, 16, 20, 22, 25 134:2 135:2, 22 136:14 137:12, 21 138:13 141:11 143:6, 22 144:13, 22 145:5 147:13, 19 160:8 166:2, 4, 9, 22 168:19 170:4, 12 171:20, 23 172:19, 20, 21 177:21 III 4:10 47:4, 7 145:16, 24 146:1 Ill 4:5, 7	imagine 30:12 43:24 61:2 125:4 immediately 94:3, 6 impact 58:16 59:4 114:12, 15, 17 impacted 109:6 impediments 71:14 implement 38:14 138:18 146:13, 20 implementation 113:4 implemented 148:9 implying 163:7 importance 103:8 important 12:1 100:16 103:17 134:18, 19 improve 14:4 17:11 132:18 improved 133:17 improving 19:1 39:5 132:16 134:9 135:12 inch 23:22 68:16, 19 117:1 inches 24:1, 13 43:13, 14 58:24 61:23 68:12 incidentally 101:16 incline 115:7 include 93:5 177:23 included 161:13 includes 102:8 incorporate 9:12 increase 36:17 117:11 137:9 increased 100:9 136:2, 4 increases 100:15 increasing 117:3
--	--	---	--

independent 43:4 164:2 INDEX 3:3 indicate 51:4 110:21 125:12 130:5 131:6 135:11 168:6 indicated 153:25 indicates 110:22 161:6 164:6 indicating 66:11 110:17, 19 174:5 indirect 128:4, 21, 23 129:12 Industrial 173:18 175:8 industry 41:18 inertia 96:9 97:21 inform 68:20 128:20 information 48:10 61:25 87:18 informed 69:10 inherent 134:17 inherently 18:2 inhibits 156:23 inner 33:1, 18 34:19 50:2, 21 52:6 91:14 93:5, 13 94:12, 23 95:8, 24 96:7, 9, 13 97:15 100:17 101:16, 18 102:9, 16 103:5 126:16 161:7 165:23 input 36:15, 16 98:16 inside 17:22 32:16, 21 33:2 34:14 49:4, 17, 19, 23 69:21 82:24 86:4 inspected 26:11 inspector 157:25 installed 137:24	instance 101:6 integrates 16:24 intend 6:6 intended 154:24 155:5 158:17, 21, 22 177:23 intentional 106:1 interchangeably 98:2 interest 26:15 interested 180:18 interesting 40:4 interface 39:18 74:21 75:22 interfacing 76:7 internal 47:25 48:21 164:16 interpret 120:14 interpretation 119:17 122:4 125:10 163:2 interpreting 129:6 intervening 129:13 introductory 7:16 Invektek 16:4, 5 I-N-V-E-K-T-E-K 16:4 invention 127:11 152:5 155:12 172:18 178:16 investigate 150:9 investigation 73:23 148:12, 19 151:14 163:25 involve 124:20 involved 38:22 83:8 inward 137:15 iPhone 39:13, 15, 16, 17 IPR 5:15, 20 143:1 IPR2024-00835 1:1	issue 118:9 128:14 135:17 its 11:2 39:17 52:17, 20 53:25 56:5 63:12 64:21 67:4 81:17 84:25 85:6, 14 86:12 87:3, 6 88:5, 9, 17 91:8, 9 100:16, 21 101:15, 19 104:13 108:7, 15, 18, 19 111:5 124:23 125:6, 18 126:8, 9 131:7 133:4 134:10, 12 135:13 136:20 138:3 140:25 148:15 150:17, 25 151:12 157:12 158:22 159:1, 6, 23 164:3 166:25 169:5, 6, 13, 14 175:22 177:16 < J > jack 89:8, 22, 23 116:16 jacked 89:10 jacking 32:4, 5, 6, 11, 12, 19 34:25 40:24 41:2, 3, 7, 13 48:18 49:17 51:4, 6, 8, 15, 19 53:19 54:19 57:25 90:3 91:9 92:6 93:20 95:25 97:15, 16 100:16, 20 101:2, 5, 11, 17, 19 102:11, 16, 24 104:12 118:24 119:2, 11, 13, 19 120:2, 6, 9, 14, 15 121:7, 16, 20, 23, 24 122:5, 17, 20 123:20, 23 124:5, 13, 14, 18 125:24	126:8, 14, 17, 19, 23 127:15, 16, 23, 24 128:1, 17 160:21 161:14 162:4, 24 163:3, 4, 8 165:3, 8, 16, 23 jam 107:18 JEFFREY 2:18 job 12:6 14:10, 16 22:3, 4 25:17 28:10 59:4 65:17 76:18 77:6 96:4 133:11 jobs 22:2 Joe 23:22 jog 76:15, 22, 23, 25 77:1, 2, 14 133:4 jogging 77:4 Johns 4:15 153:25 154:6 joint 85:4 103:3, 4 joints 9:5 joysticks 39:10, 14, 23 jprice@kramerlevi n.com 2:20 jump 102:3 173:13 < K > keep 10:13 67:5 78:1 108:24 110:2 123:17 127:7 175:15 keeping 23:18 136:20 172:4 keeps 113:5, 11 158:2 kept 14:19 key 31:8, 11, 12 34:20, 21 94:4 166:6 keyed 163:13 keys 93:17 102:9
--	---	--	--

keyway 34:17, 18, 21, 22 94:4 166:7 keyways 93:17 kid 61:2 kids 79:21 kin 180:15 kind 11:8 13:8 15:7, 18, 24 17:23 18:2, 25 19:6 23:10, 16 24:9 26:19 28:14 32:14 33:1 34:21 41:25 43:16 49:18 50:24 53:17 60:22 64:12 67:22, 24 70:24 77:14 78:18, 25 80:10 82:1 99:8, 15 100:24 101:16 102:21 104:2 111:19 113:20, 25 125:15 127:5 129:14 132:21 133:3, 24 134:12 142:21 147:23 150:2 152:18 156:11, 13, 14 158:8 170:3 171:19 kinds 7:20 21:23 34:16 144:2 knew 69:10 149:24 knobs 43:16 knocked 106:3 know 9:11, 21 11:20 23:21 24:20 30:2 40:25 43:11 46:22 47:19 50:23 53:10 56:19 58:7 61:13, 25 62:7, 8 64:2 66:13, 20, 24 70:7 71:4, 14, 21 74:2 76:4, 5, 25	77:17 79:13 83:10 86:23 89:10 93:24 94:3, 6, 20 95:17 98:12 100:25 105:7 110:15 112:19 113:3, 5, 7, 10 117:21 120:19 122:11 128:12 142:20, 22 152:10 156:3 159:11 161:19, 21, 23 167:14 169:9 175:14 knowing 142:19 knowledge 10:2 known 139:18 149:24 166:7 knows 48:11 70:11 71:3 87:16 112:10 Korea 37:24 KRAMER 2:13, 15 < L > lab 13:12 labeled 47:14 74:19 86:22 105:1 149:2 laid 24:5 30:6 lane 28:22 44:12 language 118:8 128:15 large 18:23 25:21 28:19, 21, 22 55:11 62:14 63:24 78:3 80:19 106:21 139:16 140:24 161:11, 13 162:1, 21, 22 larger 28:23 117:2 118:2 largest 37:22, 23 last 11:11 13:1 56:15 94:14	121:13 132:11 143:6 154:10 late 150:15 laterally 64:22 law 94:7 lay 22:16 24:25 25:1 49:16 80:14 119:25 LAYDEN 2:13 3:4 5:7, 10 6:12, 17 8:22 10:4 25:19 27:23 31:6 33:13 35:9 36:8 37:2 44:14, 21 45:1, 2, 19 46:4 51:25 52:23 56:2, 22 57:18 58:25 59:21 62:11, 19, 24 65:8 72:3 74:3 83:11 85:24 86:20 87:1 88:3 90:5 91:4 92:7 95:9 97:13 99:20 101:4, 21 107:2, 9 108:5 109:17 110:20 112:4 114:9, 25 116:7 120:10 121:10 122:14 123:4 124:2, 10 128:10 130:11 131:15, 20 132:4 136:1 137:4 138:1, 12 139:12 140:16 141:10 142:2, 24 143:5 144:6 145:12, 15 147:7 148:2, 7, 13, 20, 25 149:6, 17 150:3, 13, 22 151:4, 15, 21 153:13, 23 154:5, 15, 22 155:3, 17 159:2, 14, 21 160:7 161:25 162:12 163:6, 20 164:8,	22 165:7, 21 166:8 167:21 168:4, 12 169:10, 21 173:15 175:6, 19 176:8 178:11 179:3, 8 layer 23:24 24:20, 21, 22 laying 23:25 29:25 58:17 65:7 149:15 153:19, 21 lays 154:9 lead 123:25 124:9 leading 130:2 leads 160:6 learn 26:21 leaving 27:1 lecture 10:25 11:6 left 54:11, 14 64:17, 19 66:12, 18, 21 105:4, 11 170:13 left-hand 105:2 118:15 leg 32:2 48:16 57:3, 6, 11 58:16, 23 76:10, 17 77:20 78:4, 7 81:16, 18 82:23 83:2, 5 84:11, 17, 25 85:2, 5 87:4, 6, 9, 19, 22 88:6, 20 89:14, 22 91:9 103:12 105:4, 11 106:7 109:24 111:6, 8, 14, 17, 24 112:8, 12, 17 113:14 114:2, 7, 13, 19 115:3, 9, 12, 14, 22, 25 116:1, 3, 6, 16 123:16 124:11 126:4 127:3 135:21 136:6, 13, 14, 20 137:2, 10, 13
---	---	--	---

139:3, 7 142:7 152:17 157:9 169:6, 14, 19 170:2, 18, 23 171:9, 12, 25 173:25 174:13 175:3, 22 178:5 legal 93:25 legs 27:21 65:15 137:5, 14, 20 138:25 139:2 157:3 158:15, 16, 25 163:21 166:14 169:9 length 36:9 48:12 67:23 69:15 99:25 100:2, 14 lengths 30:21 lets 61:8 125:17 letting 73:15 level 8:14, 15 9:3 10:1 29:18 65:19, 20, 23 75:17, 20 80:18 113:3 116:9, 14 leveling 23:19, 21 lever 35:24 36:1, 13, 21 37:1 49:1, 3 98:11, 14 99:4 leverage 36:11, 13, 14, 17, 23 levers 9:6 LEVIN 2:13, 15 life 21:24 26:14 41:24 lifetime 11:3 lift 12:14 38:1 61:3, 5 90:2 152:4, 13, 16, 17, 25 153:4, 7, 11 154:12, 13 lifting 93:6 94:16 99:6 153:7, 9 160:16 161:5, 7	lifts 7:22 152:25 lighter 95:14 limit 81:13 limitation 118:22 122:13, 15 123:5 127:19 128:16 limited 69:15 122:23 123:6 178:25 limiting 29:20 58:2 87:8 123:14 limits 12:8 52:17, 20 line 67:2 78:13 91:7 100:7 102:1, 5 135:4 147:25 160:9 172:22 173:9, 13, 16 174:4 177:21 178:21 linear 91:16 160:4 lines 102:4 linkage 48:20, 24 49:2 99:2 139:10 160:4 linkages 92:17, 19 138:22 list 10:22, 23 12:5 132:12, 16 142:22 little 13:2 15:3 20:16 22:21 24:11 30:8 33:19 34:4 45:9 52:15 53:7 55:4, 7 56:10 59:9, 13 60:24 61:6 64:7, 15 65:16 72:11, 12, 14 77:13, 15 82:4 96:5, 10 97:1, 8, 19, 22 100:5, 11 107:25 108:2 133:8 134:23 135:23 137:22 140:12	144:16 150:10 153:20 Littman 4:14 151:17, 22 152:1, 5, 8 153:14 166:18, 21, 25 177:10, 12, 16, 18 178:4 live 155:24 living 21:5 LLP 2:6, 13, 15 load 143:24 168:24 169:15 170:24 178:6 loaded 18:1 62:15 loads 24:19 located 53:15 location 62:4 64:21, 25 87:24 91:24 92:13 157:1, 22 lock 44:5 57:22 58:13, 16, 21 78:5 88:18 93:15 95:3, 7 104:5, 14 105:17 108:7 locked 94:13 96:6 121:3 locking 55:15 92:22 93:19 94:23 95:4 96:9 104:16 105:12, 18 109:5, 15 175:1, 3 logic 19:17 long 7:2 11:11, 23 30:1, 11, 14 36:4 64:14 77:15 134:2 139:9, 22 145:5 longer 30:15 36:5 43:25 98:14, 18, 21, 22 99:4, 24 145:6 look 6:25 26:16 28:6 29:11 53:5 67:17 69:17 70:2	101:25 141:1, 11 170:12 looked 27:12 68:6 155:8 Looking 12:16 20:20 26:17 27:18 46:11 65:25 76:5 92:8 119:9 122:11, 15 124:3 142:22 149:7 151:3, 22 160:23 168:5 171:2, 10 172:16 looks 7:1 99:5 118:14 168:16 loop 60:2 loose 36:6 loosen 77:11, 14 loosening 137:18 lot 8:16 14:12 16:16 18:22 19:12 20:17 24:7, 19 25:12 26:20, 25 28:3 31:24 33:22 34:15 38:5, 25 40:25 41:23 58:11 59:12 67:18 76:23 81:23 83:22 97:22 99:13, 22 100:5, 9 116:23 127:6 133:5 134:5 139:19 140:2 142:16 143:21, 24 145:3, 7, 8 146:24 147:1, 21 152:11 153:9 156:16, 25 157:5 162:11 167:16, 18 171:22 172:4 lots 27:1 79:19 83:14 171:18 low 13:2 lower 16:2 32:8 50:2, 9, 11, 18
---	--	---	---

65:22 75:20 167:10 Lunch 90:7 < M > machine 8:11 14:2 22:21 29:22 37:22 38:10, 11 39:6 42:6 44:9, 13 47:7 54:9, 24 55:1, 9, 10 58:11 59:13, 17 63:22 64:11, 12, 15, 17, 20, 21 65:4, 11 66:2, 9, 10, 22, 24 68:2 69:1, 12 70:9, 17 71:7 72:8, 19, 23 73:14 74:10 76:22 79:7, 9, 20, 25 80:5, 24 81:2 82:4, 8, 12, 15 83:13, 16 88:21 89:1, 3, 15 95:11, 24 96:3, 24 103:20 106:11, 17 107:11 109:12 111:24 112:2 114:11 116:8 127:20, 21 130:20, 25 131:3, 8 133:6 135:12 136:25 137:18 138:4 140:6, 13, 15, 22 143:14, 19, 20 144:9 146:6, 10 148:3 149:8, 9, 12, 13, 16 152:1, 3, 7 154:7, 9, 23 155:4, 10 156:1, 20 157:16, 18 158:5, 17, 18 162:10, 20, 22 168:24 169:12 170:20, 23 171:12, 14, 25 173:7, 20, 25 174:6, 14	175:9 178:19, 23 machinery 15:10 machines 7:23 8:2, 4, 6 9:9 15:20 17:16 21:20, 23 31:24 41:1 80:3 81:21 84:16 95:17 97:12 132:21 133:13 140:12, 18 141:14, 21 142:8, 13, 21 146:14 147:23 148:8, 15 152:24 178:25 machine's 64:25 66:5 magic 98:17 main 22:2 53:4 117:3 maintain 11:13 55:18 56:5 78:1 106:23 107:5 108:15 109:8 110:8 173:2 maintaining 63:17 106:10 major 18:21 23:2 making 13:14 24:7 26:1 55:16 59:12 73:14 167:13 maneuver 134:13, 16 maneuverability 84:22 132:17, 19 133:9, 18 134:6, 10, 22 135:12, 25 136:3, 5 137:9, 25 maneuverable 84:16, 20 133:6 134:13 135:20 136:17 144:1 manhole 82:15 manholes 22:19 manner 111:8, 11 135:9	manual 23:21 47:3, 5 63:11 69:18 73:24 74:14, 17, 18, 19 76:5, 10, 11 78:22 79:8 104:14 107:8 manually 88:15 108:7 Manuel 4:6, 8 mark 62:11 64:1, 4 MARKED 4:2 6:13, 16 44:15, 17 62:16 86:24 143:3 145:13, 14 149:4 151:16, 19 153:24 154:2, 16, 19 159:19 167:22 168:2 Marketing 4:10, 12 145:17 149:25 marks 80:22 material 34:5, 7 42:18 159:4, 5 materials 11:17 153:12 matter 30:5 100:2 matters 100:2 mean 10:9 11:5 20:15 24:18 25:13 26:12 27:12 28:2, 21 29:2 30:11, 23 41:22 42:9 53:3 54:25 55:6 58:7, 21, 23 63:22 66:8 67:16, 22 69:1 71:24 75:1, 2 76:11 77:22 80:21 81:6 83:17 84:22 89:3, 18 91:10 95:2 101:17 111:10 112:7 119:24	120:15 121:21 126:12, 25 127:16 128:22 129:2, 4, 23 130:3, 24 134:6 137:25 139:13, 23 143:18 144:21 151:12 152:2, 10 153:17 156:23 157:17 158:14 163:1 178:2 meaning 32:7 58:22 129:16 means 11:20 37:25 69:21 80:10 119:17 130:25 144:25 163:12 177:23 measure 13:20 72:7, 17, 23 measurements 26:13 78:25 measures 48:8 87:7 measuring 7:23 8:2 mechanical 7:3, 5, 11, 17 9:5 19:3, 4, 12, 14 31:19 36:24 37:6, 8, 10 38:23 39:1, 21, 24 92:12 147:8 mechanism 31:8, 9 39:6 49:22 52:16 56:10, 18 67:24 70:1, 2, 4 98:12, 13 99:1, 2 103:21 109:5, 19 135:23 160:6, 12 161:2, 4, 9 mechanisms 9:8, 11 58:14, 15 99:13 175:3 mechatronic 8:18 meet 5:8
--	--	--	--

member 97:15 100:17 102:9, 16 103:6 165:23 members 166:5 168:19 memory 73:25 mention 178:18 mentioned 19:21 50:20 61:20 74:4 125:1 148:22 mentioning 10:24 metal 129:13 167:10, 17 meters 158:7 method 170:1 microphones 14:14 38:21 middle 141:2 miles 12:14 mill 82:17 Miller 4:13 140:25 141:3 148:22, 24 149:1, 7 150:5 162:17, 19, 23 163:21 164:2, 9 169:1, 4, 5, 12 Miller's 149:18 milling 79:20, 25 80:5 81:19 82:25 83:13, 16 89:24 90:1 136:9 156:1 mind 38:4 120:23 minimize 51:7, 9 minimizing 51:14 minute 30:4 minutes 30:3, 16 MIT 7:7 20:22 21:3 37:18, 19 Mm-hmm 85:25 103:13 172:23 MOBILE 1:4, 14 154:11 mobility 133:17 mode 74:22 76:1 109:2	model 29:11 108:12 modes 65:5 146:2 modifications 19:3, 5 111:22 modified 13:25 17:7 modify 16:6, 20 17:10 modifying 19:1 165:9 moist 42:20 mold 30:25 59:5 moldable 31:2 molding 31:3 moment 35:15 money 11:13 monitor 14:13 38:20, 23 monitoring 65:21 month 18:21 morning 7:18 motion 31:18, 19 78:4 87:9 94:7 121:1 123:18 125:11 134:8 138:21 156:22, 23 157:11, 15, 17 172:7 motions 123:10, 25 motivated 132:18 138:18 motivations 132:13 motor 16:21 17:5, 6 motors 16:17 17:3 mount 19:7 Mountain 14:7 17:19, 20, 21 18:8, 9, 12, 14, 21 mounting 18:20 38:20 39:2	move 15:13 16:22 27:25 36:2 39:17 54:14 70:4 76:17 77:17 96:8 114:18 115:9 130:20, 23 131:4, 14, 16 132:22, 23 133:3, 13 137:14 157:1, 3 159:6 175:2 moved 54:12 72:15 76:16 87:22 movement 58:3 119:12, 18 120:21, 22 121:12, 15 131:13 158:10 movements 120:5, 13 121:12, 14, 15, 17, 19, 20, 25 122:24 123:7 mover 151:23 moves 58:17 133:22 173:3 moving 27:14 38:8 68:3 77:24 79:7 89:15 97:8 105:10 106:11 111:25 116:12 123:16 124:17 131:8 133:10, 16, 19 137:19 138:5 156:20 157:18 158:18 166:15 168:24 169:15 170:24 175:23 MROZ 2:7 multiple 42:22 87:3 multiplier 37:15 multiplies 37:11 multiply 37:14 < N > NAFTALIS 2:13,	15 name 20:11 35:6 names 42:17 79:19 narrow 40:22 144:16 natural 33:16 naturally 33:22 77:6 nature 52:25 159:6 near 53:17, 23 54:19 81:19 105:21 155:24 nearby 27:3 nearer 82:24 Nebraska 1:17 180:2, 6 nebulous 11:8 necessarily 32:3 101:12 necessary 106:12 111:23 113:13 need 9:18 17:2 19:8, 10 24:23 29:18 34:20 62:8 66:25 73:13 77:9 82:17, 20 94:3, 4 95:3 104:23 107:24 110:23 112:6 117:7 129:6 130:4 133:17, 20 137:1 138:21 147:15 179:11 needed 24:25 25:2 72:5 needing 11:16 needs 9:17 64:5 neighborhood 83:25 network 63:12 73:19 74:15 never 12:3 17:16, 17 26:7 41:12 42:1 43:2 128:23
---	---	--	--

New 2:8, 19 4:5, 7 13:12 17:5 19:6, 22 39:5 47:4 77:19 79:24 80:6, 14, 16 Newton 35:8 Newton's 94:7 nice 5:8 30:9, 13 81:12 No 1:3 4:2 12:7 26:7 28:4 41:10 45:13 49:23 55:2 57:13 59:9 68:11 72:20 74:11 79:8 81:13 84:7 89:13 100:20 101:14 122:10, 12 147:3 150:20 158:14 164:20 165:6 176:9 179:1 nominal 72:10 nominally 120:8 nonmotion 157:15 normal 71:5, 8, 16 normally 21:2 24:12 35:5, 25 167:10, 12 north 131:2 Notary 1:16 180:5, 23 noticed 84:1 126:5 November 180:25 nuclear 15:22 Number 5:16 19:12 29:11 37:11, 12 62:12 67:17 68:5 103:11 113:9 115:23 117:1 145:10 numbers 12:13 45:9 69:19 173:13 numerical 12:13	NY 2:19 < O > Object 27:9 30:17 33:8 35:7, 10 55:19 83:6 85:21 89:16 92:1 107:6 164:12 Objection 6:8 9:14 25:4 35:2, 21 36:18 51:21 52:19 56:7 57:8 58:5, 19 59:6 65:2 71:20 87:10 93:22 94:25 96:18, 20 99:10 100:19 101:13 104:6 106:15 107:12 109:10 110:9 112:1 113:17 114:14 115:20 119:21 120:17 122:7, 25 123:8 124:7 128:6 129:24 131:10 135:15 136:22 137:11 138:6 139:5 140:8, 19 141:22 142:14 143:17 146:16 147:11 148:4, 10, 17 149:10, 21 150:6, 18 152:22 153:16 154:25 155:6 158:19 159:24 161:16 162:6, 25 163:9 164:4 165:5, 11, 25 168:9 169:7, 16, 24 173:11 174:16 175:11 objections 151:1, 8 objectives 172:15 objects 122:1	observations 27:19 observed 28:20 29:9 obstacle 82:18, 25 83:2 136:10, 11, 13, 16, 18 137:16, 22 obstacles 15:14 53:7 80:11 82:15 84:7, 21 134:14 obstructional 108:8, 14 obvious 94:1 176:6 obviously 12:18 95:19 119:25 120:3 156:23 175:2 Occasionally 17:1 occurring 123:7 off 14:24 17:5 19:9 30:13 58:22 59:2 64:6, 24 67:9 68:16 73:2 78:16 79:23 80:20 104:18 110:25 113:15, 20 115:4 116:16 139:10 144:1 152:16, 17 153:2 156:1 159:12 163:18 165:9 OFFICE 1:1 officially 20:14 Oh 5:10 6:21 19:11 29:2 40:4 61:15 62:19 72:6 83:21 103:15 128:12 136:8 160:22 171:3 oil 31:23 48:3 60:11 117:22, 24 okay 6:22, 23 13:5, 8 20:2, 20 32:10 40:4 44:18	46:10, 14, 17 47:12 52:3 56:25 57:23 62:19 63:5, 9 73:18 76:4 79:14 82:21 83:21 85:12, 22 86:25 102:6 103:16 104:22, 25 105:9 118:7 130:14 132:7 136:8 138:15 141:17 142:5, 11 143:8 145:18, 23 149:5 151:20 154:21 159:17 160:22 165:2 166:11, 24 167:25 177:8 178:12, 13, 17 179:4 old 15:19 17:4 30:10 36:7 64:3 80:20 81:15 82:14 150:9 156:6 157:8 once 10:16 17:24 28:11 54:17 58:9, 12 78:3 79:13 ones 10:15 18:3 28:23 29:2 42:21 52:13 57:10 75:6, 20 83:22 86:11 95:5, 6 151:5 158:3, 8 Online 1:16 open 45:14 60:8, 10, 16, 18, 24, 25 86:14 168:1 174:7 178:13 Opening 60:19 61:10, 16 72:13 operate 27:7 39:13 55:1, 3 59:2 68:2 80:25 82:12 157:10 158:9
---	---	---	--

operated 21:20, 23 26:8 27:8 38:6 42:2, 7, 12 88:15 116:9 operates 41:6 65:4 operating 38:11 59:8 71:8, 17 83:25 84:5 89:3 109:2 111:18 114:8, 21 115:1, 13 133:9 158:17 167:20 operation 26:24 27:16 29:17 47:16 48:5 68:8 71:19 76:10 107:24 111:7 155:25 156:15 157:2, 15, 17 158:14, 23 operational 54:24 68:3 70:10 72:5 88:22 89:2 158:12 operations 71:5 79:8 156:6, 25 157:11 operator 66:5 68:22 74:9, 12 75:22 76:7 107:18, 23 173:7 Operator/Service 4:5, 7 47:5 operator's 68:24 opinion 68:20 93:19 102:25 103:8 107:10 109:4 110:4, 6 115:15 118:19 123:6 124:4 126:22 128:20 131:17 opinions 6:6, 11 opportunity 108:21	opposed 34:11 99:24 115:3 133:6 opposite 67:15 94:9, 11 option 73:20 74:15, 17, 20 options 69:6 74:5, 6 order 160:15, 20 179:9 orders 179:6 ordinary 138:10 165:17 171:2, 11 174:24 Oregon 21:1, 6, 14 orientation 119:2 122:20 170:22 175:21 originating 74:24 outer 32:25 48:22 49:22 52:5 91:13 93:14 163:14 164:15 outside 33:19 48:18 82:9 outward 48:1 86:18 137:15 overall 11:19 27:17 75:18 125:11 overcome 107:5 108:8 overcoming 108:14 overdesigned 147:19 OWNER 1:8 2:12 < P > p.m 90:7 91:1 131:22 132:1 176:13 177:1 179:14	PAGE 3:2, 3, 4 46:15, 19, 22, 24 47:11 49:7, 8 56:24 59:23 63:1, 6 65:25 68:7 74:19 76:2 79:12 85:10 104:24, 25 118:5, 13 120:12 130:12 132:6, 8 138:14 141:15 142:10 143:6, 7 145:19, 21 164:23, 24 166:10 pages 44:24 74:18 180:11 paint 157:25 paints 158:3 Pancon 75:17, 23 76:3 PaR 15:18 Paragraph 46:22, 24, 25 47:10, 13 56:23 59:22 61:11, 15 62:3 66:1 79:11 85:11, 13 92:8, 10 94:14 132:10, 11 138:13 141:11 142:9 148:22 164:24 166:9 174:3 177:7, 10 paragraphs 105:6 parallel 64:8 133:24 parameters 66:4 park 133:24 parking 173:8 Part 4:5, 7 10:12 13:1 14:18 19:19 28:10 32:7, 13, 16, 19 38:2 39:10 40:7 47:25 62:6, 23, 25 63:3, 11 75:24 81:20 89:7 91:14 96:9 101:17, 18 104:24	107:20 118:10 120:1 121:13 124:12 126:17, 19 127:21 128:14 134:17, 18, 19 135:18 153:19 158:22 161:8 162:4 163:12, 14 164:15, 16 174:18 175:13 particular 63:1 65:18 67:17 96:24 108:11 118:22 174:18 parties 46:1 91:1 132:1 177:1 180:16 parts 9:5 21:10 31:24 33:23 38:23 39:1 127:16 129:14 130:4 131:3 147:23 152:16 160:15 part-time 21:9 pass 66:16 179:2 passageway 40:21 passed 83:2 PATENT 1:1, 3, 8 2:12 4:9, 13, 14, 15, 16, 17, 18 5:16 6:3 118:9, 10, 23 119:7, 10 120:12 122:6, 23 123:5 124:4, 12, 22 125:17, 22 126:6, 23 128:8 130:17, 19 131:6 142:7 149:20 150:9 patents 94:20 pave 28:24, 25 29:1 131:1, 5 151:6 pavement 149:15 Paver 4:12 10:7 22:7, 10, 14 25:6
---	--	--	--

26:4, 6, 8, 23 27:4, 7 28:5 29:9, 23 31:7, 10 42:2, 8, 10 58:17 80:1, 25 132:17, 19 137:9 141:2 142:18 143:2, 23 144:10 145:17 150:16, 24 159:18 162:2 178:19 pavers 9:25 25:22 27:24 28:19 32:4 42:19 43:20 80:9 95:21 144:17 161:13 paving 24:5 41:18 44:8 59:4 130:20, 21, 24 140:6, 11, 15, 18, 22 141:8, 9 149:9, 13, 16 151:11 152:1, 6 162:9, 20, 22 168:24 178:19, 23 pay 98:17 paycheck 20:19 41:22 paychecks 41:25 paying 15:25 payroll 20:18 PDF 45:17 63:4 people 9:18 10:12 14:21 18:2, 4 23:17 40:8 78:23 149:24 153:3, 7 154:13 people's 26:1 percentage 150:1 perfectly 78:10, 13 perform 11:21, 22 performing 157:19 158:12 period 20:17 22:1 permissive 174:5 permit 119:17 permitted 120:4	permitting 119:11 120:12, 25 person 16:12 47:8 76:19 77:7 132:13 138:10 165:17 171:1, 10 174:24 personal 26:14 personally 26:7, 9 42:12 pertinent 141:25 petition 86:22 143:1 149:2 151:18 154:1 167:24 PETITIONER 1:5 2:5 Ph.D 1:5, 15 2:3 5:3 180:8 phones 15:2 physical 41:5 44:19 physically 38:19 47:6 49:15 103:2 pick 22:2 27:14 96:3 147:24 picking 115:3 picture 74:20 105:3, 7 149:15 pictures 69:18 97:10 piece 129:13 pieces 23:3 pin 53:12, 21 54:20 77:5 88:1 92:24 104:2, 16 105:16, 22 107:16, 18, 22 108:23 109:15 pincher 156:12 pinned 53:25 54:22 pins 52:24 53:12, 14, 16, 17, 20, 23 54:23 55:1, 5, 14, 15 57:6, 14 58:1	59:3 78:13 88:12, 13 104:4, 7, 8, 10, 14 105:12 pipes 36:7 Pirates 14:8 40:6, 12 piston 160:5 pivot 124:11 125:17 169:6, 14 170:14 171:4 175:21 pivoted 126:7 pivoting 84:25 85:14 124:4 125:20 126:5 127:3 178:5 place 22:11 54:22, 23 57:11, 22 58:9, 10 78:6 88:1 92:17 93:1 94:13 104:11, 12, 15 105:17 106:3 108:7 110:18 114:7 120:6 156:21 175:1 177:22 placed 43:5, 7 planer 79:21 planks 156:2, 3 plant 31:14 plastic 11:18 platform 154:11 play 33:20 playground 125:11 PLC 19:17 please 21:22 86:23 130:13 138:14 143:7, 11 145:20 166:10 plow 42:4 plugged 66:4 plumber 36:10 plumbers 36:4 point 6:11 44:11 72:15 74:9, 13	75:16 92:10 106:22 117:11 125:3, 6 134:12 pointed 121:8 127:8 140:10 172:5, 8 pointing 78:12 114:16 123:17, 22 149:23 points 170:1 172:10 portion 18:23 116:5 122:11 126:14 161:7 posed 40:5 POSITA 132:18 138:17 position 53:13, 22, 25 54:1 55:12, 18 56:5, 14, 16, 20, 21 62:6 77:4 84:11, 17, 18 85:15, 19 86:1, 2 87:13, 20 88:2, 6, 21, 24 89:1, 11 105:11 106:10, 13 107:1 110:3, 17 111:14, 15 113:15, 24 115:8 116:10 123:13 132:24, 25 133:3, 5, 11, 21 134:25 135:1 136:7, 9, 20 157:12 173:3 possibility 127:1 possible 10:3 82:6 95:19 post 7:7 pot 62:2 potentially 59:9 potholes 80:12, 15 pound 35:24 36:2 143:23 pounds 29:13 43:3 72:19 73:9, 10 81:22 95:18
--	--	--	--

143:12, 14, 16 146:8, 11 power 25:13 31:13 33:1 91:21 powered 91:16 103:4 powering 117:8 practice 88:11, 14 preamble 130:19 131:7, 12, 18 preambles 130:16 preliminary 73:3 premarked 177:13 prep 64:1 preparation 80:24 81:2 140:2 prepare 23:1 80:6 prepared 80:10 preparing 5:22 present 46:1 91:1 132:1 177:1 pressure 31:23 47:24 48:1, 3 117:12, 18, 20 118:2 presumably 64:3 100:23 Pretty 17:14 18:13 30:2 32:24 37:9 50:15, 17, 23 53:22 81:21 84:5 99:12 107:17 150:9 155:24 156:7 162:16 174:14, 23 prevent 34:18 53:1 106:12 previous 21:19 51:3 74:2 173:6 previously 5:18 20:7 52:1 62:14 74:4 91:5 95:10 166:22 previously-laid	81:3 PRICE 2:18 primarily 8:24 87:13 154:12 primary 97:2, 7 133:19 prime 151:23 prior 20:2 148:15 149:19 161:13 priority 58:2, 8 private 12:19, 24 13:6 37:17, 20 129:18 probably 23:2 24:13, 18 29:11, 20 44:3 61:5 69:19, 23 77:2, 16 78:9 84:14 92:16 96:24 97:22 113:19 116:15 117:3 141:7 144:13 146:20, 21 156:24 163:13 171:21 175:14 problem 30:7, 16 123:10 problems 80:12 92:11 proceedings 5:1 46:2 91:2 132:2 177:2 process 10:13 78:18 79:6 83:8 85:20 137:17 processor 77:20 produce 12:4 98:7 116:19 producer 11:14 produces 117:18 product 11:2, 16 12:2, 12 14:10 63:18 71:24 147:25 products 10:3 11:20 12:25 13:6,	10, 13, 22, 24 14:1 15:1, 11, 23, 25 17:8, 11 Professional 180:5, 24 professionally 41:21 professor 12:21 14:19 129:19 programmable 19:17 project 17:17 19:20 135:13 projected 85:15, 23 87:20 88:2 115:8 135:1 projecting 84:13 85:19 88:25 89:1 113:14, 24 134:24 136:7, 9, 13 projects 14:21 26:3 41:24 propagate 80:15 propelled 40:12, 15 proper 9:11 18:16 28:14 properly 85:3 98:2 properties 19:23 83:3 prototype 72:22 protracted 84:18 88:21 protrusions 174:10 provide 6:5 10:2 11:12 86:17 99:7 119:16 138:19 139:21 provided 6:2 provides 74:5 137:5 138:21 171:17 providing 72:16 PSI 117:14	Public 1:16 180:5, 23 pull 25:6, 9, 14, 15 48:24 67:20 82:23 134:15 156:2, 4, 13 157:7 162:18 166:22 177:12 178:8 pulled 25:12 42:14 pulling 86:13 142:19 157:14, 19 pulls 86:12, 14 158:6 pump 31:22 117:13 purpose 104:4 134:15 purposes 46:12 push 25:1 55:12 56:19 76:12, 14 98:18 106:22 114:6 117:24 156:5, 15 159:4 163:18 pushed 55:11 pushes 22:11 39:24 pushing 16:12 28:2, 17, 18 32:18 71:4 114:1 115:11, 24 118:1 put 10:25 13:16 19:5 21:2 31:1 33:20 34:13, 17 35:24 43:13 48:3 52:9 53:10, 21, 24 55:9 64:7 66:12, 14, 21 72:9 77:5 79:24 80:6 92:15, 17, 25 93:11, 12 94:2 97:4 152:13, 14, 17 153:6 157:9 158:5 puts 58:2 92:24 113:2 157:12
--	--	--	---

putting 17:5 35:23 37:14 44:14 55:1 93:20 94:10 113:5 157:20 < Q > quality 11:1, 2, 4, 8, 9, 10, 14, 19, 20, 24 29:24 question 7:13 40:5 51:17 56:13, 15 67:7 68:24 69:3, 7 71:3 87:12 96:21 102:18 119:24 123:2, 3 128:24 147:3, 14 150:12 155:2 160:17 161:21 questions 26:20, 21 176:10 quick 6:25 162:16 quickly 19:21 quick-set 30:21 quit 21:3, 4 quite 10:18 12:18 13:1 29:3 31:15 67:12 68:23 70:6 123:3 161:24 174:21 quote 94:18 < R > rail 82:16 railroad 155:15, 18, 24 156:3, 18, 19 157:2, 6, 14, 19, 23 158:1 178:25 rails 155:21 rain 21:15 raise 23:14, 22 32:8 raised 113:15, 19	range 10:3 87:8 ranges 55:21 ratchet 44:2 ratchets 9:6 rated 37:25 ratio 36:24 rationale 132:9 reach 172:15 reactor 15:22 read 94:1 105:6 123:18 159:7 162:14 reading 18:14 reads 111:12, 13 ready 112:24 real 6:25 66:24 130:8 147:3 realize 94:9 really 5:12 9:4 13:24 14:16, 25 17:4, 19 19:8 23:10 25:10 27:15 28:12, 17 36:23 48:25 59:16 60:25 61:14 75:14 81:5, 13, 14 82:11, 18 85:2 86:6 96:1, 2 97:10 100:2 112:6 114:7 116:20 127:20 129:25 133:12, 22 134:18 145:2 175:12 rear 23:6 135:8 reason 28:2 83:4 109:13 133:20 141:24 reasonable 12:2 reasons 28:13 33:11 83:9 108:3 reattach 77:17 reattached 77:9 reattaching 137:20 rebar 26:19	recalibrate 78:11, 17, 19 recall 11:15 67:8 68:4 84:12 89:17, 18, 23 95:11 98:8 133:14 177:9, 15 receive 75:12 receiving 174:5 receptacles 174:11 Recess 45:21 90:7 131:22 174:6 176:13 recognized 82:20 recommended 17:16 record 179:7 recount 21:22 rectangle 43:25 50:24, 25 rectangular 32:15 49:21, 25 50:22 57:25 rectilinear 140:24 reduced 113:15 144:18 180:9 Redwood 2:14 reference 60:1 61:11, 16 62:3, 13 73:19 79:16 86:22 87:2 91:6 92:11 104:21 109:18 123:11 125:3 149:2 151:17 153:25 154:6, 17 159:8, 16 162:1, 10 166:18 167:23 168:22 169:11, 18 170:5 172:16 referenced 143:1 154:17 references 84:10 100:14 140:2, 5, 11, 17, 23 141:5 142:12, 23	referencing 97:24 referred 6:3 referring 125:10 refers 149:8 refresh 109:21 regard 133:12 Regardless 99:21 regards 6:2 77:19 87:6 Registered 180:4, 24 regular 84:6 relate 24:15 80:1 155:18 related 22:7 139:24 154:10 relating 100:13 relation 125:23 relative 33:18, 24 48:22 51:10 52:21 93:14 104:12 119:2, 12, 18 120:13, 21, 25 121:4, 15, 25 122:1, 10, 20 127:15, 24 167:18 relatively 80:21, 23 139:19 144:10 relaying 30:13 release 174:10 reliably 55:15 relying 165:8 remember 44:11 129:14 132:25 152:6 162:7, 10, 14, 19 178:9 remotely 1:15 2:2, 3, 10 removed 59:3 removing 105:12 Repair 20:7 25:21 27:2 155:15, 18 156:21 repaired 155:22 repairing 26:1
--	--	---	---

156:17, 19 repeat 51:17 repin 78:8 replaced 18:18 replacing 18:22 158:12 165:3 report 47:11 59:23 79:12 REPORTER 3:4 7:24 62:17, 21 96:16 179:6 180:5, 24 represent 92:23 representative 100:17 representing 64:25 Requests 7:24 62:17 96:16 179:6 require 8:10 70:14 97:17, 19 107:17 115:2 required 25:9, 15 68:11 70:8, 22 71:6, 18 72:24 114:12, 16 115:18, 21 116:5, 11, 15 144:19 147:15 167:5 requirement 122:12 requirements 10:17 requires 156:22 requiring 131:12, 13, 19 reread 159:9 rereading 160:22 reset 79:3 resistance 33:17, 23 34:8, 15 resistive 103:23, 24, 25 respond 53:8	response 75:13 169:5, 13 170:23 174:4, 13 responsible 63:16 responsively 172:25 restart 30:9 restate 13:4 restraining 110:2 restraint 106:19 resurface 27:4 resurfaced 27:3 retract 48:4 67:19 69:23 135:13 136:14 retracted 84:12, 13, 17 85:15, 18, 23 86:1 87:16 88:20, 23, 25 113:14, 23 115:7 134:25 136:7, 20 173:3 retracting 56:12 84:11 retraction 60:15 retracts 48:23 re-upload 62:20 reverse 156:14 review 5:23 6:1 reviewed 140:1 reviewing 140:21 rid 39:14 52:10, 12 88:8 107:22 ride 40:9, 18 ridge 28:7 riding 43:17 right 7:1 13:17 20:1 23:22 31:18 32:3, 5 34:20 40:14, 18 49:1 54:11, 14 57:3 63:9 66:13, 14, 17, 21 70:19 74:17 76:13 79:4 81:19 82:17, 22 95:3 96:4 98:1, 22	103:1, 22 107:15 119:3 126:15 135:9, 18 136:16 151:3 157:22 161:24 164:17 174:12 175:25 right-hand 143:9 145:25 rigid 50:15 66:24 107:17 rigidly 50:12 124:15, 16 126:10, 12 Rio 4:9 79:16, 18, 19, 20 80:19 81:14, 17, 18 83:4 84:10, 24 85:6, 20 86:16, 21 87:2, 7, 17, 25 88:4, 9, 10, 15, 19 89:7, 13 91:6, 8, 24 92:19 93:4, 19 94:19 95:2, 10, 13, 20 96:12, 22 97:8 99:5 101:10, 22 102:15, 22, 23 103:9 104:15 108:13, 17 109:18, 22 111:4 112:3, 5, 14 132:9 134:9, 11, 15, 18, 19, 24 135:2, 11 136:19, 25 137:9, 23 138:2 139:3, 7 141:12, 19 142:6 165:3, 10 166:13 169:17, 18, 22 170:1, 5, 7 172:16 174:2, 13 175:8, 9, 20 Rios 165:15 Rio's 87:15 110:7 137:10, 12 138:18 165:4 Riverside 19:25	20:2 28:10 41:19 ro 170:18 road 24:5, 15 25:1 26:25 44:7, 12 64:2, 3, 5, 9 71:11 79:20, 23, 25 80:5, 6, 9, 12, 17, 23, 24 81:2, 3, 10, 15, 21, 24 82:2, 14 83:12, 16 84:9 89:9 133:1 136:10 141:13, 20 142:8, 13 144:15 151:11 152:1, 8 153:15, 18 154:7, 8 155:19, 20, 21 156:1, 17 178:23 roads 24:19 26:2 82:2 144:13 151:6 155:22 ROBERT 2:7 robert.high@finne gan.com 2:9 robot 15:19 robotic 8:19 15:21 robotics 15:19 robots 14:18 rock 156:8, 10 rocks 71:2 81:11 159:11 rod 86:12, 13 roller 14:7 17:20, 22, 23, 25 22:16, 18 40:9, 10 51:7 102:11 rollers 40:12 roof 153:10 rooms 14:5 Rooney 1:16 180:4, 23 rotary 86:17 92:15, 25 93:20 99:6 102:20, 23 103:2, 3 108:18 109:6 110:7
---	--	---	---

111:5 116:18, 21 117:19 119:10 138:18, 20, 21 139:8 148:15 149:19 150:16, 25 151:7 159:22 162:2, 24 163:3, 14, 16 rotatable 123:25 rotatably 118:24 122:16 123:19 128:3 rotate 34:24 35:4, 7 48:22 49:5, 13 51:12, 15, 20 54:14, 15, 20 69:16 70:9 71:18 75:12, 15 78:14 85:9 90:3 93:14 95:23 96:6, 13 97:3, 18 101:11, 15 103:22 108:18 113:13 114:12 119:1 120:5, 16 121:4, 5, 23, 24 122:5, 19 124:12 127:4, 15, 23 128:2 144:19 147:9 148:16 157:4 158:25 159:23 160:15, 20 163:17 164:18, 19 167:5 169:5, 19 170:14, 19 171:5 176:3 rotated 54:4, 7 161:8 rotates 85:5 97:15 109:14 120:24 125:7 164:16 rotating 49:9 93:5 95:24 96:2, 8, 10 97:21 101:16, 17, 18 115:3, 4 122:1	123:21, 23 124:5, 25 125:5, 13, 15, 21 126:9, 20, 23 127:17 160:16, 21 167:3 168:23 169:13 171:13 178:4 rotation 35:13, 19 50:7 51:5, 7, 10, 14 53:2 54:3, 16 57:12, 15, 16, 19 69:14, 25 70:1 74:25 75:1, 2, 3 84:24 85:6 98:4, 7 102:10 103:3, 11, 13, 15, 16 122:10 124:19, 21, 23 125:1, 22 126:2, 3, 4 160:5, 6 161:14 162:3 164:2 rotational 52:18, 21 56:20 58:3 99:7 103:5 105:18, 23 119:12, 18 120:4, 13, 21, 22, 25 121:15, 18, 19 122:24 123:6, 10 139:16 170:22 rotations 54:5, 7, 21 rough 179:10 round 33:6, 25 34:2, 3 51:4 165:24 166:5 RPR 1:16 180:23 rubber 167:11, 15 run 15:14 18:6 59:18 66:15 84:23 117:13 144:1 running 18:11 82:14 84:3 89:5 93:1 120:8 173:2 runway 24:7	runways 24:19 rusted 36:6 < S > S2X 60:2 61:24 65:9, 13 67:3 68:9 75:5 sacrificing 134:23 safe 18:2 50:25 81:3 safely 174:6 safety 10:10, 14, 20, 24 11:24 106:2 satisfaction 122:5 satisfy 122:13 save 134:5 136:18 160:23 saying 51:22 52:4 65:23 67:18 68:4 76:4 83:21 96:15 127:11, 19 129:3 131:13 135:19, 20 139:7 152:6 173:21 says 19:11 46:10 64:15 66:1 68:14 69:12 88:7, 10 92:15 94:19 102:7 105:3 107:8 112:22 121:12, 14 122:16 138:9 140:22 142:17 146:7 149:14 155:14 168:11, 21 171:14 172:6, 24 177:21 scenario 100:18 115:16 school 14:15 20:24 Scope 119:22 122:8 150:6, 19 screen 45:15 160:25 screw 100:23, 25	screwdriver 99:9, 12, 16, 17, 19, 22, 24, 25 100:3, 4, 8, 10, 22 se 75:15 135:25 152:7 seal 180:20 search 163:24 168:16 171:23 searchable 163:23 171:20 second 5:13 94:15 119:1 122:19 170:17 171:8 172:25 secondary 76:24 seconds 30:4 section 34:7 79:15 91:17 173:18 175:17 178:2, 16, 18 sector 12:19, 24 13:7 37:18, 21 129:18 secure 103:17 securing 57:14 security 107:20 see 19:8 36:4 44:23 49:11 52:4 53:5 60:2 63:13 66:6 68:12, 13 70:5 74:19 83:9, 21, 24 84:5 85:15 92:13 97:7 100:14 102:6 105:4, 14 107:14 110:10 118:11 119:14 121:11, 17 128:18 129:7 130:17, 21 132:14 135:5 138:22 141:21, 23 142:23 145:23 146:3 151:11, 24 153:8 154:3 159:9 160:24 162:18
---	--	---	---

163:22 164:5 166:15 170:13 seeing 79:4 168:20 seen 26:9, 13, 23 28:1 30:22 47:6, 8 83:16, 22 150:24 151:6 158:8 sees 19:10 select 74:22 selection 9:21 sell 9:19 71:25 send 111:4 sending 65:22 111:20 sends 16:13, 16 48:9 61:24 173:8 senior 8:14 sense 26:4 76:11 80:4 89:4, 9 111:18 123:20 129:5 130:3 134:13 144:25 sensing 171:5 sensor 19:7, 10 48:8 61:11, 16, 20, 22 64:12 66:19, 21 68:9 76:6 78:11, 19 87:15, 17 111:12, 13 170:14 171:4, 5 sensors 8:10 18:8, 19 19:2, 5, 6, 8 61:12, 18 66:3, 9 146:23 170:11 sent 16:21 45:17 46:10 76:2 sentence 61:10, 16 63:15 66:1, 6 94:14 132:12 135:17 138:9, 16 139:14 142:4 168:6, 10 sentences 170:4	separation 18:16 168:18 serve 104:3 served 136:19 servo 60:1, 5, 7, 22 61:7 72:13 set 27:19 30:10, 20, 23 31:3 43:14, 15 53:23 65:4 66:16 67:13 69:12 72:9 74:9, 13 75:16 78:23 89:24 90:1 130:25 131:2 144:15 165:16, 19 sets 30:25 53:17 setting 31:4 58:10 62:6 75:25 132:23 settles 28:16 setup 161:20 set-up 66:4 seventy-nine 180:11 shape 22:12 28:14 29:19 31:1 33:5 42:24 43:8 49:25 52:2, 4, 5, 8 145:4 shapeable 31:3 shaped 16:22 shifted 14:11 shims 33:21 52:9 shipyard 38:1 shoot 75:19 Shores 2:14 shorthand 180:8 should 7:14 9:13 12:7 51:7 62:20 77:11 101:1 shouldn't 64:18 show 11:6 45:5 167:2 169:22 showing 5:12 68:11 149:15 152:3 163:15	shown 86:9 131:9 152:12 153:1 162:1 shows 74:21 97:9 160:25 161:1 166:25 169:12 side 23:22 43:14, 25 47:24 48:3 51:10 60:18, 19 64:6 66:2, 3, 8, 12, 13, 19, 23, 24, 25 67:1 82:5 139:10 143:9 160:25 163:18 170:13, 16 sides 71:12 107:16 sidewalk 24:14 25:7 28:24 29:1, 7 sidewalks 24:10, 12 29:3 144:11 sideways 131:5 134:4 156:10, 14 signal 16:13 61:24 64:24 74:24 75:12, 15 76:2 111:13, 19 173:9 signals 65:22 111:5, 13, 16 174:5 signature 46:18 180:20 significantly 25:2 similar 42:10 98:22, 24 99:8 104:4, 8, 13, 15 108:17 118:20 119:6 similarities 109:3 similarly 54:19 simple 37:9 42:17 68:19 98:12 99:17 simply 146:12 simulator 14:5	SINGHOSE 1:5, 15 2:3 4:4 5:3, 8 6:18, 22 46:5 91:5 132:5 149:7 151:22 154:6, 23 168:5 176:8 177:6 180:8 single 92:13 155:8 sink 61:2 sit 76:15 89:20 site 22:3, 4 23:2 63:25 133:11 152:19 153:12 sites 66:13 153:9 sitting 6:10 23:9 30:11 44:24 81:25 112:24 situation 129:7 130:1 161:23 163:8 six 44:3, 4 164:19 size 96:4 sizes 95:19, 20 sketch 73:3 sketches 139:24 skill 132:13 138:10 165:17 171:2, 11 174:24 slew 91:19 93:11, 12 94:2 97:4 128:17 140:7, 10 147:18, 19 slide 167:18 slides 11:6 34:23 slightly 113:22 slip 29:4 161:11 167:13 slipform 9:25 10:7 22:7, 10, 13 25:6, 22 26:3, 6, 8, 23 27:4, 7, 24 28:5, 14, 19 29:9, 23 31:7, 9 32:4, 8 42:2, 8, 10, 19 43:19 59:10 80:1,
--	---	---	---

9, 25 95:20 141:2, 8, 9 143:23 144:10, 17 150:16, 24 159:18 161:13 162:2 178:19 Slipform/Paver 4:10 slope 43:13 71:1 slot 34:22 slow 18:17 27:14, 15 28:17 60:25 133:16, 19, 22 134:1 slowly 23:16 27:25 28:1 133:14 small 5:12 8:9 18:3 22:18 80:23 99:23 smaller 14:21 25:8 26:2 34:5, 14 144:10 147:20 smallest 44:3 smart 9:25 10:6, 10 15:3, 6 47:14, 17 48:7, 13, 15, 16, 23 49:1, 8 60:16 61:21 smashes 22:23 Smolders 4:17 159:16, 18, 22 160:8, 14, 19 smooth 30:9 80:10 sold 15:18 solidified 30:7 solidify 13:13, 15 24:21 somewhat 22:7 104:8 112:14 sophisticated 8:16 18:7, 13 Sorry 6:21 37:19 54:6 56:9 61:15 67:17 89:1 96:19 160:18 161:11	162:11 164:24 165:1 sort 12:13 14:9 19:3 22:12 23:2 30:12 32:25 34:6 35:5 44:8 48:7, 19 53:2 55:12 68:19 71:15 81:11, 24 86:17 88:16 91:13 105:18 107:13 109:5 113:4 117:4 130:6 132:20 134:7 140:23 146:22 155:13 166:2 167:9 172:8, 11 sound 161:24 source 31:22 33:1 Space 14:6 17:19, 21 18:8, 12 25:25 speaker 38:20 speakers 14:14 speaking 35:22 120:20 121:6 127:18 135:17, 24 157:21 special 11:18 17:23 50:24 60:22 specialized 9:2 11:17 35:6 specific 95:2 98:10 123:14, 24 129:16 146:18 155:13 175:25 specifically 112:21, 22 168:11, 21 176:5 specification 129:8, 11, 15 specifications 12:11, 12 145:24 specifics 167:19 specified 141:3	specifies 143:10 146:1 spectrum 8:20 25:17 speed 29:15, 17, 20 spits 156:10 spitter 79:22 spot 63:9 spray 157:24, 25 158:3 spread 25:3 spreader 22:5, 6 23:5 42:4, 13, 14 spreading 44:9 spring 21:13, 18 square 32:15 33:5, 14, 16 34:8 49:21, 25 50:22, 23, 24 51:1, 3 52:8 57:24 94:5 165:24 squared 166:2 squares 33:12 square-shaped 34:9 50:21 Ss 180:2 stability 83:3 84:7, 8 134:20, 23 137:15 stabilizes 157:13 stabilizing 87:8 stable 82:10 83:1 136:24 stake 64:10 standalone 16:23 standard 146:2, 5, 9 179:12 start 9:16 13:8 17:13 23:16 30:13, 23 35:17 39:16 59:13 60:8 62:25 80:18 81:12 89:8, 22 91:11 170:9 175:9, 13	started 15:8 16:1 20:23 starting 39:5 54:8 86:2 117:4 133:5 177:21 178:20 starts 18:17 23:15 30:24 31:4 64:17 132:10 157:13 178:16, 21 State 1:17 8:3 48:11 94:15 138:17 141:12, 19 180:2, 6 stated 84:16 statement 49:6, 11 STATES 1:1 119:10 127:14 173:7 174:4 station 77:1 stationary 156:21 stay 172:2 stays 49:18 117:25 120:6 steam 22:16, 18 steer 47:14, 17 48:13, 15 60:16 63:12 66:2 68:9 69:2, 4, 12 73:19 74:9, 11, 15, 17, 19, 22 75:25 107:25 108:1, 20 112:19 135:22 151:13 steered 66:9, 11 steering 39:6, 7, 9, 12, 18, 21 40:17 49:8 55:17, 24 56:4, 10, 18 59:24 61:19 64:23 67:3 68:21, 25 69:1, 5 74:5, 6, 14, 23 75:2 98:23, 24 107:4 109:7 110:24 111:9 135:5, 8, 23
---	--	--	---

138:20 160:11 161:1, 2, 8 steers 160:1 stepfather 20:10 steps 89:21 stick 65:24 99:2 sticking 84:23 86:5 139:10 sticks 19:9 34:22 64:13 66:19 stiff 102:19 stiffer 55:16 stop 13:9 18:10 30:1 77:4 79:9 stopped 18:6 30:3 174:6, 14 stopping 103:11 137:18 156:25 174:18 stops 18:10 29:23 173:7 straight 23:19 55:14 67:19 78:12, 21 79:1, 5 108:23, 24 110:17 123:17, 22 127:8 134:4 straighten 78:17 strategies 7:19 strength 24:23 34:6 strike 37:4, 19 110:5 116:17 161:11 strips 144:14 stroke 67:10, 24 strong 13:21 53:5, 6 87:22 107:4 109:7 110:7 stronger 13:15 99:14 116:24 structure 32:13, 25 33:16, 22 43:23 50:12 52:11 53:12	55:16, 25 67:23 91:12 153:21 155:12 structures 34:16 39:2 49:21 stuck 165:15 student 20:24 students 8:6 9:11 10:20 11:9 stuff 13:20 14:15, 22 15:2, 8 18:20, 22, 25 19:13 21:15 23:19 24:8, 10 26:19 27:22 31:25 52:11 53:7 57:16 69:11 77:18 80:13, 22 84:3, 23 89:6 107:19 119:24 120:19 129:15 144:2 146:18, 23, 25 147:5, 6 162:22 167:9 subcontrollers 75:10, 11, 19 submit 6:6 submitted 5:14 successful 165:18 suggest 110:6 suggesting 123:15 155:9 suggestion 110:11 suggestive 110:5 121:18 suitably 174:7 Suite 2:14 summer 20:3 21:12 supplies 153:8, 10 support 39:1 82:6, 11 137:1 166:17 supporting 177:24 supports 23:21 suppose 63:23 136:8	sure 27:10, 16 28:3, 16 63:21 67:16, 21 68:5 69:9 73:24 81:18 83:7, 17 86:1 88:7 91:10 93:23 96:21 103:18 111:10 117:20 119:23 124:24 128:7, 22 137:7 140:20 144:12 156:22 163:22, 25 169:25 170:9 surest 73:1 surface 64:1 71:11, 13 73:7 79:23, 24 80:6, 7, 14, 16, 18, 20 81:12 surfaces 52:8 129:9 167:18, 20 survey 64:4 149:25 swerve 137:22 swing 15:13 16:23 48:16 53:18, 24 54:9, 10, 13, 18 55:24 56:17 57:3, 6, 11 58:3, 9, 16, 23 59:12, 15 65:14 76:9, 17 77:20 78:4, 7 81:16, 18 82:9, 23 83:2, 5, 19, 22 84:1, 6, 11, 17, 25 85:2, 14 86:3, 7, 14, 18 87:3, 6, 9, 18, 19, 20, 24 88:6, 20 89:11, 14, 21 91:8 103:12 104:11, 13 105:3, 11 106:7 109:24 111:6, 8, 14, 17, 24 112:8, 12, 17, 23 113:14 114:7, 12, 18	115:3, 12, 14, 22, 25 116:1, 6, 16 123:16 124:5, 11, 15, 17, 18, 22, 25 125:4, 11, 13, 17 126:4, 7, 11, 15 127:3, 6 135:14, 21 136:11, 15 137:2, 5, 10, 13, 14, 23 138:3, 25 139:2, 3, 7 142:7 152:17 158:15, 16, 25 163:21 166:14 169:6, 9, 14, 19 170:2, 18, 23 171:9 172:14 173:25 174:13 175:3, 22 178:5 swinging 89:21 116:10 124:19 125:4, 10 137:19 171:12, 25 swings 56:17 85:5 124:17 126:16 switch 76:1 sworn 5:4 swung 58:9 86:3 system 16:8, 9, 18 18:7, 13, 19 19:2, 16, 18 38:3, 14, 24 39:18 41:6 59:24 104:19 111:23 112:10 113:7 117:8, 10, 12 146:21 171:3, 4 systems 7:20 8:19, 25 14:17 39:12 41:1 63:16 146:21 < T > tabs 45:9 take 9:13 10:14 14:23 15:22 26:16 31:20
--	--	--	--

37:12 39:16 45:20 73:8 78:24 90:5 97:6 131:20 134:1 150:10 158:1, 4 176:11 179:10 taken 1:15 45:21 90:7 131:22 176:13 180:8 takes 22:12 28:13 42:23 talk 8:4 11:4 12:5 68:16 125:14 158:15 176:1 talked 7:21, 22 38:18 41:20 48:25 50:1 52:13 56:10 76:1 78:5 80:8 85:3 87:14 88:12 92:21 93:16 104:9 106:16 134:21 138:7 162:20 166:4 174:20 talking 5:10 39:8 40:2 43:20 51:24 52:1 54:22 57:1, 10 59:23 60:9 68:8 86:11 91:12 98:9 101:1 102:13 103:12 105:10 112:3 126:2 129:5 130:10 135:18 139:11 143:22 154:11 156:17 160:11 161:2 162:8 166:12 168:18, 25 174:18, 19 178:21 talks 63:15 86:16 126:3 135:7 171:22 172:4 178:22	tamper 22:21 targets 12:13 tarmac 24:15, 17 taught 7:6, 7, 17 9:4 124:11 Tax 4:18 166:18 167:23 168:6, 7, 14 teach 7:14, 16, 18 8:13, 20 9:2, 16 10:22 11:9 12:11 177:18 teaches 78:10 91:8, 10 102:22, 23 170:1 teaching 7:2, 5, 8 9:10 12:17 37:21 88:16 136:25 161:6 164:20 165:10 169:18 171:14 172:13 173:4, 5, 24 teachings 165:14, 16, 22 team 19:14, 15 tear 18:24 81:14 tearing 82:13 Tech 7:4 14:24 techniques 8:21 9:24 technology 175:16 teeth 80:22 81:6, 7, 20 117:1 145:5 telescope 44:5 166:5 telescopes 44:2 49:19 91:15, 17 telescoping 32:13, 23 33:15 43:23 91:15 163:12 tell 10:20 17:1 24:3 47:1 61:22 63:20 74:6 78:11 112:14 143:11	telling 65:19 75:12, 18 104:16 136:25 tells 35:8 110:11 ten 14:2 44:4 tend 8:15 53:7 55:3 tends 126:1 tens 29:13 95:17 tenths 78:16 term 8:12 9:8 36:20 93:25 129:12, 19, 22 130:7 177:22 178:1 terminology 128:8 terms 11:21 73:19 76:9 81:16 87:7 95:2 100:11, 13 167:3 test 13:17 72:8 testified 5:5, 19 20:7 TESTIMONY 3:3 5:24 6:1 21:19 180:7, 13 testing 73:16 textual 171:18 theoretical 73:12 theoretically 164:17 thereof 180:18 thick 23:24 24:13 25:11 53:4, 6 thicker 24:8, 11, 17 thickness 24:2, 3, 14, 15 thing 17:18 27:13 31:13 42:11 49:2 88:17 96:7 104:2 124:25 133:25 172:9	things 8:19 9:6, 22 10:23 12:15 18:15, 17 33:20 34:4 35:6, 17 38:18 69:23 127:9 140:14 144:23 146:19 155:11, 16 158:9 159:12 175:15 think 7:9 10:10 12:20 19:21 20:14 21:25 24:6 27:24 29:16 31:11 33:9, 10 37:24 41:4 44:2 45:7, 9 48:11 50:22, 24 51:9 54:25 57:9 66:10 67:5 73:22, 23 75:2 76:22 77:5 84:19 87:11 88:10, 11 89:6, 8, 20, 22, 24 90:4 92:14 94:18 95:1, 4, 15, 16 96:1, 5, 22 97:12 100:24 107:7 109:21, 22, 23 112:6, 22 115:1 119:23 120:18 123:1, 9, 14, 15 125:9 127:10 128:13, 24 131:11, 18 135:16 136:23 138:8, 10 140:9, 10, 12 141:4, 25 148:24 149:22 151:9 152:2, 23 153:17, 19 154:8 155:7, 9 159:7, 8 161:6, 10, 12 162:15 163:12 165:14 168:25 169:3, 12, 17 171:21 175:24 176:4 179:4, 11
--	--	--	---

thinking 37:23 133:10 162:17 third 65:25 94:7 142:3 thought 27:11, 13 56:9 120:22 thousand 43:3 thousands 29:13 95:18 98:13 139:23 three 32:24 61:23 117:3 144:24, 25 158:1, 7 three-track 146:2, 6 throw 28:11 tie-downs 52:25 ties 156:3 157:14, 19, 23 158:2 173:5 tilting 82:5 time 7:15 11:12, 23 13:21 14:25 18:4 19:18 20:16, 17, 22, 25 21:7, 11, 16, 17, 25 23:4 24:10 25:23, 24 30:21 37:21 41:16 55:9 61:9 75:8 82:12 127:6 134:2, 5 136:18, 21 150:21, 23 160:23 169:20 171:13 172:1 176:9 times 26:10 35:11, 15 37:15 76:24 83:14 139:25 TIMOTHY 2:13 tiny 100:4, 11 tip 82:7 tires 167:12 title 173:17	tlayden@kramerle vin.com 2:15 today 5:8, 23 7:20 9:4 38:18 91:13 today's 10:25 toe 70:20 145:6, 7 told 66:18 78:1 88:13 tons 12:15 37:25 tool 100:22 tools 22:24 154:13 top 20:21 28:4 32:16, 19 49:8 63:13 67:9 79:23 80:14 81:1 94:16 97:9, 14 130:15 159:12 160:24 topics 8:20 torches 22:25 torque 35:8, 10, 11, 16, 19 36:3, 6, 16, 21 37:4, 5, 7, 15 48:24 49:4 50:6 85:9 86:18 97:20, 25 98:3, 6, 8, 10, 15, 21 99:1, 16, 23 100:6 103:24, 25 110:2, 23 112:17 116:23 117:4, 15 138:19 139:13, 15, 16, 19 147:14 torques 35:5 85:3, 4 98:2 total 73:11 touch 39:17 92:10 touches 64:13 66:19 touching 64:14 129:10 tougher 52:14 tow 172:10	to-wit 5:2 46:3 91:3 132:3 177:3 track 31:18 34:25 41:9, 13 49:10, 14 50:4, 5, 6, 8, 17 51:6, 8, 11, 15, 19 52:17 53:1 54:3, 4, 6, 13, 16 55:18 56:4, 6, 12 57:7, 13, 20 58:4 62:4, 10 68:15 69:16 70:12, 13, 18, 21 72:8 73:8 75:3, 13 77:21, 24 78:8 85:7, 9 86:4 89:19 90:2 91:9, 19, 22, 25 93:7, 21 94:10, 24 95:23 96:2, 6, 11 97:3, 17 101:6, 12, 15, 20 102:11, 17, 24 103:7, 14, 15, 16, 18, 23 104:5 105:13, 16, 19, 23, 25 106:11, 13, 22 108:7, 16, 19 109:6, 8, 14, 25 110:3, 8, 13, 14, 18 111:7, 8, 15, 18 112:9, 20 114:10 115:12, 18, 25 116:12 118:24, 25 119:11, 13, 19 120:3, 5, 14, 16 121:8, 16, 19, 22 122:4, 16, 18, 24 123:7, 17, 19, 21 125:23 126:3, 17, 24 127:2, 4, 7, 14, 22 128:1, 18 144:20 147:9 148:16 150:11 157:2 158:3 159:3 160:15, 20 161:14 162:4 163:5, 17 167:6	168:15, 17 169:20 170:3, 22 171:9, 13 172:2, 5, 8, 11 174:1 175:23 176:4 178:5 tracks 18:25 43:4 59:14 65:10 69:3, 13, 15 70:9 71:12, 18 73:6 74:25 75:9, 15 82:9 121:24 134:3, 4 141:1 144:24 150:17, 25 151:12, 13 155:24 157:4, 6, 18 158:13, 16, 22, 23, 24 159:1, 23 160:6 164:3 166:14 167:9, 17 168:8, 14, 21, 23 169:5, 13 177:21 178:1, 3 tractors 27:22 TRADEMARK 1:1 trade-offs 33:10 97:11 98:19 traditionally 76:18 train 17:25 19:9, 12 156:17 trains 17:24 18:3 155:21 transcript 179:12 Transcription 180:10, 12 transition 30:7, 9 translational 56:21 travel 67:15 108:15 traveling 109:9 110:8 tree 66:15 71:14 TRIAL 1:1 trigger 64:18 triggering 18:17
--	--	--	---

Trimmer/Paver 4:5, 7 47:4 Trimmer/Slipform 4:10 142:18 143:2 145:17 truck 22:1, 5 23:7, 13, 14 25:14 42:15 43:6 143:25 152:15 true 12:20 180:12 truth 21:13 113:9 try 9:7 59:3 65:6 70:20 72:13 100:4 108:7 112:25 170:5 trying 9:18 10:1 17:10 21:24, 25 27:17 28:3 51:9, 11 59:5 75:21 78:1 92:20 95:23 96:20 101:3, 9, 11, 14 115:25 132:24 141:6 147:13 158:15 173:13 tube 32:14, 17 48:22 49:16, 22 50:2, 9, 11, 18, 21 52:2 94:12 95:8 96:7, 13 100:21 tubes 49:10, 14, 18 51:12 tubular 100:17 102:9, 16 103:6 165:23 turn 13:3 44:1 46:15 50:14, 16 56:23 57:1, 2, 5, 10 58:1 59:2, 22 61:13 63:1 64:17 67:12, 18 68:2, 7 70:20 77:8, 11, 14 79:11 85:10 91:25 94:10 100:22 101:3, 9, 20 104:17, 20, 23 108:25 109:1	110:12, 13, 25 111:17 117:24 118:5, 13 130:12 132:5 133:7 134:2, 4 135:2 137:18, 19 138:13 144:23 145:9 147:15 150:17, 25 160:8 164:23 166:9 171:7 177:6 178:15 turnbuckle 77:16 turnbuckles 52:25 turned 68:16 89:4, 5 100:21 105:25 151:12, 13 turning 44:24 64:19 67:14 91:21 106:1 108:13 110:15, 16 142:9 145:8 148:21 169:4 171:12 turns 16:15 52:6 68:11 70:5 91:20 171:9 Twin 2:14 twist 33:18, 24 35:7, 17 40:21 49:4 167:16 twisted 49:24 twisting 33:17, 23 34:9, 15, 19 166:3 twists 49:22 two 14:23 15:8 18:21 21:1 24:1 30:4 33:4, 23 43:12, 14 45:18 47:21 49:3, 17 53:17 54:21 57:2 62:14 69:24 70:25 78:13, 16 83:19 102:20 105:6, 12 109:22 111:13, 16 122:1	129:9 130:3, 4, 16 144:14 164:9 two-person 77:6 type 13:6 177:18 178:18 typewriting 180:9 typical 24:2 83:15 94:17, 19 96:12, 21 101:10 107:14 typically 23:24 < U > U.S 1:3 5:15 ultimately 75:8 96:3 underdesigned 109:16 undergoing 131:8 undergrad 7:8 20:22 undergraduate 9:3 underload 166:15 underpowered 109:13 understand 9:18 68:23 87:12 96:20 123:3, 11 125:2, 16 129:1, 4 138:11 147:16 158:21 163:11 178:24 understanding 9:17, 20 69:2 78:22 100:1 109:25 163:2 undesired 53:2 unequal 48:1 unimpeded 70:13 unintentionally 105:25 unison 49:10 51:16, 20 unit 173:1 174:7	175:5 177:19 UNITED 1:1 units 12:13 135:8 universal 10:9 University 20:25 unlock 108:25 unmovable 102:19 unsafe 10:11 updated 155:22 updating 41:12 upgrade 14:3 17:2 41:9 upload 6:12 uploaded 62:14 86:20 148:25 151:15 154:15 167:21 upper 49:16, 18, 22 upright 119:13, 19 120:7 use 9:19 22:20, 25 23:1 25:13 28:23 34:5, 6 36:20 42:17 44:21 69:4 72:23 80:4 81:9, 13 86:16 87:17 94:3, 4 98:1 100:1, 4, 10 108:21 109:5 112:13, 16 116:22, 25 117:2 124:22 126:1 129:11, 22 137:10 144:13 147:18 149:18 150:2 151:7 152:12 153:11, 21 154:24 155:5, 8, 10, 16 158:25 159:10 166:4, 6 168:16, 17 171:1 175:9 176:5 180:9 uses 61:18, 25 74:15 111:4, 15 152:5 176:2
--	---	---	--

Usually 17:24 31:14 130:5 171:24 utilized 81:16 < V > value 24:6 71:22 valve 60:1, 6, 7, 8, 15, 17, 18, 22, 23 61:1, 8 72:13 valves 60:9, 10, 20 variations 106:12 variety 11:18 155:11 172:15 various 14:20 79:2 91:10 92:3 94:20 95:19, 20 131:3 140:14 vehicle 40:7, 15 verify 63:6 version 16:3 163:23 171:20 versions 74:2 vertical 92:6 120:8 vibrate 28:9, 12 29:18 144:3 vibrating 28:18 VIDEOCONFERENCE NCE 1:4, 14 videos 47:8 view 160:25 171:11 Vitae 4:3 voltages 16:21 volume 13:3 < W > wait 13:18, 19 72:14 walk 7:15 172:20 walking 26:15 158:2 173:22 175:25 wall 40:20 70:19, 21, 24	want 11:21 12:6 28:15 29:19 31:1 35:3, 7 43:8 44:7 47:20 53:21 57:22 58:10 59:11, 16 61:7 62:8, 10 64:2, 9, 16 66:16 67:2, 6 68:18 70:3 76:4, 5 77:3, 4, 16 78:25 80:14, 17 82:5, 12 89:12 92:25 103:17, 24 106:23 108:22, 25 110:25 112:13, 15 114:22, 23 116:3 125:2, 7, 14 127:5, 6 130:8 131:1, 4 132:22 133:8 142:23 156:24 157:3, 7 165:18 166:4 170:4 172:9, 19, 20 175:1 178:15 wanted 34:24 39:13 59:1 63:24 81:11 97:6 99:1 112:11 113:23 137:14, 21 wanting 53:9 wants 62:1 87:18 113:12 Washington 2:8 waste 7:15 watch 10:6 watched 155:23 watches 9:25 10:11 15:6 watching 27:6 water 61:4, 6 146:21 way 6:22 9:15 14:20 15:9 16:22 36:12, 20 40:5 54:15 59:11 61:4 62:5 63:21 67:20	70:23 72:6, 12, 25 73:2 76:8 77:15 84:19 88:9, 17 89:23, 25 96:25 97:1 98:10 99:5, 17 107:15 108:4, 6 111:2, 19 126:18 127:23 128:2 158:8 159:11 162:21 165:13 172:9, 15 173:22, 23 180:15 ways 36:22, 25 53:4 65:4 116:20 117:3 wear 81:8 week 13:19 weeks 24:22 weigh 29:13 43:1 weighed 29:12 43:2 weighing 72:19 weight 29:9, 21 114:11 143:10 144:18, 22 145:1 146:1, 5, 7, 9, 14 147:17 weights 95:16 weird 153:21 well 5:20 7:4 9:15 11:21 13:4 16:9 19:4 24:17 33:15 34:20 35:3, 11 36:19 38:17 39:23 41:19 45:16 48:15 49:15, 24 50:7, 10 52:1, 24 53:13, 16 54:1, 13, 21 55:8 57:21 58:1 59:20 61:20 67:5 70:15, 22 71:6, 10, 22 72:1 74:8 75:14 78:22 80:2, 10 85:1 86:1 89:3 93:10 96:13	97:16 99:25 102:12 110:22 114:20 117:20 126:13 132:20 133:19 134:11 137:12 139:6, 18 144:21 147:12 149:13, 24 150:14 155:7, 20 158:20 160:16, 21 162:5 163:10 164:13 168:10 170:9, 25 174:17 well-prepared 71:11, 16 went 20:25 21:3 28:5 38:2, 10 44:11 71:24 we're 10:1 17:19 43:20 57:10 60:9 82:24 100:25 103:12, 22 129:5 135:17 west 133:22 we've 38:18 45:19 80:8 86:11 91:12 98:12 154:16, 17 162:10 whack 55:24 wheel 39:7 167:1, 5 177:23 wheels 43:5, 9 167:2 168:7, 11 177:16, 19, 22 WHEREOF 180:19 Whitaker 4:16 141:5 154:16, 24 155:4 178:8, 24 whizzing 19:11 wide 10:3 25:11 29:3, 4 44:3, 11 82:6 84:8 144:12 wider 44:9 82:11 137:1, 2, 6 147:1
--	---	--	---

width 43:18, 19, 21 44:6, 12 widths 144:11 wiggle 77:23 133:3 WILLIAM 1:5, 14 2:3 5:3 180:7 windows 45:14, 18 winter 21:14 wire 64:8, 15, 17, 20 66:12, 20 within 1:16 12:24 51:5 52:17 55:20 70:15 71:6, 22 72:1 107:3 117:12 132:16 174:2 180:6 without 11:16 55:1, 13 59:18 73:15 80:11 138:21 140:21 142:19 160:22 167:13 WITNESS 2:2 6:9 8:1 9:15 25:5 27:10 30:18 33:9 35:3, 22 36:19 44:18, 23 51:22 52:20 55:20 56:8 57:9 58:6, 20 59:7 62:22 65:3 71:21 73:22 83:7 85:22 86:25 87:11 89:17 92:2 93:23 95:1 96:19 99:11 100:20 101:14 104:7 106:16 107:7, 13 109:11 110:10 112:2 113:18 114:15 115:21 119:23 120:18 122:9 123:1, 9 124:8 128:7 129:25 131:11 135:16	136:23 137:12 138:7 139:6 140:9, 20 141:23 142:15 143:4, 18 146:17 147:12 148:5, 11, 18 149:5, 11, 22 150:8, 20 151:2, 9, 20 152:23 153:17 154:3, 21 155:1, 7 158:20 159:17, 25 161:18 162:7 163:1, 10 164:5, 13 165:6, 12 166:1 167:25 168:10 169:8, 17, 25 173:12 174:17 175:12 178:12 179:2 180:13, 19 witnessed 156:20 wonder 13:3 won't 11:7 33:18 117:9 wood 156:2, 3, 6 word 100:1 125:19, 20 126:1 words 79:2 142:1 171:1 work 8:7 12:24 14:12 15:3 19:18 21:14 22:20 25:21 26:5, 25 31:5 37:17, 20 38:5 39:20 40:3, 23 41:8, 12, 23, 25 49:17 59:17 70:17 71:25 80:9 93:13 120:1 129:18 153:4 154:11 156:24 workable 30:2 42:20 worked 13:11, 22, 23 14:4, 6, 24 15:7 19:13 20:6, 17 21:11, 21	38:13, 19 39:4 40:6 41:19 working 6:20 14:2, 20 17:12, 15 25:25 26:18 49:3 59:19 68:14 73:1 150:14 works 17:6 147:24 worksite 71:16 world 8:3 13:23 14:1, 3 17:7 18:3 38:25 worm 116:22, 23, 25 117:1, 2, 5, 15, 24 139:17, 22 would 8:15, 16, 23 9:1, 20 10:5, 8, 11, 13, 20 11:11 12:10, 12, 22 13:13, 15, 16, 17, 18, 19, 20 14:3 15:2 17:1 18:6 20:21 21:7, 17 22:4, 15, 17, 20, 21 23:1 24:1, 4, 5, 11, 12, 17, 21, 24 25:16 26:2 28:6, 7, 21, 23 29:5, 8, 10, 11, 15, 16, 22, 24 30:15, 16 31:11 32:14, 15, 16, 17, 18 33:2, 11, 12, 14, 25 34:2, 6, 17, 18, 22 35:1 36:9 37:7 38:9 40:14 41:5, 21 42:7, 9 43:17, 21 44:5 49:13 51:4, 13, 18 52:14 53:1, 14 54:25 55:17, 21 56:4 57:19 58:16 59:4, 10, 18 60:14, 17, 19, 20 61:5 64:7 66:20, 22 67:14 69:15,	24 70:2, 8 71:10, 15, 18 72:4, 6, 11, 12, 14, 17, 21, 25 73:4, 7, 9, 10, 13 75:22 76:20 77:8 78:14 80:3, 5, 9, 15, 25 86:18 89:24 93:1, 10 94:1, 2, 3, 4, 6, 9 95:13, 18, 22 96:5 97:4, 17, 19, 24 98:22, 24 99:2, 3, 7, 8, 17, 22 100:15, 24 101:2 102:20 103:4, 17, 25 104:3 106:3, 6, 7, 17 107:11 109:4, 14, 18 111:23 112:15 113:10, 13, 18, 21, 24 114:1, 5, 15, 17, 18 115:2, 15 116:9, 17, 18 117:7, 15 118:1 123:18 125:9, 12 129:25 132:13, 17, 22 133:5, 12, 17, 20 134:19 136:2, 4, 11, 19, 24 137:8, 16, 23 138:2, 11, 17, 25 139:3, 10 140:1 141:25 142:16, 22 143:13, 21, 23 144:2, 4, 5, 7, 18 145:3 146:12, 19 147:9, 14 149:1 150:10 152:8, 20 153:7, 14 155:18 157:3 163:8 164:14 165:17, 18, 23 166:13 167:7, 12, 16, 17, 19 170:17 171:3, 11 176:6 wouldn't 15:13, 14 24:20 30:4 36:19, 23 55:14
---	--	---	--

59:19 70:17 71:24, 25 80:13 92:25 93:13 100:2 114:11 wraps 179:5 wrench 36:5, 10 98:11, 14, 21 wrenches 36:4 wrong 59:14 wrote 6:10 < Y > Yeah 6:9, 25 7:1 12:1, 4, 9, 22, 23 15:16 20:14 23:9 24:6 25:23 27:10 29:2, 10 30:5, 18 32:6 33:11 36:12 40:4 41:19 42:16 44:21 46:10 53:3 56:15 63:9 68:13 69:9 72:25 75:24 76:7 84:14 88:7 92:2 96:23 99:11 101:8 102:6 103:1, 16 104:8, 13 106:16 110:1 111:12 122:9 131:18 134:11, 17 142:5 146:17, 24 148:6 151:2, 10 152:10, 23 160:13 162:7, 18 163:1, 12 164:14 165:12 169:3 171:18 172:19 173:17 174:21 177:20 year 21:11 years 7:6, 8 14:2, 23 17:4 21:1 98:13 139:23 Yep 15:5 yes 5:11, 17, 21, 25 6:4 10:8, 22 17:9 19:24 20:5 26:10, 25 34:10	38:15 39:7 46:7, 12, 20 47:15 49:12 51:9 57:4, 21 59:25 60:4 61:17 62:5 63:19 65:12 66:7 69:8, 17 76:11 77:10 79:17 84:13 85:17 87:5, 12 92:14 93:8 94:18 95:12 98:9, 25 101:24 105:5, 15 106:9 109:11, 21 115:5 118:12, 16, 18, 21 119:4, 8, 15 121:17, 21 122:22 125:19 126:1, 10 127:3 128:19 129:21 130:18, 22 132:15 133:15 134:21 135:6, 10 137:7 138:24 140:4 145:22 146:4 148:24 151:25 154:3 162:19 164:5 166:16, 20 167:2 169:2 177:11, 17 178:7, 20 yoke 50:11, 12, 13, 18 91:18 103:6 York 2:8, 19 < Z > zero 79:3, 5 123:13 126:21 ZIMMERMAN 1:7 Zoom 45:16		
---	--	--	--