

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GODBERSEN-SMITH CONSTRUCTION COMPANY
d/b/a GOMACO CORPORATION
Petitioner

v.

GUNTERT & ZIMMERMAN CONST. DIV., INC.
Patent Owner

Case IPR2024-00835
Patent No. 11,535,318

**EXPERT DECLARATION OF WILLIAM SINGHOSE IN SUPPORT OF
PETITION FOR INTER PARTES REVIEW**

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I. INTRODUCTION AND SUMMARY OF OPINIONS

1. I, William Singhose, have been retained as an independent expert by Godbersen-Smith Construction Company d/b/a GOMACO Corporation (“Petitioner” or “GOMACO”) in connection with an *inter partes* review of U.S. Patent No. 11,535,318 (the “’318 patent”) (Ex. 1001). I have prepared this declaration in connection with Petitioner’s Petition for *Inter Partes* Review.

2. Specifically, this document contains my opinions about the technology claimed in claims 1-8 of the ’318 patent (the “Challenged Claims”) and the ground against these claims that has been asserted by Petitioner. I was not asked to provide any opinions that are not expressed herein.

II. SUMMARY OF OPINIONS

3. This declaration considers the Challenged Claims of the ’318 patent. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge. In forming my opinions, I have assumed that the priority date of the ’318 patent is March 26, 2010, which I am told is the earliest effective filing date of the ’318 patent. My opinions would not change if I assumed a later effective filing date.

4. Based on my experience, knowledge of the art at the time of the applicable priority date, analysis of Petitioner’s asserted ground and references,

and the understanding a person of ordinary skill in the art would have had of the claims in light of the specification as of the applicable priority date, it is my opinion that the Challenged Claims of the '318 patent would have been obvious over the asserted grounds.

5. I am being compensated for my time at the rate of \$750 per hour. This compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. BACKGROUND AND QUALIFICATIONS

6. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience, discussed below and in my curriculum vitae, which is submitted as Exhibit 1003.

7. I am a Professor of Mechanical Engineering at the Georgia Institute of Technology ("Georgia Tech"). I received a B.S. in Mechanical Engineering from the Massachusetts Institute of Technology ("MIT") in 1990. I then received an M.S. in Mechanical Engineering from Stanford University in 1992. Finally, I received a Ph.D. in Mechanical Engineering from MIT in 1997. After receiving my Ph.D., I was a postdoctoral researcher at MIT before becoming a professor at Georgia Tech.

8. Based on my work experience, described in my curriculum vitae and in more detail below, I am knowledgeable about the subject matter of the '318

patent and the related prior art. Specifically, my qualifications as an expert in the fields of heavy machinery, automation, and product design stem from my prior work experience, as well as my experience as a Professor in the Woodruff School of Mechanical Engineering at Georgia Tech performing research, teaching, working, and consulting. I have several patents and dozens of publications that are directed toward understanding and improving heavy machinery.

9. In my current position at Georgia Tech, I teach courses in mechanical design, system dynamics, and controls. I also lead teams of professors, post-docs, graduate students, and undergraduate students that conduct research in mechanical design, dynamics, controls, automation, robotics, spacecraft, human-machine interfaces, and product design. During my more than 25 years at Georgia Tech, I have also had visiting appointments at MIT, Stanford, the Polytechnic University of Madrid, and the Tokyo Institute of Technology.

10. Throughout my upbringing, I was exposed to various types of construction equipment and heavy machinery. My mother was a truck driver and my father was an operator of various types of heavy machinery. Our family owned log trucks, road graders, excavators, bulldozers, front-end loaders, truck-mounted hoists, and tractors. I worked in road construction for more than two years at my family-owned road-construction company. I operated many types of road

construction equipment, including paving machines, dump trucks, steam rollers, and compactors.

11. I also worked one summer as a lab technician at Riverside Cement Company. My job responsibilities included preparing various types of concrete mixtures and testing their mechanical properties under various conditions and over extended periods of time. These activities required me to operate forklifts, cement pumps, sand sifters, flat-bed trucks, climatic test chambers, and compression testing machines.

12. Throughout my engineering career, I have worked with heavy machinery and large automated systems. Before starting my teaching career at Georgia Tech, I worked as a full-time mechanical engineer for several companies, including Walt Disney World, Apple Computers, Inc., and Convolv, Inc.

13. In my role at Walt Disney World, I designed and developed a number of structures and components for the parks' rides, including, but not limited to, operational control procedures for the Body Wars simulators. These simulators are rooms that hold about 40 people at a time. The entire rooms, and the guests seated within, are automatically manipulated through a series of preprogrammed motions using six large linear hydraulic cylinders. The machines were equipped with numerous transducers that enabled accurate feedback control of the power drives.

14. For Convolve, Inc., I analyzed the dynamics of automated robots, satellites, and NASA high-altitude balloons. I also developed automated control systems for manufacturing machines, large-scale coordinate measuring machines, and laser interferometer sensors. One of my Convolve projects required the development and installation of a system to control a crane at the Savannah River Nuclear facility. The crane was a large overhead bridge structure that moved barrels of nuclear waste. The system we developed reduced the unwanted pendulum swing of the barrels.

15. Throughout my years at Georgia Tech, I have worked as an engineering consultant or research partner for numerous companies. For example, I worked with Boeing for several years to improve the safety of their overhead bridge cranes. The crane controllers that I developed have been deployed at multiple Boeing manufacturing facilities. One of the Boeing cranes I operated included four large rotary slew drives that enabled the controlled rotation of very large aircraft components. I have also worked on several projects involving boom cranes that travel on crawler tracks.

16. In addition to my engineering experience as a professor and an engineer, I have commercialized technology developed in my research group at Georgia Tech by founding two companies: CAMotion Cranes and InVekTek. CAMotion Cranes designs and installs crane control systems that decrease payload

swing, automatically avoid obstacles, and improve crane safety. These improvements are achieved through sensor systems and control methods that my research group developed, patented, and deployed. CAMotion Cranes was acquired by PAR Systems in 2013. InVekTek develops and commercializes control systems for robotic and industrial material-handling systems. The control systems are embedded in motor drives to reduce unwanted machine motion.

IV. MATERIALS CONSIDERED

17. In forming my opinions, I have analyzed the materials listed in Appendix A. My opinions are based on my experience, knowledge of the relevant art, the documents identified in Appendix A, and the documents discussed in this declaration.

V. LEGAL STANDARDS

18. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the Challenged Claims.

A. Claim Construction

19. I have been instructed that the terms appearing in the '318 patent should be interpreted in view of the claim language itself, the specification, the prosecution history of the patent, and any relevant extrinsic evidence. The words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention, which I have assumed here is March 26, 2010. While claim limitations cannot be read in from the specification, the specification is the single best guide to the meaning of a disputed term. I have followed these principles in reviewing the claims of the '318 patent and forming the opinions set forth in this declaration.

20. I am told that claim construction is not necessary where there is no controversy as to the meaning of the terms with respect to the prior art. I am told that in the district court, GOMACO identified for construction the terms “swing leg” and “hinge bracket” of U.S. Patent No. 10,029,749, and those terms also appear in the '318 patent. In my opinion, the prior art asserted in the petition grounds discloses an embodiment within the indisputable scope of the ordinary and customary meaning of the claims and in particular the “swing leg” and “hinge bracket” terms. Therefore, it is my opinion that no explicit claim constructions are needed to apply the prior art to the challenged claims.

B. Level of Ordinary Skill

21. I understand a person of ordinary skill in the art is determined by looking at, among other considerations, (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field.

22. In light of these considerations, a person of ordinary skill in the art (“POSITA”) pertinent to the ’318 patent would have had at least a four-year degree in mechanical engineering or a closely related field and at least two years of experience designing, developing, or operating heavy machinery, including their components and control systems. Additional education could substitute for professional experience and significant work experience—such as working with, servicing, or operating heavy machinery in the field—could substitute for formal education.

23. The ’318 patent describes the technology at a level that someone with the above education and work experience would understand. A POSITA, as described above, would understand the different mechanical components and functionality of control systems of heavy machinery that are required to practice the Challenged Claims. They would have gained this understanding from either developing those components and control systems, or from operating the

machinery in the field, which frequently requires knowledge of the machines to perform repairs in the field, reconfigure and calibrate the components and control systems for different operations, and perform maintenance on the components and control system consistent with the requirements of operator manuals. Indeed, operator manuals for heavy machinery assume that the operator is familiar with the mechanical components, hydraulic systems, and control systems and how they work, at least at the level described in the '318 patent.

24. I often find it useful to compare the claimed subject matter to the topics taught in engineering curricula. This helps guide the selection of the formal educational requirements. My requirement of a four-year degree in mechanical engineering or a closely related field is based on my experience teaching mechanical engineering students for more than 25 years. The material taught to mechanical engineering students covers the subject matter of the Challenged Claims. For example, in our sophomore-level design class at Georgia Tech we teach the students how to use a processor and sensors to control the actions of an automated machine. The students are then required to design, build, and demonstrate an automated machine in an end-of-the-term “robot” contest. All of the machines have some type of frame to which the students attach the processor, sensors, and moving components. Therefore, after their sophomore year,

mechanical engineering students would be able to understand the majority of the claimed features, as well as how those features would be combined and operate.

25. As noted in my proposed definition of a POSITA above, I believe that work experience could substitute for formal educational training. The basis for this opinion is twofold. First, the claimed technology is not sophisticated. The claimed subject matter combines machine frames, swing legs, jacking columns, crawler tracks, slew drives, transducers, and processors. The combination and use of such components can be learned through on-the-job-training, such as while operating and maintaining construction equipment. I note that none of the claims require the design of the more sophisticated components such as the transducers or processors; only the use of such components in combination with the other components is required. Second, when I worked in the construction industry, I learned a great deal about the design and operation of the machines that I operated. It is often the case that machine operators are also required to maintain, debug, and even repair (to a limited extent) the machines that they operate. For example, when I operated an asphalt paving machine, I had to continually clean and adjust the telescoping mechanism that was used to adjust the width of the screed that spreads and finishes the asphalt.

26. I was at least a POSITA as of March 26, 2010.

C. Obviousness

27. I have been told that under 35 U.S.C. § 103, a patent claim may be obvious if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

28. I have been told that a proper obviousness analysis requires the following:

- a. Determining the scope and content of the prior art;
- b. Ascertaining the differences between the prior art and the claims at issue;
- c. Resolving the level of ordinary skill in the pertinent art; and
- d. Considering evidence of secondary indicia of non-obviousness (if available).

29. I have been told that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the date of invention for the Challenged Claims is March 26, 2010. My opinions would not change if I assumed a later date of invention.

30. I have been told that a reference may be modified or combined with other references or with a POSITA's own knowledge if the person would have found the modification or combination obvious. I have also been told that a person of ordinary skill in the art is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

31. I have been told that obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. I have been told that whether a prior art reference renders a patent claim obvious is determined from the perspective of a person of ordinary skill in the art. I have been told that there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention. I have also been told that a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually and may consider the inferences and creative steps a person of ordinary skill in the art would employ, as filtered through the knowledge of one skilled in the art.

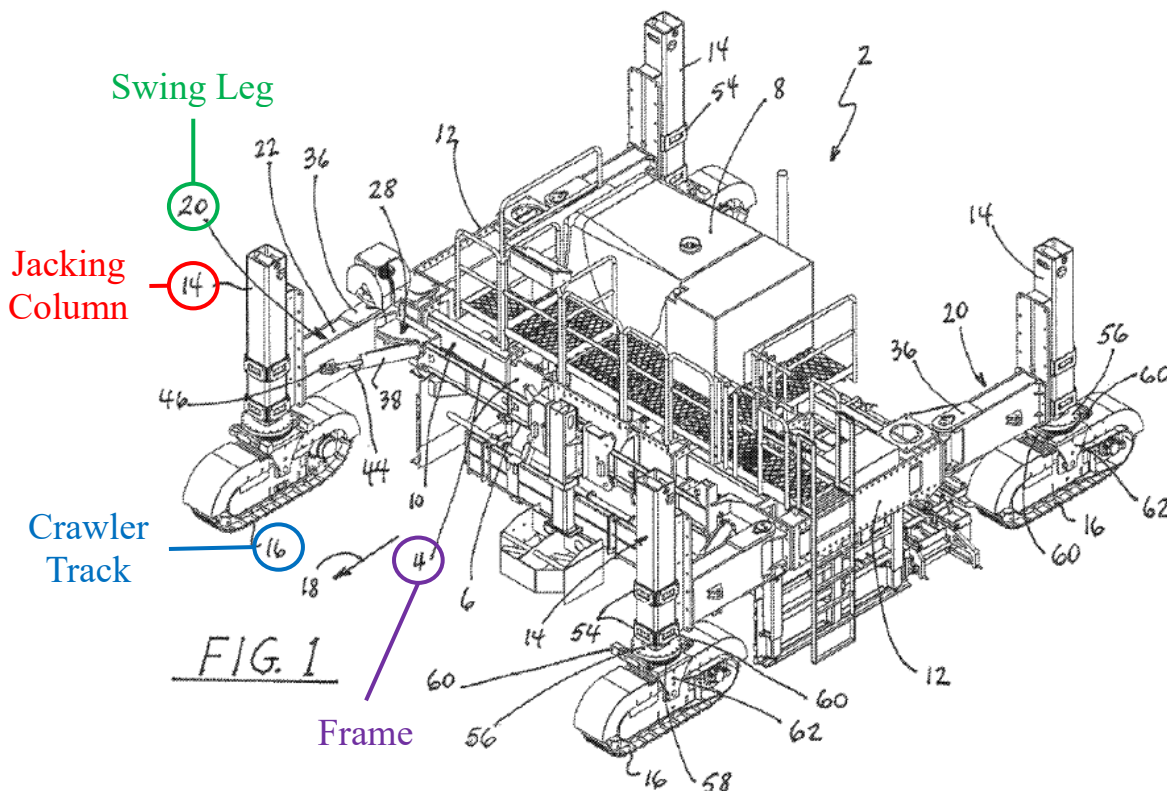
32. I have been told that there is no rigid rule that a reference or combination of references must contain a "teaching, suggestion, or motivation" to combine references. But I also have been told that the "teaching, suggestion, or

motivation” test can be used in establishing a rationale for combining elements of the prior art. I have also been told to be aware of distortions caused by hindsight bias, and that reading into the prior art the teachings of the invention at issue is improper.

VI. THE '318 PATENT

A. Overview of the '318 Patent

33. Generally, the '318 patent describes and claims a swing-leg assembly for use on a paving machine. As shown below, each swing-leg assembly of the '318 patent contains a jacking column 14, a crawler track 16, and a swing leg 20 that couples the jacking column to frame 4. [Ex. 1001 ('318 patent), 8:53-10:51.]



[Ex. 1001 ('318 patent), Fig. 1 (annotated).]

The crawler tracks “are mounted to” and rotate relative to the jacking columns.

[Ex. 1001 ('318 patent), 8:65-9:1.] Each jacking column includes two hollow tubes (outer 48 and inner 50) that telescope relative to each other in response to an internal hydraulic actuator that extends and retracts, which raises and lowers the machine. [Ex. 1001 ('318 patent), 8:63-65, 11:20-39.]

34. The swing leg is fixed to the jacking column on one end and is pivotally connected to the machine on the other, allowing the swing leg to pivot horizontally. [Ex. 1001 ('318 patent), 2:24-32, 9:30-37.] When the swing leg pivots, it swings the jacking column and crawler track to various positions.

[Ex. 1001 ('318 patent), 10:52-11:2.] Every feature described above predates the '318 patent, as the specification admits. [Ex. 1001 ('318 patent), 1:28-5:61 (describing features as “conventional” and “well known”).]

35. Regarding the '318 patent's purported invention, the specification discloses actuators that pivot the swing leg and a “slew or worm gear drive” that rotates the crawler track. [Ex. 1001 ('318 patent), 6:17-23, 6:36-41, 6:66-7:6, 11:40-61.] Angular position transducers provide outputs to a processor, which uses those signals to control rotation of the crawler track as the swing leg pivots. [Ex. 1001 ('318 patent), 6:17-28.] Under this design, “no matter what the swing leg angle is, the crawler track stays straight ahead in the paving direction and

position.” [Ex. 1001 (’318 patent), 6:29-31.] It is this coordinated rotation of the swing leg and crawler track that forms the basis of the purported invention.

B. Prosecution History

36. During prosecution of the application that issued as the ’318 patent, the examiner never applied the prior art that I use below in my analysis of the petition grounds in any rejection. The examiner allowed independent claim 1 after the applicant filed a terminal disclaimer following a double-patenting rejection over claim 2 of U.S. Patent No. 10,589,807. [Ex. 1004, 148, 205, 215.] The applicant then added the dependent claims following the allowance. [Ex. 1004, 289-291.]

37. Following the notice of allowance, the applicant submitted an IDS citing the Board’s Final Written Decisions regarding U.S. Patent No. 10,029,749 (“’749 patent”; Ex. 1033) and three other related patents without specifically noting that these decisions held all claims unpatentable. [See Ex. 1004, 530-532.] The examiner then issued another notice of allowance without any explanation as to how the claims were allowable despite reciting substantially similar language to claims the Board just found obvious. [Ex. 1004, 549.] I discuss the similarity between the claim language of the ’318 and ’749 patents further below. Indeed, none of the notices of allowance provide any explanation as to how the claims

differ from what is disclosed in the prior art of record during prosecution.

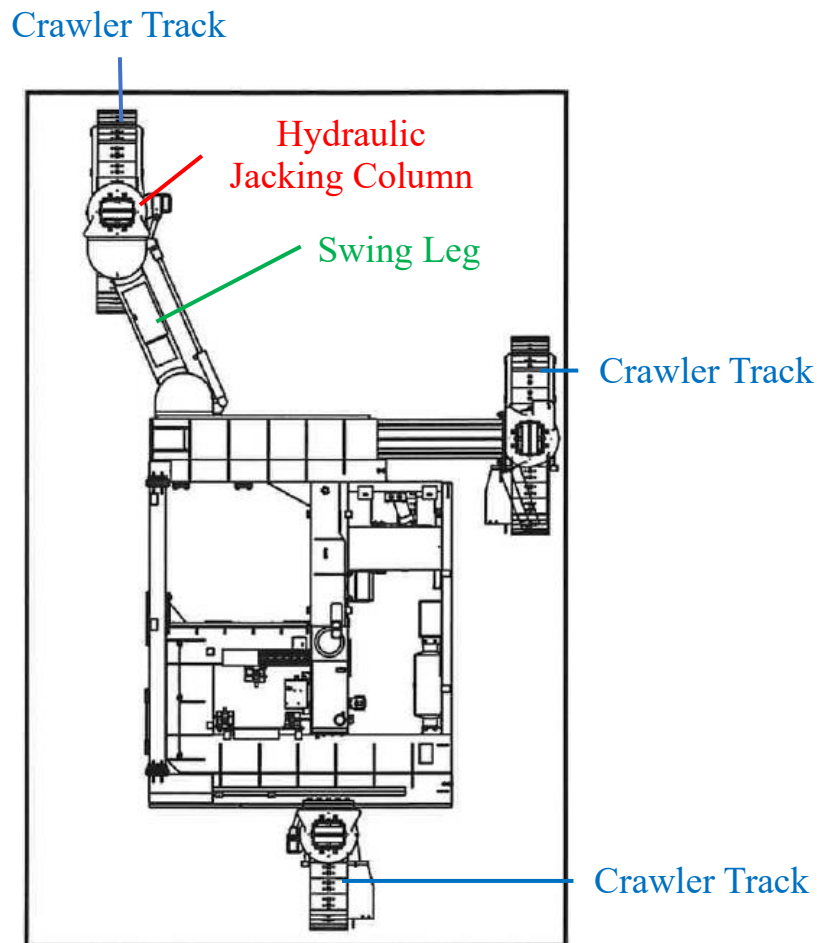
[Ex. 1004, 309, 420, 480, 548-549.]

VII. ANALYSIS OF PETITION GROUNDS

A. Ground 1: Claims 1-8 Are Obvious over CIII and Rio

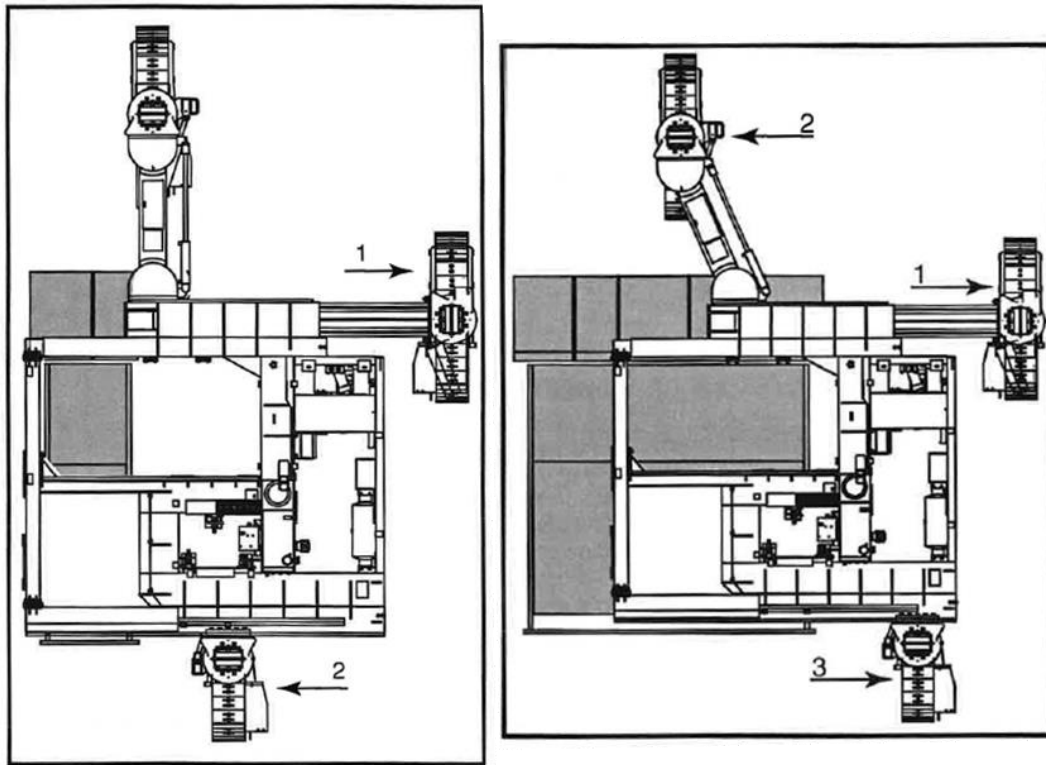
1. Summary of CIII

38. Commander III New Generation Trimmer/Paver Operator/Service Manual G21 Controls (“CIII”; Ex. 1005) discloses a slipform paver that can be converted between three-track and four-track configurations, depending on the project. [Ex. 1005 (CIII), 42, 194, 204-206, 209; *see* Ex. 1005 (CIII), 15 (depicting three-track configuration), 19 (depicting four-track configuration).] Its three-track configuration includes a pivoting swing leg, a laterally telescoping leg, and a slidable rear-mounted leg. [Ex. 1005 (CIII), 76, 201, 204.] The swing leg is shown on the top left of the annotated version of a schematic diagram from CIII provided below.



[Ex. 1005 (CIII), 201 (annotated top-down view).]

39. CIII describes using different leg positions for different types of jobs. [Ex. 1005 (CIII), 76.] The two schematic diagrams below show how the three tracks can be moved to various positions. The swing leg, mounted to the front left of the machine frame on one end and the hydraulic jacking column on the other end, can pivot left and right to move its corresponding track. [Ex. 1005 (CIII), 79-80, 34.]



[Ex. 1005 (CIII), 76 (top-down views showing positioning for curb and gutter projects (left) and sidewalk projects (right)).]

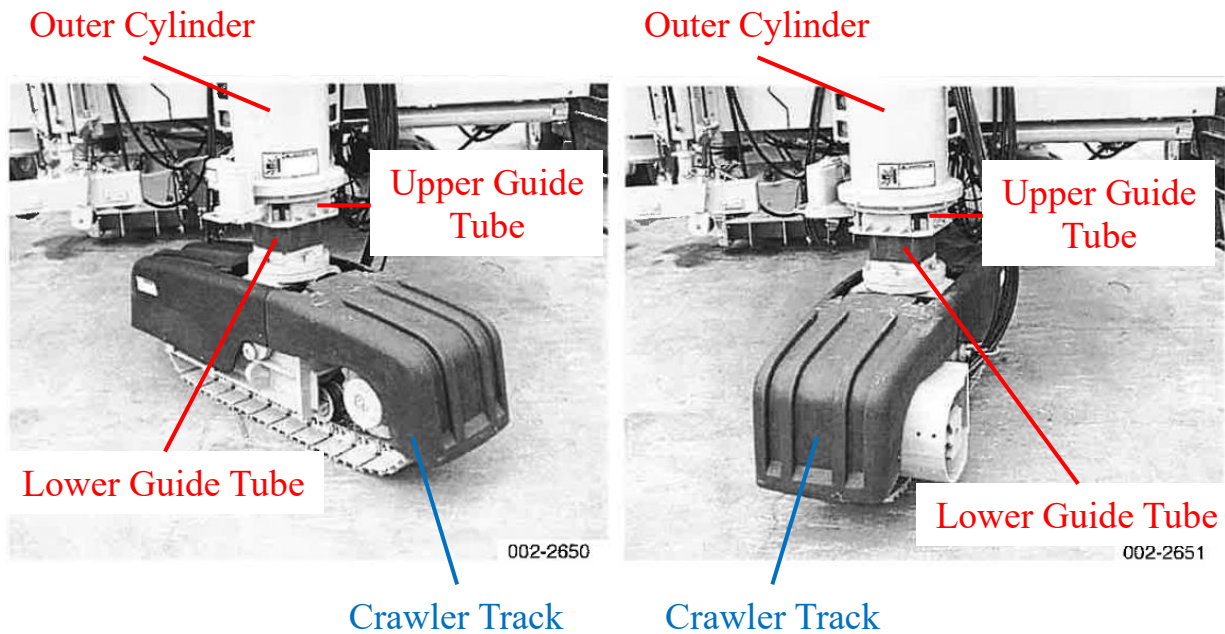
40. The hydraulic jacking column has an outer cylinder fixed to the swing leg, a rectangular-shaped “upper guide tube” (also referred to as an “outer guide tube”¹), and a slightly smaller rectangular-shaped “lower guide tube” (also referred

¹ [See Ex. 1005 (CIII), 175, 194 (calling the component both “outer guide tube” and “upper guide tube”).]

to as an “inner guide tube”²) that telescopes into and out of the upper guide tube.

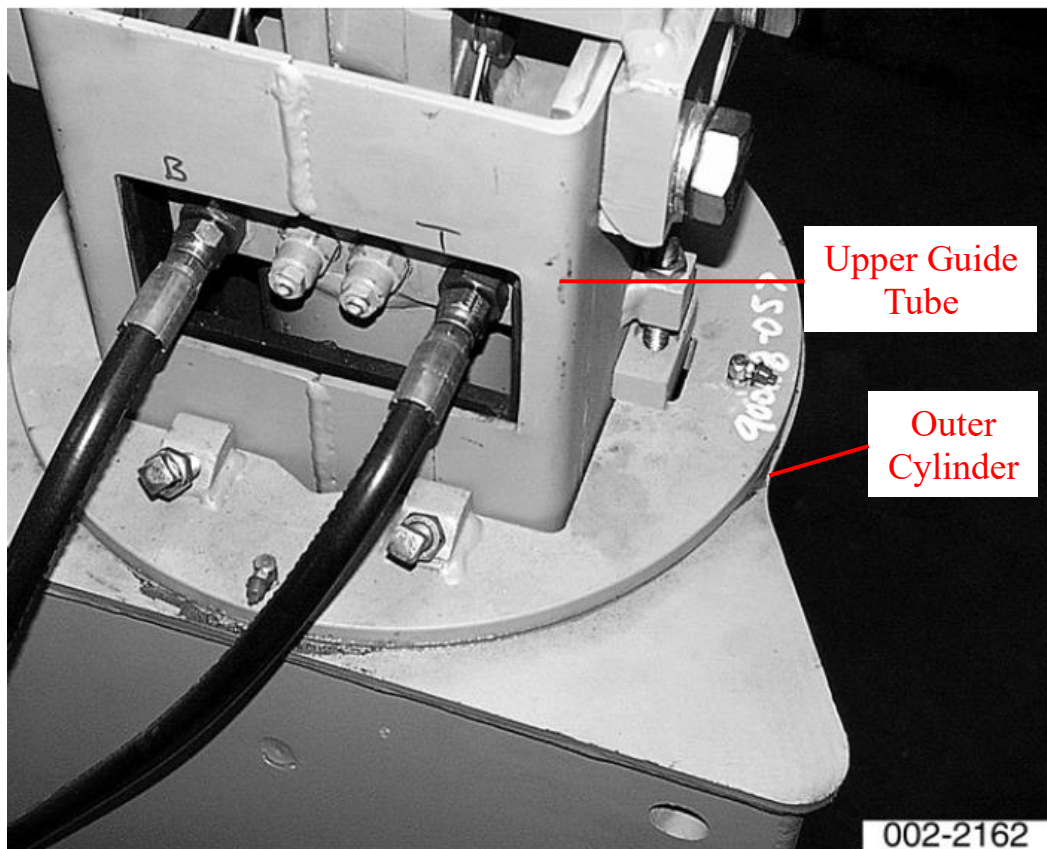
[Ex. 1005 (CIII), 74, 173-175.] These guide tubes are configured such that, when a rotational torque is applied to the upper guide tube, the upper guide tube and the lower guide tube rotate in unison relative to the outer cylinder. [Ex. 1005 (CIII), 193, 195.] This rotation of the guide tubes also rotates the crawler track, attached to the bottom of the lower guide tube. [Ex. 1005 (CIII), 193, 195.] This rotation relative to the outer cylinder is depicted in the images below. Note that, based on the label affixed to the outer cylinder, the outer cylinder is at the same position in both of the images below. However, the crawler track has rotated through a large angle.

² [See Ex. 1005 (CIII), 173-174, 376 (calling the component both “inner guide tube” and “[l]ower guide tube”).]



[Ex. 1005 (CIII), 193, 195 (annotated).]

The upper guide tube also protrudes from the top of the outer cylinder, as shown below. [Ex. 1005 (CIII), 175.]



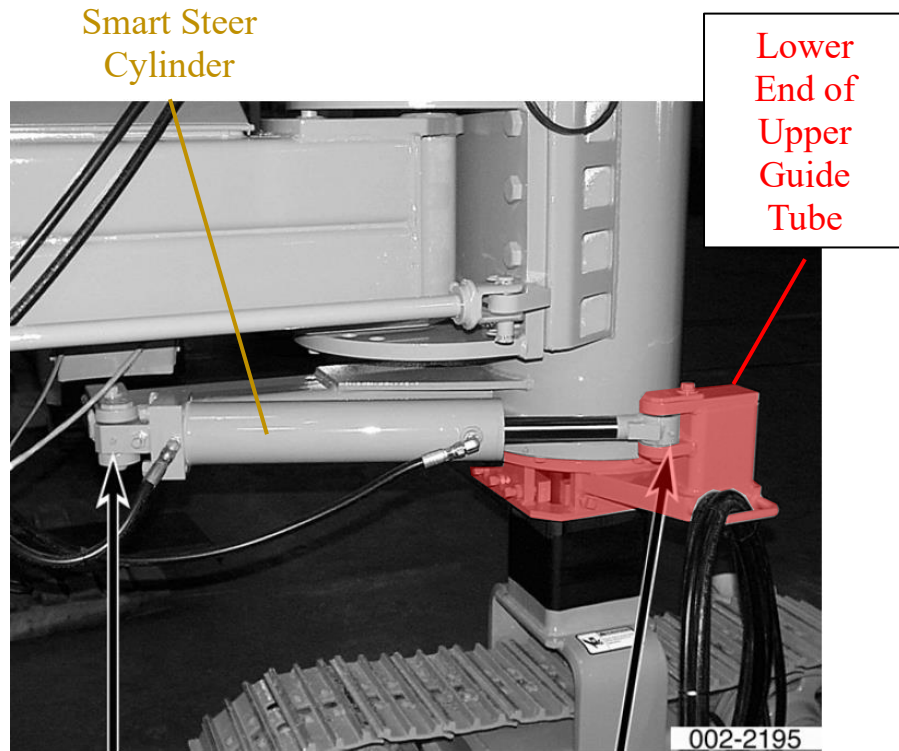
[Ex. 1005 (CIII), 175 (annotated image showing top of jacking column).]

Each jacking column has an internal hydraulic “lift cylinder” that extends/retracts to control the jacking column’s vertical position (and thus the elevation of the machine). [Ex. 1005 (CIII), 373-374, 79.]

41. CIII further discloses a hydraulic “smart steer cylinder,” depicted below, that attaches between the lower end of the upper guide tube and to a lever arm protruding from the outer cylinder. [Ex. 1005 (CIII), 407-409, 165.] The upper and lower guide tubes rotate together because of their rectangular cross-sections. [Ex. 1005 (CIII), 407-409, 165.] Thus, the steering cylinder, when actuated, rotates

both guide tubes and the crawler track in unison relative to the outer cylinder.

[Ex. 1005 (CIII), 407-409, 373-374, 193, 195.]

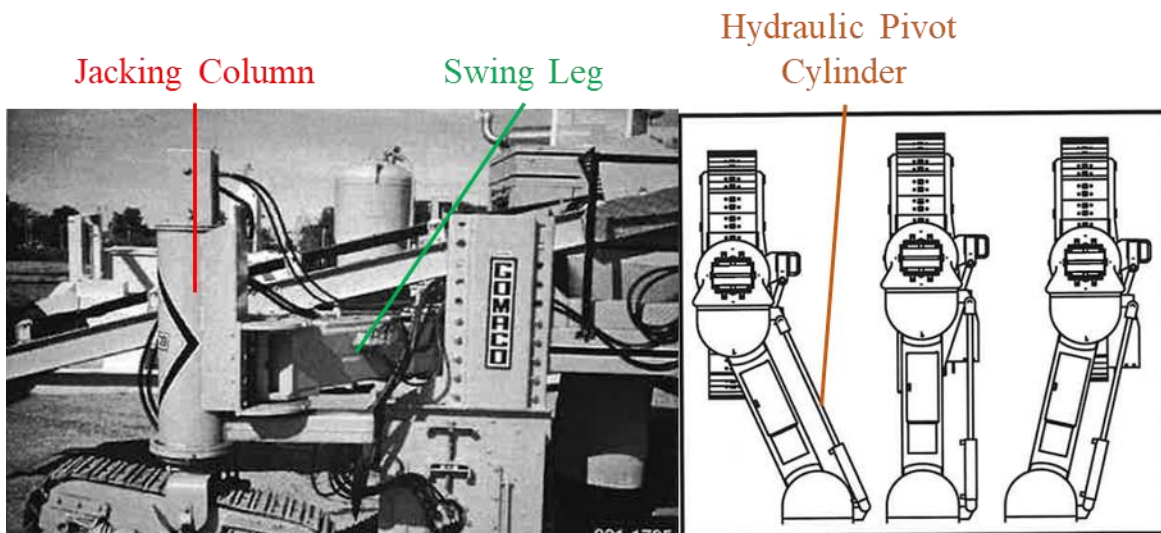


[Ex. 1005 (CIII), 165 (annotated).]

42. An electronic steering system for each leg assembly, consisting of “a sensor, a feedback pot [(potentiometer)], a servo valve and a control loop on a S2X controller,” is “networked to the other S2X controllers on the machine, including the Pancon controller in the control box.” [Ex. 1005 (CIII), 407.] The Pancon controller is the central controller that receives signals from the S2X controller associated with each crawler track and sends corrective steering signals to the appropriate S2X controller when required. [Ex. 1005 (CIII), 406-408.] For each

crawler track, “[t]he feedback pot measures the position of the track and sends a continuous signal to the S2X, indicating the track position.” [Ex. 1005 (CIII), 408.] The feedback pot associated with the steering cylinder is what makes this cylinder “smart.” [Ex. 1005 (CIII), 408.] The Pancon controller receives signals from each S2X controller indicating the track positions, compares the steer signal and feedback pot signals for each leg assembly, and generates corresponding corrective signals that cause each track to rotate to the desired position. [Ex. 1005 (CIII), 408.]

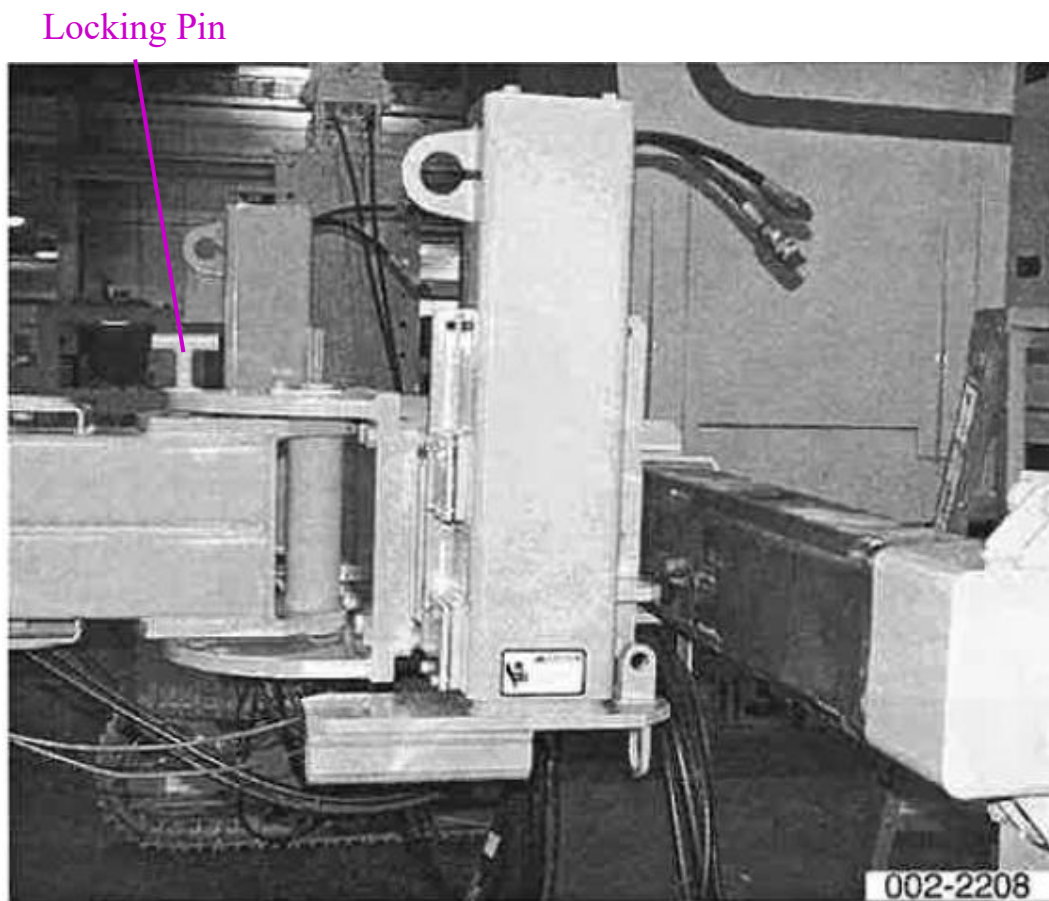
43. CIII also discloses a hydraulic cylinder that swings the leg left or right. [Ex. 1005 (CIII), 79-80, 34.] This swing leg and its various positions are shown below.



[Ex. 1005 (CIII), 79-80 (annotated).]

44. To swing the leg, an operator supports the corresponding corner of the machine frame with blocking, raises the crawler track off the ground with the jacking column, removes the pin locking the leg in place, and holds a switch to extend or retract the pivot cylinder until the leg reaches the desired position.

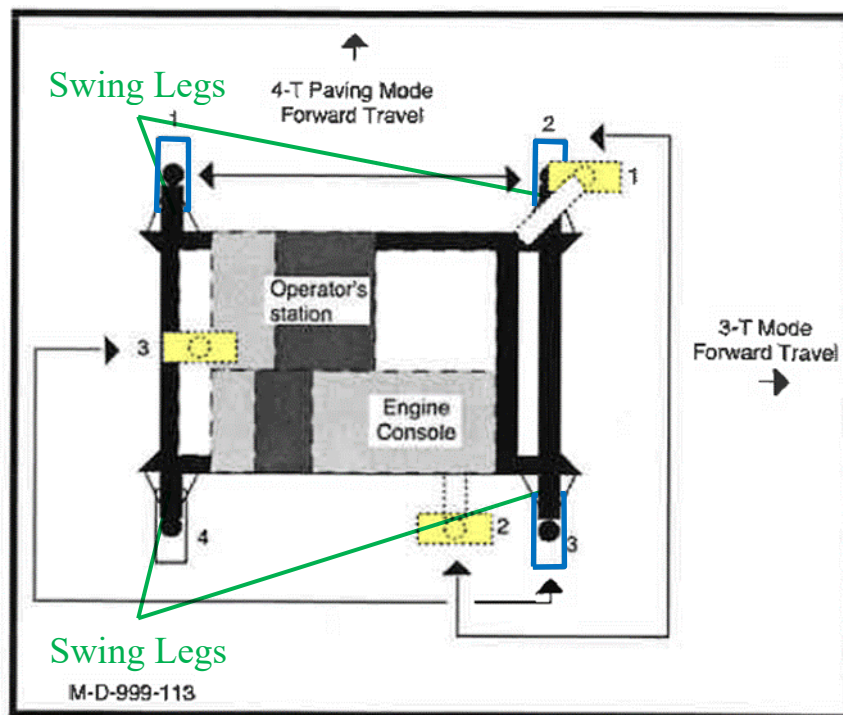
[Ex. 1005 (CIII), 79-80.] The operator then reinserts the locking pin, shown below, to lock the swing leg in place in its desired position. [Ex. 1005 (CIII), 80.]



[Ex. 1005 (CIII), 85 (annotated).]

45. CIII also discloses how to convert the paver from its three-track to four-track configuration by removing the jacking columns and crawler tracks in the

three-track configuration (highlighted in yellow in the diagram below), attaching them as indicated by the blue outlines to swing legs (identified in green below) on a four-track frame, and attaching a fourth jacking column and crawler track assembly to the final swing leg on the rear-left corner. [Ex. 1005 (CIII), 204-206, 209, 253.]



[Ex. 1005 (CIII), 204 (annotated top-down view).]

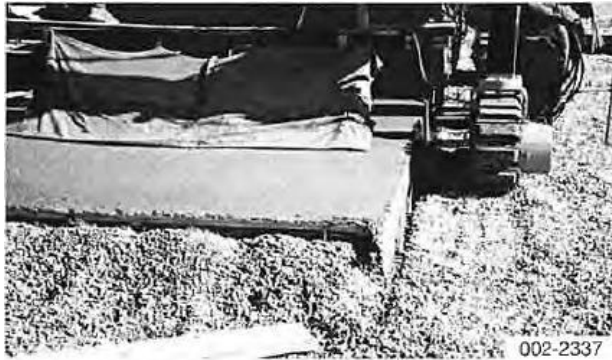
46. The four-track configuration allows the slipform paver to carry out different projects. For example, as shown below, an auger can spread concrete placed in front of the slipform paver “evenly across the width of the paving mold” that is “mounted to the machine frame.” [Ex. 1005 (CIII), 199, 211, 240-242.]



Concrete spread evenly in front of machine

[Ex. 1005 (CIII), 242.]

47. As the slipform paver moves forward, it levels and finishes the concrete into a form having a generally upwardly exposed, finished concrete surface and terminating in lateral concrete sides, as shown below. [Ex. 1005 (CIII), 241-245.] Examples of such finished concrete are shown below.



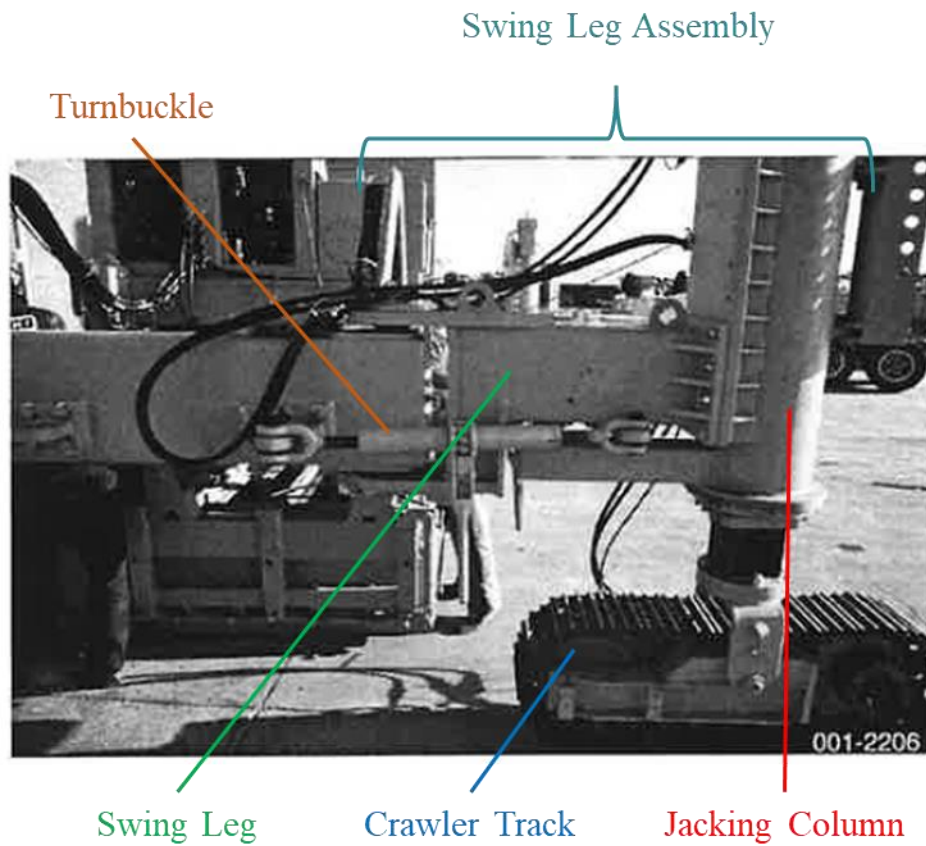
Finish concrete around header



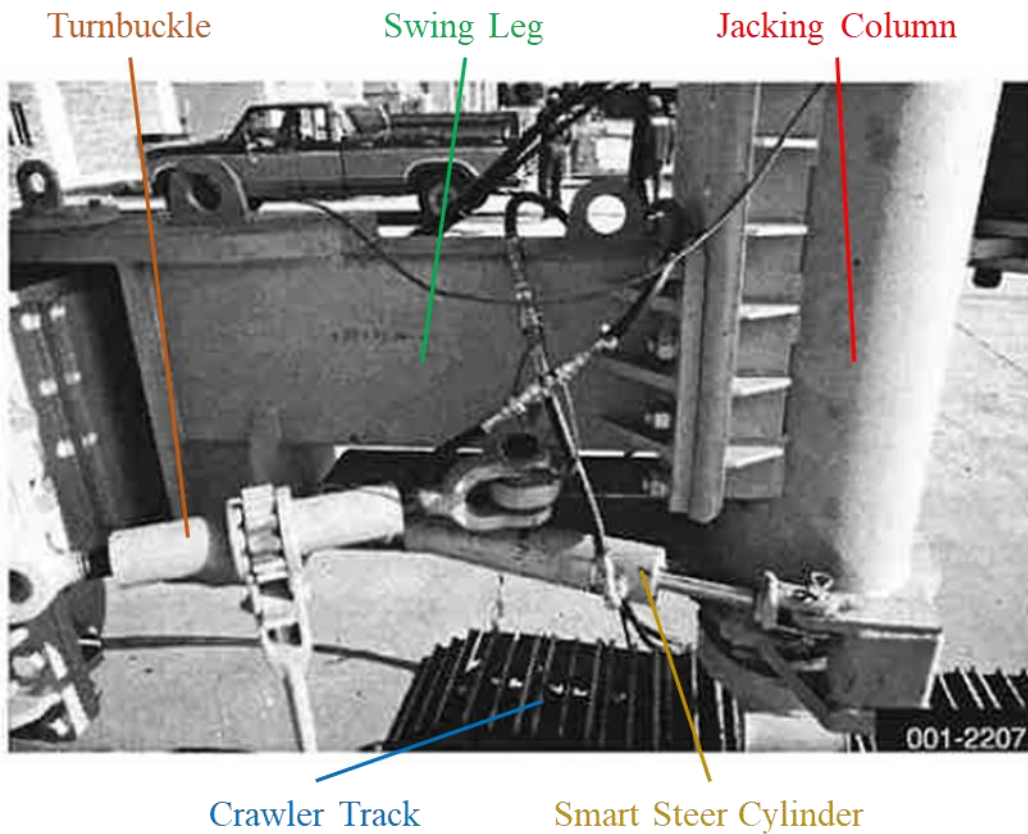
Check concrete grade

[Ex. 1005 (CIII), 241 (left), 243 (right).]

48. Each of the four swing-legs has two turnbuckles that can be adjusted for minor swing-leg rotations or removed for larger rotations. [Ex. 1005 (CIII), 209, 253-254, 265.] A turnbuckle was one of several known mechanisms used to hold a swing leg at a fixed position and commonly included extendable rods to change the length of the turnbuckle via, for example, a ratchet mechanism. CIII discloses removing the turnbuckles when rotating the swing legs from “paving mode to barrier/transport mode.” [Ex. 1005 (CIII), 253.] A swing-leg assembly with the turnbuckles attached is depicted in each of the below annotated images.



[Ex. 1005 (CIII), 209 (annotated, depicting outer side of a first swing-leg assembly).]

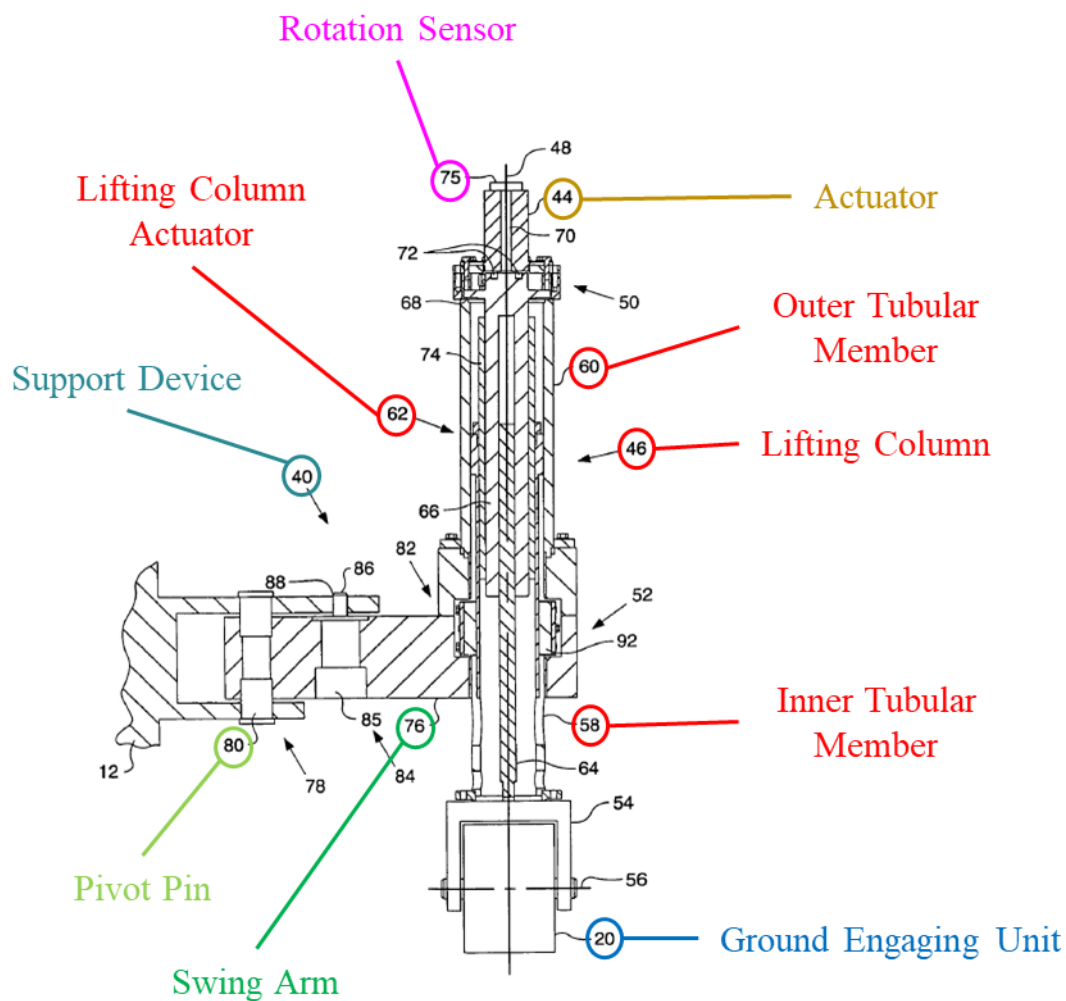


[Ex. 1005 (CIII), 265 (annotated, depicting inner side of second swing-leg assembly).]

2. Summary of Rio

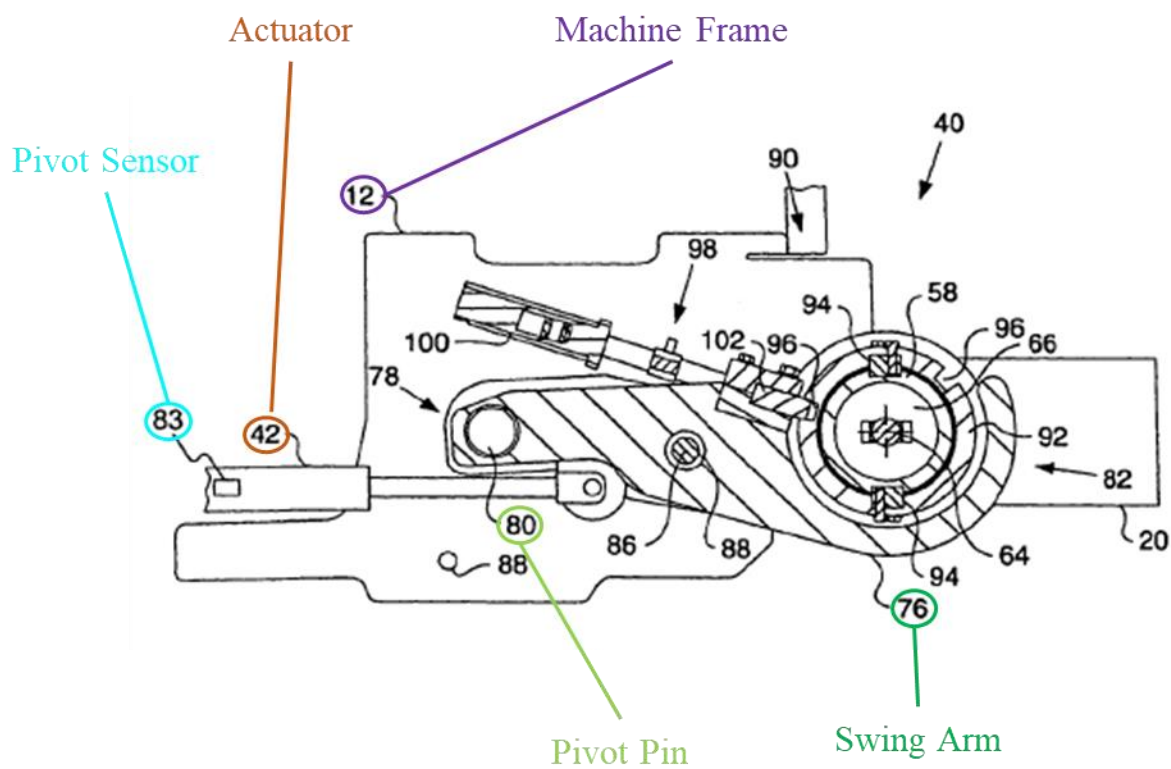
49. U.S. Patent No. 7,523,995 to Rio et al. (“Rio”; Ex. 1006) discloses a road-milling machine with a machine frame 12 supported by four ground engaging units (e.g., tracks). [Ex. 1006 (Rio), 1:5-7, 3:43-45, 3:48-49.] As shown below, support device 40, consisting primarily of swing arm 76 and lifting column 46, connects the ground engaging unit 20 to machine frame 12. [Ex. 1006 (Rio), 4:38-40, 4:51-53, 6:12-15.] Lifting column 46 has two hollow tubes (i.e., “inner tubular

member 58” and “outer tubular member 60”) that telescope relative to each other in response to an internal hydraulic “lifting column actuator 62” that extends and retracts. [Ex. 1006 (Rio), 5:32-53.] The extension/retraction of “lifting column actuator 62” raises and lowers the machine. [Ex. 1006 (Rio), 5:32-53.] Figure 2 of Rio shows these components:

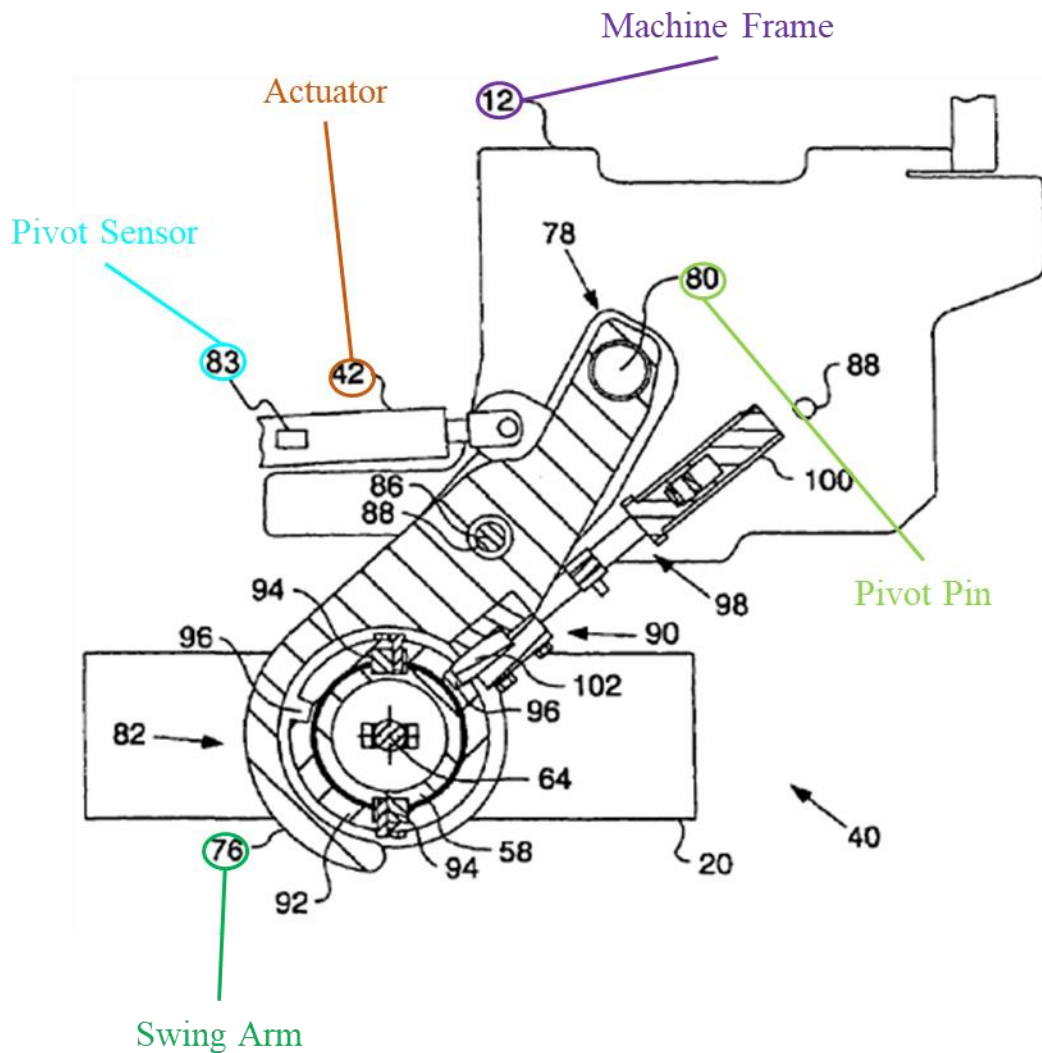


[Ex. 1006 (Rio), Fig. 2 (annotated).]

50. Rio further discloses a first actuator 42 that pivots swing arm 76 about pivot pin 80, moving ground engaging unit 20 between retracted and projecting positions (shown below in Figures 3 and 4, respectively). [Ex. 1006 (Rio), 6:19-22.] Second actuator 44 (shown at the top of the lifting column in the figure above) rotates ground engaging unit 20 about a vertical lifting column axis 48. [Ex. 1006 (Rio), 4:56-60, 6:4-6.] Actuators 42 and 44 may be linear actuators or rotary actuators such as “worm or sun gear designs.” [Ex. 1006 (Rio), 4:61-5:3.] Although Figure 2 shows the second actuator 44 at the top of the lifting column in a “typical embodiment,” Rio discloses “another of the preferred embodiments” in which “the second actuator 44 is positioned on the lifting column 46 . . . along the lifting column axis 48” in any position that “avoids problems caused by an accumulation of mechanical devices at a single location on the lifting column 46.” [Ex. 1006 (Rio), 4:53-60, 5:8-24.]



[Ex. 1006 (Rio), Fig. 3 (annotated).]



[Ex. 1006 (Rio), Fig. 4 (annotated).]

51. Rio discloses a rotation sensor 75 (shown in Figure 2 above) associated with actuator 44 that generates signal 124 “indicating the instantaneous rotation angle of the one ground engaging unit 20.” [Ex. 1006 (Rio), 7:23-27.] A pivot sensor 83 associated with actuator 42 or the swing arm 76 generates signal 122 “indicating the instantaneous angular position of the swing arm 76 relative to

the machine frame 12.” [Ex. 1006 (Rio), 7:19-23.] Controller 32 uses these signals to counter-rotate ground engaging unit 20 *while swing arm 76 pivots* so that the wheel/track “remain[s] parallel to the machine frame 12 at all points in the pivot arc.” [Ex. 1006 (Rio), 6:65-7:13, 8:31-55.] Therefore, Rio teaches the simultaneous arm swing and counter rotation of the ground engaging unit that is central to the claims of the ’318 patent.

3. Comparison of ’318 Patent Claims to ’749 patent Claims

52. The ’318 patent issued from a continuation application claiming priority to the ’749 patent, which was the subject of a prior IPR in which the Board found all claims unpatentable based on the same prior art asserted here. [See *Godbersen-Smith Const. Co. v. Guntert & Zimmerman Const. Div., Inc.*, IPR2020-01698, Paper 80 (Apr. 12, 2022) (“’749 FWD”).]

53. The table below shows how claims 1-8 of the ’318 patent contain substantively similar limitations to those found in claims 2, 4-6, 10-11, 14, 17-18, and 20 of the invalidated ’749 patent. For purposes of patentability, the claims of the ’318 patent do not meaningfully differ from the corresponding claims of the ’749 patent.

'318 Patent Claim Language	'749 Patent Claim Language
[1pre]: A swing leg assembly configured to be coupled to a paving machine configured to move in a paving direction for spreading, leveling, and finishing concrete into a form having a generally upwardly exposed, finished concrete surface and terminating in lateral concrete sides, the swing arm assembly comprising:	[17pre]: “A paving machine configured to move in a paving direction for laying concrete into a molded form, having a generally upwardly exposed concrete surface and terminating in lateral concrete sides, the paving machine comprising . . . two or more swing leg assemblies” [Ex. 1033, 23:54-24:2.]
[1A]: a swing leg configured to be coupled to the paving machine, and configured to pivot about a first axis to a first angular orientation relative to the paving machine;	[17C]: “a swing leg configured to mechanically couple with a surface of the module frame” [Ex. 1033, 24:4-5.] [17G]: “an angular orientation of the swing leg relative to the module frame” [Ex. 1033, 24:19-21.] [17I]: “pivotal motions of the swing leg about an upright pivot shaft” [Ex. 1033, 24:32-33.]
[1B]: a jacking column coupled to the swing leg;	[17E]: “an upright jacking column secured to the swing leg” [Ex. 1033, 24:7.]

[1C]: a crawler track rotatably coupled to the jacking column, wherein the crawler track is configured to rotate about a second axis to a second angular orientation relative to the jacking column;	[17D]: “a crawler track” [Ex. 1033, 24:6.] [17E]: “a rotary connection between the jacking column and the crawler track permitting relative rotational movements of the crawler track and the jacking column about a first upright axis” [Ex. 1033, 24:8-11.] [17F]: “an angular orientation of the crawler track relative to the jacking column” [Ex. 1033, 24:14-16.]
[1D]: a slew drive coupled to the jacking column and the crawler track, wherein the slew drive is configured to cause rotation of the crawler track relative to the jacking column;	[17H]: “a power drive between the jacking column and the crawler track, configured for translating relative rotational movements between the jacking column and the crawler track” [Ex. 1033, 24:22-25.] [11]: “the power drive comprises a slew gear drive” [Ex. 23:37-38.]

[1E]: a first sensor configured to emit a first signal corresponding to the first angular orientation;	[17G]: “a second angular position transducer between the swing leg and the module frame, configured to emit a second signal which is indicative of an angular orientation of the swing leg relative to the module frame” ³ [Ex. 1033, 24:17-21.]
[1F]: a second sensor configured to emit a second signal corresponding to the second angular orientation; and	[17F]: “a first angular position transducer between the jacking column and the crawler track, configured to emit a first signal which is indicative of an angular orientation of the crawler track relative to the jacking column” ⁴ [Ex. 1033, 24:12-16.]
[1G]: a processor configured to:	[17I]: “a processor operable to” [Ex. 1033, 24:26.]

³ Even though the '318 patent uses the term “first” and the '749 patent uses the term “second,” the first sensor and first signal of the '318 patent correspond to the second angular position transducer and second signal of the '749 patent.

⁴ Even though the '318 patent uses the term “second” and the '749 patent uses the term “first,” the second sensor and second signal of the '318 patent correspond to the first angular position transducer and first signal of the '749 patent.

[1G1]: receive the first signal from the first sensor, and the second signal from the second sensor;	[17I]: “receive the first and second signals” [Ex. 1033, 24:26-27.]
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[1G2]: determine a change of the first angular orientation based on the first signal;	In the '749 FWD, the Board found a much more complex term obvious over the same prior art used here. That more complex term contains the limitation here in [1G2] of the '318 patent. In the '749 FWD, when addressing [17I] (“a processor operable to receive the first and second signals and configured to emit a control signal for activating the power drive and thereby rotationally move the crawler track relative to the jacking column to maintain an orientation of the crawler track in response to changes of the first signal caused by pivotal motions of the swing leg about an upright pivot shaft”), [Ex. 1033, 24:26-33], the Board found that “CIII, as modified by Rio’s teachings of its control system, discloses the subject matter of the ‘processor’ limitation” based in part on Rio’s teaching that “controller 32 actuates first actuator 42 to move swing arm 76 and pivot sensor 83 tracks the movement” and that “controller 32 uses signals 122, 124 to maintain the track in the same running direction.” [’749 FWD, 67-68, 95-96.] This means that a change of the angular orientation of Rio’s swing arm relative to the frame (the '318 patent’s “first angular orientation”) is determined based on the corresponding signal 122 indicating the angular orientation of the swing arm relative to the frame (the '318 patent’s “first signal”) so that the corresponding change to the angular orientation of the crawler track can be made. Accordingly, the Board found
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	[1G2] of the '318 patent to be within the scope of [17I] of the '749 patent.
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[1G3]: in response to determining the change of the first angular orientation, determine a target second angular orientation based on the determined change of the first angular orientation and the second angular orientation based on the second signal; and	In the '749 FWD, the Board found a much more complex term obvious over the same prior art used here. That more complex term contains the limitation here in [1G3] of the '318 patent. In the '749 FWD, when addressing [17I] (“a processor operable to receive the first and second signals and configured to emit a control signal for activating the power drive and thereby rotationally move the crawler track relative to the jacking column to maintain an orientation of the crawler track in response to changes of the first signal caused by pivotal motions of the swing leg about an upright pivot shaft”), [Ex. 1033, 24:26-33], the Board found that “CIII, as modified by Rio’s teachings of its control system, discloses the subject matter of the ‘processor’ limitation” based in part on Rio’s teaching that “controller 32 actuates first actuator 42 to move swing arm 76 and pivot sensor 83 tracks the movement” and that “controller 32 uses signals 122, 124 to maintain the track in the same running direction.” [’749 FWD, 67-68, 95-96.] This means that, in response to determining the change of the angular orientation of Rio’s swing arm relative to the frame (the ’318 patent’s “first angular orientation”), a target angular orientation of Rio’s track relative to its lifting column (the ’318 patent’s “second angular orientation”) is determined based on the determined change of the angular orientation of Rio’s swing arm relative to the frame
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	(the '318 patent's "first angular orientation") and the angular orientation of Rio's track relative to its jacking column (the '318 patent's "second angular orientation") based on the corresponding signal 124 indicating the angular orientation of the track relative to the lifting column (the '318 patent's "second signal") so that the corresponding change to the angular orientation of the crawler track can be made. Accordingly, the Board found [1G3] of the '318 patent to be within the scope of [17I] of the '749 patent.
[1G4]: send a control signal to the slew drive in order to cause the second angular orientation of the crawler track to rotate to the target second angular orientation.	[17I]: "emit a control signal for activating the power drive and thereby rotationally move the crawler track relative to the jacking column to maintain an orientation of the crawler track" [Ex. 1033, 24:27-30.]
[2]: The swing leg assembly of claim 1, further comprising a hinge bracket arranged to be interposed between the swing leg and a surface of a module frame of the paving machine.	[2], [18A]: both, "a hinge bracket arranged to be interposed between the swing leg and the surface of the module frame" [Ex. 1033, 23:2-3, 24:36-37.]
[3]: The swing leg assembly of claim 2, further comprising a hydraulic actuator mounted between the hinge bracket and the swing leg, wherein the hydraulic actuator is configured to cause the swing leg to pivot relative to the module frame.	[4], [18C]: both, "a hydraulic actuator mounted between the hinge bracket and the swing leg, permitting the swing leg to pivot relative to the module frame" [Ex. 1033, 23:12-14, 24:45-47.]

[4]: The swing leg assembly of claim 2, wherein the hydraulic actuator is configured to be disengaged from at least one of the hinge bracket and the swing leg when the swing leg is positioned in a transport orientation.	[5], [18C]: both, “wherein the hydraulic actuator is configured to be disengaged from at least one of the hinge bracket and the swing leg when the swing leg is positioned in a transport orientation” [Ex. 1033, 23:15-18, 24:47-50.]
[5]: The swing leg assembly of claim 2, wherein the first sensor is positioned between the swing leg and the hinge bracket.	[6B]: “wherein the second angular position transducer is positioned between the swing leg and the hinge bracket” [Ex. 1033, 23:21-24.]
[6]: The swing leg assembly of claim 2, wherein the swing leg assembly is configured to be removably coupled to the module frame.	[14]: “wherein the swing leg assembly is removably coupled to the module frame” [Ex. 1033, 23:46-47.]
[7]: The swing leg assembly of claim 2, wherein the swing leg is configured to change orientation by up to 180° relative to the module frame.	[20]: “wherein the swing leg is configured to change orientation by up to 180° relative to the module frame” [Ex. 1033, 24:54-56.]
[8]: The swing leg assembly of claim 1, further comprising an angular crawler track adjuster for changing an angular, rotational inclination between the crawler track and the swing leg in a substantially horizontal plane.	[10]: “an angular crawler track adjuster for changing an angular, rotational inclination between the crawler track and the swing leg in a substantially horizontal plane” [Ex. 1033, 23:33-36.]

4. CIII and Rio Are Analogous Art

54. I understand that a prior art reference is analogous art if it is in the same field of endeavor as the patent or is reasonably pertinent to the particular problem faced by the inventor (even if it is not in the same field of endeavor as the patent). CIII and Rio are analogous art to the '318 patent. The '318 patent “concerns concrete slipform paving machines,” which is a form of road-construction machine, with swing-leg assemblies. [Ex. 1001, ('318 patent), 1:28-32, Abstract.] CIII and Rio are in the same field of endeavor as the '318 patent because they each describe swing-leg assemblies for road-construction machines. [Ex. 1001, Abstract, 1:28-32, Fig. 1; Ex. 1005 (CIII), 79-80, 209, 253; Ex. 1006 (Rio), 8:18-9:14; Fig. 2.] Additionally, both the '318 patent and CIII disclose concrete slipform paving machines. [Ex. 1001 ('318 patent), Fig. 1, 1:28-32; Ex. 1005 (CIII), 19, 240-249.]

55. Rio is also analogous art because it is reasonably pertinent to the problems the '318 patent purports to solve, namely, reducing the profile of the actuator used to rotate the crawler tracks and the “costly” and “time-consuming” processes associated with repositioning and controlling swing legs and crawler tracks on road-construction machines, which often required extensive manual intervention. [Ex. 1001 ('318 patent), 2:8-11, 4:20-36, 5:6-9; Ex. 1006 (Rio), 2:30-41.] Rio eliminated these hardships in the same way as the '318 patent—by using a

rotary actuator to rotate the crawler tracks and automating the positioning of swing legs and crawler tracks. [Ex. 1006 (Rio), 2:30-41, 4:61-5:7, 8:31-9:14, 9:37-42.]

5. Rationale for Combining CIII and Rio

56. A POSITA would have been motivated to combine CIII and Rio and would have had a reasonable expectation of success in doing so. The Board agreed with my opinion that this was the case in the '749 FWD.⁵ ['749 FWD, 40-63.] It would have been obvious to use Rio's rotary actuator instead of CIII's steering cylinder to rotate each crawler track and to incorporate Rio's teaching of a control system that maintains the track in a desired orientation as the corresponding swing leg pivots. As I explain below, a POSITA would have been motivated to make this combination for various reasons, including greater rotational range of motion of the crawler track, improving maneuverability of the paver, reducing the amount of time needed to adjust the positions of the swing legs and crawler tracks and to set up the steering system, to eliminate bulky linkages, to simplify the jacking-column design, to improve the maintenance of the jacking column, and to automate the rotation of the swing leg and crawler track.

⁵ Throughout my declaration, each time I discuss what the Board previously found in the '749 FWD and cite to that decision, I am indicating that I agree with those findings.

57. A POSITA would have been motivated to modify CIII by replacing each steering cylinder with Rio's rotary actuator 44 (e.g., worm-gear design). A POSITA would have recognized that a rotary actuator would give the crawler track greater rotational range of motion than CIII's steering cylinder. [U.S. Patent No. 4,029,165 ("Miller"; Ex. 1008), 2:51-53, 7:36-60, Fig. 7 (disclosing a rotary actuator for 360° steering); U.S. Patent Publication No. 2010/0181136 ("Swasey"; Ex. 1013), ¶¶ [0041], [0044] (disclosing worm-gear rotary actuator that can "be turned either clockwise or counterclockwise, in full circles," while simultaneously "bearing a very large load and providing a significant amount of torque").] For example, Rio discloses that the rotary actuator and sensors allow the crawler track to rotate more than 120° between the retracted and projecting positions and be independently steered in each position. [Ex. 1006 (Rio), 9:37-42, Figs. 3-4.] Greater range of motion would have led to greater maneuverability of the paver, faster adjustments in crawler-track position, and fewer risks to the safety of the operators.

58. A POSITA would have been motivated to provide these benefits of Rio to eliminate CIII's manual adjustments required to "center the stroke of the steer cylinder" after "adjusting the swinging legs." [Ex. 1005 (CIII), 209.] This centering the stroke requires supporting the frame, lowering the frame onto the support to take the weight off the track, removing four bolts from the track yoke,

extending/retracting the steer cylinder to the desired position, turning the track on the center spindle bolt to face straight ahead, and reattaching the track yoke via the bolts. [Ex. 1005 (CIII), 209.] Eliminating the need for these manual adjustments greatly reduces the risk that an accident might occur due to operator error during the adjustment process.

59. A POSITA would have further been motivated to implement Rio's rotary actuator to provide "a compact apparatus" with high torque that achieves "fine rotary steering control" and provides "rotary motion without the need for complicated and bulky linkages." [Ex. 1006 (Rio), 4:66-5:7.] CIII's steering cylinder assembly is the type of "bulky linkage[]" for which Rio provides a solution. [Ex. 1005 (CIII), 408.] Rotary actuators were well known before the '318 patent and were commonly used to rotate wheel and track assemblies, as disclosed in Rio, U.S. Patent No. 4,558,758 ("Littman"; Ex. 1007), Miller, U.S. Patent Publication No. 2003/0173130 ("Johns"; Ex. 1009), GT-3200 Trimmer/Slipform Paver ("GT-3200"; Ex. 1010), and U.S. Patent No. 5,127,335 ("Whitaker"; Ex. 1011). [Ex. 1007 (Littman), 3:31-5:52; Ex. 1008 (Miller), 2:51-53, 7:36-60, Fig. 7; Ex. 1009 (Johns), ¶ [0020], Fig. 2; Ex. 1010 (GT-3200), 3; Ex. 1011 (Whitaker), 4:7-16, Fig. 3.]

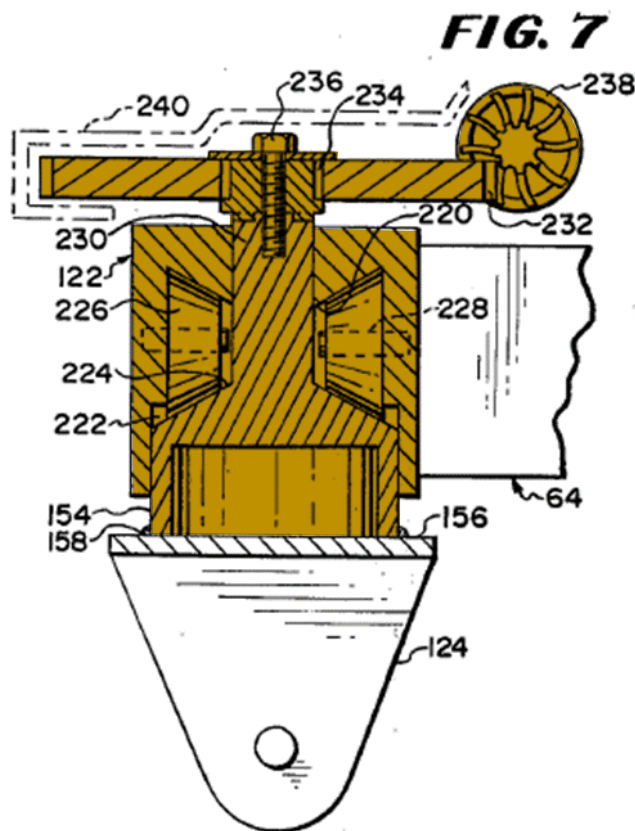
60. Both Rio and CIII disclose a sensor that measures the angular position of the crawler tracks and a controller that rotates the crawler tracks based on the

receipt of multiple signals. [Ex. 1005 (CIII), 407-408; Ex. 1006 (Rio), 6:6-11, 8:39-47, 9:37-42.] Combining aspects of these swing-leg assemblies would have involved substituting one known element for another according to known methods to yield predictable results.

61. Given Rio's disclosure that rotary actuator 44 can be a worm-gear design and that rotary actuator 44 can be "positioned on the lifting column 46" anywhere "along the lifting column axis 48," a POSITA would have known to mount Rio's rotary actuator 44 at the bottom of CIII's jacking column between the jacking column and crawler track. [Ex. 1006 (Rio), 5:8-11.] At a minimum, such a design would have been an obvious design choice. Given the finite number of places to mount a rotary actuator with a worm-gear design "along the lifting column axis 48," a POSITA would have been motivated to try positioning the rotary actuator between the jacking column and crawler track. [Ex. 1006 (Rio), 5:8-11.]

62. A POSITA would have already been aware of such a design and the maneuverability that it provides. For example, Miller discloses a similar rotary actuator comprising a "driven gear 232," a "drive pinion gear 238 [that] engages the driven gear 232," and a steering spindle (housing) 122 that transfers rotational torque from driven gear 232 to the crawler track. [Ex. 1008 (Miller), 7:35-53, Fig. 7.] These components of the rotary actuator are highlighted in gold below in

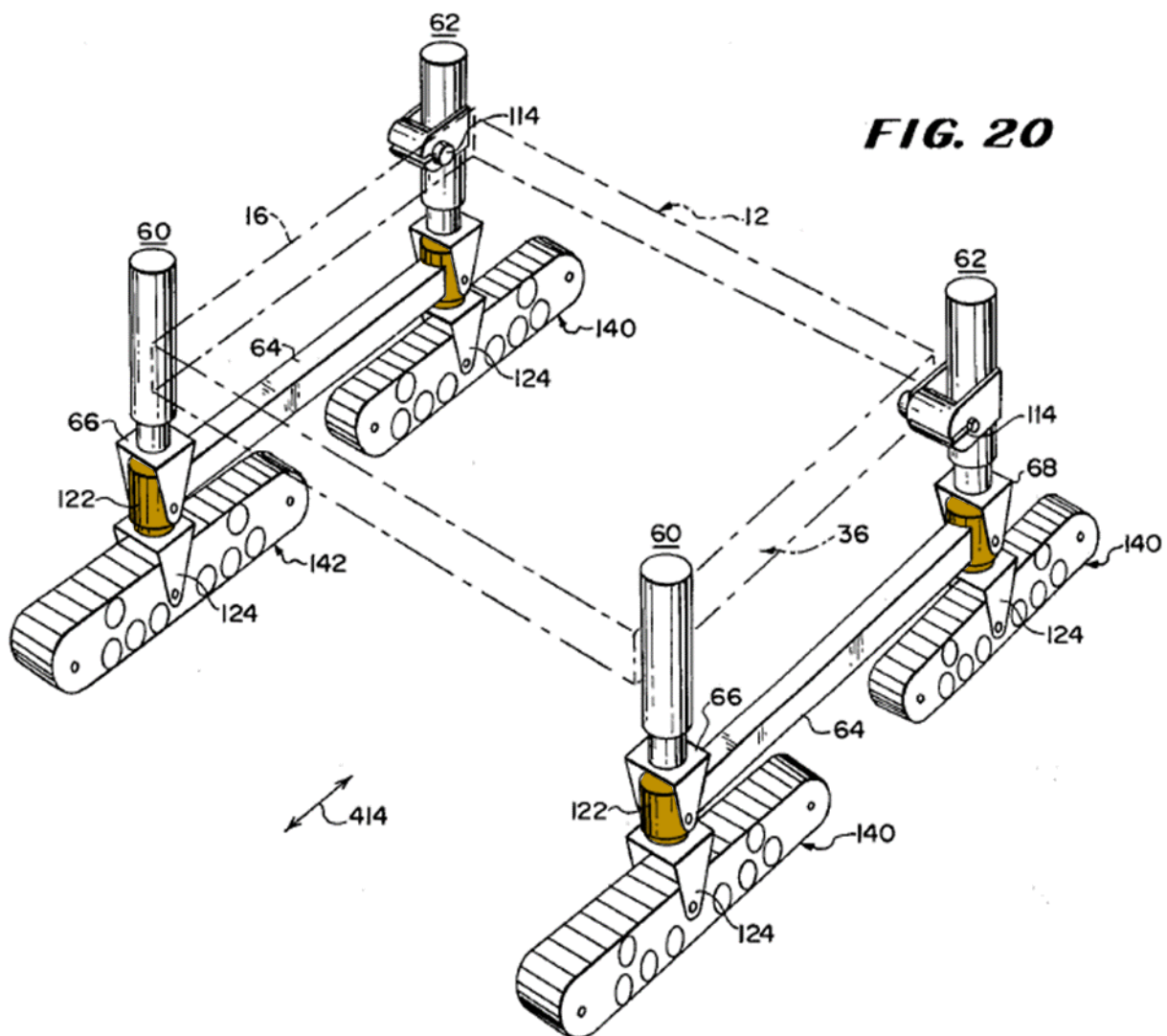
Figure 7. Miller's rotary actuator also includes a "drive motor," not pictured," that "would be mounted on a non-turning part such as the walking beam 64." [Ex. 1008 (Miller), 7:48-51.] Actuation of the drive motor creates rotational torque through the drive pinion gear 238, driven gear 232, and the vertical spindle 230 within steering spindle (housing) 122 that causes the crawler track to rotate.



[Ex. 1008 (Miller), Fig. 7 (annotated).]

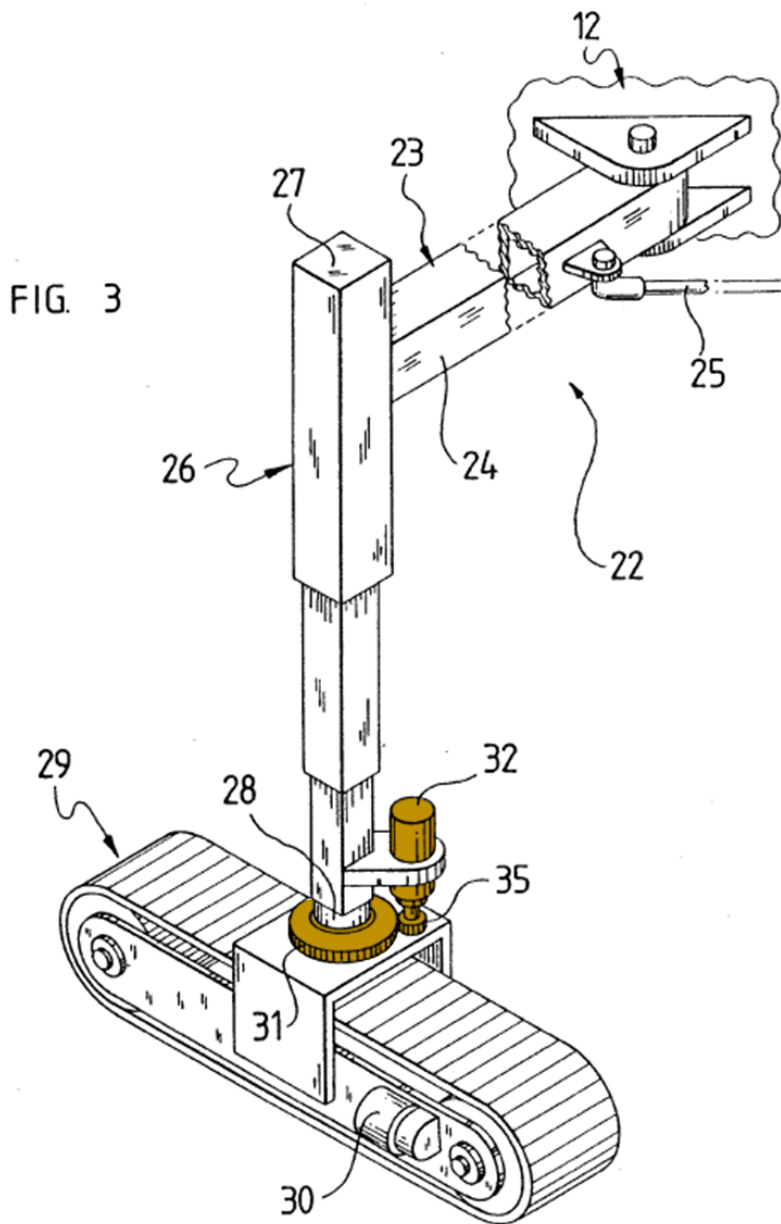
63. As can be seen in the embodiment from Miller depicted below in annotated Figure 20 (among others), Miller discloses that this rotary actuator is positioned between the bottom of the jacking column (adjustable or extendable

support means 60 and 62) and the top of the crawler tracks (tractors 140). Though not pictured in the large-scale view of Figure 20, a POSITA would have understood from Figure 7 that the drive pinion gear 238 and driven gear 232 would again be positioned immediately above the steering spindles (housings) 122, shown highlighted below in gold, as they were in Figure 7 above.



[Ex. 1008 (Miller), Fig. 20 (annotated).]

64. Similarly, Whitaker discloses “a ring gear 31 affixed to the tracked conveyor 29 and rotatively mounted to the lower end” of a jacking column’s lower guide tube and rotated “about a vertical axis” via a steering motor 32 and pinion gear 35. [Ex. 1011 (Whitaker), 4:7-16, Fig. 3.] The rotary actuator components comprising the steering motor 32, pinion gear 35, and ring gear 31 are highlighted in gold in Figure 3, below. As can be seen in this figure, Whitaker’s ring gear 31 is positioned between the bottom of the jacking column (fluid operated downwardly extendible telescopic shaft 26 having an upper end 27 mounted to the free end 24 of the arm 23 and a lower end 28) and the top of the crawler track (tracked conveyor 29), with the steering motor 32 and pinion gear 35 off to the side. [Ex. 1011 (Whitaker), 3:63-4:16.]

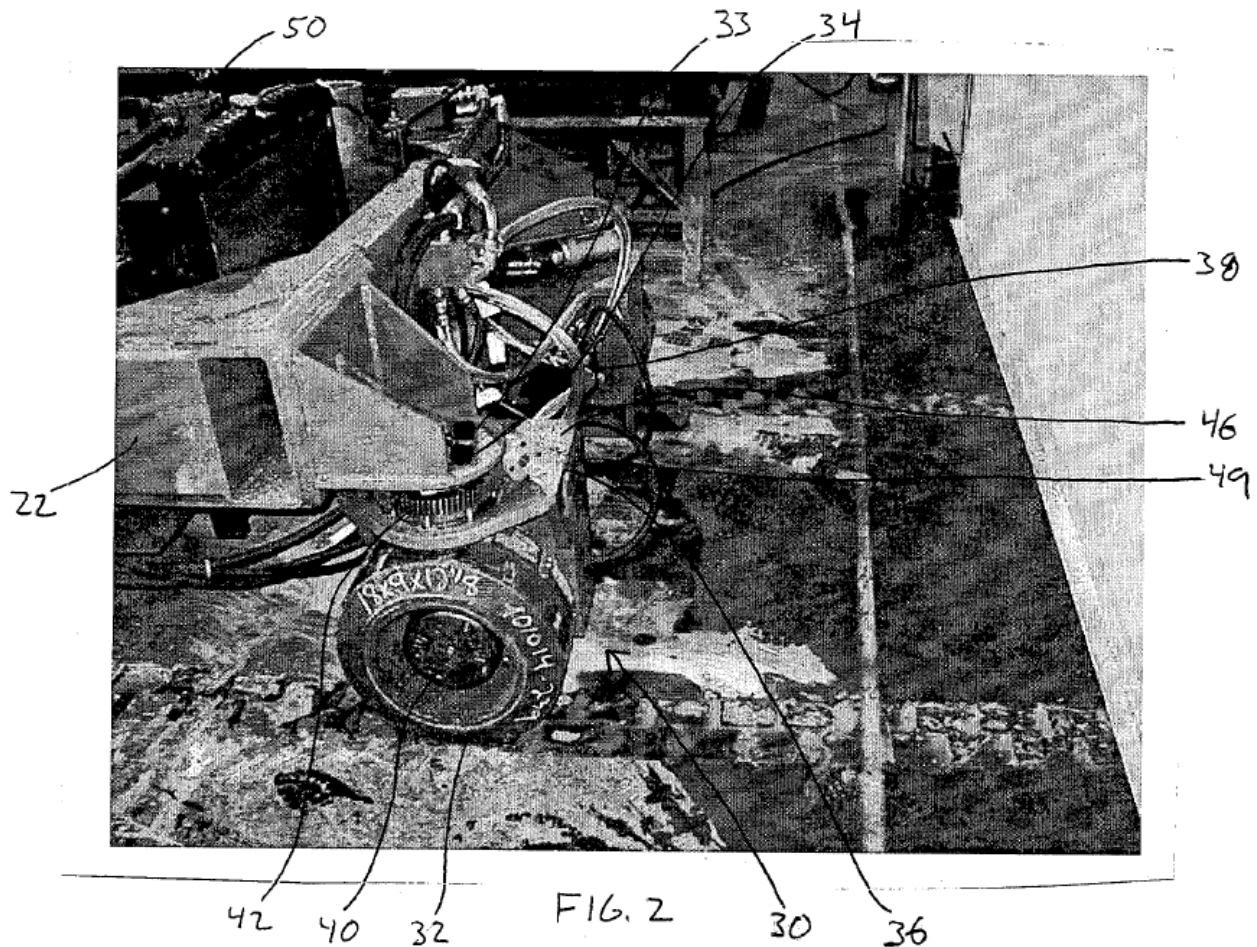


[Ex. 1011 (Whitaker), Fig. 3 (annotated).]

65. Johns similarly discloses a “slew drive 42” positioned between a wheel bracket 36 and a chassis 22 that supports heavy components such as “an engine” and “boom assembly 70,” the slew drive “allow[ing] the wheel bracket 36 to be rotated about a vertical axis through 180 degrees of motion, thus, allowing

steering of the wheel 32.” [Ex. 1009 (Johns), ¶¶ [0005], [0019]-[0020], Fig. 2.]

This is depicted in Figure 2 of Johns, below.



[Ex. 1009 (Johns), Fig. 2.]

66. Littman likewise discloses another example of a rotary actuator similarly positioned. [Ex. 1007 (Littman), 5:14-59, Figs. 4-5 (disclosing rotary actuator 122 for wheels 90 at bottom of second section 70).]

67. And Swasey similarly discloses a worm-gear rotary actuator that “enables a large load to be placed directly on top of the unit 10 for omnidirectional

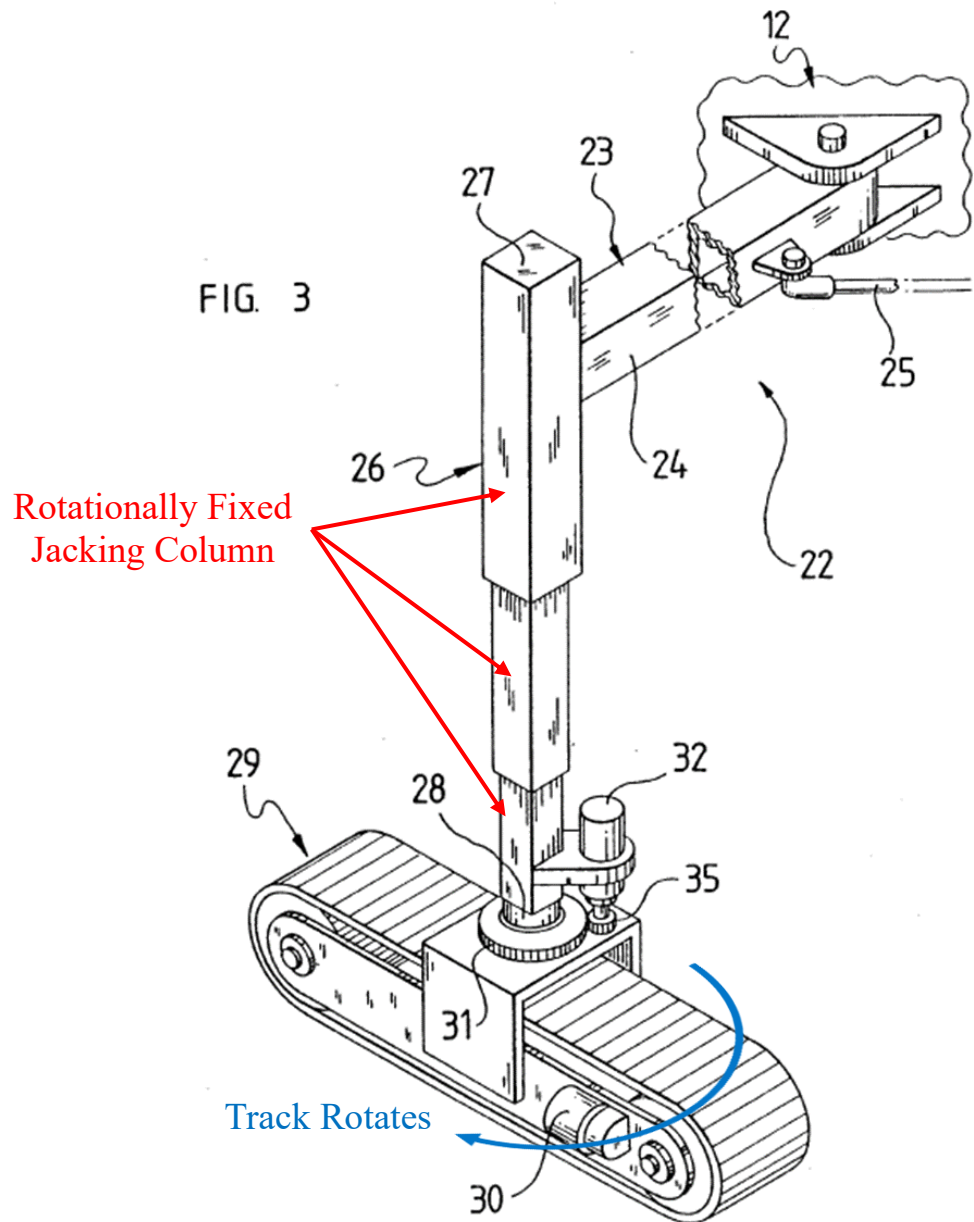
movement of the load without altering the orientation of the load relative to the unit 10,” further motivating a POSITA to position the rotary actuator between the jacking column’s lower guide tube and the crawler track. [Ex. 1013 (Swasey), ¶¶ [0041], [0044]-[0045].]

68. A POSITA would have been motivated to mount Rio’s rotary actuator with a worm-gear design in this way because it would have simplified CIII’s jacking column design, as the guide tubes would no longer need to rotate relative to the outer cylinder. For example, this design would have allowed a POSITA to eliminate the required rotational relationship between the outer cylinder and upper guide tube.

69. To provide for this simpler design, it would have been routine and obvious to combine the outer cylinder and upper guide tube into one unitary component that allows the lower guide tube to telescope vertically, and then connect the rotary actuator to the bottom of the lower guide tube, allowing only the components below the jacking column, including the crawler tracks, to rotate. Such a configuration would have been advantageous because it would have reduced the number of components to manufacture.

70. A POSITA would have been aware of such designs, for example, from references like Whitaker, the jacking column of which is depicted above in Figure 3. [Ex. 1011 (Whitaker), 3:65-4:16, Fig. 3.] The annotated version of

Whitaker Fig. 3 below clarifies how the telescoping jacking column remains rotational fixed as the rotary actuator turns the crawler track.



[Ex. 1011 (Whitaker), Fig. 3 (annotated).]

71. As another example, GT-3200 discloses a jacking column where the upper and lower guide tubes are rotationally fixed and a rotary actuator turns the track relative to the entire jacking column. [Ex. 1010 (GT-3200), 3.]

72. As another way to provide for this simpler design, it would have been routine and obvious to fix the upper guide tube to the nonrotatable outer cylinder, meaning each component of the jacking column is fixed rotationally, and then connect the rotary actuator to the bottom of the lower guide tube, allowing only the components below the jacking column, including the crawler tracks, to rotate. For example, a POSITA would have known to use a simple bracket (e.g., at the top or bottom of the outer cylinder). A POSITA would have understood that there were any number of known ways to fix the upper guide tube rotationally to the outer cylinder at the top, bottom, and/or anywhere in the middle of the outer cylinder, including the use of a key and keyway arrangement. [Ex. 1006 (Rio), 5:63-6:7.] Due to the geometry of the guide tubes, fixing the upper guide tube to the outer cylinder would have permitted the lower guide tube to telescope in and out of the upper guide tube but prevent it from rotating relative to the outer cylinder. This is evidenced by (1) the rectangular cross-sections of the upper and lower guide tubes and (2) the fact that one end of the steering cylinder is attached to the upper guide tube so that it can rotate the lower guide tube without preventing the lower guide tube from telescoping. [Ex. 1005 (CIII), 165, 173-175, 193, 195.]

73. Alternatively, a POSITA would have known to use a key and keyway design between the lower guide tube and the upper guide tube, which would have precluded the lower guide tube from rotating while allowing it to telescope into and out of the outer cylinder. Rio discloses a key and keyway design for this very purpose in its lifting column. [Ex. 1006 (Rio), 5:63-6:2 (explaining that “cylinder 66” and “inner tubular member 58” are “engaged” by “a pair of keys 74 fitted into corresponding longitudinal keyways” and that “[t]his key and keyway arrangement permits linear sliding movement between the inner tubular member 58 and the cylinder 66 while preventing rotational movement between these components”).]

74. A design where each component of the jacking column is fixed rotationally would have been desirable, as relative movement between parts can create wear, leading to other problems, including loose connections and “vibration of the machine.” [U.S. Patent No. 3,792,745 (“Files”; Ex. 1012), 1:13-17.] This design also would have improved the maintenance of the jacking column by eliminating the relative rotation between the upper guide tube and outer cylinder and reduced the power needed to rotate the actuator because no portion of the jacking column would need to rotate. In view of these benefits and the existence of similar designs in Miller, Whitaker, Johns, Littman, and GT-3200, a POSITA would have known that positioning the rotary actuator below the bottom of the

jacking column and above the crawler track was a simple and obvious design choice.

75. CIII discloses time-consuming manual adjustments for repositioning the swing legs and crawler tracks. In the three-track configuration, CIII discloses supporting the frame, raising the track off the ground, removing a first locking pin and swinging the leg to the desired position, reinserting the first locking pin, removing a second locking pin and rotating the jacking column and crawler track to the desired position, reinserting the second locking pin, and recalibrating the turn limits of the crawler track. [Ex. 1005 (CIII), 79-80, 193-195.] CIII discloses similar adjustments for the four-track configuration that involve removing or manually adjusting turnbuckles on each of the four swing legs and then manually calibrating the steering cylinders for each of the four crawler tracks, which requires setting the left turn limit, the center, and the right turn limit for each steering cylinder. [Ex. 1005 (CIII), 193-195, 209-211, 253.] A POSITA would have recognized that requiring manual adjustments to heavy machinery like CIII's swing legs risks the safety of operators, as well as damage to the machine and work site. When discussing the three-track configuration, CIII warns of a serious risk that "THE MACHINE MAY TIP OVER TO THE LEFT," if the legs are not positioned correctly when the swing leg is pivoted. [Ex. 1005 (CIII), 80.] A POSITA would have also recognized that these manual adjustments add cost and

time to paving operations. Accordingly, a POSITA would have been motivated to eliminate the manual adjustments described above.

76. Rio solves these adjustment problems. Its control system includes controller 32 that receives signals from pivot sensor 83 and rotation sensor 75 and counter-rotates the track so it remains oriented in a particular direction even as actuator 42 pivots the swing leg. [Ex. 1006 (Rio), 6:65-66, 7:11-13, 8:31-59.] Rio discloses steering the tracks both before and after swing-leg movements without the need for manual recalibration of the track position. [Ex. 1006 (Rio), 8:31-9:42.] A POSITA would have been motivated to implement Rio's control system in the CIII machine to automate rotation of the swing leg and the crawler track, eliminating the manual adjustments described in CIII above. CIII already discloses a feedback system like Rio's for steering the slipform paver, where a controller receives signals from a steering sensor and a feedback pot and rotates the tracks to a desired position based on those signals. [Ex. 1005 (CIII), 407-408.] A POSITA would have thus found it obvious to use the feedback system described in Rio to simultaneously control the angles of the swing legs and crawler tracks in the CIII machine.

77. In view of modifying CIII's leg assemblies to include a rotary actuator, a POSITA would have found it obvious to implement Rio's rotation sensor to measure the rotation of the crawler track relative to the jacking column.

[Ex. 1006 (Rio), 6:6-11.] This would have been a routine substitution of one known sensor for another—CIII already discloses using a sensor (i.e., CIII’s feedback pot) to measure rotation of the crawler track relative to the outer cylinder of the jacking column. Moreover, Rio discloses that rotation sensor 75 can be “associated with” any “rotating component” driven by rotary actuator 44, which includes the crawler track. [Ex. 1006 (Rio), 6:6-11.] Indeed, it was well known to position a rotation sensor at the bottom of a jacking column and use it to sense rotation of the crawler track. [Ex. 1007 (Littman), 5:34-42, 6:12-26, Figs. 4-6 (disclosing synchro 130 at the bottom of second section 70 for sensing angle of wheels 90); Ex. 1008 (Miller), 12:23-46, Fig. 3 (disclosing sensor 506 below extendable support means 62, above tractor 140, and off to the side); Ex. 1009 (Johns), ¶ [0021] (disclosing positional reader 34 attached to steering shaft 33 of wheel 32).]

78. A POSITA would have further known from Rio to implement pivot sensor 83 either as a rotary encoder associated with the shaft about which CIII’s swing leg pivots or as a linear sensor associated with a linear actuator for pivoting the swing leg. [Ex. 1006 (Rio), 6:22-26; Ex. 1005 (CIII), 79, 85.] The swing leg’s pivot sensor and the crawler track’s rotation sensor would have allowed CIII’s controller to determine the angle of the crawler tracks relative to the frame

regardless of the location of the swing leg. [Ex. 1006 (Rio), 8:31-59, 9:15-21; Ex. 1005 (CIII), 407-408.]

79. In view of implementing Rio's control system in CIII, a POSITA would have been motivated to further implement a hydraulic actuator, such as CIII's swing cylinder or Rio's rotary or linear actuator, allowing an operator to pivot each swing leg about a vertical axis. The use of a hydraulic actuator to pivot each of four swing legs was well known in the art. [Ex. 1011 (Whitaker), 3:56-64, Figs. 1, 3 (disclosing that, for each of four swing legs (arms 23), "a fluid operated piston and rod assembly 25 mounted to said box frame 12 and said arm 23" is used to mechanically pivot the arm 23).] A POSITA would have known that implementing Rio's control system and a hydraulic actuator for pivoting each swing leg would have allowed an operator to automatically orient the associated crawler track in the paving direction or another desired direction without needing to rotate the swing leg and crawler track in separate steps or recalibrate the crawler tracks. [Ex. 1005 (CIII), 34, 79-80, 253-254; Ex. 1006 (Rio), 4:40-44, 4:61-5:7.] It would have been obvious to substitute CIII's locking pin (when using CIII's hinge bracket) or CIII's turnbuckles for Rio's automatic anti-swing device 84 to fully automate the rotation of the swing leg "for the convenience of the operator." [Ex. 1006 (Rio), 6:27-37, 8:21-30; Ex. 1005 (CIII), 79-80.] A POSITA would have known that modifying CIII with Rio, as described, would provide manufacturing

and operational cost savings, as well as improve the safety of the machine. A POSITA would have known from Rio that implementing Rio's automatic anti-swing device 84 would permit pivotal movement of the swing legs when desired and would lock the swing legs "against unintentional pivotal movement" relative to the frame when wanting to maintain the same swing-leg orientation. [Ex. 1006 (Rio), 6:27-37.]

80. Though not required by the claims, a POSITA would have understood that combining CIII and Rio to implement Rio's rotary actuator and control system, as described above, would have allowed the swing legs to pivot and the crawler tracks to rotate while the paving machine is moving and under load. For example, Littman discloses modes in which a wheel is "positioned perpendicular to the stabilizer legs so as to allow the legs to pivot while the legs are on the ground supporting the prime mover and its load." [Ex. 1007 (Littman), 9:61-64.] Similarly, U.S. Patent No. 3,572,458 to Tax ("Tax"; Ex. 1016) discloses narrowing the "track width" by angling the wheels inward so that, when the vehicle "is moved forward," the four swing legs "are swung toward the median longitudinal plane of the carriage by friction between the wheels and the ground on which the wheels roll while supporting the carriage." [Ex. 1016 (Tax), 5:1-27, Figs. 7a-7c.] In the CIII-Rio modified paving machine, a POSITA would have understood from the state of the art, like Littman and Tax, that such a technique for pivoting the swing legs and

rotating the crawler tracks while moving and under load would have been available, for example, to avoid obstacles or to change the track width. For example, CIII discloses that each crawler track can be individually steered and each jacking column and crawler track can be individually relocated. [Ex. 1005 (CIII), 32, 34, 38-39.] Accordingly, this modified paving machine would have allowed the operator to individually steer the crawler tracks at an angle to pivot the swing legs and while the machine was moving.

81. A POSITA would have had a reasonable expectation of success in combining CIII and Rio as described herein. Implementing Rio's actuators and control system on the CIII machine would have constituted nothing more than a combination of well-known prior-art elements according to known methods to yield predictable results. Rio's actuators and control system already successfully allowed an operator to move a swing leg while orienting the associated crawler track in the travel direction. Additionally, a POSITA would have reasonably expected from Rio's teachings about steering and the use of similar designs known in the prior art that the design may be implemented as described above with a rotary actuator having sufficient torque. And while a POSITA would have reasonably expected that Rio's rotary actuators with a worm-gear design would support the necessary weight when positioned between the jacking column and crawler track, [see Ex. 1009 (Johns), ¶ [0020], Fig. 2; Ex. 1008 (Miller), 7:35-53,

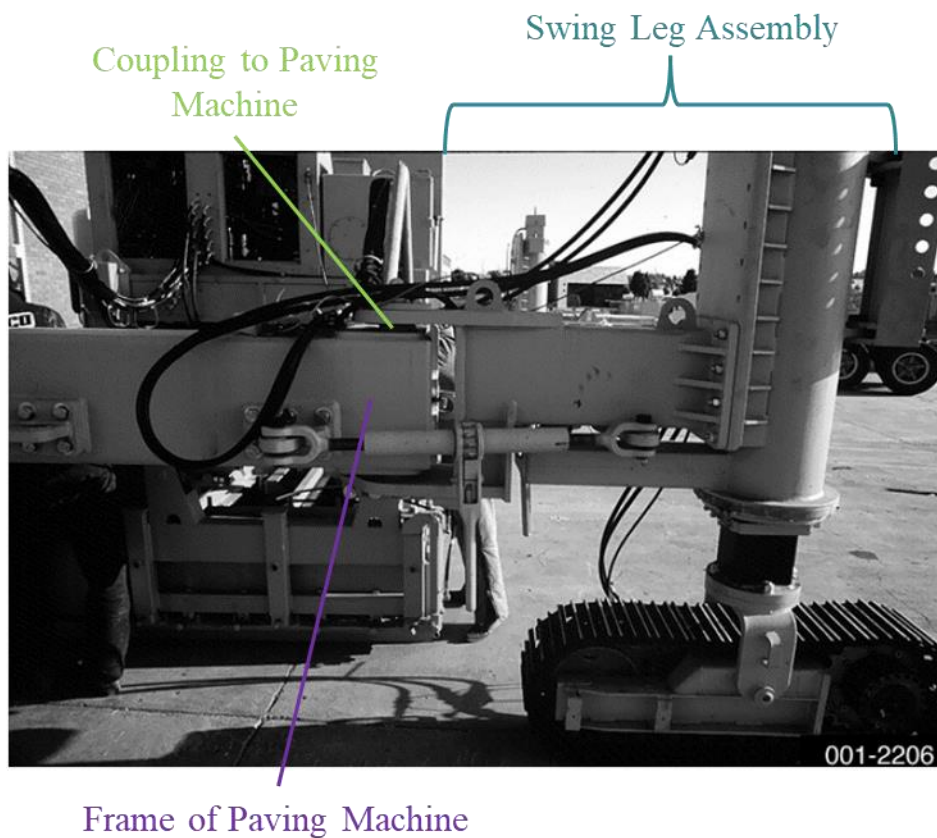
Fig. 20; Ex. 1011 (Whitaker), 4:1-16, Figs. 1, 3; Ex. 1013 (Swasey), ¶¶ [0041], [0044]-[0045] (disclosing a rotary actuator with a worm-gear design, like Rio, that includes the ability to “drive and steer simultaneously . . . while bearing a very large load and providing a significant amount of torque relative to the overall size of the unit”)], a POSITA would have known how to design a housing for the rotary actuator to help support the weight, if desired. Thus, a POSITA would have recognized that Rio’s actuators and control system when implemented on CIII’s paver would function in the same manner as they functioned on Rio’s machine.

6. Independent Claim 1

- a. **[1pre]: “A swing leg assembly configured to be coupled to a paving machine configured to move in a paving direction for spreading, leveling, and finishing concrete into a form having a generally upwardly exposed, finished concrete surface and terminating in lateral concrete sides, the swing arm assembly comprising:”**

82. Generally, the ’318 patent describes and claims a paving machine with one or more swing legs. If the preamble is limiting, CIII discloses its features. The Board found that CIII discloses a substantially similar limitation in claim 17 of the ’749 patent. [Ex. 1033, 23:54-24:2 (“A paving machine configured to move in a paving direction for laying concrete into a molded form, having a generally upwardly exposed concrete surface and terminating in lateral concrete sides, the paving machine comprising[] . . . two or more swing leg assemblies”); ’749 FWD,

95-96.] CIII discloses a four-track configuration that includes four swing-leg assemblies configured to be coupled to a paving machine. [Ex. 1005 (CIII), 204-206, 209, 253-254, 265.] CIII discloses these swing-leg assemblies coupled to the paving machine in the images below:



[Ex. 1005 (CIII), 209 (annotated).]

Coupling to Paving
Machine

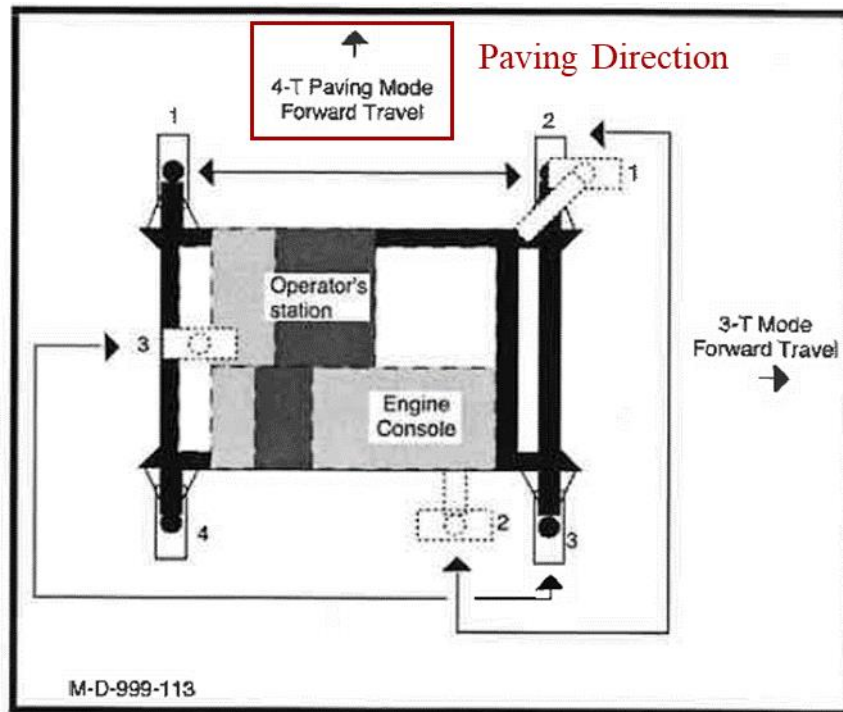
Swing Leg Assembly



Frame of Paving Machine

[Ex. 1005 (CIII), 265 (annotated).]

83. CIII discloses a “Paving Mode” for the four-track configuration in which the paving machine moves in a paving direction indicated by the “Forward Travel” arrow in the image below. [Ex. 1005 (CIII), 204.]



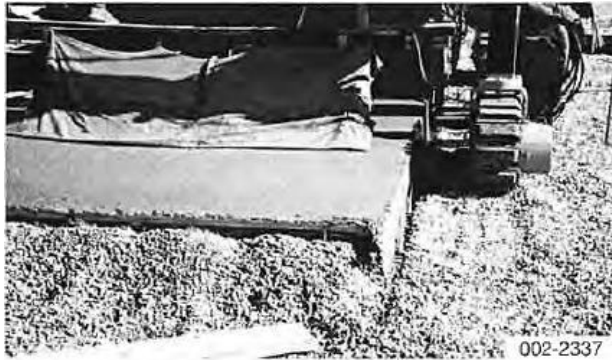
[Ex. 1005 (CIII), 204 (annotated top-down view).]

In this mode, an auger attached to the paving machine spreads concrete placed in front of the paving machine “evenly across the width of the paving mold” that is “mounted to the machine frame.” [Ex. 1005 (CIII), 199, 211, 240-242.] Such an operation is shown below.



[Ex. 1005 (CIII), 242 (annotated).]

As the paving machine moves in the paving direction, it levels and finishes the concrete into a form having a generally upwardly exposed, finished concrete surface and terminating in lateral concrete sides, as shown below. [Ex. 1005 (CIII), 241-245.]



Finish concrete around header

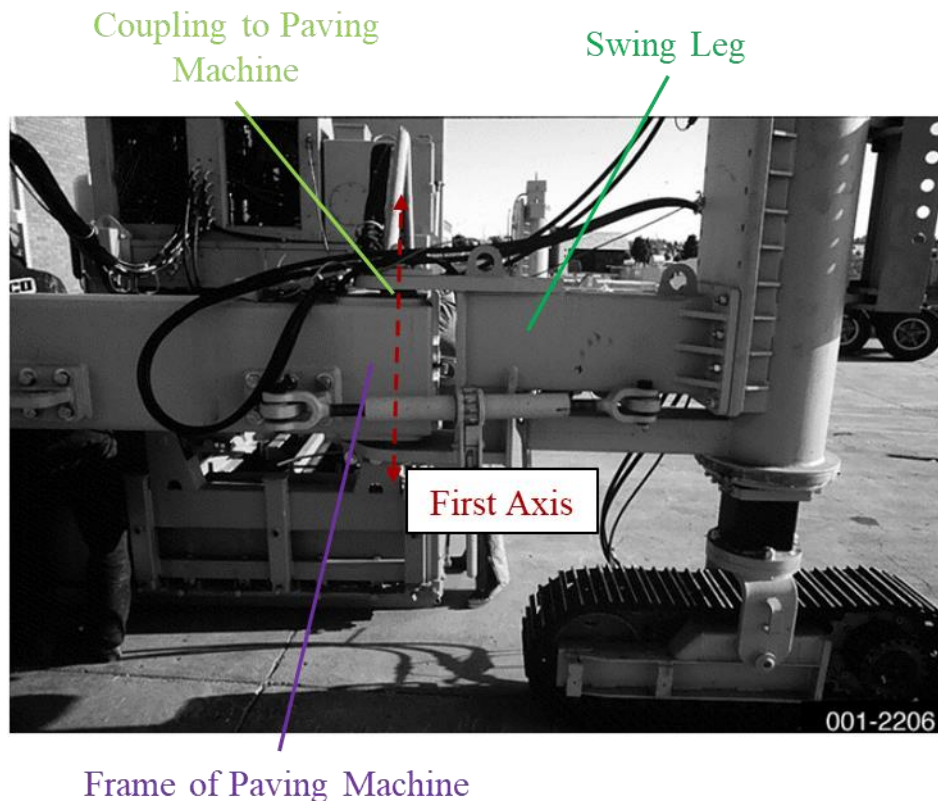


Check concrete grade

[Ex. 1005 (CIII), 241 (left), 243 (right).]

- b. **[1A]: “a swing leg configured to be coupled to the paving machine, and configured to pivot about a first axis to a first angular orientation relative to the paving machine;”**

84. CIII discloses this feature. The Board previously found that CIII discloses a similar limitation of the '749 patent. [Ex. 1033, 24:4-5 (“a swing leg configured to mechanically couple with a surface of the module frame”), 24:19-21 (“an angular orientation of the swing leg relative to the module frame”), 24:32-33 (“pivotal motions of the swing leg about an upright pivot shaft”); '749 FWD, 64, 66-68, 95-96.] CIII discloses four swing legs that are coupled to the paving machine in its four-track configuration, one of which is shown in the image below. [Ex. 1005 (CIII), 204-206, 209, 253-254, 265.]



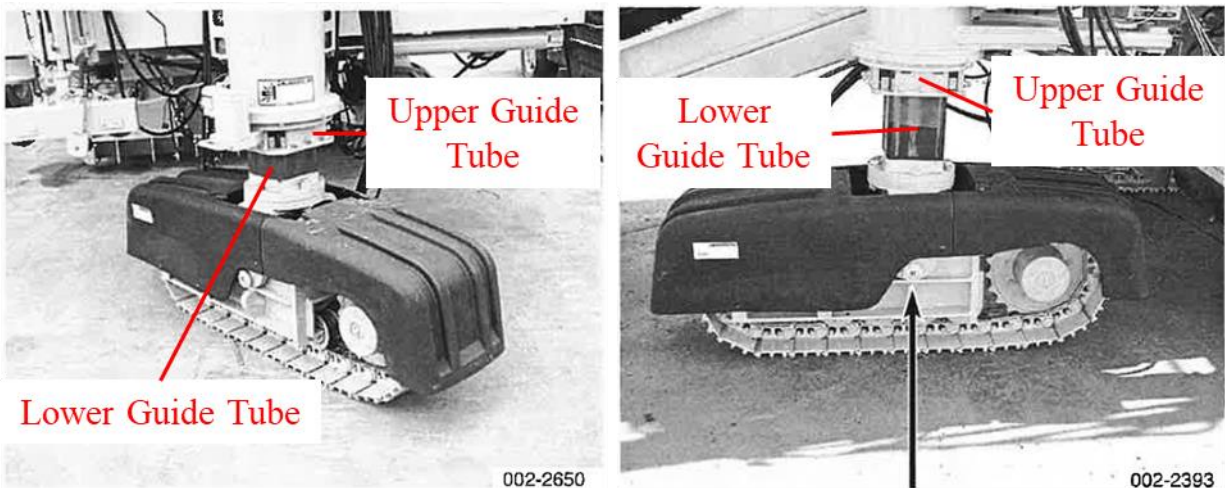
[Ex. 1005 (CIII), 209 (annotated).]

Each swing leg pivots about a first axis (labeled above) to a first angular orientation relative to the paving machine. For example, CIII discloses “[s]wing[ing] the swinging legs into position and attach[ing] the turnbuckles on either side of each leg,” adjusting the angular orientation of each swing leg “to the left or right of an in-line position with the end frames to bypass obstacles or for narrow clearances” by loosening or tightening the turnbuckles, and adjusting the angular orientation of each swing leg to change from the paving mode to the

transport mode by removing the turnbuckles and pivoting each leg “around to the end of the 4-track frame” about its axis. [Ex. 1005 (CIII), 209, 253-254.]

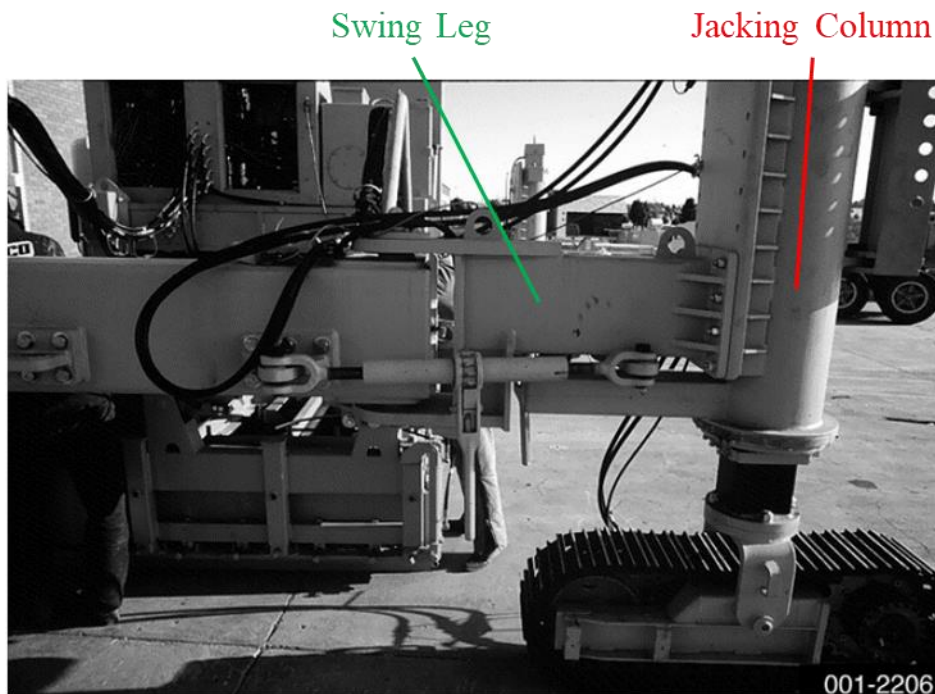
c. [1B]: “a jacking column coupled to the swing leg;”

85. CIII discloses this feature. The Board previously found that CIII discloses a similar limitation of the '749 patent. [Ex. 1033, 24:7 (“an upright jacking column secured to the swing leg”); '749 FWD, 64-65, 95-96.] CIII discloses a jacking column that can raise/lower the crawler track or the machine frame. [Ex. 1005 (CIII), 38-39, 44, 74, 79.] As shown below, the jacking column includes a lower guide tube that telescopes in and out of an upper guide tube. [Ex. 1005 (CIII), 79, 173; *supra* Section VII.A.1 (Summary of CIII).]



[Ex. 1005 (CIII), 193, 175 (showing lower guide tube telescoped at different heights).]

86. CIII discloses that the same jacking columns are used in both the three-track and four-track configurations, with the jacking columns coupled to the swing legs in the four-track configuration, as shown in the image below. [Ex. 1005 (CIII), 204-206, 209, 265.]

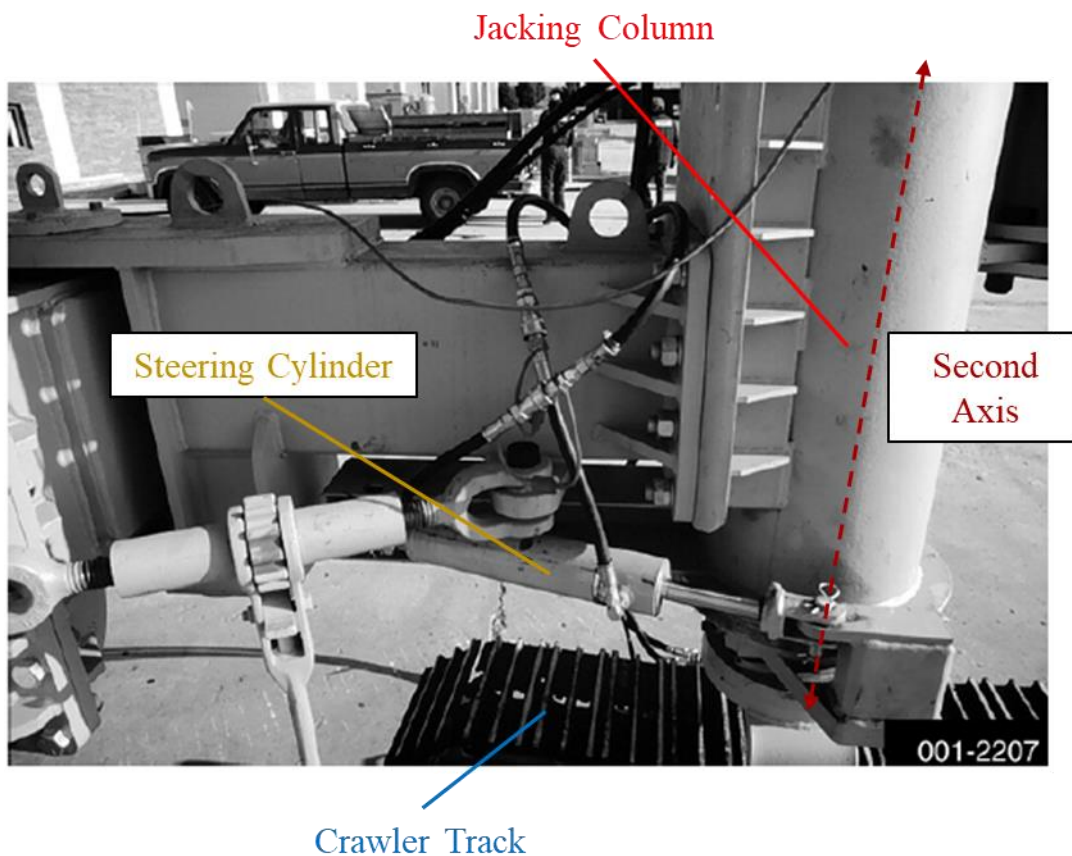


[Ex. 1005 (CIII), 209 (annotated).]

- d. **[1C]: “a crawler track rotatably coupled to the jacking column, wherein the crawler track is configured to rotate about a second axis to a second angular orientation relative to the jacking column;”**

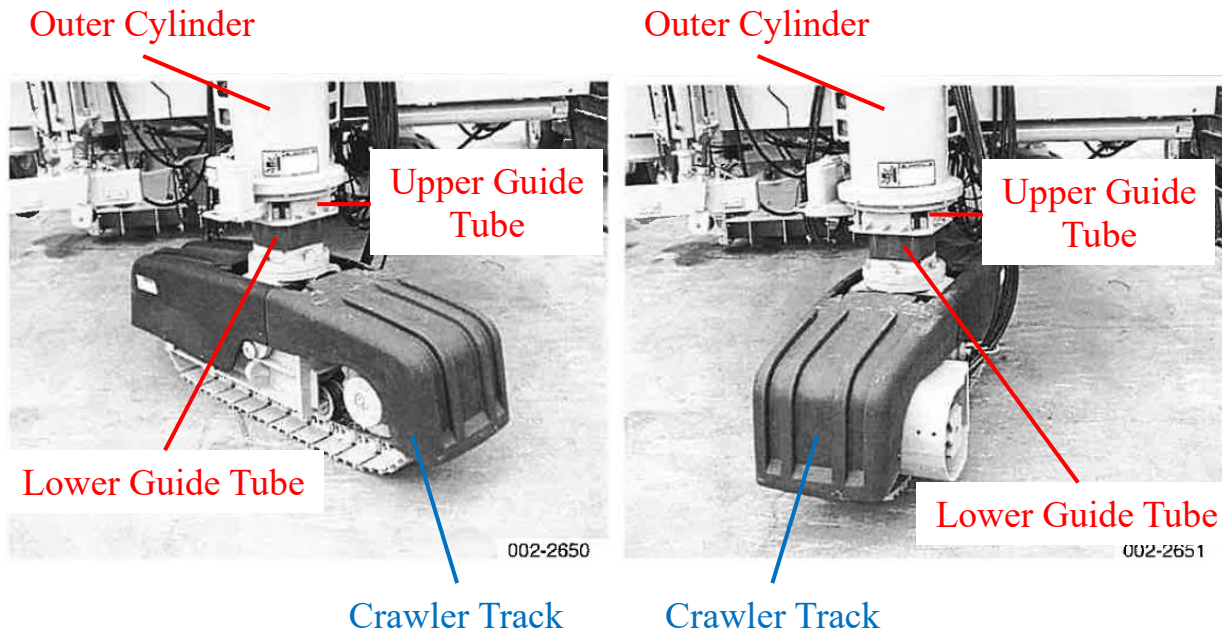
87. CIII and Rio renders obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:6 (“a crawler track”), 24:8-11 (“a rotary connection between the jacking column

and the crawler track permitting relative rotational movements of the crawler track and the jacking column about a first upright axis”), 24:14-16 (“an angular orientation of the crawler track relative to the jacking column”); ’749 FWD, 64-66, 95-96.] CIII discloses four crawler tracks in its four-track configuration, each of which are rotated about the claimed “second axis” to a second angular orientation relative to the outer cylinder of the jacking column via a hydraulic steering cylinder that extends and retracts. [Ex. 1005 (CIII), 165, 193, 195, 204-206, 373-374; *supra* Section VII.A.1 (Summary of CIII).]



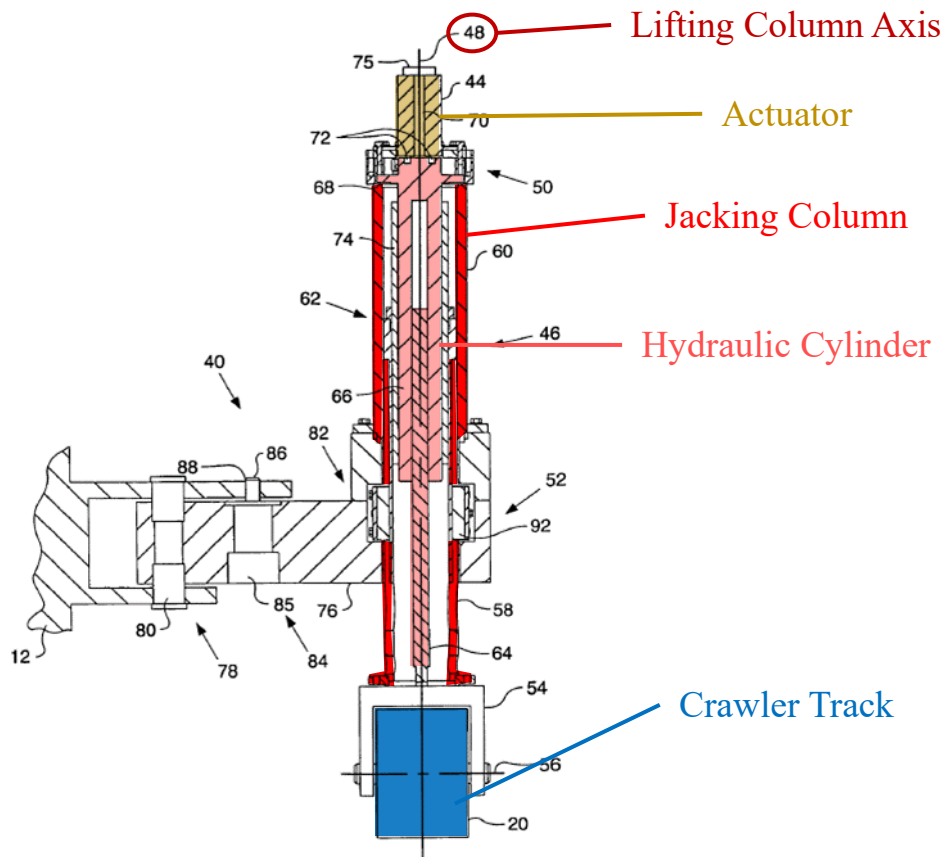
[Ex. 1005 (CIII), 265 (annotated).]

The rotation of the track and guide tubes relative to the outer cylinder of the jacking column is shown below.



[Ex. 1005 (CIII), 193, 195 (annotated).]

88. Rio discloses a rotary actuator 44 positioned “along the lifting column axis 48” (a “second axis”) that moves the crawler track “rotationally about the lifting column axis 48.” [Ex. 1006 (Rio), 4:56-5:16, 5:32-34, 6:2-6.] In the embodiment depicted in Figure 2, below, rotary actuator 44 “moves” the “ground engaging unit 20 rotationally about the lifting column axis 48” via connections between cylinder 66, inner tubular member 58, and bracket 54. [Ex. 1006 (Rio), 5:54-6:6, 5:25-29, 5:34-35.]



[Ex. 1006 (Rio), Fig. 2 (annotated); *supra* Section VII.A.2 (Summary of Rio).]

89. For the reasons explained in Section VII.A.5 (Rationale for Combining CIII and Rio), it would have been obvious to modify CIII's leg assembly by positioning Rio's rotary actuator 44 between the bottom of the jacking column and the top of the crawler track and using that rotary actuator to rotate CIII's crawler track relative to the entire jacking column, rather than just its outer cylinder. This design was well known in the art. [*Supra* Section VII.A.5 (Rationale for Combining CIII and Rio); Ex. 1007 (Littman), 5:14-59, Figs. 4-5 (disclosing a rotary actuator at the bottom of a jacking column that rotates a crawler track

relative to the jacking column); Ex. 1008 (Miller), 7:35-58, Fig. 7 (same); Ex. 1011 (Whitaker), 4:7-16, Fig. 3 (same); Ex. 1009 (Johns), ¶ [0020], Fig. 2.] Rio also provides disclosure and motivation for this modification. [Ex. 1006 (Rio), 5:8-11 (explaining that the rotary actuator 44 can be “positioned on the lifting column 46” anywhere “along the lifting column axis 48”).]

- e. **[1D]: “a slew drive coupled to the jacking column and the crawler track, wherein the slew drive is configured to cause rotation of the crawler track relative to the jacking column;”**

90. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:22-25 (“a power drive between the jacking column and the crawler track, configured for translating relative rotational movements between the jacking column and the crawler track”), 23:37-38 (“the power drive comprises a slew gear drive”); '749 FWD, 68-79, 95-96, 102.] As described in Sections VII.A.5 (Rationale for Combining CIII and Rio) and VII.A.6.d ([1C]), it would have been obvious to modify CIII’s leg assembly by substituting its steering cylinder that rotates the crawler track relative to the outer cylinder of the jacking column for Rio’s rotary actuator 44 positioned between the bottom of the jacking column and the top of the crawler track, such that the rotary actuator rotates CIII’s crawler track relative to the entire jacking column.

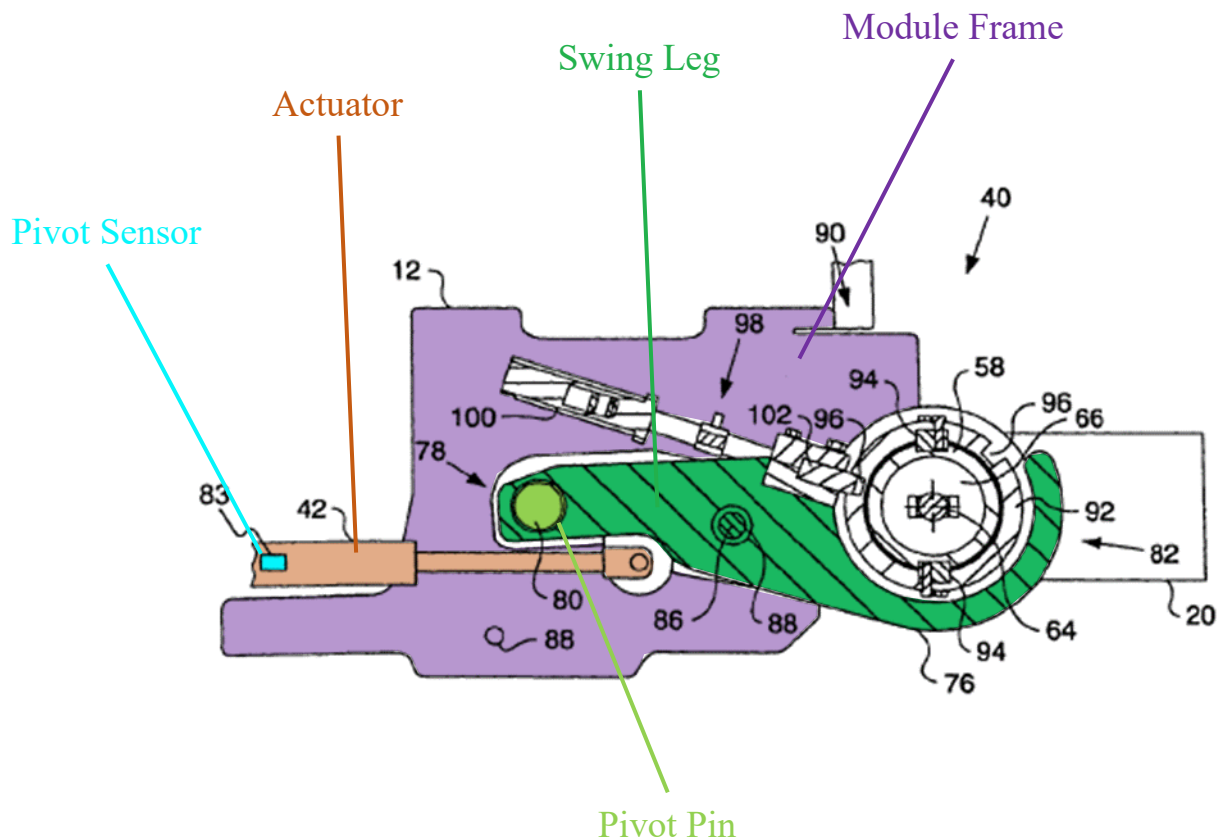
91. Rio discloses that rotary actuator 44 can use a worm-gear design—a “well-known mechanical implementation[]”—“with good result.” [Ex. 1006 (Rio), 4:61-5:3.] Rio discloses that such a worm-gear rotary actuator was preferred over linear actuators like CIII’s steering cylinder because it provides “fine rotary steering control” and “a compact apparatus to achieve rotary motion without the need for complicated and bulky linkages.” [Ex. 1006 (Rio), 5:3-7.] A POSITA would have understood that Rio’s worm-gear rotary actuator, for example, discloses a slew drive. Indeed, I agree with Patent Owner’s expert representation that a slew gear drive can be “a drive that comprises a worm gear.” [Ex. 1032, 84:12-86:17; *see also* Ex. 1001 (’318 patent), 11:40-61 (describing a ring gear “with two oppositely arranged worm drives” as a slew drive).]

92. Rio discloses positioning its rotary actuator 44 “on the lifting column 46 . . . along the lifting column axis 48,” and using the rotary actuator to cause the crawler track to rotate “about the lifting column axis 48.” [Ex. 1006 (Rio), 5:8-11, 6:2-6.] For the reasons explained in Section VII.A.5 (Rationale for Combining CIII and Rio) and VII.A.6.d ([1C]), it would have been obvious to modify CIII’s leg assembly by coupling Rio’s rotary actuator 44 to the bottom of the jacking column and the top of the crawler track, such that actuating the rotary actuator causes the crawler track to rotate relative to the entire jacking column, rather than just its outer cylinder.

f. [1E]: “a first sensor configured to emit a first signal corresponding to the first angular orientation;”

93. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:17-21 (“a second angular position transducer between the swing leg and the module frame, configured to emit a second signal which is indicative of an angular orientation of the swing leg relative to the module frame”)⁶; '749 FWD, 66-67, 95-96.] As shown in annotated Figure 3, below, Rio discloses a pivot sensor 83 (“first sensor”) associated with the first actuator 42 or pivot pin 80 that emits a pivot position signal 122 (“first signal”) “indicating the instantaneous angular position of the swing arm 76 relative to the machine frame 12” (i.e., “corresponding to the first angular orientation”) and sends the signal to controller 32. [Ex. 1006 (Rio), 6:22-26, 7:19-23, 8:32-34.]

⁶ The “first sensor” and “first signal” in the '318 patent claims correspond to the “second angular position transducer” and “second signal,” respectively, in the '749 patent claims.



[Ex. 1006 (Rio), Fig. 3 (annotated).]

94. For the reasons explained in Section VII.A.5 (Rationale for Combining CIII and Rio), it would have been obvious to implement Rio's pivot sensor 83 in CIII's machine. For example, as explained in Section VII.A.6.b ([1A]), each swing leg is configured to pivot about a first axis, similar to Rio's swing arm rotating about pivot pin 80. [Ex. 1006 (Rio), 6:12-15.] In view of Rio's disclosure that the pivot sensor 83 can be "a rotary encoder associated with the pivot pin 80," it would have been obvious to similarly position Rio's pivot sensor

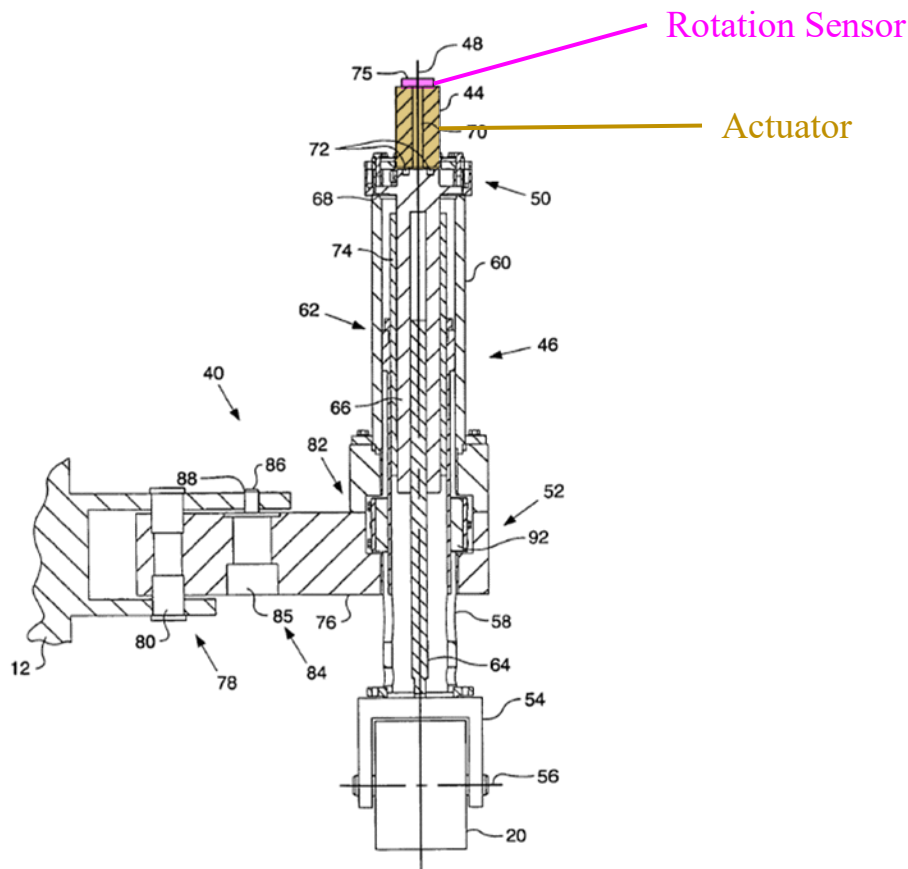
83 between CIII's swing leg and machine frame by using a rotary encoder at its pivot point. [*Supra* Section VII.A.5 (Rationale for Combining CIII and Rio).]

g. [1F]: “a second sensor configured to emit a second signal corresponding to the second angular orientation; and”

95. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:12-16 (“a first angular position transducer between the jacking column and the crawler track, configured to emit a first signal which is indicative of an angular orientation of the crawler track relative to the jacking column”)⁷; '749 FWD, 65-66, 95-96.]

96. As shown below in annotated Figure 2, Rio discloses a rotation sensor 75 (“second sensor”) associated with rotary actuator 44 or a “connected rotating component” that “deliver[s] signals representing the rotation angle of the one ground engaging unit 20 relative to the machine frame 12.” [Ex. 1006 (Rio), 6:6-11.] Sensor 75 emits a rotational position signal 124 associated with the angular position of the crawler track. [Ex. 1006 (Rio), 7:23-27, 8:38-39, Fig. 5.]

⁷ The “second sensor” and “second signal” in the '318 patent claims correspond to the “first angular position transducer” and “first signal,” respectively, in the '749 patent claims.



[Ex. 1006 (Rio), Fig. 2 (annotated).]

97. Because Rio describes sensor 75 as “a rotary encoder” “associated with the second actuator 44” that rotates about lifting column axis 48, a POSITA would have understood that sensor 75’s rotation position signal 124 indicates the angular orientation of the crawler track relative to the outer tubular member 60 of lifting column 46 (“second signal corresponding to the second angular orientation”). [Ex. 1006 (Rio), 6:6-11, 8:39-47, Fig. 2.] This is apparent from at least Rio’s depiction of sensor 75 in Figure 2, shown above, which shows sensor 75 coupled to a fixed portion of the rotary actuator 44, which is attached to outer

tubular member 60, and its rotating rotor. [Ex. 1006 (Rio), 5:54-56, 6:6-11, Fig. 2.]

In this configuration, the sensor would determine the relative rotation between the outer tubular member of the lifting column and the crawler track.

98. While Rio discloses that the rotational position signal 124 indicates “the instantaneous rotation angle of the one ground engaging unit 20 relative to the machine frame 20,” a POSITA would have understood this disclosure as meaning that the controller 32 uses the pivot position signal 122 and rotational position signal 124 to determine the angular orientation of the one ground engaging unit 20 relative to the machine frame to “coordinate the actuators 42, 44” such that “the one ground engaging unit 20 remain[s] parallel to the machine frame 12 at all points in the pivot arc.” [Ex. 1006 (Rio), 7:23-27, 8:38-47.]

99. To the extent Patent Owner argues that Rio’s sensor 75 does not emit a signal corresponding to the second angular orientation, it would have been obvious to have it do so given the configuration depicted in Rio’s Figure 2. A POSITA would have understood that, with the signals from sensors 83 and 75, the controller may determine the angular orientation of the crawler track relative to the machine frame and would have been motivated to have sensor 75 emit a signal corresponding to the second angular orientation because this would have been a simpler design typical of how rotary encoders were used at the time. Moreover, CIII already discloses a sensor-based steering cylinder, which measures the crawler

track's rotational position and sends continuous position signals to the S2X controller, and a POSITA would have found it obvious to similarly design sensor 75 to emit such a signal. [Ex. 1005 (CIII), 408, 412.]

100. For these reasons, and the reasons explained in Section VII.A.5 (Rationale for Combining CIII and Rio), it would have been obvious to implement Rio's rotation sensor 75 in CIII's swing-leg assembly such that it emits a second signal corresponding to the second angular orientation.

h. [1G]: “a processor configured to: . . .”

101. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:26 (“a processor operable to”); '749 FWD, 67-68, 95-96.] As explained in Sections VII.A.6.b ([1A]) and VII.A.6.d ([1C]), each swing leg in CIII's four-track configuration is configured to pivot about a first axis, and each crawler track is configured to pivot about a second axis. CIII discloses a controller that receives a steer signal and a signal corresponding to the position of each crawler track and can control the steering cylinder so that the crawler-track position reaches the desired position. [Ex. 1005 (CIII), 407-408.] However, before this can occur, CIII discloses, each crawler track must be manually aligned to the frame of the paver via time-consuming measurements to calibrate CIII's steering system. [Ex. 1005 (CIII), 193-194; *supra* Section VII.A.5 (Rationale for Combining CIII and Rio).]

Rio discloses a control system that eliminates the need for this manual alignment procedure after pivoting a swing leg. [Ex. 1006 (Rio), 8:31-9:14.] As explained in Section VII.A.5 (Rationale for Combining CIII and Rio), it would have been obvious to implement Rio's actuators and control system in CIII to improve the steering system of CIII.

102. Rio's control system includes a controller 32, such as "a programmed computer logic unit and associated memory," that receives signals from the sensors and coordinates movements of the swing leg and crawler track via signals to the actuators. [Ex. 1006 (Rio), 4:16-20, 4:47-50, 6:56-7:42, Fig. 5.] A POSITA would have understood that Rio's controller discloses a processor configured to perform the actions in the following sections for [1G1]-[1G4] (Sections VII.A.6.h.i-VII.A.6.h.iv). It would have been obvious to combine CIII and Rio such that the control system includes a processor configured to perform these actions. [*Supra* Section VII.A.5 (Rationale for Combining CIII and Rio).]

i. [1G1]: receive the first signal from the first sensor, and the second signal from the second sensor;

103. The modified CIII-Rio controller is configured to receive the pivot position signal 122 ("first signal") from the pivot sensor 83 ("from the first sensor") and the rotational position signal 124 ("second signal") from the rotation sensor 75 ("from the second sensor"). [Ex. 1006 (Rio), 6:65-66, 7:11-13, 8:32-34,

8:38-39; *supra* Sections VII.A.6.f ([1E]) (identifying the same first sensor and first signal from Rio), VII.A.6.g ([1F]) (identifying the same second sensor and second signal from Rio).] The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 24:26-27 (“receive the first and second signals”); '749 FWD, 67-68, 95-96.] For example, Rio discloses that “the controller 32 may receive . . . a ground engaging unit pivot position signal 122[] and a ground engaging unit rotational position signal 124” and uses these signals “to coordinate activation of the first and second actuators 42, 44.” [Ex. 1006 (Rio), 6:65-7:13, 8:38-41, Fig. 5.]

ii. [1G2]: “determine a change of the first angular orientation based on the first signal;”

104. The modified CIII-Rio controller is configured to determine a change of the angular orientation of the swing leg relative to the machine frame (“first angular orientation”) based on the pivot position signal 122 (“first signal”). [Ex. 1006 (Rio), 6:65-66, 7:11-12, 7:19-23.] The Board previously found that CIII and Rio render obvious a similar feature. [*Supra* Section VII.A.3 (when comparing [1G2] of the '318 patent to the '749 patent, explaining how the Board’s findings mean that the Board found [1G2] of the '318 patent to be within the scope of [17I] of the '749 patent); '749 FWD, 67-68, 95-96; *see* Ex. 1033, 24:26-33.]

105. For example, Rio discloses that “pivot sensor 83 tracks” the movement of the swing arm 76 “and sends responsive pivot position signals 122 to the controller 32,” which uses this signal to counter-rotate the one ground engaging unit 20 “to continuously and precisely offset the rotation caused by the pivoting, resulting in the one ground engaging unit 20 remaining parallel to the machine frame 12 at all points in the pivot arc.” [Ex. 1006 (Rio), 8:31-47.] A POSITA would have understood that this discloses the controller determining a change of the swing leg’s angular orientation based on the signal from the pivot sensor 83.

- iii. **[1G3]: “in response to determining the change of the first angular orientation, determine a target second angular orientation based on the determined change of the first angular orientation and the second angular orientation based on the second signal; and”**

106. The modified CIII-Rio controller is configured such that, in response to determining the change of the angular orientation of the swing leg relative to the machine frame (“first angular orientation”), it determines a target second angular orientation for the crawler track based on the determined change of the first angular orientation and the angular orientation of the crawler track relative to the swing leg (“second angular orientation”) based on the signal from the rotation sensor indicating the angular orientation of the crawler track relative to the swing leg (“second signal”). [Ex. 1006 (Rio), 2:52-57, 3:5-22, 4:47-50, 7:23-36, 8:31-

9:14.] The Board previously found that CIII and Rio render obvious a similar feature. [*Supra* Section VII.A.3 (when comparing [1G3] of the '318 patent to the '749 patent, explaining how the Board's findings mean that the Board found [1G3] of the '318 patent to be within the scope of [17I] of the '749 patent); '749 FWD, 67-68, 95-96; *see* Ex. 1033, 24:26-33.]

107. For example, Rio discloses that the controller 32 receives signals from the pivot sensor 83 and rotation sensor 75 and “may send control signals to” the first and second actuators 42, 44. [Ex. 1006 (Rio), 7:19-33.] Rio discloses that the controller 32 uses the pivot position signal 122 to determine the change of the swing leg's angular orientation relative to the machine frame and “responsively actuates the second actuator 44 to counter-rotate the one ground engaging unit 20 to maintain it in the same running direction” as the swing leg pivots. [Ex. 1006 (Rio), 8:31-37.] Rio discloses that, “[a]s counter-rotation begins, the rotation sensor 75 sends rotation position signals 124 to the controller 32,” which “uses the pivot and rotation signals 122, 124 to coordinate activation of the first and second actuators 42, 44 . . . in a manner to cause the counter-rotation of the one ground engaging unit 20 to continuously and precisely offset the rotation caused by the pivoting, resulting in the one ground engaging unit 20 remaining parallel to the machine frame 12 at all points in the pivot arc.” [Ex. 1006 (Rio), 8:38-47.]

108. A POSITA would have understood that this discloses the controller, in response to determining the change of the angular orientation of the swing leg as it moves between different positions, determining a target angular orientation for the crawler track, i.e., an angular orientation that maintains it parallel to the machine frame, based on this determined change of the angular orientation of the swing leg and the second angular orientation based on the second signal.

- iv. **[1G4]: “send a control signal to the slew drive in order to cause the second angular orientation of the crawler track to rotate to the target second angular orientation.”**

109. The modified CIII-Rio controller is configured to send a control signal to the worm-gear rotary actuator 44 (“slew drive”) to cause the angular orientation of the crawler track relative to the jacking column (“second angular orientation of the crawler track”) to rotate to the target second angular orientation. [Ex. 1006 (Rio), 2:52-57, 3:5-22, 4:47-50, 4:61-5:3, 7:28-36, 8:31-9:14.] The Board previously found that CIII and Rio render obvious a similar feature of the ’749 patent. [Ex. 1033, 24:27-30 (“emit a control signal for activating the power drive and thereby rotationally move the crawler track relative to the jacking column to maintain an orientation of the crawler track”); ’749 FWD, 67-68, 95-96.]

110. For example, Rio discloses that the controller 32 “may send control signals to” the second actuator 44. [Ex. 1006 (Rio), 7:19-33.] Rio discloses that the

second actuator 44 is preferably “a rotary actuator” having a worm-gear design.

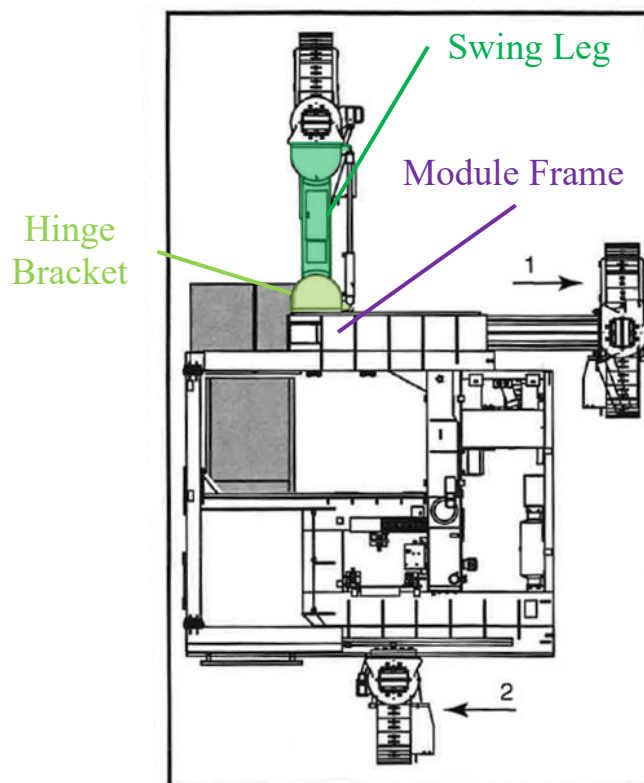
[Ex. 1006 (Rio), 4:61-5:3.] Rio discloses that the controller 32 “responsively actuates the second actuator 44 to counter-rotate the one ground engaging unit 20 to maintain it in the same running direction” as the swing leg pivots. [Ex. 1006 (Rio), 8:31-37.] Specifically, Rio discloses that the controller 32 coordinates “activation of the first and second actuators 42, 44 . . . in a manner to cause the counter-rotation of the one ground engaging unit 20 to continuously and precisely offset the rotation caused by the pivoting, resulting in the one ground engaging unit 20 remaining parallel to the machine frame 12 at all points in the pivot arc.”

[Ex. 1006 (Rio), 8:38-47.] A POSITA would have understood that this discloses the controller sending a control signal to the slew drive to cause the second angular orientation of the crawler track to rotate to the target second angular orientation.

7. Claim 2: “The swing leg assembly of claim 1, further comprising a hinge bracket arranged to be interposed between the swing leg and a surface of a module frame of the paving machine.”

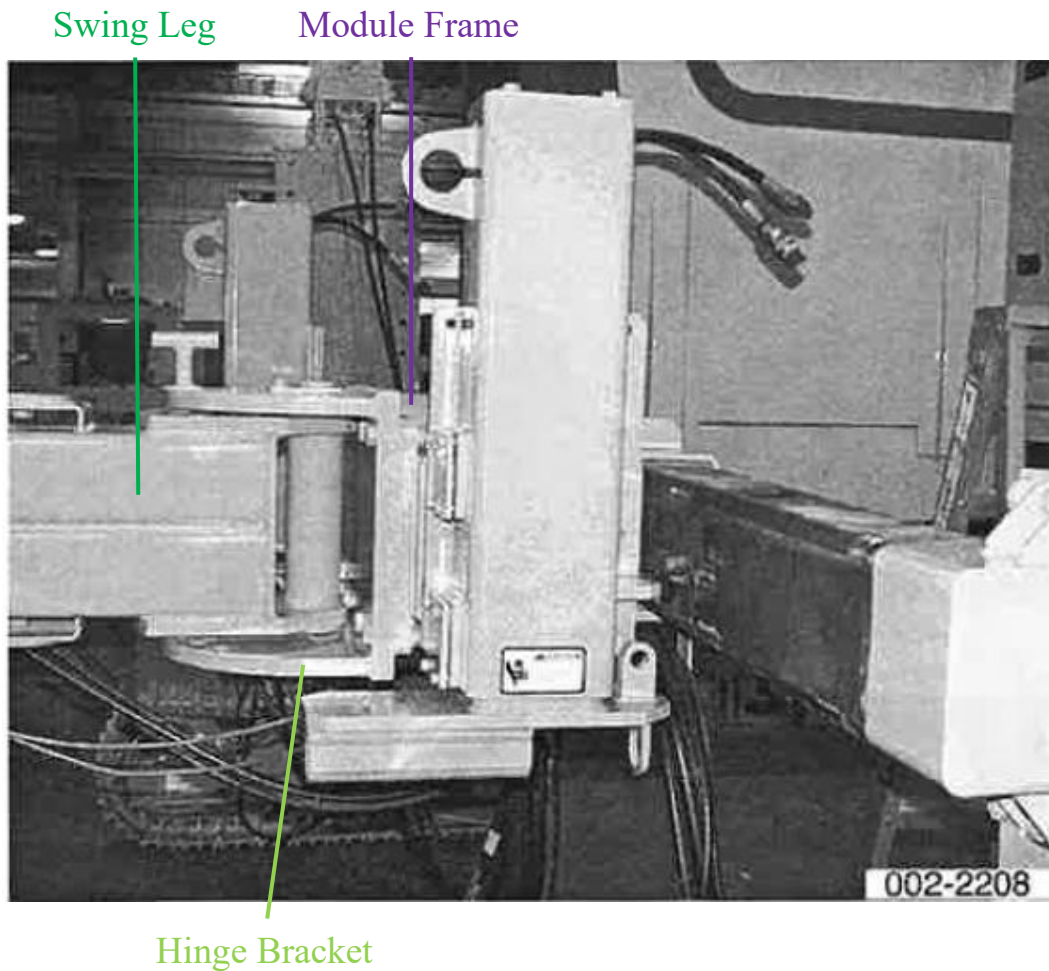
111. CIII alone or in view of Rio renders obvious this feature. The Board previously found that CIII discloses a similar feature of the '749 patent in its three-track configuration and that CIII and Rio render obvious a similar feature of the

'749 patent in its four-track configuration.⁸ [Ex. 1033, 23:2-3, 24:36-37 (both, “a hinge bracket arranged to be interposed between the swing leg and the surface of the module frame”); '749 FWD, 96-97, 105-106.] CIII discloses a hinge bracket in its three-track configuration arranged to be interposed between the swing leg and a surface of the module frame of the paving machine, as shown below.



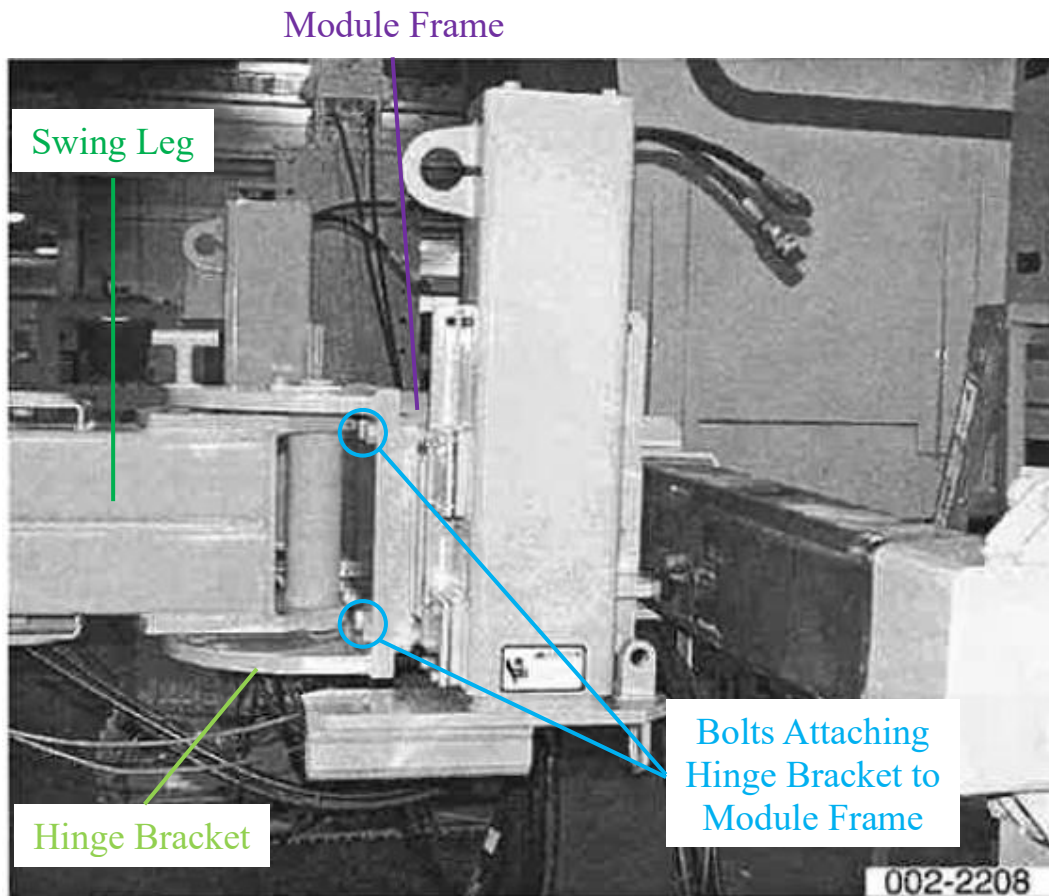
⁸ Claim 18 of the '749 patent, which depends from claim 17, requires “two or more swing leg assemblies,” [Ex. 1033, 24:2], so the Board’s analysis for this claim also includes a third reference for the disclosure of “hinged brackets on multiple swing legs.” [’749 FWD at 105.] No such requirement exists here.

[Ex. 1005 (CIII), 76 (annotated).]



[Ex. 1005 (CIII), 85 (annotated).]

112. A POSITA would have recognized that this hinge bracket provides an easy-to-assemble/disassemble bracket that can be attached/removed from the frame, allowing for removal of the entire swing-leg apparatus. [Ex. 1005 (CIII), 204.]



[Ex. 1005 (CIII), 85 (annotated).]

113. It would have been obvious to use this hinge bracket to attach each of the four swing legs (or at least one of the swing legs) to the module frame in the four-track configuration, (*supra* Section VII.A.6.b ([1A])), because this design permits easy attachment and removal of each swing-leg assembly. A POSITA would have recognized that the ability to quickly attach and remove each swing-leg assembly facilitates swing-leg maintenance, allows greater flexibility in paving configurations, and allows faster changes between configurations.

114. For example, CIII discloses another modification to its four-track configuration, which it refers to as a “Minimum Clearance Setup.” [Ex. 1005 (CIII), 255.] This configuration involves operating the four-track configuration ‘without the left rear leg attached to the machine frame.” [Ex. 1005 (CIII), 255.] To set up this alternate configuration, CIII discloses separate steps of “[r]emoving the left rear leg from the machine frame” and “[r]emov[ing] the left rear leg swinging pivot to reduce the weight hanging on the left rear corner of the machine frame.” [Ex. 1005 (CIII), 255.] A POSITA would have seen that incorporating a hinge bracket, like the one from CIII’s three-track configuration, to be interposed between this swing leg and a surface of the module frame to be beneficial, as it would have reduced the number of steps needed to remove the left rear swing-leg assembly from the frame, leading to more efficient changes in the paver configurations.

115. Moreover, a POSITA would have been motivated to modify CIII in this way because it would have reduced manufacturing costs. For example, CIII discloses a swing leg in its three-track configuration that, when the machine is changed to its four-track configuration, is not used. [Ex. 1005 (CIII), 204 (“Set the left front leg pivot off to the side of the work area as it will not be used.”).] By incorporating CIII’s hinge bracket into the swing-leg assemblies of the four-track configuration, it would have allowed the machine to use the same swing leg in both

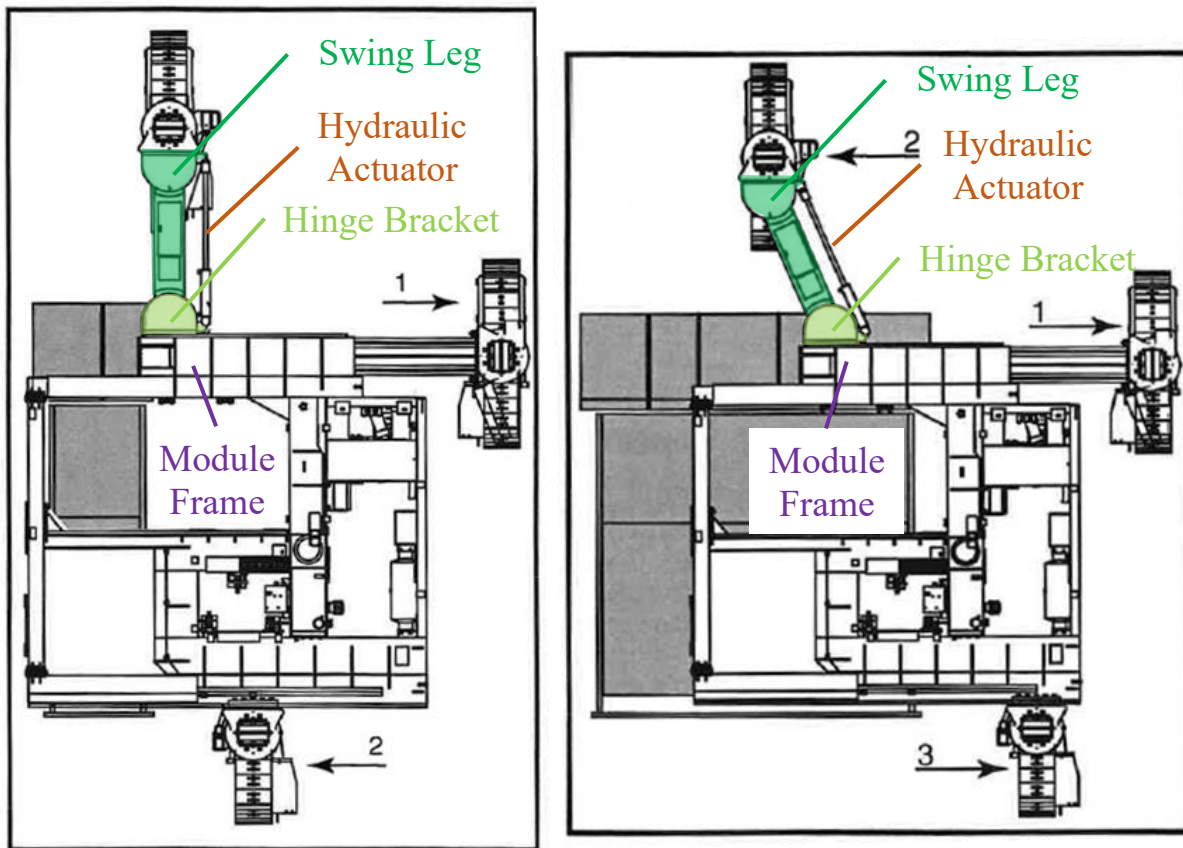
configurations, thereby reducing the need to manufacture separate swing legs for each configuration.

116. A POSITA would have had a reasonable expectation of success in such a modification, as this would have simply been a combination of familiar elements according to known methods to yield predictable results. Indeed, CIII discloses that this hinge bracket works well with the three-track configuration, and a POSITA would have likewise expected it to work in the four-track configuration. A POSITA would have expected success in incorporating CIII's hinge bracket into the four-track configuration from references like Files, which disclose a similar hinge bracket between the frame and each of the four swing legs in a similar machine. [Ex. 1012 (Files), 2:57-61, Fig. 2.]

117. Moreover, Rio discloses an "anti-swing device 84" that "locks the swing arm 76 against unintentional pivotal movement." [Ex. 1006 (Rio), 6:27-37.] A POSITA would have recognized that replacing the turnbuckles on CIII's swing legs with actuators, [*supra* Section VII.A.6.b ([1A])], and replacing CIII's locking pins with an actuated locking pin like Rio's anti-swing device 84, which would have automated the locking/unlocking of the swing leg, would have improved CIII's swing legs by allowing automated swing-leg locking and rotation without needing to manually adjust turnbuckles. [Ex. 1005 (CIII), 209; *supra* Section VII.A.5 (Rationale for Combining CIII and Rio).]

8. **Claim 3: “The swing leg assembly of claim 2, further comprising a hydraulic actuator mounted between the hinge bracket and the swing leg, wherein the hydraulic actuator is configured to cause the swing leg to pivot relative to the module frame.”**

118. CIII alone or in view of Rio renders obvious this limitation. The Board previously found that CIII discloses a similar feature of the '749 patent in its three-track configuration and that CIII and Rio render obvious a similar feature of the '749 patent in its four-track configuration. [Ex. 1033, 23:12-14, 24:45-47 (both, “a hydraulic actuator mounted between the hinge bracket and the swing leg, permitting the swing leg to pivot relative to the module frame”); '749 FWD, 97, 105-106.] For the reasons explained in Section VII.A.7 (Claim 2), it would have been obvious to use CIII’s hinge bracket in its four-track configuration to attach the swing legs to the module frame. This hinge bracket includes a “swing cylinder” (“hydraulic actuator”) mounted between the hinge bracket and swing leg, permitting the swing leg to pivot relative to the module frame. [Ex. 1005 (CIII), 76, 79-80; *supra* Section VII.A.7 (Claim 2).] CIII illustrates the swing cylinder causing the swing leg to pivot relative to the module frame in the annotated images below.



[Ex. 1005 (CIII), 76 (annotated).]

119. Because this hinge bracket is already designed to accommodate a hydraulic actuator, it would have been obvious to mount CIII's swing cylinder or Rio's linear actuator 42 between CIII's hinge bracket and the swing leg to pivot the swing leg. [Ex. 1005 (CIII), 76, 79-80; Ex. 1006 (Rio), Figs. 3-4, Claims 1, 12.] In its four-track configuration, CIII discloses turnbuckles that, to pivot the swing leg, must be either manually loosened/tightened or removed entirely. [Ex. 1005 (CIII), 209, 253.] CIII also discloses a need to pivot the swing legs "left or right of an in-

line position with the end frames to bypass obstacles or for narrow clearances.”

[Ex. 1005 (CIII), 209.]

120. A POSITA would have been motivated to replace these turnbuckles with a hydraulic actuator, as disclosed in CIII’s three-track configuration and in Rio, mounted between the hinge bracket and the swing leg to facilitate the pivoting of the swing leg, improving usability and the speed of changing swing-leg positions. [*Supra* Sections VII.A.5 (Rationale for Combining CIII and Rio), VII.A.7 (Claim 2).] Doing so would have replaced the time-consuming manual adjustments to a turnbuckle with the quicker, less labor-intensive press of a button. [Ex. 1005 (CIII), 79-80.] Moreover, the use of a hydraulic actuator to pivot each of four swing legs was well known in the art. [Ex. 1011 (Whitaker), 3:56-64, Figs. 1, 3 (disclosing that, for each of four swing legs (arms 23), “a fluid operated piston and rod assembly 25 mounted to said box frame 12 and said arm 23” is used to mechanically pivot the arm 23).] A POSITA would have understood that mounting the hydraulic actuator between the hinge bracket and the swing leg would have allowed the swing-leg assemblies to be more easily attached and removed because removing the hinge bracket from the frame of the paving machine would detach essentially the entire swing-leg assembly (except for any electrical/hydraulic lines between the swing-leg assembly and the frame), thereby improving the speed with which the paving machine can change configurations.

9. Claim 4: “The swing leg assembly of claim 2, wherein the hydraulic actuator is configured to be disengaged from at least one of the hinge bracket and the swing leg when the swing leg is positioned in a transport orientation.”

121. CIII renders obvious this limitation. The Board previously found that CIII discloses an identical feature of the '749 patent in its three-track configuration and that CIII renders obvious an identical feature of the '749 patent in its four-track configuration. [Ex. 1033, 23:15-18, 24:47-50 (both, “wherein the hydraulic actuator is configured to be disengaged from at least one of the hinge bracket and the swing leg when the swing leg is positioned in a transport orientation”); '749 FWD at 98, 105-106.] For the reasons explained in Section VII.A.7 (Claim 2), it would have been obvious to use CIII's hinge bracket in its four-track configuration to attach the swing legs to the module frame. For the reasons explained in Section VII.A.8 (Claim 3), it would have been obvious to mount CIII's swing cylinder or Rio's linear actuator 42 between CIII's hinge bracket and the swing leg to pivot the swing leg.

122. As shown below, CIII discloses a transport orientation for its four-track configuration, shown below, where the turnbuckles are removed and the four swing legs are pivoted to the ends of the frame. [Ex. 1005 (CIII), 253-254.]



[Ex. 1005 (CIII), 253.]

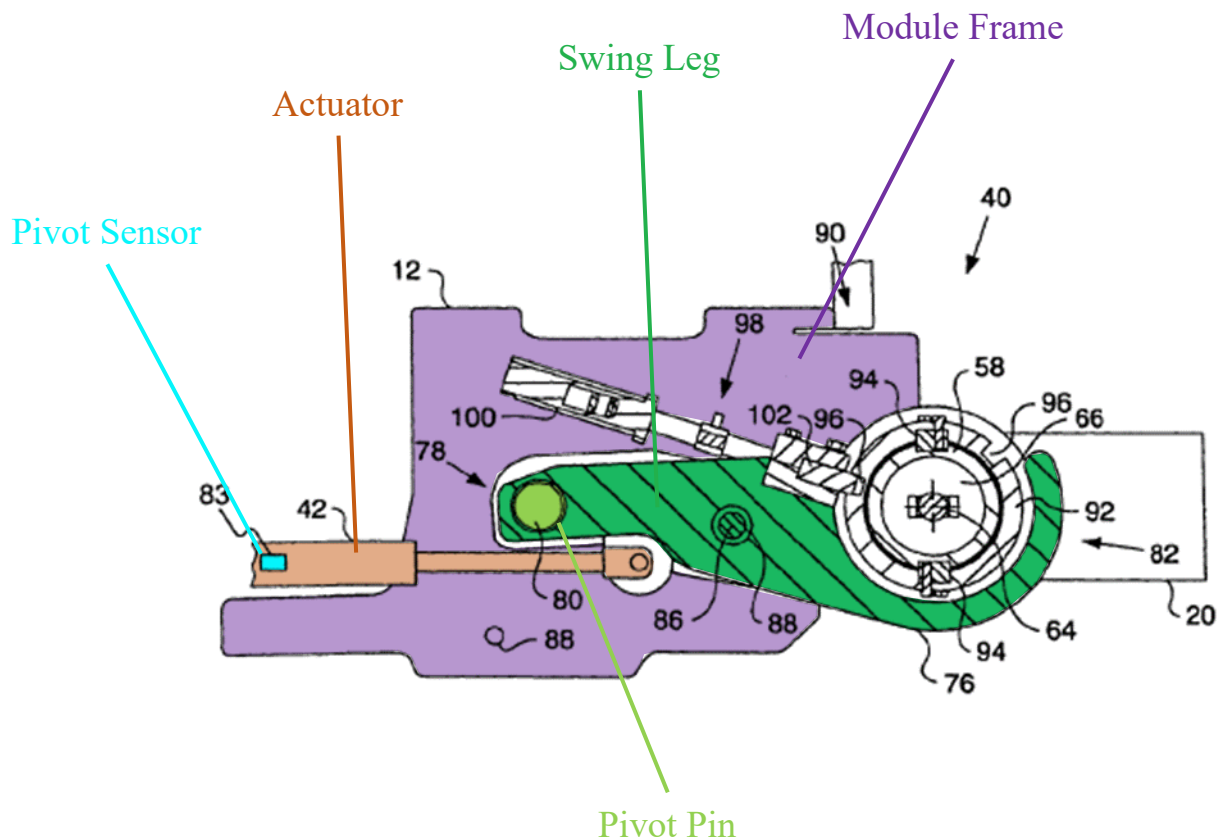
123. With this in mind, a POSITA would have recognized that for swing-leg assemblies with linear actuators, those actuators likewise would need to be removed to prevent them from interfering with the swing-leg's path to the compact transport position. [Ex. 1005 (CIII), 76 (disclosing the "maximum left position" of the swing-leg assembly).] Indeed, CIII's disclosures regarding disconnecting turnbuckles in transport mode provide motivation for doing the same with actuators. [Ex. 1005 (CIII), 253.] It would have been obvious to provide more range of motion in CIII's transport mode by disengaging each linear actuator from the hinge bracket and swing legs, thereby allowing each swing leg to pivot to the

end of the frame. [Ex. 1005 (CIII), 253-254.] Doing so would have involved known methods to achieve predictable results, especially since CIII already discloses this disconnection operation for turnbuckles. [Ex. 1005 (CIII), 253-254.]

10. Claim 5: “The swing leg assembly of claim 2, wherein the first sensor is positioned between the swing leg and the hinge bracket.”

124. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious a similar feature of the '749 patent. [Ex. 1033, 23:21-24 (“wherein the second angular position transducer is positioned between the swing leg and the hinge bracket”); '749 FWD at 99.] Rio discloses a pivot sensor 83 (“first sensor”) that emits a pivot position signal 122 “indicating the instantaneous angular position of the swing arm 76 relative to the machine frame 12.” [Ex. 1006 (Rio), 6:22-26, 7:19-23.] It would have been obvious to modify CIII to incorporate Rio’s pivot sensor 83. [*Supra* Sections VII.A.5 (Rationale for Combining CIII and Rio), VII.A.6.f ([1E]).]

125. Rio discloses that its pivot sensor 83 can be “a linear sensor associated with the first actuator 42” and depicts the pivot sensor 83 within the linear actuator that pivots the swing leg relative to the module frame, as shown below. [Ex. 1006 (Rio), 6:22-26.]



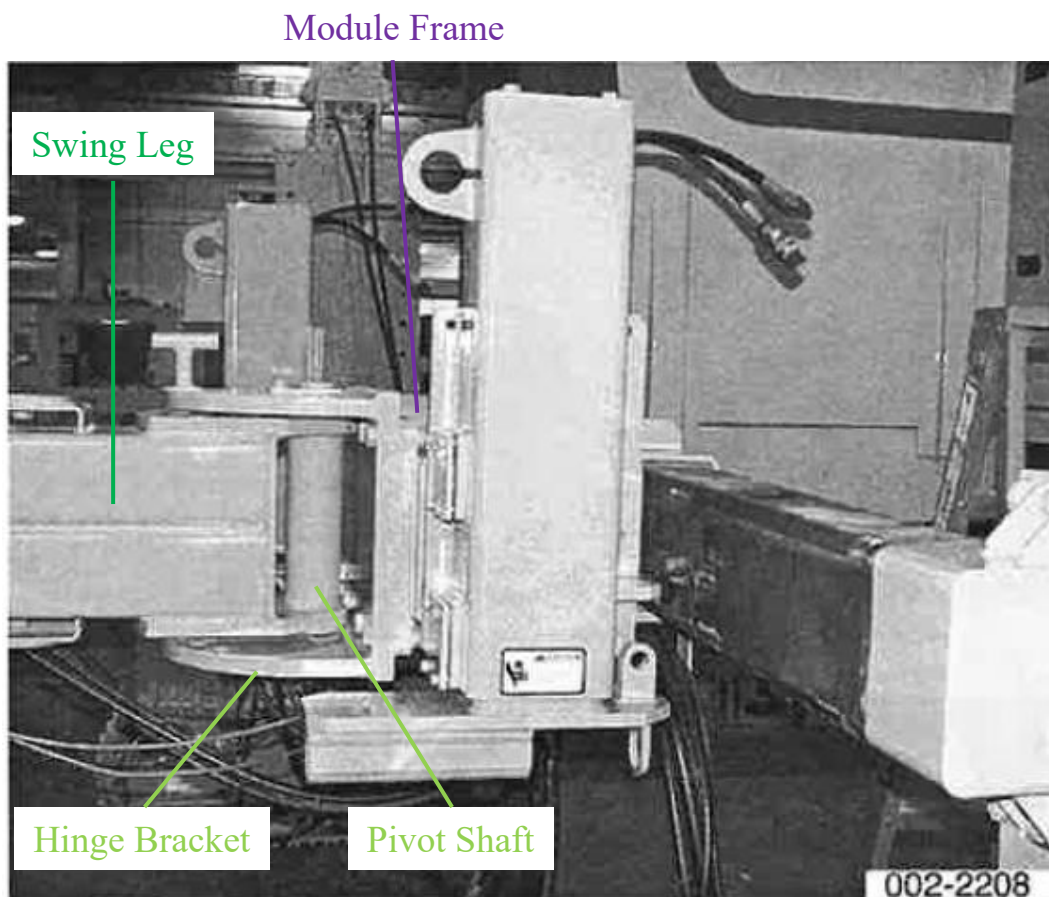
[Ex. 1006 (Rio), Fig. 3 (annotated).]

126. Rio also discloses that the pivot sensor 83 can be “a rotary encoder associated with the pivot pin 80.” [Ex. 1006 (Rio), 6:22-26.]

127. For the reasons explained in Section VII.A.8 (Claim 3), it would have been obvious to incorporate a hydraulic linear actuator mounted between a hinge bracket and the swing leg that is configured to cause the swing leg to pivot relative to the module frame. Because this linear actuator is mounted between a hinge bracket and the swing leg, incorporating Rio’s pivot sensor 83 as a linear sensor in the linear actuator would result in a first sensor positioned between the swing leg

and the hinge bracket. Given Rio's disclosure of a linear sensor positioned in a linear actuator, this would have been an obvious design choice and a simple combination of familiar elements according to known methods to yield predictable results. [Ex. 1006 (Rio), 6:22-26, Fig. 3.]

128. CIII and Rio also render obvious an alternative way to implement Rio's pivot sensor 83 between the swing leg and the hinge bracket. Similar to Rio's pivot pin 80, CIII's hinge bracket includes a pivot shaft, about which the swing leg rotates, as shown below.

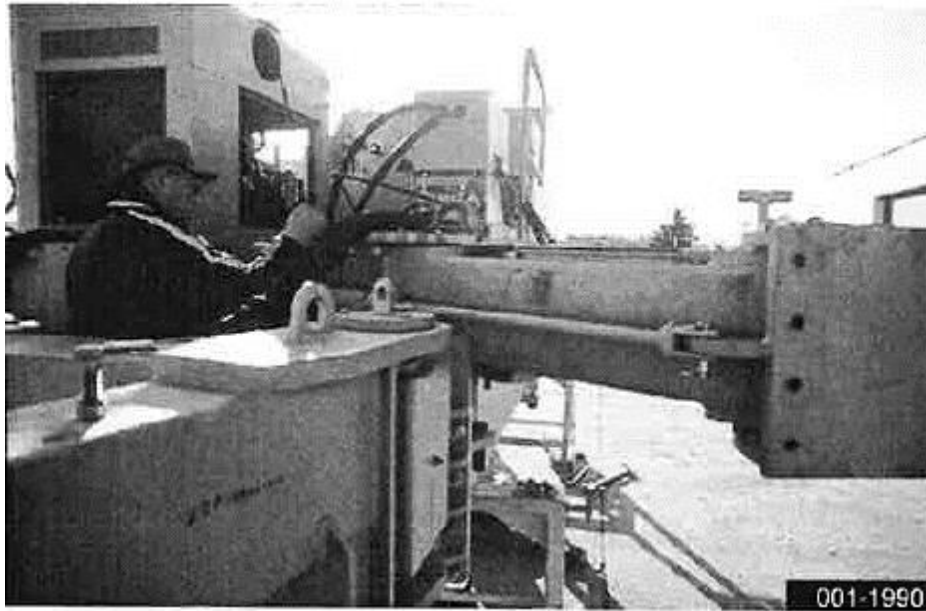


[Ex. 1005 (CIII), 85 (annotated).]

For the reasons explained in Section VII.A.7 (Claim 2), it would have been obvious to incorporate CIII's hinge bracket into its four-track configuration. Considering Rio's disclosure that sensor 83 can be "a rotary encoder associated with the pivot pin 80," about which the swing arm 76 rotates, [Ex. 1006 (Rio), 6:22-26, Figs. 3-4], it would have been obvious to associate Rio's sensor 83 with the pivot shaft of CIII's hinge bracket such that the sensor is positioned between the swing leg and hinge bracket. [*Supra* Sections VII.A.5 (Rationale for Combining CIII and Rio), VII.A.7 (Claim 2).] This would have been an obvious design choice and a simple combination of familiar elements according to known methods to yield predictable results. [Ex. 1006 (Rio), 6:22-26.]

11. Claim 6: "The swing leg assembly of claim 2, wherein the swing leg assembly is configured to be removably coupled to the module frame."

129. CIII renders obvious this feature. The Board previously found that CIII discloses a similar feature of the '749 patent. [Ex. 1033, 23:46-47 ("wherein the swing leg assembly is removably coupled to the module frame"); '749 FWD at 103.] CIII discloses steps for converting the paver between three-track and four-track configurations. [Ex. 1005 (CIII), 204-206.] When converting the paver from its three-track configuration to its four-track configuration, CIII discloses that the swing-leg assembly in its three-track configuration is removed from the frame ("module frame"). [Ex. 1005 (CIII), 204.]



[Ex. 1005 (CIII), 204 (showing removal of jacking column from swing leg and swing leg from module frame).]

130. For the reasons explained in Section VII.A.7 (Claim 2), it would have been obvious to use CIII's hinge bracket in its four-track configuration to attach the swing legs to the module frame. For example, this design would have permitted easy attachment and removal of each swing-leg assembly, meaning each swing-leg assembly would have been removably coupled to the module frame. A POSITA would have recognized that the ability to quickly attach and remove each swing-leg assembly facilitates swing-leg maintenance, allows greater flexibility in paving configurations, and allows faster changes between configurations.

131. Moreover, a POSITA would have been motivated to modify CIII in this way because it would have reduced manufacturing costs. For example, CIII

discloses a swing leg in its three-track configuration that, when the machine is changed to its four-track configuration, is not used. [Ex. 1005 (CIII), 204 (“Set the left front leg pivot off to the side of the work area as it will not be used.”).] By incorporating CIII’s hinge bracket into the swing-leg assemblies of the four-track configuration, it would have allowed the machine to use the same swing leg in both configurations, thereby reducing the need to manufacture separate swing legs for each configuration.

12. Claim 7: “The swing leg assembly of claim 2, wherein the swing leg is configured to change orientation by up to 180° relative to the module frame.”

132. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious an identical feature of the ’749 patent. [Ex. 1033, 24:54-56 (“wherein the swing leg is configured to change orientation by up to 180° relative to the module frame”); ’749 FWD at 104-05.] As explained in Section VII.A.8 (Claim 3), it would have been obvious to use CIII’s hinge bracket, which includes a “swing cylinder” to cause the swing leg to pivot relative to the module frame, in its four-track configuration. [Ex. 1005 (CIII), 76, 79-80; *supra* Section VII.A.7 (Claim 2).] Additionally, Rio discloses a first actuator 42 that is adapted to cause the swing leg to pivot relative to the machine frame, where the actuator is a rotary actuator. [Ex. 1006 (Rio), 4:38-44, 4:61-62, 6:19-22.] The swing-leg assemblies in both the three- and four-track configurations require manual

adjustments to pivot the swing leg and rotate the crawler track. [Ex. 1005 (CIII), 76, 79-80, 209, 253-254.] A POSITA would have been motivated in both configurations to automate swing-leg pivoting and crawler-track rotation to eliminate these manual adjustments. [*Supra* Section VII.A.5 (Rationale for Combining CIII and Rio).]

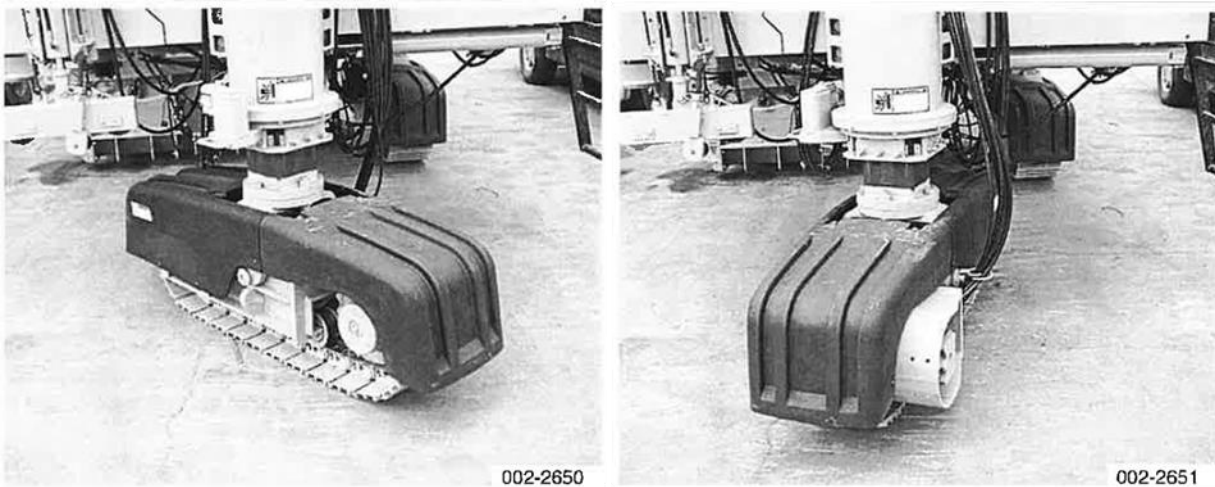
133. It would have been obvious in view of CIII's pivot cylinder and Rio's actuator 42 to include a rotary actuator for pivoting all four CIII swing legs. [Ex. 1005 (CIII), 79-80; Ex. 1006 (Rio), 4:38-44, 4:61-62, 6:19-22, Figs. 3-4.] A POSITA would have known that rotary actuators like Rio's permit more range of motion than linear-actuator designs and allow swing legs to rotate up to 180°. [*Supra* Section VII.A.5 (Rationale for Combining CIII and Rio); *see also* Ex. 1008 (Miller), 7:35-60, Fig. 7 (disclosing rotary actuator like Rio's permitting 180° rotation); Ex. 1010 (GT-3200), 3 (disclosing a "rotary actuator system that allows" for 180° rotation).]

134. A POSITA would have known to modify CIII's swing legs to include Rio's rotary actuator 42 and permit each swing leg to change orientation by up to 180° relative to the module frame. Such a modification would have improved the usability and efficiency of the machine because, for example, it would have allowed the machine to more quickly change between the paving mode and the transport mode, which would have otherwise required removing the turnbuckles or

the linear actuator between the swing leg and hinge bracket to swing the swing legs “around to the end of the 4-track frame.” [Ex. 1005 (CIII), 253; *supra* Section VII.A.9 (Claim 4).] Incorporating Rio’s rotary actuator 42 would have made such manual disconnecting unnecessary.

13. Claim 8: “The swing leg assembly of claim 1, further comprising an angular crawler track adjuster for changing an angular, rotational inclination between the crawler track and the swing leg in a substantially horizontal plane.”

135. CIII and Rio render obvious this feature. The Board previously found that CIII and Rio render obvious an identical feature of the ’749 patent. [Ex. 1033, 23:33-36 (“an angular crawler track adjuster for changing an angular, rotational inclination between the crawler track and the swing leg in a substantially horizontal plane”); ’749 FWD at 101-02.] As described in Sections VII.A.5 (Rationale for Combining CIII and Rio) and VII.A.6.e ([1D]), it would have been obvious to use Rio’s rotary actuator to rotate the crawler track relative to the jacking column. A POSITA would have understood that this rotary actuator is an “angular crawler track adjuster” when implemented on CIII’s jacking column, which is fixed to the swing leg, because it drives changes to an angular, rotational inclination between the crawler track and the swing leg in a substantially horizontal plane. Such rotational inclination changes are shown below.

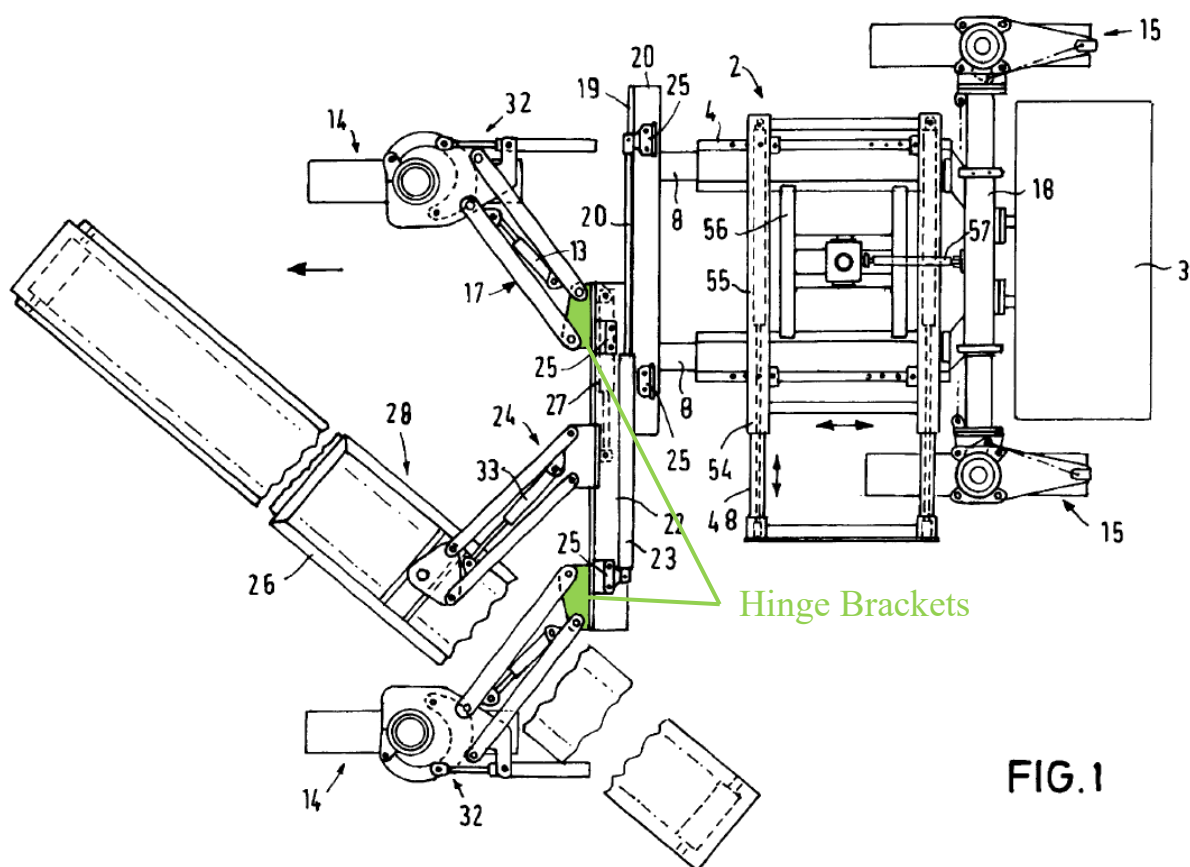


Ex. 1005 (CIII), 193, 195 (showing crawler track's rotational movement in CIII).

B. Ground 2: Claims 2-7 Are Obvious over CIII, Rio, and Smolders

1. Summary of Smolders

136. U.S. Patent No. 6,481,924 to Smolders et al. (“Smolders”; Ex. 1021) discloses a “slip-form paver” that includes a “machine frame 4” and multiple pivoting devices 17. [Ex. 1021 (Smolders), 3:48-53, 5:13-20.] These pivoting devices 17 are pivoted “with the associated piston-cylinder units 23 [that] allow for the setting of different track widths between the two front truck assemblies 14 while the track position can be varied by means of the slidable traverse member 22.” [Ex. 1021 (Smolders), 5:16-20.] Annotated Figures 1 and 3, below, depicts how each of the two pivoting devices 17 are coupled to the machine frame of the paver with a hinge bracket.



[Ex. 1021 (Smolders), Fig. 1 (annotated).

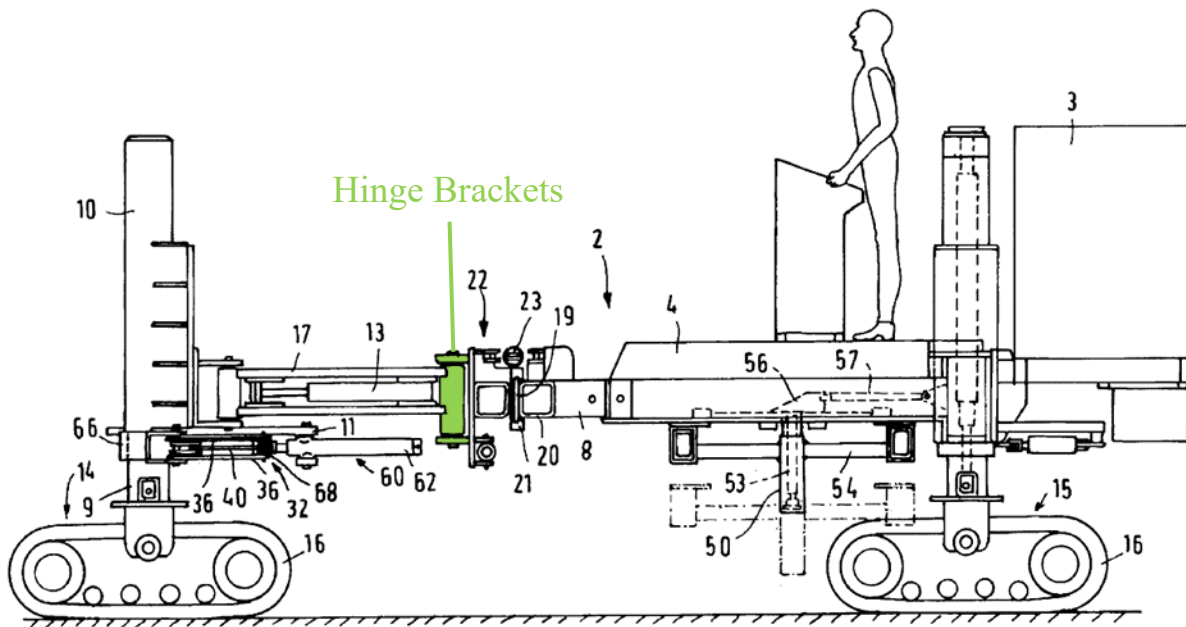


FIG. 3

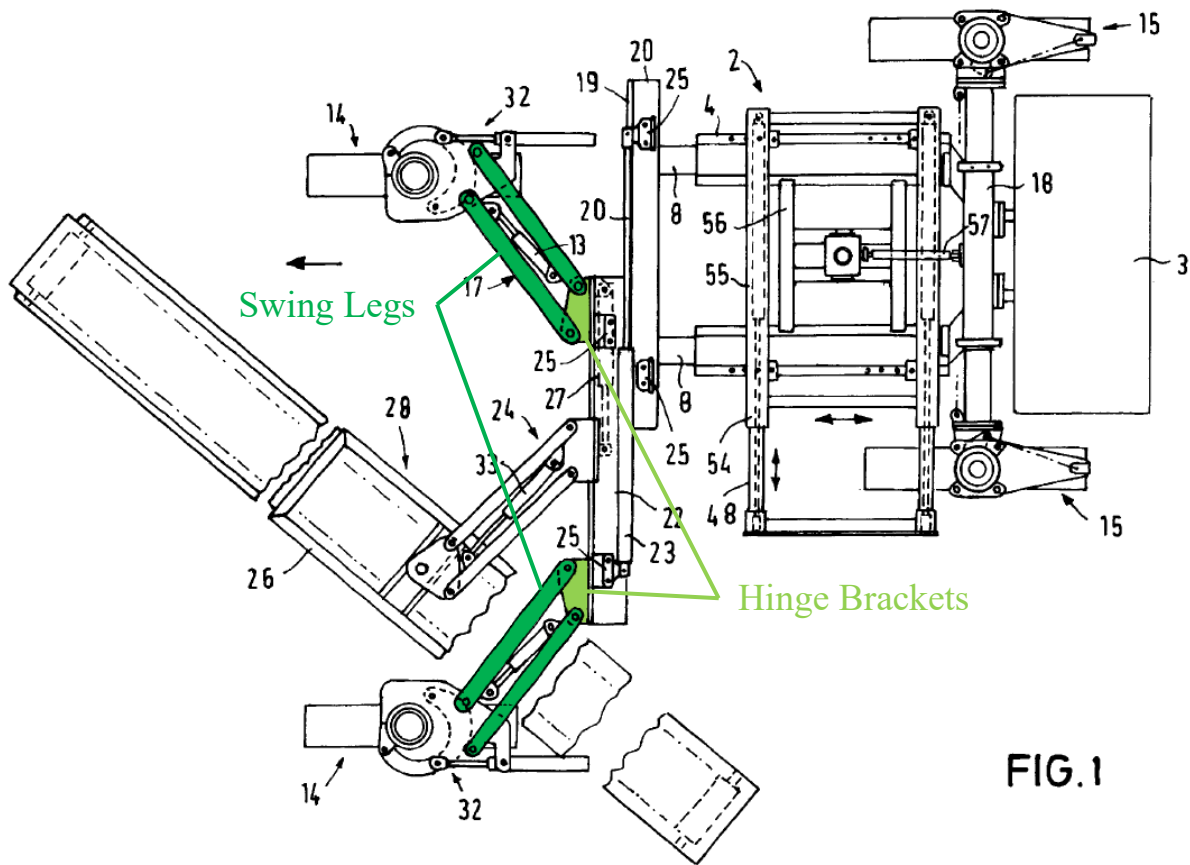
[Ex. 1021 (Smolders), Fig. 3 (annotated).]

2. **Claim 2: “The swing leg assembly of claim 1, further comprising a hinge bracket arranged to be interposed between the swing leg and a surface of a module frame of the paving machine.”**

137. To the extent CIII alone or in view of Rio does not render obvious this feature, CIII in view of Rio and Smolders renders obvious this feature. The Board previously found that CIII, Rio, and Smolders render obvious a similar feature of the '749 patent in its four-track configuration. [Ex. 1033, 24:36-37 (“a hinge bracket arranged to be interposed between the swing leg and the surface of the module frame”); '749 FWD at 96-97, 105-106.]

138. For the reasons explained in Section VII.A.7 (Ground 1, Claim 2), CIII discloses a hinge bracket in its three-track configuration arranged to be interposed between the swing leg and a surface of the module frame of the paving machine, and it would have been obvious to incorporate this hinge bracket in all four of the swing-leg assemblies of CIII's four-track configurations.

139. In addition to the reasons that a POSITA would have had a motivation to do so with a reasonable expectation of success explained in Section VII.A.7 (Ground 1, Claim 2), a design with hinge brackets on multiple swing-leg assemblies is further obvious in view of Smolders. As shown below, Smolders discloses two swing-leg assemblies that are each coupled to the frame of a paver with a hinge bracket.



[Ex. 1021 (Smolders), Fig. 1 (annotated).]

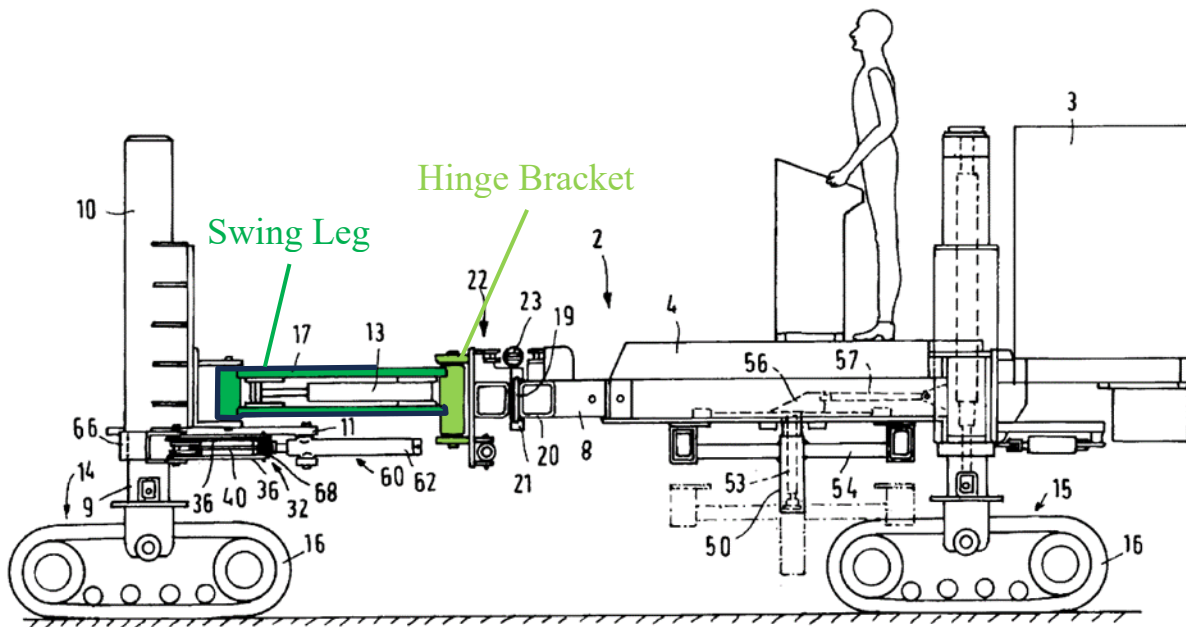
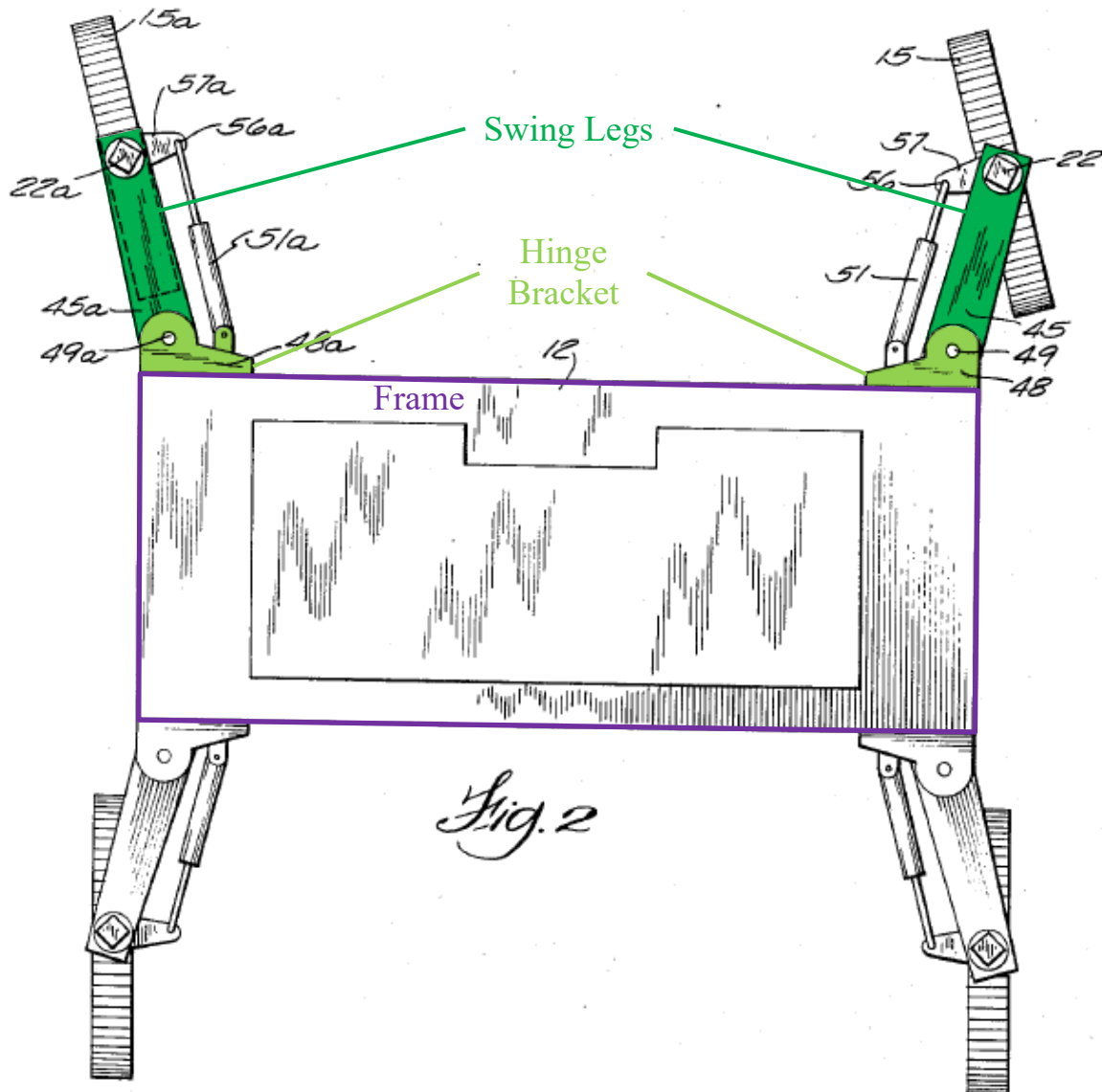


FIG. 3

[Ex. 1021 (Smolders), Fig. 3 (annotated).]

140. A POSITA would have understood from Smolders that, where multiple swing-leg assemblies are present, such as in the above embodiment of Smolders and in the four-track configuration of CIII, it is beneficial to connect each swing leg-assembly to the frame of the paver with a hinge bracket. A POSITA would have understood that doing so would have been beneficial because it would have allowed each of the four swing-leg assemblies to be easily attachable/detachable, as explained in Section VII.A.7 (Ground 1, Claim 2). This was a well-known design in the art, as references like Files similarly disclose interposing a hinge bracket between a swing leg and the frame for each of multiple

swing-leg assemblies. [Ex. 1012 (Files), 2:57-61, Fig. 2.] Files' design is depicted below in annotated Figure 2.



[Ex. 1012 (Files), Fig. 2 (annotated).]

141. Accordingly, modifying CIII's four-track configuration to interpose a hinge bracket, like the one in CIII's three-track configuration, between each of the

four swing legs and a surface of the module frame would have been a combination of familiar elements according to known methods to yield the predictable result of a swing-leg assembly that is more easily attachable and removable from the module frame.

3. **Claim 3: “The swing leg assembly of claim 2, further comprising a hydraulic actuator mounted between the hinge bracket and the swing leg, wherein the hydraulic actuator is configured to cause the swing leg to pivot relative to the module frame.”**

142. CIII, Rio, and Smolders render obvious claim 2 for the reasons explained in Section VII.B.2 (Ground 2, Claim 2). CIII alone or in view of Rio renders obvious the additional limitations of claim 3 for the reasons explained in Section VII.A.8 (Ground 1, Claim 3).

4. **Claim 4: “The swing leg assembly of claim 2, wherein the hydraulic actuator is configured to be disengaged from at least one of the hinge bracket and the swing leg when the swing leg is positioned in a transport orientation.”**

143. CIII, Rio, and Smolders render obvious claim 2 for the reasons explained in Section VII.B.2 (Ground 2, Claim 2). CIII renders obvious the additional limitations of claim 4 for the reasons explained in Section VII.A.9 (Ground 1, Claim 4).

5. Claim 5: “The swing leg assembly of claim 2, wherein the first sensor is positioned between the swing leg and the hinge bracket.”

144. CIII, Rio, and Smolders render obvious claim 2 for the reasons explained in Section VII.B.2 (Ground 2, Claim 2). CIII and Rio render obvious the additional feature of claim 5 for the reasons explained in Section VII.A.10 (Ground 1, Claim 5).

6. Claim 6: “The swing leg assembly of claim 2, wherein the swing leg assembly is configured to be removably coupled to the module frame.”

145. CIII, Rio, and Smolders render obvious claim 2 for the reasons explained in Section VII.B.2 (Ground 2, Claim 2). CIII renders obvious the additional feature of claim 6 for the reasons explained in Section VII.A.11 (Ground 1, Claim 6).

7. Claim 7: “The swing leg assembly of claim 2, wherein the swing leg is configured to change orientation by up to 180° relative to the module frame.”

146. CIII, Rio, and Smolders render obvious claim 2 for the reasons explained in Section VII.B.2 (Ground 2, Claim 2). CIII and Rio render obvious the additional feature of claim 7 for the reasons explained in Section VII.A.10 (Ground 1, Claim 5).

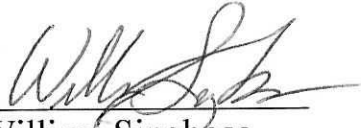
* * *

147. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

148. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

149. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: April 29, 2024

By: 
William Singhose

APPENDIX A: LIST OF MATERIALS CONSIDERED

Description
U.S. Patent No. 11,535,318
Prosecution History for U.S. Patent No. 11,535,318 (downloaded from Patent Center)
Commander III New Generation Trimmer/Paver Operator/Service Manual G21 Controls (“CIII”)
U.S. Patent No. 7,523,995 to Rio et al. (“Rio”)
U.S. Patent No. 4,558,758 to Littman et al. (“Littman”)
U.S. Patent No. 4,029,165 to Miller et al. (“Miller”)
U.S. Patent Publication No. 2003/0173130 to Johns (“Johns”)
GT-3200 Trimmer/Slipform Paver (“GT-3200”)
U.S. Patent No. 5,127,335 to Whitaker (“Whitaker”)
U.S. Patent No. 3,792,745 to Files (“Files”)
U.S. Patent Publication No. 2010/0181136 to Swasey et al. (“Swasey”)
U.S. Patent No. 3,572,458 to Tax (“Tax”)
U.S. Patent No. 6,481,924 to Smolders et al. (“Smolders”)
Disclosure of Preliminary Claim Constructions and Extrinsic Evidence, <i>Guntert & Zimmerman Const. Div., Inc. v. GOMACO Corp.</i> , Case No. 5:20-cv-4007-CJW-KEM (N.D. Iowa) (Sept. 15, 2020)
Deposition Transcript of Kenneth Bryden, Ph.D., <i>Guntert & Zimmerman Const. Div., Inc. v. GOMACO Corp.</i> , Case No. 5:20-cv-4007-CJW-KEM (N.D. Iowa) (Aug. 13, 2020)
U.S. Patent No. 10,029,749
<i>Godbersen-Smith Const. Co. v. Guntert & Zimmerman Const. Div., Inc.</i> , IPR2020-01698, Paper 80 (Apr. 12, 2022)
U.S. Patent No. 10,589,807
U.S. Patent No. 9,908,571
U.S. Patent No. 9,708,020
U.S. Patent No. 10,029,749
U.S. Patent No. 10,053,167
U.S. Patent No. 10,196,101
U.S. Patent No. 8,459,898
Prosecution History for U.S. Patent No. 10,589,807
Prosecution History for U.S. Patent No. 10,196,101
Prosecution History for U.S. Patent No. 10,589,807
Prosecution History for U.S. Patent No. 10,029,749

Prosecution History for U.S. Patent No. 9,908,571
Prosecution History for U.S. Patent No. 10,053,167
Prosecution History for Provisional Application No. 61/318,223
A History of Control Engineering 1930-1955
Modern Control Engineering, Ogata, 1970
Dudley's Gear Handbook (1992)
Handbook of Practical Gear Design (1984)